GEOLOGICAL CURATOR

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'FOSSILLEGAL' SYMPOSIUM ON ETHICS IN PALAEONTOLOGY

and

THE ETHICS OF UK FOSSIL COLLECTING: FROM THE SHORE TO THE STORE

GEOLOGICAL CURATORS' GROUP

Registered Charity No. 296050

The Group is affiliated to the Geological Society of London. It was founded in 1974 to improve the status of geology in museums and similar institutions, and to improve the standard of geological curation in general by:

- holding meetings to promote the exchange of information
- providing information and advice on all matters relating to geology in museums
- the surveillance of collections of geological specimens and information with a view to ensuring their wellbeing
- the maintenance of a code of practice for the curation and deployment of collections
- the advancement of the documentation and conservation of geological sites
- initiating and conducting surveys relating to the aims of the Group.

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Cover: see Figure 2 in Martill inside.

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EDITORIAL

As the regular editor, it is a privilege to acknowledge the real work behind this issue, which was undertaken by our Guest Editor, Jeff Liston. Most of the hard work in getting manuscripts out of authors after they have made their presentations at meetings was completed by Jeff, along with soliciting referees and communicating back to authors, and again leveraging revised manuscripts from busy people. That most of the contributors to the two meetings involved are represented here is perhaps a testament to the high regard Jeff is held in by his colleagues in palaeontology and in curatorial circles.

This issue comprises contributions to the Fossillegal symposium on ethics in palaeontology, convened by Jeff at the European Association of Vertebrate Palaeontologists in July 2016. A truly international panel of authors brings together a wide spectrum of views on the topic, and the views expressed are those of the authors, not of GCG. To do justice to the complexity of the issues, we have left papers very much in the original style, giving authenticity to the views presented. The second meeting included was GCG's own AGM Seminar in Bristol in December 2016, on the ethics of UK fossil collecting, giving further substance to this issue of the journal, which we hope will become a useful resource for members. It is my pleasure to thank the many referees who have taken often quite raw manuscripts and helped improve them and bring them through to publication along with all the authors

As a demonstration of relevance, in the time during which this volume was being compiled, we became aware of a particular situation in Scarborough and the result is that we were able to include a paper by Jennifer Dunne and Jim Middleton. Whilst still a fresh situation for them, it is clear to us that this is a case study which may resonate for many years. The colour of our cover in this issue is chosen to reflect the very grey areas that we can find ourselves trying to navigate when it comes to ethics in fossil collecting, anywhere in the world.

Matthew Parkes, December 2018

GUEST EDITORIAL

In academia, one can come across many examples of unprofessional behaviour, that often cross into the realm of the unethical: the departmental staff member that takes the opportunity to erase a colleague's figure plates and data, to hinder their publication from being submitted; the manuscript referee that fails to declare a conflict of interest, while acting to delay a competitor's paper until after their own is published; the field worker who quietly disposes of colleagues' finds, so that they alone can get the personal credit for what is recovered during the field season; the supervisor who refuses to read a thesis chapter until their students are long out of funding. All of these actions can be regarded as in some way 'unethical' as well as unprofessional (often forming the basis of anecdotal academic 'morality plays'), but unethical usually falls very far short of 'illegal'. Generally, one accepts such undesirable behaviours - either because there is little choice after the fact, or because one naively assumes that such actions are part of the 'ways of academia'. I had personally not envisaged ever becoming engaged with such issues or topics during my career (other than, perhaps, as a bystander or witness).

That changed in early 2013, when I began work in China. Whilst there, I encountered a (not entirely unexpected) bureaucracy that slowed down work (eleven months to obtain an excavation permit, and just as long to obtain permission to take a specimen outside the province, never mind the country), and prompted me to reflect on comparable procedures in other countries. At the same time, I came across the phenomenon of scientists from outside China illegally removing specimens from the country in order to publish on them in high impact factor journals. This made me consider the more specific issue of fossil protection legislation, and its effectiveness (or otherwise). Given how often the 'commercial sector' was lambasted by academics as a uniform mass, I found the idea of academics acting illegally - yet very unlikely to be called out on it - to be particularly abhorrent. There was a remarkable hypocrisy at work, with very little being done to directly challenge it.

I spoke about this in Opole, Poland, at the European Association of Vertebrate Palaeontologists' thirteenth annual meeting in July 2015, shortly after leaving China. As a backdrop to some dinosaur egg material that I had found in Yunnan, I had digressed within my presentation to talk about the obstacles to working on fossils

in China, and how some researchers from outside China were circumventing the law in order to do so. To my surprise, at the end of my talk I was besieged by audience members who had had similar experiences in many other countries. I have to acknowledge Dino Frey here, the (then) new President of the EAVP, for encouraging me to hold a symposium at our next annual meeting. That meeting was to be in Haarlem, the Netherlands, with a host committee led by Femke Holwerda. The idea for the one day 'FossilLegal' symposium was born that day, and began to take shape - different countries, different legislatures, different issues - and I approached Matthew Parkes to see whether the Geological Curator would be interested in hosting the proceedings from such a meeting. *The Geological Curator* was a logical choice as a journal to approach, as they had hosted the controversial 'Commercial Trade: Ethics versus Science' proceedings from the 2001 GCG meeting at the University of Manchester, organised by John Nudds. To my surprise, Matthew agreed: the roles of money, publishing, culture, government, definitions of heritage, the private sector and industrial and commercial interests all intersecting between legislation and palaeontology, and so providing a rich and diverse spread of perspectives and articles, presented the possibility of a rich and diverse series of papers. Separately, the (then) Chair of the GCG, Giles Miller, invited me to present at the GCG's annual meeting in December 2016 in Bristol, as part of the day seminar on the theme of 'The Ethics of UK Fossil Collecting: From the Shore to the Store'. Although far from identical topics, there was a clear overlap and connection between the meetings in Bristol and Haarlem, with the UK museum dimension forming an extremely important component of the global debate, so Matthew suggested that the proceedings for both meetings be published together, owing to their complementarity.

I have to pay tribute to the patience of all the contributors: whether, researchers, private collectors, lawyers, commercial dealers, government officials, publishers, historians or curators, they have all had to put up with me haranguing them to present at meetings, submit manuscripts or return reviews (some for the best part of three years), but I think that the breadth of the result has made it all worthwhile.The first dozen papers in this volume represent the proceedings from around three quarters of the presentations made during the original day symposium in Haarlem, with more than half of the presentations from GCG in Bristol also represented. (There are also likely to be occasional related papers that may crop up in a later issue of *Geological Curator*, which have been omitted for reasons of space.) The results from this work have been quite surprising and dynamic - not only in terms of publications, surveys of palaeontologists and debate generated, but feeding into the Society of Vertebrate Paleontology's revision of its ethics statement, *Nature* altering its requirements for authors, and SVP hosting a workshop on 'Global Perspectives on Ethics in Paleontology' (jointly chaired with Scott Foss) at its 2018 meeting in Albuquerque. A follow-up to this is planned for SVP in Brisbane in October 2019 (jointly chaired with John Long), where the focus will be on whether UNESCO needs to be approached to change the terms of palaeontology's inclusion within the 1970 Convention on the ownership of Cultural Property. The debate around these issues is far from a static one: since the announcement of the Haarlem meeting, the controversial 'Kulturschutzgesetz' has been introduced in Germany, Morocco has legislated for significant new restrictions on fossils leaving their territory, and it is a tribute to the roster of authors that some of these issues have been addressed, no matter how recent they are.

In conclusion, I can only once more express my gratitude to Matthew Parkes for his receptiveness to the idea of publishing an important (yet inevitably contentious) proceedings topic, as well as his continuing Herculean efforts on behalf of this journal. I also acknowledge Dino Frey for his encouragement to host the first symposium, and Kenshu Shimada for always providing stimulating discussions as Chair of SVP's Government Affairs Committee. In this regard, I must salute my colleagues Scott Foss and John Long for co-organising the Albuquerque and Brisbane SVP meetings with me on the general topic of 'Global Perspectives on Ethics in Paleontology', which have very much grown out of that original Haarlem meeting.

I expect that you will find some of what is written in these papers to be stimulating - and a lot that you might not easily agree with. Above all, I hope that you will find them of interest.

Jeff Liston, December 2018

PUBLISH OR PROHIBIT? THE ETHICS OF PUBLISHING ON PRIVATELY-OWNED FOSSILS

by Paul M. Barrett

Barrett, P.M.. 2018. Publish or prohibit? The ethics of publishing on privately-owned fossils. *The Geological Curator* 10 (10): 551-560.

Fossils are a limited resource and the information they provide is critical for unraveling evolutionary history. Private collections sometimes contain fossils that can provide unique scientific insights, but vary in the levels of access that they provide to researchers. Some palaeontologists have advocated publishing on specimens in private collections to unlock critical data, but these observations cannot be verified independently unless future access is guaranteed. Technological approaches, such as CT-scanning, might provide some solutions to this apparent conflict, but do not solve all of these issues. As a core scientific principle, reproducibility should be the key criterion applied when making decisions over whether to publish on a specimen or not.

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Introduction

Fossils represent our only direct window on to past diversity and ecology and they provide examples of organismal form that are unknown in the extant biota (e.g. Kemp 1999). Consequently, they deliver critical, and often unique, information that increases our understanding of the evolution of life on Earth. However, in addition to contributing crucial scientific evidence, fossils are common cultural property as they inform us on our origins and place within the natural world (e.g. Schmidt 2000; Besterman 2001; but see Nudds [2001a] and Liston [2014] for contrary opinions). Moreover, the study and interpretation of fossils has formed the basis for many philosophical and societal changes, including appreciation of concepts like deep time (with its obvious implications for origin stories) and extinction (which has influenced ideas of societal development), as well as their use as devotional or folkloric objects in some cultures (e.g. Rudwick 1985; Thomson 2005). As a result, fossils cannot be regarded as the sole property of scientists, and it should be recognised that other communities have valid reasons for acquiring and collecting them.

Due to differences in preservation potential and sampling opportunities, some fossil taxa are known only from singleton specimens (e.g. many fossil vertebrates), whereas others are represented by thousands, or even millions, of individuals (e.g. microfossils, marine molluscs). Regardless of their exact number, however, the fossil specimens available for any taxon are a limited, non-renewable resource. As a result, conflicts can arise over how this resource is distributed among the varied parties interested in acquiring this material, whether for personal, academic, political, educational or commercial purposes (e.g. Padian 2000; Nudds 2001b). From a research standpoint, it is essential to optimise the use of fossil specimens in order to extract the greatest amount of information possible and to make that information accessible in perpetuity. As a result, a dialogue is necessary between scientists and those parties controlling access to fossil material, including commercial collectors and collection owners. Discussions of collection ownership are frequently reduced to the binary state of whether these collections are considered to be 'private' or 'public', as these terms imply differing levels of access to material, although this masks important nuance and complexity (see below).

Here, I discuss one of the many issues concerning access to fossil material - the accessibility of the scientifically significant information that it provides. In particular, should scientists publish on specimens that are kept in privately-held collections or should they avoid the use of this material when conducting research? This builds on earlier debates that have been played out in various informal venues, including a series of spirited exchanges in the pages of The

Palaeontological Association's *Newsletter* (Etches 1997; Loydell 1996; Martill 1996, 1997; Martin 1997; Milner 1997; Taylor and Crowther 1997; Tunnicliff 1997; Wyse Jackson 1996) and more recent contributions in *Nature* (Barrett and Munt 2014; Rauhut *et al.* 2014). In order to facilitate this discussion, I provide a brief description of the criteria used to describe 'private' vs 'public' collections, list the pros and cons associated with working on material in private ownership, and illustrate these issues with examples drawn from the scientific literature.

'Private' vs 'public' collections

Privately-held collections of fossils range widely in scope, encompassing everything from a handful of fossil seashells on a child's bookshelf, through the extensive, well-documented collections amassed by amateur palaeontologists, to those in large-scale, purpose-built private museums or corporate showrooms. These types of collections represent different legal entities and are amassed for diverse reasons. Collectors might appreciate the aesthetic beauty of fossils; they may reflect the owner's cultural and/or scientific interests; collections might be compiled to reflect regional or national identity; they can be built as the result of philanthropic drives to advance education or research; and the acquisition of large, rare or exquisitely-preserved specimens can provide social cachet, which can rival that more traditionally associated with fine art or antiquities, thereby acting as proxies for personal or corporate wealth. Ownership of the material resides with an individual, private trust or corporation, and decisions on whether to allow access to material, and regarding the acquisition or disposal of material, lie solely with the owner.

Historically, private collections have had a useful role in engaging the public with fossils and the scientific concepts associated with them (e.g. Etches and Clarke 2010; Crane 2016); indeed, a large number of professional palaeontologists followed this career path due to the interest sparked by making fossil collections of their own (e.g. Bird 1985; Croft 2016; Scriven 2016). Many private collections are retained for the sole pleasure of an individual and/or their immediate circle; however, unless legal provision is made for the cohesion of these collections they are often at risk of loss following changes to the personal circumstances of the collector (such as bankruptcy, divorce, illness or death). For example, within the UK, important specimens and collections have been lost or destroyed following the death of the owner (e.g. Seeley 1876), due to either the absence of legacy planning or lack of interest from the executors. Other high-profile examples, such as the loss of the Maxberg *Archaeopteryx*, are also known (e.g. Hecht 2012). However, in other cases, some private collections are donated or sold to publicly owned institutions (see below) and thereby enter the public domain; indeed, many of the collections in major museums have been built upon the foundation of former private collections. For example, the palaeontological collections of the Natural History Museum, London contain numerous specimens acquired from private collections both historically (e.g. the Mantell Collection, composed of hundreds of fossils from south-east England: Cleevely and Chapman 1992) and more recently (e.g. the Curry Collection, containing molluscan and micropalaeontological samples from the UK and France: Hensley and Muir 2010). Other privately-owned collections are open for viewing and actively encourage the public and/or researchers to visit, with varying levels of access to the material. For example, Steve Etches made his extensive collection of Late Jurassic Kimmeridge Clay fossils available to visiting scientists prior to establishing a permanent home for them in The Etches Collection, situated in Kimmeridge, Dorset, UK (Churchill 2017), which has resulted in publications on a variety of taxonomic groups (e.g. Etches *et al.* 2009; Martill and Etches 2013; Underwood and Claeson in press). Other privately-owned, but publicly or academically accessible, collections such as the Sauriermuseum (Aathal, Switzerland: White 2015) and the Hayashibara Museum of Natural Science (Shimoishii, Japan), have also allowed extensive access to scientists on a regular basis, resulting in numerous studies, including the establishment of new taxa (e.g. Carpenter *et al.* 2001; Tschopp and Mateus 2013).

By contrast, publicly-owned collections are those held by national, regional and local museums, government research institutes and some universities. These are owned, or governed on behalf of, local and national governments or non-governmental public organisations, such as charitable trusts. The majority of these institutions have legal or statutory obligations to make the collections in their care accessible to researchers and the public and to care for the material in perpetuity (e.g. Kavanagh 1994). In contrast to the diverse remits that drive the accumulation of private collections, these institutions usually exist for the purpose of education and research and often form an integral part of a nation's or region's scientific, educational and cultural infrastructure, as well as being custodians for objects that are regarded as national patrimony (e.g. Allmon 1994; Lane 1996; Pettitt 1997; Suarez and Tsutsui 2004; Bradley *et al.* 2014). Nevertheless, although holding material in the public trust, these institutions vary in the levels of

access that they can provide, and also in staff expertise, depending on the levels of funding available, policy decisions and potential conflicts between exhibition and research usage.

Reproducibility: the key criterion?

Palaeontologists use the scientific method in order to increase our knowledge and understanding of past life. This involves the same processes and procedures that are used by all scientists, regardless of discipline, which include the taking of observations and measurements, the erection and testing of hypotheses, the design of experiments and models, and the principles of reproducibility and replicability (e.g. Gauch 2003). Levels of support for any hypothesis depend upon the quality and quantity of the data underpinning it and these data should in turn be subjected to regular and critical review in order to establish their consistency, applicability and veracity. Where interpretations of the available data change, hypotheses should, in turn, be forced to change also, leading to new insights, as encapsulated in T. H. Huxley's famous aphorism that beautiful theories can be slain by ugly facts (Huxley 1873). Although palaeontology is a historical science, and experimentation is not usually possible in the ways familiar to chemists or molecular biologists, hypothesis testing still follows these same basic rules. In the case of palaeontology, raw data include the biological and geological information provided by the fossil and its wider geological context (e.g. morphology, spatiotemporal occurrence, taphonomy, geochemical signature, environmental association, etc.). 'Experiments' might include the examination of common evolutionary or ecological phenomena occurring across different environments, taxa, or time slices in order to identify or dismiss shared causative agencies (e.g. in establishing the generality and directionality of macroecological patterns: Mannion *et al.* 2014). These 'historical experiments' can also be conducted in parallel with actualistic experiments that use extant proxies under laboratory conditions and whose sensitivity can be constrained by consideration of living and fossil material (e.g. the building and testing of Finite Element models for assessing biomechanical function in extinct taxa: Rayfield 2007).

Palaeontologists cannot re-run the tape of life (although this notion has led to some interesting thought experiments: Gould 1989), but they can re-assess the original fossil data and the discovery of new specimens or localities can also be used to test prior assumptions. Indeed, many new discoveries in palaeontology result from the detection of previously unknown or overlooked features in fossils that might have been examined on numerous occasions (e.g. Bertazzo *et al.* 2015). Taxonomic, systematic and palaeobiological results are regularly overturned by the reassessment of the same specimens, due to varied interpretations by different investigators or the application of new technologies (such as CT-scanning) that allow the more precise or thorough characterization of a specimen. Reproducibility and replication of observations is as important in palaeontology as in any other area of science and should be the *de facto* criterion by which palaeobiological hypotheses stand or fall. As noted by Popper (2005, 66): "non-reproducible single occurrences are of no significance to science". Data derived from fossil specimens need to be reproducible in order to elevate them above the status of mere anecdote (Loydell 1996; Milner 1997; Taylor and Crowther 1997; Wyse Jackson 1997).

Issues of accessibility to raw fossil data are directly comparable to those raised by the broader 'Open Access' (OA) and 'Open Data' (OD) movements in academia, which aspire to make published research, and the data on which the conclusions of that research are based, more easily available. Proponents of OA/OD aim to increase the ease of peer communication between scientists and between scientists and the broader community (the general public, funders, politicians, and the media) and to increase transparency and accountability. Although publishing on material in private collections might seem to accord with the principles of OA/OD, as it would make previously hidden information available, the lack of access for all in perpetuity runs contrary to these ideals, as only a very few individuals may ever gain genuine access to the material and as transparency and the opportunities for future verification are low.

Currently, many journals, such as *Palaeontology*, have clear guidelines in place that emphasize the requirement for observations to be reproducible, as enshrined within their editorial policy. To quote from the 'Instructions for Authors' on The Palaeontological Association website: "Illustrated and type specimens and other materials of importance (e.g. key thin sections) must be permanently curated in a museum or institutional repository to which other researchers are ensured access" (https://www.palass.org/publications/authors/instructions-authors-2012) and *Nature*'s editorial guidelines state that "Palaeontological and type specimens should be deposited in a recognised museum or collection to permit free access by other researchers in perpetuity" (http://www.nature.com/authors/policies/availability.html#data). Similar statements can be found in the editorial guidelines of *Journal of Vertebrate*

Paleontology, Journal of Paleontology and *Monographs of the Palaeontographical Society*, although in some cases these changes were made only recently. By contrast, other journals, including high-impact venues like *Science* and *Proceedings of the National Academy of Sciences of the USA*, and some subject specific journals (such as those of The Geological Society), have no such requirement, although in most cases they do require other forms of raw data - such as gene sequences - to be deposited routinely, thus setting different standards for reproducibility between disciplines. Nevertheless, editorial lapses break these policies on occasion, so that even journals with policies in place to prevent the publication of privately-owned specimens sometimes bend or break their own rules. Once a specimen is published, however, unless a paper is formally retracted, the information presented therein remains on public record in perpetuity, regardless of whether verification is possible or not.

Publish or perish?

Any fossil has the potential to offer new and potentially valuable scientific insight. As noted elsewhere, evolution does not respect political boundaries (Nudds 2001a) and, by extension, it could be argued that the information provided by fossils is independent of human ownership issues, as long as that information is made generally available (Martill 1996; Rauhut *et al.* 2014). Fossils in privately-owned collections can represent otherwise unknown taxa, the best examples of previously described - but otherwise incompletely known - species, examples that expand geographical, stratigraphical or palaeoenvironmental ranges, and they might also be preserved in ways that enable types of palaeobiological analysis that were impossible previously (Martill 1996; Martin 1997). As a result, it has been suggested that restricting publication to specimens held in public collections does a disservice to the subject, as the community would be wilfully ignoring a potentially important source of critical scientific data (Martill 1996, 1997; Rauhut *et al.* 2014). It has been further implied that concerns over reproducibility could be overruled *quid pro quo*, as a pragmatic solution to unlock important information hidden in private collections (Rauhut *et al.* 2014).

Although these are all reasonable arguments, verification is surely essential, however. After all, even the most diligent palaeontologist is capable of making an honest mistake. Errors introduced in the published descriptions of specimens that are not accessible to other workers have the potential to become entrenched and positively misleading in perpetuity if these observations cannot be checked. The normal self-correcting mechanisms of science cannot address these errors, which would have to be accepted subjectively as 'fact' or dismissed as unreliable thereafter. The former could represent a major disservice to the subject, impeding progress and obscuring the 'true' answer; the latter would essentially render the initial exercise of working on the specimen worthless. Although there are examples of published specimens that have been lost to science for a variety of reasons (fires, wars, burglary, breakage, etc.), from both private and public collections, these historical losses do not justify practices that do not attempt to maximise the opportunities for future verification. In some instances, these historical losses have been compensated for by the discovery of additional specimens (such as the recovery of new *Spinosaurus* material following the destruction of the holotype during World War II: e.g. Dal Sasso *et al.* 2005; Ibrahim *et al.* 2014), but even in these cases the interval separating loss and rediscovery can set science back by decades and create numerous false trails.

In addition to the proposed scientific benefits, publishing on privately-owned specimens can also be viewed as an avenue for building stronger ties with members of the amateur and commercial palaeontological communities, by emphasizing the scientific value of their material and fostering a sense of inclusivity and mutual respect (e.g. Etches 1997; Rauhut *et al.* 2014). Close personal and working relationships between these different stakeholders can foster the donation of key material into public collections at a later date, as evidenced by the numerous generous donations received by museums around the world on an annual basis. Nevertheless, although many academic palaeontologists do clearly recognize the important contributions that amateur and commercial collections have made to the subject, and have often developed solid, reciprocally beneficial relationships, this does not mandate the publication of specimens in private hands unless there are reasonable guarantees that the material in question will be accessible to others in perpetuity (Loydell 1996).

Finally, it is important to note that the promotion of a privately-owned specimen, whether through formal publication or by other means (such as featuring in a TV documentary or museum exhibition) can affect the financial value of a fossil, in exactly the same way that exhibiting works of painting or sculpture impacts the art market. This additional cachet is likely to make the specimen more attractive to other collectors, allowing the price tag to be increased beyond the levels usually accessible to museums and other public repositories (see also Padian 2000).

Are specimens necessary?

Various mechanisms have been proposed that could satisfy the need for reproducibility and accessibility, while enabling the original specimens to remain in private hands. These include specimen photography, the production of replicas, the use of CT-scans, surface laser scans or photogrammetry to construct virtual models, and the distribution of 3D prints generated from these digital data (Martin 1997; Martill 1997; Rauhut *et al.* 2014). Replicas and digital models can record morphology with exceptional accuracy and digital models can be shared easily between researchers (e.g. Pruitt *et al.* 2017; Racicot 2017). As a result, these new technologies could provide solutions that would satisfy both researchers and fossil owners, at least to some extent, offering a pragmatic way forwards for sharing data that would be acceptable to both communities. Indeed, some fossil taxa lack a physical holotype ('virtual fossils'), as the specimens were destroyed intentionally during the process of their description (e.g. Siveter *et al.* 2017).

However, advances in specimen imaging are not a panacea. Although these techniques capture morphology, which might be sufficient for addressing specific taxonomic or biomechanical issues, original fossil specimens contain other critical information that is less easily archived. These other data include the soft tissue features, histology and chemical composition of the fossil itself and the textures and composition of the surrounding matrix. All of these contribute vital information on palaeobiology, taphonomy, history of collection, and palaeoenvironments that would be lost if the only accessible version of a fossil were a physical or virtual replica. It is worth recalling that only 20 years ago CT scans were rare, expensive, low resolution and would not have been a viable option for widespread data archiving. This situation has changed substantially for the better, but it illustrates the point that new techniques for studying fossils become available on a regular basis and that novel methods might become important in ways that are unforeseen. Many of the most exciting advances in palaeontology are currently being made using analytical methods that require access to the original material to produce results, including isotopic analysis, elemental mapping, histochemistry, histology, and advanced microscopy, which have all revealed new results on topics ranging from colouration to developmental biology to palaeoecology (e.g. Schweitzer *et al.* 1999; Vinther *et al.* 2008; Amiot *et al.* 2010; Edwards *et al.* 2014; Erickson 2014; Bertazzo *et al.* 2015; and many others). None of these studies would have been possible, or have the potential to be reproducible, if the original specimens were not available for continued study. In addition, long-term solutions for archiving massive volumes of digital morphological data have yet to be found and this also assumes that owners are willing to part with the digital data derived from their specimens, as this involves the transfer of intellectual property, especially if the data are to be shared widely (Davies *et al.* 2017). Finally, digital data and replicas are themselves subject to human error: decisions taken over casting procedures or during the processes of segmentation and model reconstruction can lead to errors in the morphology recorded, which would then also be etched in stone if verification was not possible.

Case studies

Several recent studies that have appeared in a variety of venues illustrate the pros and cons associated with publishing on privately-owned material. Perhaps the highest profile example relates to the description of what could be a pivotal taxon for understanding early snake evolution, *Tetrapodophis amplectus* (Martill *et al.* 2015). This species, based on a unique, almost complete individual from the Lower Cretaceous Crato Formation of Brazil, possesses four distinct, but reduced, limbs, and may thus represent a critical intermediate stage in snake origins. In addition to bearing limbs, it was proposed that other features of the skull and skeleton of this previously unknown species illuminated further aspects of the lizard-to-snake transition, with the authors suggesting that *Tetrapodophis* was a burrower, thus bolstering one of the two major competing palaeoecological scenarios that vie for primacy in debates over snake origins (Martill *et al.* 2015). Initially, access to the specimen was possible and another research team was able to provide a preliminary re-analysis, which argued that *Tetrapodophis* was not a snake after all, but a lizard, although further details of this work are not yet available (Caldwell *et al.* 2016; Gramling 2016). A more detailed discussion of the limbs of *Tetrapodophis* also followed, which suggested that their morphology was more consistent with swimming than burrowing, thus favouring the aquatic origin hypothesis more strongly (Lee *et al.* 2016). Either way, *Tetrapodophis* was clearly an important new taxon that had the potential to advance our understanding of snake and lizard evolution (Evans 2015). While these studies were being conducted, the specimen was on display in the Bürgermeister-Müller Museum, Solnhofen, Germany; the museum did not own the material, however, but had borrowed it from a private individual (Gramling 2016). Subsequently, the owner has restricted access and other scientists wishing to examine the specimen have been unable

to do so (Gramling 2016). As a result, the significance of *Tetrapodophis* has been seriously undermined, as it is not currently possible for others to test the opposing views that have been advanced, leaving it in limbo. As noted by Jason Head (in Gramling 2016): "The best way to move forward is to literally erase the specimen from our research program. *Tetrapodophis* is no longer science. … It's not repeatable, it's not testable. If any good can come out of *Tetrapodophis*, it's the recognition that we have got to maintain scientific standards when it comes to fossils … they have to be accessible."

Two other prominent examples, both relating to dinosaurs, also demonstrate the difficulties of working with private collections in terms of accessibility. One of these relates to the Hayashibara Museum of Natural Science, which was not a public museum, but owned by the Hayashibara Corporation, which had to close the museum when the company encountered financial difficulties. During its short lifespan, the museum's staff published numerous articles, collaborated with many international colleagues, collected significant specimens, and made these available to others (e.g. Tusihiji *et al.* 2011; Hone *et al.* 2014). Relatively few of the specimens housed in its permanent collection were unique (important specimens collected by the museum's staff during their expeditions to Mongolia were always destined to be returned to their country of origin), but they included the holotype specimen of the stegosaurian dinosaur *Hesperosaurus mjosi* (Carpenter *et al.* 2001). Fortuitously, in this instance, the orphaned collection was passed to the Fukui Prefectural Dinosaur Museum, thus ensuring its continuing availability (Sonoda and Noda 2016). However, this example highlights the potential pitfalls of working on private specimens, as although the owners had the noblest intentions, and conducted excellent work, they were unable to guarantee the long-term future of the collection. A second example, which received widespread media attention, involved the description of an iguanodontid braincase from the Lower Cretaceous of the UK, which was discovered by a commercial fossil collector and that possesses evidence of mineralised neurological tissues (Brasier *et al.* 2016). This mode of preservation is highly unusual and the specimen offers direct information on soft tissues that had yet to be reported from any dinosaur fossil. Although histological samples from this specimen have been accessioned into a public repository (the Oxford University Museum of Natural History, Oxford, UK: Brasier *et al.* 2016), the braincase remains in private hands and future access arrangements are currently undecided. The long-term accessibility of several other privately-owned fossil reptile specimens that were published in high-profile venues is also unknown, although medium- to long-term arrangements for continued study have been agreed in some of these instances (Frey *et al.* 1997; Rauhut *et al.* 2012; Foth *et al.* 2014).

In some cases published specimens residing in private collections do make their way into the public domain through the generosity of their owners, although significant time lags in appreciating their impact can ensue. For example, *Megarachne servinei*, from the Carboniferous of Argentina, was initially described as the largest spider of all time on the basis of a unique, privately-owned specimen that was designated the holotype (Hünicken 1980). A detailed description of this specimen was provided and numerous casts were made and distributed to museums around the world. However, shortly after its description the holotype was deposited in a bank vault by its owner. Although other researchers noted that some of the features described by Hünicken (1980) were incompatible with his taxonomic conclusions, these could not be checked due to the inaccessibility of the holotype (Selden *et al.* 2005). Subsequently, however, the specimen was accessioned into a public collection and an additional specimen was found, which has allowed testing of the published information. This new work demonstrated that *Megarachne* was not the world's largest spider after all, but a eurypterid (Selden *et al.* 2005), a major re-identification that has profound consequences for understanding chelicerate evolution, as well as requiring numerous changes to museum displays and textbook explanations on early terrestrial arthropod evolution.

More positively, however, it must be noted that some private collectors have gone to considerable lengths to make their specimens publicly available, with several turning their extensive collections into large museums. These include The Etches Collection (Kimmeridge, UK) and the Sauriermuseum (Aathal, Switzerland), which both collaborate regularly with scientists to enable research on their specimens, are open to the general public (providing a variety of exhibitions and outreach activities), and have legacy plans to ensure the long-term accessibility of their type and figured material.

Interestingly, there is at least one major category of material where all scientists seem to at least tolerate the publication of privately-owned specimens - fossil trackways. Ichnologists routinely describe specimens that are usually left *in situ*, for practical reasons of size, extent and difficulty of extraction, and many tracksites have been documented from private lands. For example, one of the most significant dinosaur trackways from the UK, that at Ardley Quarry,

Oxfordshire is owned by a company that quarries limestone and uses part of the site for storing domestic waste as landfill. Access to the site was granted by the quarry owners to enable research to be carried out, which led to the description of this important Middle Jurassic ichnocoenosis, including lengthy trackways of large theropod and sauropod dinosaurs, the latter representing some of the earliest evidence of titanosaurian sauropods in the fossil record globally (Day *et al.* 2002, 2004; Mossman *et al.* 2003). Although parts of the site have been preserved, they are not generally accessible as they were covered to enhance their long-term stability (Anonymous 2010). By contrast with other fossil material, trackways are rarely collected as few museums have space to store them and the logistic challenges of collecting many cubic metres of rock per trackway are simply too daunting. In addition, although important, the information provided by trackways is recorded routinely through detailed measurements, mapping, photography and casting whereas additional sources of information found in body fossils, such as histology and chemical composition, are lacking. Moreover, as trackways are generally left *in situ*, they are usually subject to natural erosion that alters the information they provide over time. Repeatability is still an issue in terms of access to any particular trackway, but the community seems to have accepted that in these cases it might not be possible for a number of practical reasons.

Conclusions

Collaborations between private collectors and professional palaeontologists have been beneficial to the science and the development of private collections continues to nurture interest and engagement with the natural world. However, for science to advance observations need to be repeatable and the data underpinning new interpretations needs to be accessible in perpetuity. This enables science to operate as a self-correcting process, whereas observations that cannot be repeated potentially embed error within the published record. Continued access also 'future-proofs' specimens, allowing them to be subjected to new analytical procedures. Publication of specimens that remain in private ownership is, therefore, incompatible with scientific progress and runs contrary to the ideals of Open Access and Open Data. New technologies and contractual agreements regarding access do offer some solutions to these issues, but the long-term viability of these options has yet to be demonstrated and they currently impart weaker guarantees regarding continued access than those that have been provided by the track-record of public collections. Collectors and palaeontologists need to work together to ensure accessibility if scientifically significant fossils are to enter the public domain.

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References

ALLMON, W. D. 1994. The value of natural history collections. *Curator* **37**, 83-89.

AMIOT, R., BUFFETAUT, E., LÉCUYER, C., WANG, X., BOUDAD, L., DING, Z.-L., FOUREL, F., HUTT, S., MARTINEAU, F., MEDEIROS, M. A., MO, J.-Y., SIMON, L., SUTEETHORN, V., SWEETMAN, S., TONG, H.-Y., ZHANG, F.-S. and ZHOU, Z.-H. 2010. Oxygen isotope evidence for semi-aquatic habits among spinosaurids theropods. *Geology* **38**, 139-142.

ANONYMOUS 2010. Dinosaur tracks in Oxfordshire mudflats to be protected. http://news.bbc.co.uk/1/hi/england/oxfordshire/8469459.stm. Accessed 17/01/2018.

BARRETT, P. M. and MUNT, M. C. 2014. Private collections hold back science. *Nature* **512**, 28.

BERTAZZO, S., MAIDMENT, S. C. R., KALLEPITIS, C., FEARN, S., STEVENS, M. M. and XIE, H.-N. 2015. Fibres and cellular structures preserved in 75 million year old dinosaur specimens. *Nature Communications* **6**, 7352. doi: 10.1038/ncomms8352

BESTERMAN, T. P. 2001. Frontiers to science: free trade and museum ethics. *Geological Curator* **7**, 199-209.

BIRD, R. T. 1985. *Bones for Barnum Brown: Adventures of a Dinosaur Hunter*. Fort Worth: Texas Christian University Press.

BRADLEY, R. D., BRADLEY, L. C., GARNER, H. J. and BAKER, R. J. 2014. Assessing the value of natural history collections and addressing issues regarding long-term growth and care. *BioScience*

64, 1150-1158.

BRASIER, M. D., NORMAN, D. B., LIU, A. G., COTTON, L. J., HISCOCKS, J. E. H., GARWOOD, R. J., ANTCLIFFE, J. B. and WACEY, D. 2016. Remarkable preservation of brain tissues in an Early Cretaceous iguanodontian dinosaur. *Geological Society of London, Special Publications* **448**, 383-398.

CALDWELL, M. W., REISZ, R. R., NYDAM, R. L., PALCI, A. and SIMOES, T. R. 2016. *Tetrapodophis amplectus* (Crato Formation, Lower Cretaceous, Brazil) is not a snake. *Journal of Vertebrate Paleontology, Program and Abstracts* **2016**, 108.

CARPENTER, K., MILES, C. A. and CLOWARD, K. 2001. New primitive stegosaur from the Morrison Formation, Wyoming. *In* K. Carpenter (ed.) *The Armored Dinosaurs*. Bloomington; Indianapolis: Indiana University Press. 55-74.

CALLAHAN, W. R., SHANKLE, W. and MEHLING, C. M. 2017. The Monmouth Amateur Paleontologists' Society: 46 years of collaboration between avocational and professional palaeontologists. *Geological Society of America, Abstracts with Programs* **49**(2). doi:10.1130/abs/2017NE-289073

CHURCHILL, N. 2017. From beach to museum. *Dorset Life* http://www.dorsetlife.co.uk/2017/06/from-beach-to-museum/ Accessed 17/01/18.

CLEEVELY, R. J. and CHAPMAN, S. D. 1992. The accumulation and disposal of Gideon Mantell's fossil collections and their role in the history of British palaeontology. *Archives of Natural History* **19**, 307-364.

CRANE, C. D. 2016. The Aurora Fossil Museum: a model showcase of the contributions of the citizen scientist. *Geological Society of America, Abstracts with Programs* **48**(3). doi:10.1130/abs/2016SE-273478

CROFT, D. A. 2016. *Horned Armadillos and Rafting Monkeys: The Fascinating Fossil Mammals of South America.* Bloomington and Indianapolis: Indiana University Press.

DAL SASSO, C., MAGANUCO, S., BUFFETAUT, E. and MENDEZ, M. A. 2005. New information on the skull of the enigmatic theropod *Spinosaurus*, with remarks on its size and affinities. *Journal of Vertebrate Paleontology* **25**, 888-896.

DAVIES, T. G., RAHMAN, I. A., LAUTENSCHLAGER, S., CUNNINGHAM, J. A., BARRETT, P. M., BATES, K. T., BENGTSON, S., BENSON, R. B .J., BOYER, D. M., BRAGA, J., BRIGHT, J. A., CLAESSENS, L. P. A. M., COX, P. G., DONG, X.-P., EVANS, A. R., FALKINGHAM, P. L., FRIEDMAN, M., GARWOOD, R. J., GOSWAMI, A., HUTCHINSON, J. R., JEFFERY, N. S., JOHANSON, Z., LEBRUN, R., MARTÍNEZ-PÉREZ, C., MARUGÁN-LOBÓN, J., O'HIGGINS, P. M., METSCHER, B., ORLIAC, M., ROWE, T. B., RÜCKLIN, M., SÁNCHEZ-VILLAGRA, M. R., SHUBIN, N. H., SMITH, S. Y., STARCK, J. M., STRINGER, C., SUMMERS, A. P., SUTTON, M. D., WALSH, S. A., WEISBECKER, V., WITMER, L. M., WROE, S., YIN, Z., RAYFIELD, E. J. and DONOGHUE, P. C. J. 2017. Open data and digital morphology. *Proceedings of the Royal Society B* **284**, 20170194. doi: 10.1098/rspb.2017.0194

DAY, J. J., NORMAN, D. B., GALE, A. S., UPCHURCH, P. and POWELL, H. P. 2004. A Middle Jurassic dinosaur trackway site from Oxfordshire, UK. *Palaeontology* **47**, 319-348.

DAY, J. J., UPCHURCH, P., NORMAN, D. B., GALE, A. S., and POWELL, H. P. 2002. Sauropod trackways, evolution and behavior. *Science* **296**, 1659.

EDWARDS, N. P., MANNING, P. L., BERGMANN, U., LARSON, P. L., VAN DONGEN, B. E., SELLARS, W. I., WEBB, S. M., SOKARAS, D., ALONSO-MORI, R., IGNATYEV, K., BARDEN H. E., VAN VEELEN, A., ANNÉ, J., EGERTON, V. M. and WOGELIUS, R. A. 2014. Leaf metallome preserved over 50 million years. *Metallomics* **6**, 774-782.

ERICKSON, G. M. 2014. On dinosaur growth. *Annual Reviews of Earth and Planetary Science* **42**, 675-697.

ETCHES, S. 1997. Palaeo-Reply II. To: Specimens in private collections. *Palaeontology Newsletter* **33**, 16-17.

ETCHES, S. and CLARKE, J. 2010. *Life in Jurassic Seas: The Autobiography of a Fossil Collector.* Chandler's Ford: Ashfield Books.

ETCHES, S., CLARKE, J. and CALLOMON, J. 2009. Ammonite eggs and ammonitellae from the Kimmeridge Clay Formation (Upper Jurassic) of Dorset, England. *Lethaia* **42**, 201-217.

EVANS, S. E. 2015. Four legs too many? *Science* **349**, 374-375.

FOTH, C., TISCHLINGER, H. and RAUHUT, O. W. M. 2014. New specimen of *Archaeopteryx* provides insights into the evolution of pennaceous feathers. *Nature* **511**, 79-82.

FREY, E., SUES, H.-D. and MUNK, W. 1997. Gliding mechanism in the Late Permian reptile *Coelurosauravus*. *Science* **275**, 1450-1452.

GAUCH, H. G. 2003. *Scientific Method in Practice*. Cambridge: Cambridge University Press.

GOULD, S. J. 1989. *Wonderful Life: The Burgess Shale and the Nature of History*. London:

Hutchinson Radius.
GRAMLING, C. 2016. 'Four-legged snake' may be ancient lizard instead. *Science* **354**, 536-537.
HECHT, J. 2012. Lost treasures: the Maxberg *Archaeopteryx*. *New Scientist* **213**(Issue 2850). 40-41.
HENSLEY, C. and MUIR, L. A. 2010. The Dennis Curry Collection at the Natural History Museum, London. *In* J. E. Whittaker and M. B. Hart (eds.) *Micropalaeontology, Sedimentary Environments and Stratigraphy: A Tribute to Dennis Curry*. London: The Micropalaeontological Society, Special Publications. 11-15.
HONE, D. W. E., FARKE, A. A., WATABE, M., SHIGERU, S. and TSOGTBAATAR, K. 2014. A new mass mortality of juvenile *Protoceratops* and size-segregated aggregation behaviour in juvenile non-avian dinosaurs. *PLoS ONE* **9**, e113306. doi:10.1371/journal.pone.0113306
HÜNICKEN, M. A. 1980. A giant fossil spider (*Megarachne servinei*) from Bajo de Véliz, Upper Carboniferous, Argentina. *Boletin de la Academia Nacional de Ciencias, Córdoba* **53**, 317-341.
HUXLEY, T. H. 1873. Biogenesis and abiogenesis. *In* T. H. Huxley (ed.) *Critiques and Addresses*. London: MacMillan and Co..
IBRAHIM, N., SERENO, P. C., DAL SASSO, C., MAGANUCO, S., FABBRI, M., MARTILL, D. M., ZOUHRI, S., MYHRVOLD, N. and IURINO, D. A. 2014. Semiaquatic adaptations in a giant predatory dinosaur. *Science* **345**, 1613-1616.
KAVANAGH, G. (ed.) 1994. *Museum Provision and Professionalism*. London; New York: Routledge.
KEMP, T. S. 1999. *Fossils and Evolution*. Oxford: Oxford University Press.
LANE, M. A. 1996. Roles of natural history collections. *Annals of the Missouri Botanical Garden* **83**, 536-545.
LEE, M. S. Y., PALCI, A., JONES, M. E. H., CALDWELL, M. W., HOLMES, J. D. and REISZ, R. R. 2016. Aquatic adaptations in the four limbs of the snake-like reptile *Tetrapodophis* from the Lower Cretaceous of Brazil. *Cretaceous Research* **66**, 194-199.
LISTON, J. 2014. Fossil protection legislation: Chinese issues, global problems. *Biological Journal of the Linnean Society* **113**, 694-706.
LOYDELL, D. K. 1996. Palaeo-Comment I. Specimens in private collections. *Palaeontology Newsletter* **31**, 6.
MANNION, P. D., UPCHURCH, P., BENSON, R. B. J. and GOSWAMI, A. 2014. The latitudinal biodiversity gradient through deep time. *Trends in Ecology and Evolution* **29**, 42-50.
MARTILL, D. M. 1996. Palaeo-Reply II. To: Specimens in private collections. *Palaeontology Newsletter* **32**, 6.
MARTILL, D. M. 1997. Palaeo-Reply XCV. To: All who replied to Loydell. *Palaeontology Newsletter* **34**, 13-14.
MARTILL, D. M. and ETCHES, S. 2013. A new monofenestratan pterosaur from the Kimmeridge Clay Formation (Kimmeridgian, Upper Jurassic) of Dorset, England. *Acta Palaeontologica Polonica* **58**, 285-294.
MARTILL, D. M., TISCHLINGER, H. and LONGRICH, N. R. 2015. A four-legged snake from the Early Cretaceous of Gondwana. *Science* **349**, 416-419.
MARTIN, J. 1997. Palaeo-Reply XCIV. To: Specimens in private collections - editorial responsibilities. *Palaeontology Newsletter* **34**, 10-12.
MILNER, A. C. 1997. Palaeo-Reply I. To: Specimens in private collections - editorial responsibilities. *Palaeontology Newsletter* **33**, 15.
MOSSMAN, D. J., BRUNING, R. and POWELL, H. P. 2003. Anatomy of a Jurassic theropod trackway from Ardley, Oxfordshire, UK. *Ichnos* **10**, 195-207.
NUDDS, J. R. 2001a. Ethics, science and the trade: let's get together. *Geological Curator* **7**, 191-198.
NUDDS, J. R. (ed.) 2001b. The Commercial Trade: Ethics versus Science. *Geological Curator* **7**, 189-230.
PADIAN, K. 2000. Feathers, fakes, and fossil dealers: how the commercial sale of fossils erodes science and education. *Palaeontologica Electronica* **3**(2). http://palaeo-electronica.org/2000_2/toc.htm
PETTITT, C. 1997. The cultural impact of natural history collections. *In* J. R. Nudds, and C. Pettitt (eds.) *The Value and Valuation of Natural Science Collections*. London: The Geological Society. 94-103.
POPPER, K. 2005. *The Logic of Scientific Discovery* (reprint of 1959 English version). London: Taylor and Francis.
PRUITT, J. B., CLEMENT, N. G. and TAPANILA, L. 2017. Laser and structured light scanning to acquire 3-D morphology. *The Paleontological Society Papers* **22**, 57-69.
RACICOT, R. 2017. Fossil secrets revealed: X-ray CT scanning and applications in paleontology. *The Paleontological Society Papers* **22**, 21-38.
RAUHUT, O. W. M., FOTH, C., TISCHLINGER, H. and NORELL, M. A. 2012. Exceptionally preserved juvenile megalosauroid theropod dinosaur with filamentous integument from the Late Jurassic of Germany. *Proceedings of the National Academy of Sciences of the United States of America* **109**, 11746-11751.

RAUHUT, O. W. M., LÓPEZ-ARBARELLO, A. and WÖRHEIDE, G. 2014. Private collections of fossils are a plus. *Nature* **512**, 371.

RAYFIELD, E. J. 2007. Finite Element Analysis and understanding the biomechanics and evolution of living and fossil organisms. *Annual Review of Earth and Planetary Sciences* **35**, 541-576.

RUDWICK, M. J. S. 1985. *The Meaning of Fossils: Episodes in the History of Palaeontology*. (2nd Edition) Chicago: Chicago University Press.

SCHMIDT, A. C. 2000. The *Confuciusornis sanctus*: an examination of Chinese cultural property law and policy in action. *Boston College International and Comparative Law Review* **23**, 185-227.

SCHWIETZER, M. H., WATT, J. A., AVCI, R., KNAPP, L., CHIAPPE, L., NORELL, M. and MARSHALL, M. 1999. Beta-keratin specific immunological reactivity in feather-like structures of the Cretaceous alvarezsaurid, *Shuvuuia deserti*. *Journal of Experimental Zoology (Mol Dev Evo)* **285**, 146-157.

SCRIVEN, S. 2016. *Fossils of the Jurassic Coast.* East Lulworth: The Jurassic Coast Trust.

SEELEY, H. G. 1876. Notice of the occurrence of remains of a British fossil *Zeuglodon* (*Z. wanklyni*, Seeley) in the Barton Clay of the Hampshire Coast. *Quarterly Journal of the Geological Society of London* **32**, 428-432.

SELDEN, P. A., CORRONCA, J. A. and HÜNICKEN, M. A. 2005. The true identity of the supposed giant fossil spider *Megarachne*. *Biology Letters* **1**, 44-48.

SIVETER, D. J., BRIGGS, D. E. G., SIVETER, D. J., SUTTON, M. D. and LEGG, D. 2017. A new crustacean from the Herefordshire (Silurian) Lagerstätte, UK, and its significance in malacostracan evolution. *Proceedings of the Royal Society B* **284**, 20170279. doi:10.1098/rspb.2017.0279

SONODA, T. and NODA, Y. 2016. Transfer of museum collection from the Hayashibara Museum of Natural Sciences to the Fukui Prefectural Dinosaur Museum. *Memoir of the Fukui Prefectural Dinosaur Museum* **15**, 93-98.

SUAREZ, A. V. and TSUTSUI, N. D. 2004. The value of museum collections for research and society. *BioScience* **54**, 66-74.

TAYLOR, M. A. and CROWTHER, P.R. 1997. Palaeo-Reply IV. To: Specimens in private collections -editorial responsibilities (2). *Palaeontology Newsletter* **33**. 19-21.

THOMSON, K. 2005. *Fossils: A Very Short Introduction*. Oxford: Oxford University Press.

TSCHOPP, E. and MATEUS, O. V. 2013. The skull and neck of a new flagellicaudatan sauropod from the Morrison Formation and its implications for the evolution and ontogeny of diplodocid dinosaurs. *Journal of Systematic Palaeontology* **11**, 853-888.

TSUIHIJI, T., WATABE, M., TSOGTBAATAR, K., TSUBAMOTO, T., BARSBOLD, R., SUZUKI, S., LEE, A. H., RIDGELY, R. C., KAWAHARA, Y. and WITMER, L. M. 2011. Cranial osteology of a juvenile specimen of *Tarbosaurus baatar* (Theropoda, Tyrannosauridae) from the Nemegt Formation (Upper Cretaceous) of Bugin Tsav, Mongolia. *Journal of Vertebrate Paleontology* **31**, 497-517.

TUNNICLIFF, S. 1997. Palaeo-Reply III. To: Specimens in private collections. *Palaeontology Newsletter* **33**, 17-18.

UNDERWOOD, C. J. and CLAESON, K. M. In press. The Late Jurassic ray *Kimmerobatis etches* gen. et sp. nov. and the Jurassic radiation of the Batoidea. *Proceedings of the Geologists' Association*.

VINTHER, J., BRIGGS, D. E. G., PRUM, R. O. and SARANATHAN, V. 2008. The colour of fossil feathers. *Biology Letters* **4**, 522-525.

WHITE, J. S. 2015. The Dinosaur Museum (Sauriermuseum) in Aathal, Switzerland, and Dr. Hans-Jakob Siber. *Rocks and Minerals* **90**, 56-62.

WYSE JACKSON, P. N. 1996. Palaeo-Reply I. To: Specimens in private collections - editorial responsibilities. *Palaeontology Newsletter* **32**, 5-6.

PUBLISH BEFORE THEY PERISH: DEALING WITH PRIVATELY-OWNED SPECIMENS IN PALAEONTOLOGY

by Oliver W. M. Rauhut [1,2]

Rauhut, O.W.M.. 2018. Publish before they perish: Dealing with privately-owned specimens in palaeontology *The Geological Curator* 10 (10): 561-564.

The question of whether it should be permissible to publish palaeontological specimens kept in private collections is a contentious issue. Many colleagues and scientific journals tend to reject publication of such specimens, mainly based on two objections: that private collectors fail to collect or keep important contextual data, and that such specimens are in permanent danger of being lost to science, endangering the repeatability of results. I argue here that both of these arguments are fallacious, as they are a) not only applicable to specimens in private collections, but also to material in many public collections, and b) scientific importance and repeatability of results does not entirely depend on contextual data and availability of actual specimens. More importantly, however, this issue touches on a more essential principle in science in general, the incorporation of all available data - and not only a selection - in hypothesis formation. Thus, I consider proper publication and detailed documentation of data gained from privately-owned specimens to be preferable over willfully ignoring relevant scientific data simply on the basis of the repository of the respective specimens.

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Introduction

Private collections have a long history in the science of Palaeontology and have provided the basis of many scientific collections and scientific institutions (e.g. Norman 1999). However, the discussion about the relationship between academic palaeontologists and interested laymen, or also commercial fossil dealers, is almost as long, and both the problems and benefits of private collections have been discussed repeatedly in the literature (e.g. Norman 1992; Catalani 2014; Larson and Russell 2014; Shimada *et al.* 2014; MacFadden *et al.* 2016). Much of this debate is centred around the questions of whether private collecting of fossils and/or their sale should be allowed, and if collecting by non-academic enthusiasts is harmful or beneficial to the science of Palaeontology. As outlined elsewhere (Rauhut *et al.* 2014), I consider private collections to be beneficial to science, if properly documented and cared for, as private collectors often provide much needed manpower to secure potentially important specimens from erosion or destruction by human activities (construction, quarrying, etc.).

However, another question not only of interest, but of significant scientific impact is how to deal with fossil specimens that are kept in private collections. Should such material be ignored, or should valuable scientific information be published regardless of the repository of the material? Many academic journals now follow a policy that prohibits publication of privately-owned specimens, and arguments brought forward in favour of not publishing privately-owned specimens include that such specimens are allegedly often collected in a non-professional and potentially harmful way and without the proper associated information (e.g. Shimada *et al.* 2014) and that privately-owned specimens are at a constant risk of disappearing from public access (e.g. due to sale), making verification of reported observations impossible (e.g. Barrett and Munt 2014).

In my opinion, both of these objections are 'straw man' arguments. Many private collectors I know are enthusiastic about fossils and collect and document their specimens to the highest possible standards. Collaborating with these individuals can thus not only bring scientifically important specimens into the realm of science, but also pertinent additional information that might otherwise be lost (e.g. when specimens are sold or donated to public institutions after

the death of the original collector). However, even if this is not the case, such specimens can still be of significant scientific value. In many instances, historical specimens in public collections lack exact locality information. This is even the case for some of the most iconic fossils, such as the Berlin *Archaeopteryx* (Tischlinger 2005) or the small theropod dinosaur *Compsognathus* (Mäuser 1983), the scientific importance of which is unquestionable. Likewise, public institutions still purchase numerous specimens with limited or no associated information, many of which are subsequently published (e.g. Xu *et al.* 2012; Godefroit *et al.* 2013; Evans *et al.* 2015). The lack of detailed locality or associated information is thus always unfortunate, but there is no reason why this should be an argument against publishing material from private collections, while it seems to be generally acceptable to publish specimens lacking such information (but provide other scientifically important data) that are kept in public institutions. Of course, adherence to higher standards in collecting and documenting fossil specimens are desirable, but, rather than ignoring private collectors, collaboration with and education of such individuals have the potential to improve the situation.

The second argument refers to one of the fundamental principles of science - repeatability of results - and thus seems more pertinent than the former objection. However, there are many sources of primary data in the natural sciences - mainly observations in the natural world - that are not repeatable, for example gamma ray bursts due to supernova explosions, earthquakes, or volcanic eruptions. In these cases, thorough documentation of the event is the key for scientific interpretation and hypothesis formation. The documented data thus replaces the original observation as the source for the derived scientific hypothesis, and it is this data that serves as a means to test and possibly falsify the interpretations, together with additional observations of new events of the same phenomenon. Although each of these classes of phenomena occur repeatedly in the natural world, not two events are exactly the same, nor are the observations and data recorded with any one of them. This situation may thus be compared with the thorough documentation of privately owned fossils, in which then at least the documented data remains in the public realm. Even if the original specimen might be lost at a later stage, it is the recorded data and newly discovered specimens of the same or closely related taxa (the palaeontological equivalent of the 'repeatability' of individual natural events) that allows testing the formulated hypotheses.

In palaeontology, analogous substitutions of original specimens by thoroughly documented descriptions of those specimens already occur in many circumstances and are accepted as proxies that enable testing of these observations. In palaeoichnology, for example, tracks or traces are not recovered in the field in many instances, but are documented photographically, with interpretative drawings, casts, and, more recently, by photogrammetry, while the original specimens are frequently lost due to erosion or quarrying activity (e.g. Lallensack *et al.* 2015). Even in vertebrate palaeontology, this procedure has been applied in exceptional circumstances: the lungfish genus and species *Apatorhynchus opistheretmus*, for example, is based on field observations, photographs and the cast of a specimen that could not be retrieved and was subsequently destroyed (Friedman and Daeschler 2006; interestingly, this taxon was published in a journal that has strict rules against publication of privately-owned specimens due to concerns of accessibility of original specimens). Thus, the exclusion of privately-owned specimens from such procedures, simply due to the fact that they are privately-owned, seems arbitrary.

In part, the question of whether to publish on privately-owned specimens also touches on a more fundamental issue in science: what kind of data should be used for hypothesis formation in the natural sciences? In my opinion - and I guess most scientists would agree - all available data that is relevant for the question at hand should be taken into consideration. Willfully ignoring relevant data - such as fossil specimens that we know to exist but are kept in private hands - is thus unscientific! There might be reasons to not use parts of the available data - e.g. if it is considered to be unreliable, impossible to obtain for technical reasons, or not relevant for the question at hand - but ignoring data that is available (if only in the scientific literature) and pertinent does certainly not fall into this category. Indeed, in cases where published specimens are subsequently lost or destroyed, most researchers would consider it fortunate that these specimens were well-documented, and the data thus conserved is frequently used in scientific research. A good example for this is the holotype material of the gigantic theropod dinosaur *Spinosaurus aegyptiacus*, which was kept in a public institution, the Bavarian State Collection of Palaeontology and historical Geology, before it was destroyed in World War II, together with most other material from the Cenomanian of the Baharyia Oasis kept at that institution (Nothdurft and Smith 2002). Despite the fact that this material was destroyed, the data published by Stromer (e.g. 1915, 1934, 1936) stands as a reference point for this fauna and has figured prominently in our understanding of Cretaceous African vertebrate faunas. Furthermore, any new information on these lost specimens is welcome (e.g.

Smith *et al.* 2006). Likewise, although it is unfortunate that the Maxberg specimen of *Archaeopteryx* is currently lost, the thorough documentation of this third specimen of the famous 'urvogel' (Heller 1959, 1960) has greatly enhanced our understanding of this important taxon, and the data is still frequently used in discussions of the anatomy, biology, and evolutionary significance of *Archaeopteryx* (e.g. Christiansen and Bonde 2004; Christiansen 2006; Wellnhofer 2008). Furthermore, in many instances data reported in the scientific literature replaces personal observations in scientific studies - if every scientist had to repeat every experiment and every observation in order to develop a new hypothesis there would not be any scientific progress, nor any point in publishing observations in the first place. Thus, publication and thorough documentation of specimens at the very least conserves some of the available data for future scientific studies. It is difficult to see why this approach, which is widely applied to other cases, as documented above, would not be beneficial for science in the case of privately-owned specimens.

To make this absolutely clear: I also consider it by far preferable if scientifically important specimens are excavated professionally, with all associated data being recorded, and subsequently prepared by trained preparators and curated by experts in a public institution! In an ideal world, public institutions should have the staff and the funds to carry out all necessary excavations, preparation work and curation, and to purchase important specimens from private collectors when needed. However, in the real world, most public institutions barely have the necessary staff and funds to ensure basic operations, and need external funding (public or private) for any excavation or collecting activities and for purchase of scientifically important specimens. Thus, in this situation, private collectors can provide important support for public institutions (e.g. MacFadden *et al.* 2016), and publication of privately-owned specimens can provide a benefit to science.

Of course, in the case of privately-owned specimens, every attempt should be made by the respective scientist to ensure accessibility of specimens and/or their thorough documentation to ensure that published interpretations can be evaluated by scientific peers. Based on my own experience, many private collectors are open to legal solutions that ensure future availability of specimens, even if they are unwilling to donate or sell them. Such solutions can be legal documents ensuring access to specimens or their deposition in a public collection at a later stage. However, even in the absence of a legally binding agreement with the owner, modern technology offers multiple approaches to thoroughly document specimens, from physical casts via photographs to micro-CT or Synchrotron scans, which can ensure even the verification of observations pertinent to questions beyond anatomical features or taxonomic identification, such as biomechanics or ecology (see Cunningham *et al.* 2014). In this case, it is, however, important that this documentation that allows testing published results is deposited in a public institution and thus publicly available, and is not only kept on the computer or in the desk of the researcher publishing on the respective specimen.

In summary, I consider the publication of privately-owned specimens to be preferable over wilfully ignoring potentially important scientific data, even if there might be a danger that the actual specimens might later be lost to science. Especially if high standards of documentation of these materials are followed, the benefit for scientific investigations largely exceeds potential problems. In the worst case, dubious finds on poorly documented material can simply be ignored, but scientific data from undocumented specimens that are lost or destroyed are lost forever.

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References

BARRETT, P. and MUNT, M. 2014. Private collections hold back science. *Nature* **512**:28-28.

CATALANI, J. 2014. Contributions by amateur paleontologists in 21st century paleontology. *Palaeontologia Electronica* **17**.2.3E:1-4.

CHRISTIANSEN, P. 2006. Allometry in phylogeny and *Archaeopteryx*. *Journal of Vertebrate Paleontology* **26**:480-486.

CHRISTIANSEN, P, and BONDE, N. 2004. Body plumage in *Archaeopteryx*: a review, and new evi-

dence from the Berlin specimen. *Comptes Rendus Palevol* **3**:99-118.

CUNNINGHAM, J, RAHMAN, I, LAUTENSCHLAGER, S, RAYFIELD, E, and DONOGHUE, P. 2014. A virtual world of paleontology. *Trends in Ecology & Evolution* **29**:347-357.

EVANS, D.C, BARRETT, P.M, BRINK K.S, and CARRANO, M.T. 2015. Osteology and bone microstructure of new, small theropod dinosaur material from the early Late Cretaceous of Morocco. *Gondwana Research* **27**:1034-1041.

FRIEDMAN, M, and DAESCHLER, E. 2006. Late Devonian (Famennian) lungfishes from the Catskill Formation of Pennsylvania, USA. *Palaeontology* **49**:1167-1183.

GODEFROIT, P, CAU, A, HU, D, ESCUILLIÉ, F, WU W, and DYKE, G.J. 2013. A Jurassic avialan dinosaur from China resolves the early phylogenetic history of birds. *Nature* **498**:359-362.

HELLER, F. 1959. Ein dritter *Archaeopteryx*-Fund aus den Solnhofener Plattenkalken von Langenaltheim/Mfr. *Erlanger Geologische Abhandlungen* **31**:1-25.

HELLER, F. 1960. Der dritte *Archaeopteryx*-Fund aus den Plattenkalken des oberen Malm Frankens. *Journal of Ornithology* **101**:7-28.

LALLENSACK, J, SANDER, P, KNÖTSCHKE, N, and WINGS, O. 2015. Dinosaur tracks from the Langenberg Quarry (Late Jurassic, Germany) reconstructed with historical photogrammetry: Evidence for large theropods soon after insular dwarfism. *Palaeontologia Electronica* **18**.2.31A:1-34.

LARSON, P, and RUSSELL, D. 2014. The benefits of commercial fossil sales to 21st century paleontology. *Palaeontologia Electronica* **17**.1.2E:1-7.

MACFADDEN, B, LUNDGREN, L, CRIPPEN, K, DUNCKEL, B, and ELLIS, S. 2016. Amateur paleontological societies and fossil clubs, interactions with professional paleontologists, and social paleontology in the United States. *Palaeontologia Electronica* **19**.2.1E:1-19.

MÄUSER M. 1983. Neue Gedanken über *Compsognathus longipes* Wagner und dessen Fundort. *Weltenburger Akademie, Erwin Rutte - Festschrift*:157-162.

NORMAN, D.B. 1992. Fossil collecting and site conservation in Britain: are they reconcilable? *Palaeontology* **35**:247-256.

NORMAN, D. 1999. Mary Anning and her times: the discovery of British palaeontology (1820-1850). *Trends in Ecology & Evolution* **14**:420-421.

NOTHDURFT, W, and SMITH, J. 2002. *The lost dinosaurs of Egypt*. New York: Random House.

RAUHUT, O.W.M., LÓPEZ-ARBARELLO A, and WÖRHEIDE G. 2014. Fossil descriptions: Private collections of fossils are a plus. *Nature* **512**:371.

SHIMADA, K, CURRIE, P, SCOTT, E, and SUMIDA, S. 2014. The greatest challenge to 21st century paleontology: When commercialization of fossils threatens the science. *Palaeontologia Electronica* **17**.1.1E:1-4.

SMITH, J.B., LAMANNA, M.C., MAYR, H. and LACOVARA, K.J. 2006. New information regarding the holotype of *Spinosaurus aegyptiacus* Stromer, 1915. *Journal of Paleontology* **80**:400-406.

STROMER, E. 1915. Ergebnisse der Forschungsreisen Prof. E. Stromers in den Wüsten Ägyptens. II. Wirbeltierreste der Baharije-Stufe (unterstes Cenoman). 3. Das Original des Theropoden *Spinosaurus aegyptiacus* nov. gen., nov. spec. *Abhandlungen der Königlich Bayerischen Akademie der Wissenschaften, Mathematisch-physikalische Klasse* **28**:1-32.

STROMER, E. 1934. Ergebnisse der Forschungsreisen Prof. E. Stromers in den Wüsten Ägyptens. II. Wirbeltierreste der Baharije-Stufe (unterstes Cenoman). 13. Dinosauria. *Abhandlungen der Bayerischen Akademie der Wissenschaften, Mathematisch-naturwissenschaftliche Abteilung, Neue Folge* **22**:1-79.

STROMER, E. 1936. Ergebnisse der Forschungsreisen Prof. E. Stromers in den Wüsten Ägyptens. VII. Baharije-Kessel und -Stufe mit deren Fauna und Flora. Eine ergänzenden Zusammenfassung. *Abhandlungen der Bayerischen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Abteilung, Neue Folge* **33**:1-102.

TISCHLINGER, H. 2005. Neue Informationen zum Berliner Exemplar von *Archaeopteryx lithographica* H. v. Meyer 1861. *Archaeopteryx* **23**:33-50.

WELLNHOFER P. 2008. Archaeopteryx. *Der Urvogel von Solnhofen*. Munich: Verlag Dr. Friedrich Pfeil.

XU, X, WANG, K, ZHANG, K, MA, Q, XING, L, SULLIVAN, C., HU, D., CHENG, S., and WANG, S. 2012. A gigantic feathered dinosaur from the Lower Cretaceous of China. *Nature* **484**:92-95.

40 YEARS AS A FOSSIL PROSPECTOR, COLLECTOR AND EXHIBITION MAKER

by H.J. 'Kirby' Siber

Siber, H.J. 2018. 40 years as a fossil prospector, collector and exhibition maker *The Geological Curator* 10 (10): 565-568.

Even 200 years of fossil collecting for the benefit of public and private collections has not exhausted the supply of fossils by any means. One can even argue that we have barely scratched the surface, and that the best and most important finds are still out there. The primary reason for this is that the technical means for excavating, collecting and preparing fossils have considerably advanced during the last three decades, up to the level that the present act of collecting is - under ideal circumstances - far superior to past collecting efforts.

Who has the ambition, the skills, the financial resources and the legal rights to collect fossils properly? Traditionally, three groups engage themselves in the art and technique of fossil collecting: professional palaeontologists, advanced amateurs, and commercial palaeontologists. All of these groups have made significant contributions to classical and modern palaeontology and to museum collections worldwide. Recent developments regarding restrictions to collect fossils primarily target amateurs and so called 'commercials' or independent palaeontologists, and have greatly diminished the opportunities for legal fossil collecting. However, these three groups work best together if they pool their resources. Many models of cooperation exist and have proved beneficial for all parties involved. In addition, the restrictions on fossil collecting in more fossiliferous areas and countries is well meant, but essentially counterproductive. Palaeontology requires the effort and input of all three groups. Their cooperation is essential and eventually determines the amount and quality of important fossils found and saved for future generations. It is not necessary that scientifically important fossils are exclusively housed in "public repositories". The criterion should be accessibility for continued scientific research and not ownership.

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Introduction

Looking back at my career in collecting fossils from around the globe, my feelings are mixed for the future of young people who would like to enter this field. I am joyful for having been able to collect so many wonderful fossils (that otherwise would most likely be still in the field weathering away). But I am also sorrowful about recent developments banning or restricting the collecting of fossils - often encouraged by professional palaeontologists - measures that are in my view counterproductive and prevent largely young fossil enthusiasts from entering this field of science, either as advanced amateurs or independent professionals. I strongly doubt that a similar career to mine will be possible for future generations.

But let me first recount some of the highlights of my life as a fossil collector and prospector. My first significant fossil experience started in the Green River Formation of Wyoming, Utah and Colorado. I used to travel regularly to the USA in the 1970s and 1980s to visit commercial fish quarries in Wyoming. Here, I found not only five important fish fossils for sale, but also other fossils like leaves, insects, crocodiles, turtles, birds, etc. Inspired by the great collections of the Late Jurassic Solnhofen beds I started a collection of every kind of fossil I could get my hands on and - since there was at the time not much available in the way of literature - and I eventually published a small book in German on the fossils of the Green River Formation (Siber 1982).

After some years of collecting and expanding this Green River collection with the help of a professionally trained preparator, the word must have gotten around that my collection contained rare specimens, especially birds. One day I got a call from the

National Museum of Natural History (Smithsonian Institution) in Washington, D.C. expressing an interest in purchasing my entire collection, which they did. As a result, my Green River collection ended up in a large public institution, some of the pieces are on public display, and some serve as research specimens, especially the Eocene birds. During the early and late 1970s I developed a passion for other fossils, this time from the White River Badlands. My friends from South Dakota took me out into the field to where they collected Oligocene turtles, oreodonts, camels, horses, rhinos, rabbits, etc. Here I was introduced to the fantastic unique landscape of the Big Badlands and to the real artistry of collecting vertebrate fossils. At this time, large parts of the South Dakota badlands were still open to collecting. Soon another large collection grew and grew. Eventually, I could add some of my own finds, which I had found in corresponding rock layers in Wyoming or Nebraska. Together with specimens purchased from local collectors, I put these Oligocene fossils on display at our premises in Aathal, Switzerland. I believe that this was the first time that a major collection of White River Badlands fossils were shown anywhere in Europe. This drew the attention of the University of Zurich, which eventually purchased the entire collection for its Palaeontology Museum, where it is today on public display.

In 1985, I lived for a year in Lima, Peru. During this time, I became aware of the immensely rich fossil deposits of the coastal Pisco Formation, containing mostly Miocene fossil whales, dolphins, sea lions, various sharks, crocodiles, birds, etc.

Under a permit from the Natural History Museum of Lima and the Peruvian Institute of Culture I organized over a dozen fieldtrips to the fossiliferous areas, lasting anywhere from one week to over one month at a time. All in all, I spent over a year of my life prospecting and digging in this very special place along the southern coast of Peru, a place that often looks like the Sahara because of its many sand dunes. Part of the deal with the Peruvian authorities was that I build a museum over a well-known large fossil whale specimen situated near the Panamerican Highway, a specimen that was in danger of being lost due to both heavy wind erosion and vandals. I therefore drew up plans to protect and save this spectacular whale specimen in a building we called the 'Museo de Sitio de Sacaco', which is situated near Kilometer 540 on the Panamerican Highway South. This museum still exists today (after surviving several earthquakes). It also contains written and graphic information regarding marine life in the Miocene epoch.

My part of the deal enabled me to dig up five fossil whale specimens, which we excavated over the following 7 years. Two of these specimens went to German museums (Stuttgart and Karlsruhe) and two to Japanese museums (Gomagori and Kanagawa Prefectural Museums). A fifth whale we kept for our own museum, the Sauriermuseum Aathal, which opened its doors in 1992. Professor Pilleri from the Brain Institute at Bern University, Switzerland, published two volumes on the Cetacea from the Miocene of Peru essentially using material that was found, excavated and prepared by our group (Pilleri 1989).

After the whales from Peru, my interest shifted to dinosaurs. In 1990 I reopened a famous site, the Howe Dinosaur Quarry in north central Wyoming (USA), where Barnum Brown of the American Museum of Natural History had excavated the remains of at least 25 medium-sized sauropods in 1934. This project kept our group busy for 14 years and was eminently successful. After the original historic site dug by Brown was worked out in 1991, we located a new site on the same ranch, which yielded even better results. In quick succession, we excavated a very well preserved *Camarasaurus* skeleton (nicknamed 'E.T.'; Tschopp et al. 2015; Wiersma and Sander 2016), several partial diplodocid skeletons (e.g. Tschopp and Mateus 2013, 2017), a stegosaur (nicknamed 'Victoria'; Christiansen & Tschopp 2010), a nearly complete allosaur (dubbed 'Big Al Two'; Foth et al. 2015), an *Othnielosaurus* specimen (known as 'Barbara') and a rare sauropod baby (called 'Toni'; Schwarz et al. 2007; Carballido et al. 2012), which was only about 2m in size and nearly complete, except for the skull. In the year 2001, we moved to a new site nearby and excavated another very complete stegosaur (called 'Lilly') and a new type of sauropod that was eventually described as *Galeamopus pabsti* (Tschopp & Mateus 2017). These authors had already described one of our early sauropod finds from the original Howe Quarry, naming it *Kaatedocus siberi* (Tschopp & Mateus 2013).

After some difficulties arose regarding the rights to fossils from the Howe Ranch (a former owner, who had registered the fossil rights in his name, fought with the present owner in court over the ownership of these rights), the Siber Team moved to the Dana Quarry near Ten Sleep, Wyoming, about 80 miles south of the Howe Quarry. The Dana Quarry also lies within the Morrison Formation and yielded a very large, quite complete diplodocid specimen (known as 'Arapahoe'). In 2003, the team also excavated a very well-preserved stegosaur from Red Canyon Ranch (now known as 'Sophie'; Brassey et al. 2015, 2017; Maidment et al. 2015; Lautenschlager et al. 2016; Barrett 2017) that is now on public display at the

Natural History Museum, London. A quite complete *Camptosaurus* specimen was also recovered from this quarry, completing the list of Morrison dinosaurs we have excavated.

Currently, the Sauriermuseum Aathal's collection of Morrison dinosaurs consists of 10 important specimens. They are on public display and have already been the objects of study of numerous scientific investigations, resulting in more than 50 publications (see above for some key examples). Around 70-90,000 visitors come to see these dinosaurs every year. It seems absurd to me, therefore, that the collection of the Sauriermuseum Aathal, which is registered as a private enterprise, is often considered a 'Private Collection', unsuitable for the conduct of serious research work, as if this collection was stashed away in a private home. It seems to me that accessibility to scientific research should be the criterion and not ownership. I think we should see what is best for palaeontology. Traditionally, collectors and advanced amateurs have contributed in numerous ways to this science.

If private collecting and state sponsored palaeontology could work together in a spirit of cooperation it would result in a far greater number of important fossils being saved. The real work is saving all the unknown fossil treasures that are still out there, somewhere on or near the surface of the Earth, and that have no chance of ever being collected and studied, because of a lack of adequate staff who have the means to properly collect and save them.

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References

BARRETT, P. 2017. *Stegosaurus*: an extraordinary specimen and the secrets it reveals. Natural History Museum, London.

BRASSEY, C.A., MAIDMENT, S.C.R., BARRETT, P.M. 2015. Body mass estimates of an exceptionally complete *Stegosaurus* (Ornithischia: Thyreophora): comparing volumetric and linear bivariate mass estimation methods. *Biology Letters* **11** (3) : 20140984 - 20140984. doi: 10.1098/rsbl.2014.0984

BRASSEY, C.A., MAIDMENT, S.C.R., BARRETT, P.M. 2017. Muscle moment arm analyses applied to vertebrate paleontology: a case study using Stegosaurus stenops Marsh, 1887, *Journal of Vertebrate Paleontology*, DOI: 10.1080/02724634.2017.1361432

CARBALLIDO, J.L., MARPMANN, J.S., SCHWARZ-WINGS, D., PABST, B., 2012. New information on a juvenile sauropod specimen from the Morrison Formation and the reassessment of its systematic position. *Palaeontology* **55**, 567-582. https://doi.org/10.1111/j.1475-4983.2012.01139.x

CHRISTIANSEN, N.A., TSCHOPP, E., 2010. Exceptional stegosaur integument impressions from the Upper Jurassic Morrison Formation of Wyoming. *Swiss J Geosci* **103**, 163-171. https://doi.org/10.1007/s00015-010-0026-0

FOTH, C., EVERS, S.W., PABST, B., MATEUS, O., FLISCH, A., PATTHEY, M., RAUHUT, O.W.M., 2015. New insights into the lifestyle of *Allosaurus* (Dinosauria: Theropoda) based on another specimen with multiple pathologies. *PeerJ* **3**, e940. https://doi.org/10.7717/peerj.940

LAUTENSCHLAGER, S., BRASSEY, C.A., BUTTON, D.J., AND BARRETT, P.M. 2016. Decoupled form and function in disparate herbivorous dinosaur clades. *Scientific Reports* **6**, 26495 (doi: 10.1038/srep26495).

MAIDMENT, S.C.R., BRASSEY, C.A. and BARRETT, P.M. 2015. The Postcranial Skeleton of an Exceptionally Complete Individual of the Plated Dinosaur *Stegosaurus stenops* (Dinosauria: Thyreophora) from the Upper Jurassic Morrison Formation of Wyoming, U.S.A.. PLOS ONE, 10 (10) : e0138352 - e0138352. doi: 10.1371/journal.pone.0138352

PILLERI, G. 1989 *Balaenoptera siberi*, Ein neuer spätmiozäner Bartenwal aus der Pisco-Formation Perus, *Beiträge zur Paläontologie der Cetaceen Perus*, 65-84, Hirnanatomisches Institut Ostermundigen, Universität Bern. 233 pp.

SCHWARZ, D., IKEJIRI, T., BREITHAUPT, B.H., SANDER, P. M. and KLEIN, N. 2007; A nearly complete skeleton of an early juvenile diplodocid (Dinosauria: Sauropodia) from the Lower Morrison Formation (Late Jurassic) of north central Wyoming and its implications for early ontogeny and pneumaticity in sauropods. *Historical Biology* **19** (3): 225-253.

SIBER, H.J. 1982 Green River Fossilien, Über ein nordamerikanisches Fundgebiet reich an Fischfossilien und andern Lebenszeugen der Eozänzeit vor 50 Millionen Jahren. Aathal: Siber und Siber AG. 91pp.

TSCHOPP, E., MATEUS, O., 2013. The skull and neck of a new flagellicaudatan sauropod from the Morrison Formation and its implication for the evolution and ontogeny of diplodocid dinosaurs. *Journal of Systematic Palaeontology* **11**, 853-888. https://doi.org/10.1080/14772019.2012.746589

TSCHOPP, E., MATEUS, O., 2017. Osteology of *Galeamopus pabsti* sp. nov. (Sauropoda:

Diplodocidae), with implications for neurocentral closure timing, and the cervico-dorsal transition in diplodocids. *PeerJ* **5**, e3179. https://doi.org/10.7717/peerj.3179

TSCHOPP, E., WINGS, O., FRAUENFELDER, T., BRINKMANN, W., 2015. Articulated bone sets of manus and pedes of *Camarasaurus* (Sauropoda, Dinosauria). Palaeontologia Electronica 18, 1-65.

WIERSMA, K., SANDER, P.M., 2016. The dentition of a well-preserved specimen of *Camarasaurus* sp.: implications for function, tooth replacement, soft part reconstruction, and food intake. *Paläontologische Zeitschrift*, Springer 1-17. https://doi.org/10.1007/s12542-016-0332-6

IVORY PIANO KEYS FROM MASTODONS: WHY POOR ANTHROPOCENTRIC LEGISLATION ENDANGERS FOSSILS

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Liston, J.J.. 2018. Ivory Piano Keys from Mastodons: Why Poor Anthropocentric Legislation Endangers Fossils. *The Geological Curator* 10 (10): 569-575.

Palaeontological material and sites have faced a variety of challenges in the last half century, often due to inadequate legislation from poorly informed legislators designed for very different objects. The most common problematic scenario is for material to be assessed on anthropocentric grounds that are more traditionally applied to archaeological and art objects as 'cultural', and are fundamentally ill-suited for palaeontology. This paper highlights some of the negative consequences of bad legislation in order to explain why it is a global problem that needs to be addressed by the international palaeontological community through direct engagement with legislative bodies.

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Introduction

In 1794, the French revolutionary forces of Napoleon occupied Maastricht in the Republic of the United Netherlands, successfully confiscating the Meuse River lizard (or 'Great Beast of Maastricht') from its legal owner, without compensation (Pieters *et al.* 2012). It had been excavated almost 15 years earlier, at a time when fossil collectors had only just started beginning to acquire specimens from the St. Peter's Mount (= St. Pietersberg) quarry locality (Liston 2015). It was, therefore, perhaps appropriate, given the associated field trip (Holwerda 2016) to the ENCI Cement Quarry (the 'Mount' has long since-been quarried away) that it was this meeting of the European Association of Vertebrate Palaeontologists that had a symposium dedicated to ethics in palaeontology ('FossilLegal', Figure 1), including (but not restricted to) the illegal removal of fossils from international territories (Liston 2016). As an early example of a vertebrate fossil as war loot, the Great Beast of Maastricht has both a high profile and perhaps the longest-standing claim to being eligible for repatriation. Although this claim may be contested, the case of this abducted celebrity mosasaur at the dawn of vertebrate palaeontology certainly demonstrates the relationship between politics and science, through the use of extinct animals for national - or self - aggrandisement (Liston and Alcalá 2017).

Figure 1 - The 'FossilLegal' logo, with use of greys in the middle to demonstrate that the issues are not as simply black and white as might be thought.

Far from being a predictable attempt to initiate yet another witch-hunt against 'commercial' palaeontologists as a whole (see Liston 2018), the FossilLegal symposium dealt with a wide range of perspectives, from problems of access to specimens in museums (whether private or public), as well as accounts of academics illegally taking material out of either China or Brazil for later publication in *Nature*, showing the interconnection of money and publishing with illegal - even criminal - academic activity. (Thanks to Dave Marshall, the entire FossilLegal symposium - including the roundtable session - is available online at www.palaeocast.com/eavp-2016.) At the end of the symposium, a roundtable discussion was held with all the disparate presenters, with a surprising amount of consensus considering the range of backgrounds and opinions represented. Perhaps unexpectedly, the loudest consensus coalesced around education as the default problem that everyone complained about, and agreed on: uninformed legislators produce ignorant legislation, and palaeontologists end up fighting a rearguard action for the failings of the legislator's early education. To help address this recurring problem, during the roundtable President Dino Frey proposed that the EAVP survey its members to assess exactly what we as vertebrate palaeontologists wanted, with respect to regulations regarding excavation and trade, whether from a commercial or a scientific perspective. There are a wide variety of member countries in the Association (not all of them in Europe), so the final results are sure to be interesting.

The problems with culture

The FossilLegal symposium was opened by John Martin (see Martin 2018) with a keynote presentation, looking at how the words 'culture' and 'cultural' had been misused to incorporate heritage as cultural property, with the resulting problems of legislation attempting to deal with fossil material while failing to address what it actually is. "It is important to be clear on the distinction between culture as a *sensu lato* definition that incorporates natural science and is fundamentally synonymous with heritage and the cultural objects dealt with in most legislation, which are those of art, archaeology, ethnography, history and so on that do not equate directly with the full meaning of heritage." (Liston 2014; p.695). Natural Heritage is NOT cultural property. Science has a cultural context, but this relates to the scientific activity rather than the objects or subjects of scientific enquiry themselves. All definitions of culture are concerned with human creativity. Fossils are not the products of human creativity. Therefore it is time to stop judging them as though they were.

Early responses to the EAVP's survey from eleven different countries revealed common threads about extracting palaeontology from inappropriate legislation - one response even pointing out that too many of the overseers for legislation were from historical rather than scientific backgrounds. Bad legislation can be ineffective because of both the wording and who administers that legislation. It may seem strange that such definitions are seen as not only important, but a significant obstacle for the field (see Ulph 2018, on English law), however it is important to highlight some of the negative consequences of bad legislation in order to explain why it is a global problem, and why it is important to address it. A good example is the recent 'Kulturschutzgesetz', a new German Culture Protection Act that was introduced primarily to protect artwork of national interest, with fossils being somewhat thoughtlessly added to it without any consultation with the German palaeontological community. The intention may have been to protect cultural goods from theft, illegal trade and vandalism as well as the looting of cultural objects from war areas, but it provoked a panic amongst the German museum community, with many collectors taking back specimens loaned to museums and effectively going underground. It was only through the pressure of private collectors that the law was finally modified in December 2015, so that fossils are thus no longer cultural goods per se in Germany (D. Frey pers. comm.).

Fossils are also misrepresented legally in other ways: as noted elsewhere (Liston 2014) geological terminology used by scientists will not necessarily be used (or interpreted) by lawyers in the same way. Under English law, the legal definition of 'mineral' refers simply to 'every substance that can be acquired from underneath the surface of the Earth for the purpose of profit'. In contrast, since 1915 (the Earl Douglass appeal), United States law has acted on the understanding that the fossil remains of dinosaurs and other prehistoric animals are not mineral in the meaning of the word in United States mining laws, although the United States Court of Appeals for the Ninth Circuit recently considered that dinosaur fossils were in fact 'mineral' (United States Court of Appeals for the Ninth Circuit 2018). However, the United States' recent Paleontological Resources Protection Act (PRPA) helpfully explicitly excluded fossils from a definition of minerals. But the most common terminological issue (see Liston 2014 for a variety of similar examples), is that of miscategorising fossils as cultural, thus lumping them in with archaeology and/or art objects. The argument can be made that as long as the material has some form of protection, then surely that is the important thing - however it is no great service that is done to palaeon-

tology by grouping fossils with such artefacts, as it does not afford palaeontological material equal status with them, but instead, distinctly inferior status - and with that, inferior levels of protection. Debating what is, and what is not, 'cultural' may seem like a semantic exercise in wordplay, but the intention is to demonstrate that there is no 'easy' way to protect fossils within law, simply by adding them as an afterthought to other legislation.

The lumping of fossils with 'cultural heritage' or 'cultural property' places fossil material at risk through being assessed with the anthropocentric criteria more suited to its enforced stablemates. Liston (2014: p.697) noted that: "By failing to recognise and address...fundamental differences between palaeontological and cultural objects, badly phrased legislation will continue to fail to protect such scientific material." It may be a little strong to say that the only 'culture' that should be regarded as present in natural sciences is the type found on the top of an agar plate in a petri dish, but that may well be a more sensible starting point than the umbrella perspective of considering all science and scientific objects to be cultural.

Comparing like with like? : a comparative dissonance

Liston (2014: p.696) noted that: "The use of human-defined geographical and political boundaries automatically frames the case for fossil protection in an anthropocentric context, and prejudges their merits on such a basis, instead of their own" and reviewed some of the problems with legal terminology affecting fossils, as well as the possible negative consequences of fossils being included under UNESCO. Examples of fossils being defined in the contexts of human ages (i.e. when they were excavated - and by whom) in China (Figure 2) (Liston 2013b), the UK and beyond (Liston 2014) send the message that a fossil in itself has no (or little) intrinsic value beyond the human interaction with it - in other words, for it to experience a transformational human event or interaction that alters it into a human historical object, as though this approach was the only way to imbue them with some 'true value', by integrating them within a human cultural context. Thus, perhaps bizarrely, scientific objects such as fossils that have experienced a degree of cultural integration - of whatever form (e.g. Oakley 1975; 1985; Liston 2014) - are more likely to attract funding, than purely scientific equivalents devoid of such incidental associations. But - setting aside (some) hominid remains - no fossil is intrinsically 'human'. Tying the significance or value of fossils into local human interaction denigrates their palaeontological value as secondary to merely having been historically engaged by human activities.

As much as we might argue that palaeontological material does not constitute cultural objects, it is often judged in those terms - yet within the field of cultural objects, it is not regarded nearly as highly as material from ethnographic, archaeological or historical contexts. Palaeontology is the poor relation of archaeology, and the mocked outcast of cultural objects - as such it is not and has never been given adequate resources for protection - so trying to prevent the predations of stakeholder groups is always highly problematic for palaeontologists. Why is this a problem? The complexities of legislation for fossils gives them a variability of treatment even within a given locality (see Underwood and Ward 2018) creating a pressure for a simplistic approach, as legislators rarely want to be involved in the complexity of practical issues (i.e. archaeological objects are very different from palaeontological ones). An example is legislation supporting recovery of the relevant material: den Ouden and Pouwer (2018) and Liston (2006) writing about the Star Pit excavation noted that industrial quarrying companies are legally obliged to fund the recovery of archaeological objects, whereas saving palaeontological material from such environments relies almost exclusively on volunteer labour and donations. Underwood and Ward (2018) also note that a lack of pragmatism in fossil protection legislation and policies causes wholesale destruction of fossils: a process that is pragmatic for archaeological objects will rarely equate to pragmatism for palaeontological ones.

Figure 2. A customs sign at the Chinese Airport of Guangzhou warning about the illegal export of goods, showing the old terminology of 'ordinary cultural relics' (Liston 2013b) that used to include fossils.

Unsurprisingly, with the protection of palaeontological material as opposed to archaeological artifacts, it does come down to money (Kjærgaard 2012). Under-resourcing leads to poor protection (especially for fossils, see Liston 2014), and as adequate protection of palaeontological resource sites is highly resource intensive, most states default to leaving policing the objects to being the responsibility of customs and border control, in order to stop material leaving across the state border…irrespective of the fact that by the time it has left the palaeontological site, much of the provenance and hence the scientific value of the object has already been lost (Schmidt 2000). Border checks themselves can often be ineffective, either due to collusion between the exporter/smuggler and the border security, or simply (through further under-resourcing) that the staffing levels are far too low (or untrained in fossils) to allow customs to effectively do their job.

As well as issues of practicality and inadequate resourcing, palaeontology suffers from a severe handicap of bad terminology in the legislation that is supposed to protect it (Liston 2017). In this regard, it is worth noting that not only Germany, but also China has recognised this, and explicitly decoupled palaeontology from its archaeological protection legislation (Liston and You 2015). The two states cannot have more different starting points in their legislation - the Chinese state owns everything in the ground, whereas there are specific 'lander' (federal states) in Germany that regard fossils as owned by the landowner to do whatever they wish with, abroad or domestically - and yet they have come to the same conclusion: palaeontology needs to be dealt with separately from archaeology.

Perspective from guardians of the objects

It is of course unsurprising that depository guardians will take their lead from the law, indeed often representing a more conservative position than that required by state legislation. In 2001, Maurice Davies went further. As a representative of the Museums Association, he attended the 'Commercial Trade: Ethics versus Science' conference at the University of Manchester in May 2001. Davies was a logical delegate to invite to the meeting, as he had sat on the Ministerial Advisory Panel on Illicit Trade, which had decided not to cover palaeontological items unless they exceeded a certain financial value (or if they were collections, and again above that critical financial value - note, once again, that the concept of a collection is once again entirely a human construct and not a natural concept, so the assessment of the material is once again being framed primarily in terms of a human interaction, being based on 'who collected it' above what it is). In the course of Davies' contribution to consideration of the fossil trade, he perhaps less than helpfully compared some palaeontological researchers to doctors that retain children's organs without consent (Davies 2001).

However, in a welcome step forward, and with somewhat more measured consideration of the issues, the Museums Association's latest ethics statement looks at objects in a way that not only allows their scientific value to be considered, above - and distinct from - their financial, treating "museum collections as cultural, scientific or historic assets, not financial assets" (reference, page 13), but also allows for objects to have a scientific value without requiring them to be a cultural object.

This clear distinction between scientific value and cultural object represents significant and heartening progress for the Museums Association and perhaps should be a model for other bodies elsewhere. However, it is all too common for museums and other institutions to look at natural sciences unfavourably within a broad collection base: it is quite common for council museums to have their artworks selected by council officials to be displayed in their council office as trappings of power and status, but natural science material simply does not have that level of regard - and therefore respect or value - in the eyes of those councillors that have so much influence over those same museums, revealing their likely preferences and prejudices. Nor are academic institutions immune to this kind of disciplinary chauvinism: in my former university museum, which was founded on the disparate collections of the eighteenth century Enlightenment anatomist William Hunter, his artworks had a bizarrely disproportionate standing within the institution. From contemporary writings, it can be seen that, after Hunter's human anatomical specimens, his fossils were the ones that he held in the highest regard, and his numismatic collection (30,000 items) was the one that he spent the most money on (Liston 2012). Yet none of these objects evoke the same status response in the modern age as artworks, so the most money and time was devoted to them (even to the extent of producing a purpose built art gallery to display those works outwith the rest of Hunter's collections), despite artworks being a minor component of his original collection (a mere 65 paintings) (Liston 2012). Thus, their significance to the original collector has become distorted in the eye of the modern observer, due to this 'cultural' bias.

The true nature of a fossil

In 1768, William Hunter demonstrated that the elephant was not the only animal that had ivory tusks, by showing the same characteristic to be present in fossilised remains of the 'Ohio incognitum' (or mastodon) (Hunter 1768; Liston 2013a). Yet the presence of ivory is incidental to the significance of the animal - as an extinct organism - in itself. The significance of the animal's remains do not lie in their mineral composition (although some information can be derived from this to perhaps indicate something about the animal's environment or life), so it is inappropriate to regard them in the sense of being a mineral resource or commodity. As the United States district court for the district of Montana recently determined after considering "dictionary definitions and several Montana mining statutes", the "common understanding of 'mineral' includes the mining of a hard compound or oil and gas for refinement and economic exploitation. In contrast, dinosaur fossils are the remains of once-living vertebrates. The fossils' properties are not what make them valuable. Fossils are not subject to further refinement before becoming economically exploitable. Instead, the fossils are valuable because of their very existence. Dinosaur bones are not economically valuable to be processed into fuel or materials or manufactured into jewelry." (United States Court of Appeals for the Ninth Circuit 2018: 12).

To assume that fossils have a human cultural context through their own nature (which noone would assume as the default position for living animals) is to place fossils within an unremittingly anthropocentric context, stripped of any intrinsic nature of their own. This is not only an anathema to the science, but also to any attempts to deal with the objects beyond simply as objects of property and theft.

In order to draft suitable legislation for fossils, it is important to consider fossils for what they are in their essence. In the words of the Emperor Marcus Aurelius: "simplicity: First principles Of each particular thing, ask: What is it in itself, in its own constitution? What is its causal nature?" (Harris 1991: p.115-116). It may be that people will pay money for them, utilise them in folklore, wear them as jewellery (Oakley 1985; Liston 2014), or excavate them at a particular moment in time, but these are entirely incidental factors, as their intrinsic nature as part of the natural world is quite distinct from this.

Thus, it is important to recognise that any assessment of a fossil cannot rely on any incidental cultural factors - any more than an elephant should be valued on a commercial basis by the number of piano keys that could be made out of its ivory tusks, or a rhinoceros should be assessed on the financial value of the quantity of fake medicine that can be produced from grinding up its horn.

Final thoughts on ill-fitting legislation

Following the FossilLegal symposium, the EAVP's annual charity fundraiser took place, at which a bottle of wine was auctioned off bearing Levillaire's famous engraving of the discovery of the mosasaur skull, beneath the legend 'Give it Back, It's Ours'. (Figure 3) The repatriation of the Meuse River Lizard from Paris does not appear to be anyone's urgent or serious priority at the moment - although if it is looted cultural property from wartime, then why should it not be considered for repatriation? Perhaps simply because people do not feel 'cultural' connections with vertebrate fossils from millions of years before their own genus (never mind any national boundaries) existed. Or perhaps because other more 'cultural' objects are regarded as a higher priority. Either way, the absence of any serious call for repatriation demonstrates that fossils will fail to receive adequate consideration (and, therefore, adequate protection) from legislation that considers them as cultural objects. However well-intentioned, in terms of protecting the material, placing palaeontological objects under culturally-driven legislation is funda-

Figure 3. Bottle of French Bordeaux donated to the EAVP charity auction, with label showing the engraving by G. R. Levillaire of the 'Discovery of the "grand animal"',* Mosasaurus hofmani*, at Maastricht.

mentally unhelpful with regard to protecting fossils as fossils. It is better to have suitable legislation appropriate to the material and its considerations, than pretend that the material can be served by ill-fitting legislation.

The use of existing legislation, ostensibly in place to protect fossils and their localities, can prove to be a cynicism-inducing experience, particularly if fossils are viewed solely or primarily as financial commodities: "Fossils as products of money will never be limited by laws. As long as fossils have a market value they will move over borders - no law will stop that. In conclusion I think that these laws are ineffective to protect sites and fossils. They only prohibit scientific research." (H-P Schultze, Former Director of Humboldt Museum) This perhaps even more highlights the necessity to assess fossils away from financial value, as well as supposed cultural associations. When China recently changed the legislation under which fossils were supposed to be protected, it also acted to fill some large holes in its definitions (Liston and You 2015), notably starting to refer to scientific significance or scientific value as the major criteria (rather than definitions that reflected financial value, or how recently a human had excavated the material) (Liston and You 2015).

Bad legislation can often do little except to restrict scientific research, sometimes by directly inhibiting the possibilities of 'saving' the specimen, because it does not end up satisfying cultural criteria created for archaeological objects or artworks...which is unsurprising, really: if you wish to pretend that an apple is an orange, then it can hardly be a shock that the apple ultimately scores poorly as an orange.

In a world where legislation automatically creates black markets with attendant exploitation, bribery and armed gangs, we as a community have to be certain that any legislation that results, and the administration of that legislation, is both necessary and effective, and worth the problems that it (however inadvertently) creates. As Martin put it: "By making something illegal, you by definition create a black market for criminal trade. . . . cultural property conventions whose existence is ultimately the main or only reason for the black market and the huge price mark-up; why carry a rifle, bribe officials and take a big cut if there is no law to be avoided?" (Martin 2004: 163). If legislation is unfit for purpose, then it should be revoked or modified until it works, as with the Chinese and German examples noted earlier, and palaeontologists in each territory should embrace their responsibility as advocates for effective legislation to protect their science.

Conclusions

Given the problems that have come to pass from uninformed legislators ignorantly lumping palaeontological material in with other legislation that they think might be appropriate, it is clear that palaeontologists need to take a direct role in drawing up and approving legislation that covers palaeontological sites and the materials derived therefrom, as well as retaining a role on any board that has to advise government on individual cases. Until palaeontologists have direct influence, if not control, over the wording of legislation to protect their scientific material, these problems will persist, and, in doing so, continue to put fossil material at risk.

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References

BROWN, A. 2018. Introducing the revised Code of Ethics for Museums. *Geological Curator* **10** (10),681-686.

DAVIES, M. 2001. Phoney stones. *The Geological Curator* **7**:229-230.

HARRIS, T. 1991 *The Silence of the Lambs*, St. Martin's Press, p.115-116.

HOLWERDA, F.M. 2016. XIV EAVP Annual Meeting, Haarlem, The Netherlands, 6 - 10 July 2016 - *The Palaeontological Association Newsletter* **93**, 40-42.

HUNTER, W. 1768. Observations on the bones, commonly supposed to be elephants bones, which have been found near the River Ohio in America. *Philosophical Transactions* **58**, 34-45.

KJÆRGAARD, P.C. 2012. The Fossil Trade: Paying a Price for Human Origins. *Isis* **103**, 340 -355.

LISTON, J.J. 2006. From Glasgow to the Star Pit and Stuttgart: A short journey around the world's longest fish. Published in *The Glasgow Naturalist* **24**(4),59-71.

LISTON J.J. 2012. Pulling Teeth: retrospective identification of William Hunter's fossil mammal material. *The Geological Curator* **9** (7), 389 - 408.

LISTON, J.J. 2013a. Pulling teeth : 2 - Hunter's Tusk, Wodrow's Tooth and the Bite of the Lepus. *The Geological Curator* **9** (8), 421 - 428.

LISTON, J.J. 2013b. Out of China: Dinosaur eggs and the Law on 'Kong Long Dan'. *The Geological Curator* **9** (10), 545 - 555.

LISTON, J.J. 2014. Fossil protection legislation: Chinese issues, global problems. *Biological Journal of the Linnean Society* **113**, 694-706.

LISTON, J.J. 2015. A collection without a catalogue: Captain John Laskey and the missing vertebrate fossils from the collection of William Hunter. Published in: *William Hunter's World: The Art and Science of Eighteenth-Century Collecting*. Chapter 12, 199-222.

LISTON, J.J. 2016. 'FossilLegal': a symposium on ethics in palaeontology - *The Palaeontological Association Newsletter* **93**, 27-31.

LISTON, J.J. 2017. Paleontological research in China in the context of the new SVP ethics statement. *Journal of Vertebrate Paleontology, Program and Abstracts* 2017, p.151.

LISTON, J.J. 2018. Ivory Towers of Entitlement?: The Commercialisation of Academic Palaeontologists. *Geological Curator* **10** (10), 671-680.

LISTON, J.J. and ALCALÁ, L. 2017 The obstetrician, the surgeon and the premature birth of the world's first dinosaur: William Hunter and James Parkinson From: Duffin, C. J., Gardner-Thorpe, C. & Moody, R. T. J. (eds) *Geology and Medicine: Historical Connections*. Geological Society, London, Special Publications, 452, https://doi.org/10.1144/SP452.7

LISTON, J.J. and YOU, H-L 2015. Chinese fossil protection law and the illegal export of vertebrate fossils from China. *Journal of Vertebrate Paleontology* **35** (2),1-7. DOI: 10.1080/02724634.2014.904791

MARTIN, J.G. 2004. All legal and ethical? Museums and the international market in fossils. In: Knell SJ (ed.). *Museums and the future of collecting*, 2nd edn, Farnham: Ashgate,155-164.

MARTIN, J.G.. 2018. Dodgy Fossils: international legislation and the meaning of 'cultural property'. *Geological Curator* **10** (10), 607-616.

OAKLEY, K.P. 1975. Decorative and symbolic uses of vertebrate fossils. Pitt Rivers Museum, Occasional papers on technology 12. Oxford: Oxford University Press, 60 pp.

OAKLEY, K.P. 1985. Decorative and symbolic uses of fossils. Selected Groups, Mainly Invertebrate. *Pitt Rivers Museum, Occasional papers on technology* **13**. Oxford: Oxford University Press. 99 pp., 8 Pl.

den OUDEN, N. and POWER, R. 2018. Professional and amateur palaeontologists - the Dutch Polder Model. *Geological Curator* **10** (10), 577-584.

PIETERS, F.F.J.M., ROMPEN, P.G.W, JAGT, J.W.M. and BARDET, N. 2012. A new look at Faujas de Saint-Fond's fantastic story on the provenance and acquisition of the type specimen of *Mosasaurus hoffmanni* Mantell, 1829. *Bulletin de la Société géologique de France*, **183** (1), 55-65.

SCHMIDT, A.C. 2000. The *Confuciusornis sanctus*:An Examination of Chinese Cultural Property Law and Policy in Action, Boston College International and Comparative Law Review 23(2)Article 3:185-227. http://lawdigitalcommons.bc.edu/iclr/vol23/iss2/3

ULPH, J. 2018. Acquiring Fossils: A complex picture. *Geological Curator* **10** (10), 657-670.

UNDERWOOD, C.J. and WARD, D.J. 2018. Site-specific limitations on the use of palaeontological resources. *Geological Curator* **10** (10), 617-631.

UNITED STATES COURT OF APPEALS FOR THE NINTH CIRCUIT 2018. Appeal from the United States District Court for the District of Montana Susan P. Watters, District Judge, Presiding Argued and Submitted February 6, 2018 Seattle, Washington Filed November 6, 2018. 28 pages.

PROFESSIONAL AND AMATEUR PALAEONTOLOGISTS - THE DUTCH POLDER MODEL

by Natasja den Ouden and Ronald Pouwer

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In the Netherlands, amateur palaeontologists are a vital part of the scientific community, working closely with professionals on an equal level. There are numerous projects that showcase this unique collaboration, some of which are highlighted in this paper. The Dutch fossil record and the knowledge thereof would be far more incomplete without the valuable contributions of our amateur community. Although the word amateur still carries a negative connotation for some professional researchers, amateur palaeontologists can and should continue to play a vital role in the Dutch scientific community.

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Introduction

The Dutch are renowned for their open-mindedness, their willingness to work together and their desire to include multiple parties in decision making. In the 1980s, the term 'Polder Model' was coined to describe a particular mode of consensus decision-making that is not purely restricted to politics but is - often unconsciously - used in all sorts of aspects of Dutch society. Crucial to this model is 'cooperation despite differences'. In many countries, amateur palaeontologists are not part of the scientific community, but instead are a separate entity. In the Netherlands, the boundaries between amateur and professional palaeontologists are often vague and at times even non-existent. The way our amateur and professional palaeontologists work together is therefore internationally unique and ties into this Polder Model way of thinking.

In the Netherlands, there is a long tradition of amateur and professional palaeontologists working together in collecting and documenting fossils, making observations and publishing articles on them. Many amateurs are dedicated, accurate and sometimes innovative collectors, bringing together important and often unique private collections. In fact, the majority of Dutch palaeontological finds are actually collected by amateur palaeontologists, while considerable parts of museum collections originate from private collections.

Researching and publishing finds is often done in collaboration with professional palaeontologists, or by the amateur palaeontologists themselves. Many amateurs are on an equal scientific level with their professional counterparts. Some are already recognised as world experts in their field, with published articles in journals such as Nature (amateur palaeontologists co-authored papers by for instance Lambert *et al.* 2010 and Lorenzen *et al.* 2011).

History

As in many countries, the first Dutch fossil collectors were not specialised palaeontologists, but people from other professions who had a keen interest in fossils. The history of fossil collecting in the Netherlands mirrors that of its surrounding countries, with notable events including the finding of the first Mosasaur in St. Pieter's Mount in 1766 (Van Marum 1790) and the recognition of the first mammoth bones from the Dutch coastal waters by Dr. J.C. de Man in 1874 (Mol *et al.* 2008). The palaeontological world in the 18th and 19th centuries was a small one, and it was not long before Dutch 'palaeontologists' were in contact with the likes of Owen, Cuvier, and other naturalists such as Blumenbach and Daubenton. The Dutch-born Petrus Camper (Liston 2013, fig.11), who was involved in the description and interpretation of the Mosasaur and the American Mastodon, was a member of the French Academy of Sciences and a fellow of the British Royal Society (Van der Korst 2008). But beyond these early academics, it was the ordinary working man and woman that did most of the fossil finding. As is the case

today, many fossils were found by chance, as a result of building works, or as a by-catch of the fishing industry.

The number of professional palaeontologists has never been very high in the Netherlands. This is in part because of the lack of paid work opportunities. The surface of the majority of the country consists of fairly recent (Holocene) sediments which contain plenty of archaeological objects, but not many purely palaeontological specimens. Also, whereas archaeological objects are protected by Dutch heritage laws, palaeontological objects are not. This means that whenever areas are affected by building works, it is required to have an archaeologist on site to guide the work, or to have salvage fieldwork carried out beforehand. This is not at all required for palaeontological sites, and as a logical result, there is generally no funding for fieldwork in these instances. Opportunities for unpaid or voluntary fieldwork or surface collecting, however, are substantial. Especially in recent years, with the construction of Maasvlakte 2 - the extension of the Port of Rotterdam - collection opportunities are on the rise and the number of people collecting fossils has increased.

Palaeontologists united

Many Dutch palaeontologists, whether amateur or professional, collaborate in associations such as the Werkgroep Pleistocene Zoogdieren (WPZ, Working Group for Pleistocene Mammals), the Werkgroep voor Tertiaire en Kwartaire Geologie (WTKG, Working Group for Tertiary and Quaternary Geology) and the Werkgroep Geologie of the Koninklijk Zeeuwsch Genootschap der Wetenschappen (WG-KZGW, Geology Working Group of the Royal Zeeland Scientific Society). These associations organise regular meetings, field trips and workshops, and publish journals and information sheets.

The WPZ was founded in 1982 by a group of both amateur and professional palaeontologists. Its aim is to encourage collaboration between amateurs and professionals, to learn from each other and encourage interaction. Today, the association has approximately 350 members and its meetings are held throughout the country, typically in natural history museums or research institutes. The primary goal of these events is to create an environment for interaction between amateur and professional palaeontologists.

The WTKG was founded in 1963 by a group of young geology enthusiasts who carried out fieldwork in the Achterhoek region in the east of the Netherlands (Van den Bosch and Janssen, 2013). Their focus was on geological and palaeontological research by excavating and drilling the Miocene deposits close to the surface. In later years, similar activities were undertaken in the Oligocene of north-eastern Belgium. A wide variety of research was and still is carried out in other parts of the Netherlands and surrounding countries. Both amateurs and professionals are members of the association, collaborating and sharing knowledge. Field trips, meetings with lectures and identification sessions, and Facebook groups ensure that the WTKG is a thriving association with about 370 members, mainly from the Netherlands, Belgium and Germany.

The WG-KZGW was founded in 1966 as a working group of the society Koninklijk Zeeuwsch Genootschap der Wetenschappen, dating back to 1769. Members are mainly amateurs, with a focus on fossils from the beaches and estuaries of the province of Zeeland in the south-west of the Netherlands. The society and many members of the working group hold large and scientifically important collections of fossil molluscs, vertebrates, elasmobranchs, etc. The working group serves as a meeting point for collectors and amateur researchers, and organises lectures, identification sessions and excursions.

Projects

Natural history museums in the Netherlands, including the Naturalis Biodiversity Center, often work in close collaboration with amateur associations. The nature of their efforts varies from writing scientific publications and conducting fieldwork to public outreach programmes, citizen science, the organisation of international conferences and dedicated access to collections.

Projects involving amateur palaeontologists can be divided into two categories: popular science projects involving the greater public, aiming to publicise palaeontology, and academic projects. Either of these categories can be initiated by both amateur and professional palaeontologists.

Popular science projects

Maasvlakte 2 and Zandmotor public events

Both Maasvlakte 2 - the extension of the Port of Rotterdam - and the Zandmotor - a man-made peninsula off the coast of Zuid-Holland - were created by extracting sand from the bottom of the North Sea and depositing it at designated areas. This sand is full of fossils of Pleistocene origin. Events are regularly organised at the visitor centres of these projects to showcase the finds made in the area and to inform

the general public of the unique fossil record of these places. These events often attract several hundred visitors and contribute substantially to the awareness of the general public. During these events, excursions are organised where participants can go on a fossil hunt with an experienced collector and learn about palaeontology. At the Maasvlakte in particular, these excursions proved so popular that they are now organised on a weekly basis with Walter Langendoen, an experienced amateur palaeontologist, acting as the excursion leader.

Oervondst checker

Maasvlakte 2 is the latest extension of the Port of Rotterdam. The area was created by extracting sand from a designated area, ca. 22 km off the coast of Rotterdam, and depositing it at the location of the new extension. In this way, new land was created. At the outer contour of the area, a recreational beach was established. As the sand of this beach is extracted from the bottom of the North Sea, it contains many fossils of Pleistocene origin. Fossils are collected on a daily basis, mostly by amateur palaeontologists. Many of them are experienced collectors, but due to the open character of the site, people that are new to palaeontology also collect. They often do not yet have the knowledge to identify the fossils and so the municipality of Rotterdam, the Natural History Museum Rotterdam and the WPZ collaborate through the platform Oertvondstchecker (ancient find checker). Via this online platform, members of the public can upload a photo of their find and researchers of the museum and members of the WPZ offer their expertise in identifying the objects and establishing contact between the collectors and researchers. A good example of the working of the Oervondstchecker is the find of a fossil macaque. A photo of the find was uploaded to the checker and recognized by the experts. The find is now being investigated and preliminary results have already been published (Moeliker and Reumer, 2014; Reumer and Moeliker, 2014)

Kijk wat ik gevonden heb!

In 2013, the WPZ celebrated its 30-year anniversary by organising an exhibition in the Natural History Museum Rotterdam. Finds made by WPZ members formed the focus of the exhibition, but the overall message was that anyone can have an extraordinary find - the title of the exhibition being 'Kijk wat ik gevonden heb!' ('Look what I found!') - and contribute to the fossil record of the Netherlands. Many of the specimens exhibited have been described in joint amateur-professional publications. The exhibition provided an overview of the variety of find locations, species and research over the last 30-35 years. During the exhibition's run, the museum had a total of 18,000 visitors.

Academic projects

Maasvlakte 2

In the 1960s, an area of land was created just west of Rotterdam to make an expansion of the Port of Rotterdam possible. The sand used to create this land yielded a large number of Pleistocene fossils and ever since the Maasvlakte has been a very popular site for amateur palaeontologists.

A second expansion, Maasvlakte 2, was completed in 2013. During the construction phase the area was closed off for collection activities. Fortunately, the authorities did permit a test with a Mega Beach Cleaner for collection of sediments (Figure 1). This Mega Beach Cleaner collected the first 15 centimetres of top soil in a traverse of 2.5 km and deposited it into large bags, which were then transported to the Naturalis Biodiversity Center for further research. The processing of the sediments collected by the Mega Beach Cleaner provided an excellent opportunity to give amateur palaeontologists a chance to work on the material and also to educate the general public. In total, 70 amateur researchers helped Naturalis to sort 12 cubic metres of sediments, the results of which are now being used for further scientific research. Another cubic metre was collected especially for educational purposes, and during a special event, 700 children and their parents were able to learn about the prehistory of the North Sea by being involved in picking out residues and recognising bones and shells.

Since the opening of Maasvlakte 2 the area has been freely accessible to everyone wanting to collect fossils. A number of the fossils collected in this area are extraordinary and proved to be the first occurrences

Figure 1. The Mega Beach Cleaner.

in the region and/or timeframe. Especially in the category of smaller mammals and birds, the contributions to the larger picture of the fauna in the Pleistocene are major (for some recent examples, see De Bruijn and De Bruijn 2016; Langeveld 2013; Langeveld 2015; Mol *et al.* 2012; Mol, Post and Van der Plicht 2012; Mol and Langeveld 2014; Post and Brand 2016; Schouten 2016; Van Hooijdonk 2013). Also particularly noteworthy is the research currently being undertaken on Pleistocene hyena coprolites. These coprolites can be found on the Maasvlakte 2 and Zandmotor beaches. Walter Langendoen, an amateur palaeontologist who surveys the Maasvlakte 2 on a daily basis, has collected over a hundred specimens. Barbara Gravendeel, researcher at the Naturalis Biodiversity Center analyses DNA, pollen and isotopes from the coprolites to reconstruct the Pleistocene environment. This is an excellent example where fossil collectors and academic researchers work closely together to expand our understanding of the fossil record.

Fossil shells of the Dutch coast: the 'fossielenatlas' project

Estuaries and many beaches in the Netherlands are a rich source of fossil molluscs from the Cainozoic era. These shells and other fossils erode from outcropping layers and wash ashore, or are sucker-dredged for the production of chalk. Since the end of the 20th century, Dutch beaches have been supplemented with sand from the bottom of the North Sea or estuaries, resulting in new sources of fossil and recent shells found on the beach. On the Wadden Islands in the north, the fossils are predominantly of Late Pleistocene age. For the beaches and estuaries in the southwest, the yield is a very diverse, mixed assemblage of mainly Pleistocene and Pliocene fossils, supplemented with Miocene, Oligocene and Eocene species. About 800 species of molluscs have been known from these locations. Although being reworked, these molluscs are an important extra source of knowledge, next to what is already known from boreholes in the Netherlands and excavations in the Antwerp harbour area (Belgium), some new species have even been described from this material (e.g. Van Regteren Altena 1954; Janssen and Van der Slik 1974).

Figure 2. The book 'De fossiele schelpen van de Nederlandse kust', published in 2010.

Fossil shells have been collected and studied by many amateurs and some professionals from the early 20th century onwards. One of the first serious studies was published by Van Regteren Altena (1937), which involved data from amateur collections, helping to start the tradition of cooperation between professionals and amateurs in the study of fossil shells in the Netherlands. Ongoing collection activities resulted in the so-called 'fossielenatlas' ('Fossil atlas'): 14 papers in the series 'De fossiele schelpen van de Nederlandse stranden en zeegaten', published between 1954 and 1984 (see Moerdijk *et al.* 2010 for details) (Figure 2).

In 1990, plans were made to revise this series, as many additional species had been found in the preceding 40 years. As such, a new project was launched, featuring an even stronger collaboration between amateurs and professionals, many of them being members of the WG-KZGW, WTKG and the Nederlandse Malacologische Vereniging (NMV, Dutch Malacological Society). This culminated in a book on the fossil bivalves, chitons and scaphopodes of the Dutch coast (Moerdijk *et al.* 2010), realised by 15 authors and two scientific illustrators, most of them amateurs. At the moment, the second part of this project, dealing with gastropods, is still ongoing. Two to five people discuss one or more families, consult amateur and museum collections, and organise identification sessions. The results are published in separate papers in the NMV journal Spirula (e.g. Wesselingh *et al.* 2012; Hoeksema and Raad 2015). In 2022, it is expected that all this research will be compiled within a single book.

This long-term 'fossielenatlas' project is a good example of what professionals and amateurs can accomplish with their shared collections and knowledge.

Figure 3. Preparing a taped block of sediment for transport (Meldert, Belgium).

Figure 4. Prepared fossiliferous soft sediment from Pliocene deposits of the Vrasenedock harbour works near Antwerp, Belgium.

Inventive collection techniques

Amateur collectors can also develop inventive collection techniques. One example to yield spectacular results is the soft sediment preparation technique, developed and executed by Freddy van Nieulande and Marcel Vervoenen. A block of fossil-holding soft sediment is taped with pressure bandage and taken home (Figure 3). There, the fossils are meticulously prepared from within the sediment, but kept in place. During this process, the fossils and sediment are consolidated with a mixture of transparent glue and acetone, resulting in a hardened slab with fossils. Broken and very fragile shells, burrows and other features that are lost during normal collecting activities are preserved by this technique. These prepared sea beds give a unique view of the fossil assemblages and the way they are deposited (Vervoenen 1995). More than 200 of these unique pieces have been prepared by Vervoenen and Van Nieulande, most of them now in Naturalis Biodiversity Center (Figure 4).

Borehole descriptions

Members of the WTKG carried out research on the stratigraphy of the Oligocene in northeast Belgium between 1971 and 1985 (Janse, 2013). The subsurface was sampled with an auger drill in order to construct various cross-sections. This research by professionals and amateurs has produced large sets of new data, which have been published in various papers (e.g. Janssen *et al.*, 1976).

ICBS 2015

In 2015, the WPZ hosted the International Cave Bear Symposium. This is an annual meeting hosted in a different country each year, whose participants are all researchers working on cave bear-related subjects. The 2015 event marked the first time that it was organised in the Netherlands. The WPZ helped to connect a variety of different institutions in the Netherlands, such as the Naturalis Biodiversity Center, the Natural History Museum Rotterdam, museum Historyland, Leiden University's Faculty of Archaeology and Utrecht University's Faculty of Earth Sciences. Fossils of Pleistocene carnivores held in private collections were exhibited especially for this conference, showcasing the diverse fossil record. It was also an opportunity to connect amateur palaeontologists to national and international scientists to establish new research projects. The proceedings of the meeting were compiled in a special issue of Cranium, the journal published by the WPZ (Figure 5).

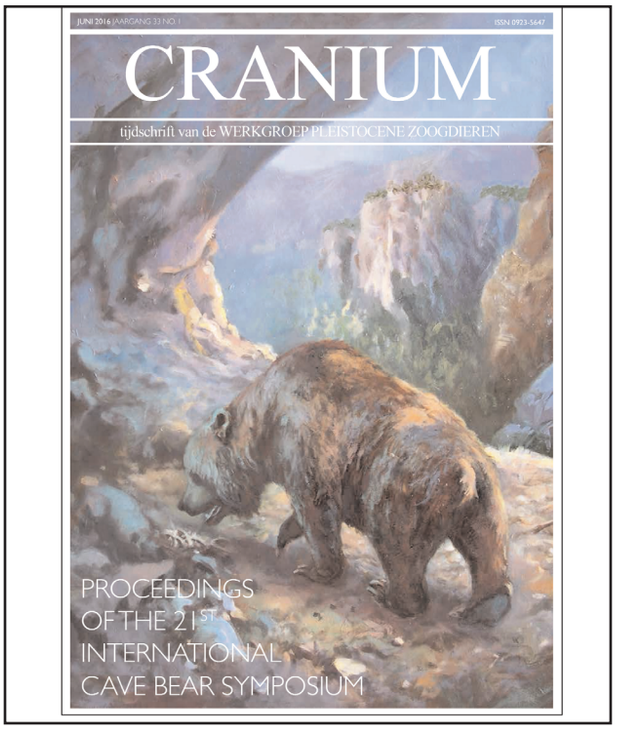

***Figure 5. Proceedings of the 21st International Cave Bear Conference published as a special issue of the journal* Cranium.**

Amateurs and museums

A number of amateur palaeontologists work on Dutch museum collections as volunteers. There, they contribute to ongoing museum projects, including conservation/restoration, digitisation and outreach.

Collection acquisition

Amateurs are often good and accurate collectors, bringing together large and important collections. Museums like Naturalis are very keen on acquiring these well-documented collections. In fact, a substantial part of the Naturalis collections (of e.g. fossil and recent molluscs, fossil vertebrates and recent insects) originate from private collections. By working together with amateurs, the museum can establish valuable contacts and also advise on the type of information registered with the collection. It is the combination of objects and information that make these collections scientifically valuable.

Taxonomic research

It is becoming increasingly difficult to obtain funding for basic taxonomy-based research. This shift in focus to other types of research, threatens taxonomic knowledge, especially in the museum environment, where taxonomic knowledge is often interweaved with collection curation, it is increasingly important to safeguard taxonomic work. At present, amateurs are able to fill the gaps currently left by professional palaeontologists. These amateurs are an indispensable part of the scientific network of professionals and, on the other hand, the professionals are important counterparts for the amateur researchers, providing access to collections, facilities and knowledge present in the institutes. Especially in Dutch museums like Naturalis Biodiversity Center, this long-time cooperation on an equal level has proven its great value for both groups of researchers.

An excellent example of a project that is being carried out at present is the Shark Teeth Project in Naturalis' geology collection. The entire fossil shark teeth collection is being moved and repacked into new museum-standard cabinets with the help of museum volunteers. Parts of the collection are not properly identified to species level yet. Amateur shark researchers are helping museum staff with this identification and at a later stage this will lead to a number of joint publications.

Dinolab

The Naturalis Biodiversity Center has opened a dinosaur preparation lab in one of its exhibition halls, where visitors can follow the progress of the preparation of a number of *Triceratops* specimens excavated in Wyoming, USA. The Dinolab is run by two professional palaeontologists and a number of volunteers. The volunteers all have very different backgrounds, from construction workers to accountants. What they have in common is a keen interest in fossil preparation and outreach. The volunteers often apply their own professional expertise in the Dinolab, making it a learning experience for all parties.

Publications

Cranium

Cranium is published twice a year by the WPZ. Its first volume appeared in 1984. The journal contains research articles, overviews, reports and reviews. The focus is on Pleistocene mammals, but related subjects, such as other Pleistocene fauna and flora are considered as well. The journal is distributed internationally, with subscribers in Belgium, Germany, the United States, the United Kingdom, Austria, Norway, Russia, Japan and Greece. Although the articles are primarily in Dutch, an English abstract and translations of figure captions are always provided. Since 2013, back issues can be accessed digitally and free of charge via Natuurtijdschriften.nl, an online platform maintained by the Naturalis Biodiversity Center, the Prins Bernhard Cultuurfonds and the Cultural Heritage Agency.

Cainozoic Research

In 1964, the WTKG began publishing the journal 'Mededeling van de Werkgroep voor Tertiaire en Kwartaire Geologie'. Initially, it contained both the results of fieldwork and communications from the board of the association, all in Dutch. In the years that followed, the quality of the papers improved, the language changed to often English or German, and Mededelingen achieved a position as a respected journal on North-West European Cainozoic geology. In 1979, the journal became purely scientific and in 1990 it changed its name to Contributions to Tertiary and Quaternary Geology.

This eventually evolved to the present-day peer reviewed journal Cainozoic Research, published in collaboration with the British Tertiary Research Group, after merging their journal Tertiary Research with Contributions. For all those years, professionals and amateurs have published their papers in the journal, often in collaboration with each other. Important stratigraphic research on the Achterhoek (the Netherlands), Tongeren (Belgium) and Antwerp (Belgium) areas have been published in it, as well as

many papers on the taxonomy of molluscs, elasmobranch teeth, otoliths and other fossils. Hundreds of new species have been described in it during the more than 50 years of its existence.

Afzettingen

In 1979, the WTKG started to publish the Dutch-language journal Afzettingen in tandem with the journal Mededelingen to facilitate association communication, field observations, tips and tricks, and other non-high level scientific information. Afzettingen quickly became the heart of the association and a huge amount of interesting and valuable information on localities, techniques and taxonomic observations have been gathered in it over the years.

The future

An online database for private collections

The most important element of a scientific collection - apart from the objects themselves - is the information that is attached to the objects within it. Objects without information have very limited scientific value, because they cannot be placed in context. When collecting palaeontological specimens, it is of the utmost importance that all available information is meticulously recorded. The Naturalis Biodiversity Center is currently exploring the possibilities of creating an online database where amateur palaeontologists can enter the data for their collection. Having all this data in one overall database means that it will be possible to create overviews of what is stored in private collections, but it also helps to ensure that all possible data about the collections are registered. Naturalis has recently made its own collection available via its online platform Bioportal. An integrated database of both museum and private collections is ultimately extremely desirable.

Discussion and conclusions

The large number of accessible field sites in the Netherlands makes it possible for amateurs to build their own collections, while information supplied by professional palaeontologists ensures the quality of the documentation. The benefits of this system are twofold: the amateurs can contribute to scientific research and the professionals gain an extra set of eyes and ears in the field.

Although the word amateur still carries a negative connotation for some professional researchers, amateur palaeontologists can and should continue to play a vital role in the scientific community. It is safe to say that the Dutch fossil record and the knowledge thereof would be far more incomplete without the valuable contributions of our amateur community. The impact of future contributions does, however, rely on professionals recognising the valiant efforts of amateurs and working together with them on an equal basis. Such collaborations not only open up new sources of information but, above all, it can be inspiring to work with enthusiastic people living and working outside of the academic sphere.

Literature

DE BRUIJN, I. and DE BRUIJN, P. 2016. Eerste vermelding van een kraanvogel Grus grus (Linnaeus, 1758) uit de Noordzee (Eurogeulgebied). *Cranium* **33**(2), 6-10.

HOEKSEMA, D.F, and RAAD, H.J. 2015. De fossiele schelpen van de Nederlandse kust II, deel 10. Hydrobiidae, Cochliopidae, Iravadiidae, Truncatellidae en Caecidae. *Spirula* **402**, 24-29.

JANSE, A. 2013. Belgisch Limburg 1971-1985. *Afzettingen WTKG* **34**(4), 182-186.

JANSSEN, A.W., and VAN DER SLIK, L. 1974. Bemerkungen zu der Astartiden-Fauna des jüngeren Känozoikums des Nordseebeckens. *Scripta Geologica* **22**, 1-23.

JANSSEN, A.W., VAN HINSBERGH, V.W.M and CADÉE, M.C. 1976. Oligocene deposits in the region North of Tongeren (Belgium), with the description of a new lithostratigraphical unit: the Atuatuca Formation. *Mededelingen van de Werkgroep voor Tertiaire en Kwartaire Geologie* **13**(3), 75-115.

LAMBERT, O., BIANUCCI, G., POST, K., DE MUIZON, C., SALAS-GRISMONDI, R., URBINA, M. and REUMER, J. 2010. The giant bite of a new raptorial sperm whale from the Miocene epoch of Peru. *Nature 466*, 105-108.

LANGEVELD, B. 2013. Trogontherium Cuvieri fischer (castoridae) van het strand van Hoek van Holland en de Zandmotor (Zuid-Holland). *Cranium* **30**(1), 8-12.

LANGEVELD, B. 2015. Vondsten van de reuzenalk *Pinguinus impennis* (Linnaeus, 1758) (aves) uit het Eurogeulgebied. *Cranium* **32**(1), 19-27.

LISTON, J.J. 2013. From obstetrics to oryctology: inside the mind of William Hunter (1718 -1783). Published in: Duffin C, Gardner-Thorpe C. & Moody, RTJ (eds) 'A History of Geology and Medicine". Special Publication 375: pp349-373. doi 10.1144/SP375.21, Geological Society, London, Special Publications Online First.

LORENZEN, E.D., NOGUÉS-BRAVO, D., ORLANDO, L., WEINSTOCK, J., BINLADEN, J., MARSKE, K.A., UGAN, A., BORREGAARD, M.K., GILBERT, M.T.P., NIELSEN,

R., HO, S.Y.W., GOEBEL. T., GRAF, K.E., BYERS, D., STENDERUP, J.T., RASMUSSEN, M., CAMPOS, P.F., LEONARD, J.A., KOEPFLI, K.-P., FROESE, D., ZAZULA. G., STAFFORD, T.W., AARIS-SØRENSEN, K., BATRA, P., HAYWOOD, A.M., SINGARAYER, J.S., VALDES, P.J., BOESKOROV, G., BURNS, J.A., DAVYDOV, S.P., HAILE, J., JENKINS, D.L., KOSINTSEV, P., KUZNETSOVA, T., LAI, X., MARTIN, L.D., MCDONALD, H.G., MOL, D., MELDGAARD, M., MUNCH, K., STEPHAN, E., SABLIN, M., SOMMER, R.S., SIPKO, T., SCOTT, E., SUCHARD, M.A., TIKHONOV, A., WILLERSLEV, R., WAYNE, R.K., COOPER, A., HOFREITER, M., SHER, A., SHAPIRO, B., RAHBEK, C. and WILLERSLEV, E. 2011. Species-specific responses of Late Quaternary megafauna to climate and humans. *Nature* **479**, 359-364.

MOELIKER, K. and REUMER, J. 2014. De makaak van Maasvlakte 2: unieke vondst bewijst nut 'oervondstchecker'. *Straatgras* **26**(2), 18.

MOERDIJK, P.W., JANSSEN, A.W., WESSELINGH, F.P., PEETERS, G.A., POUWER, R., VAN NIEULANDE, F.A.D., JANSE, A.C., VAN DER SLIK, L., MEIJER, T., RIJKEN, R., CADEÉ, G.C., HOEKSEMA, D., DOEKSEN, G., BASTEMEIJER, A., STRACK, H., VERVOENEN, M. and TER POORTEN, J.J. 2010. *De Fossiele schelpen van de Nederlandse Kust*. Nederlands Centrum voor Biodiversiteit Naturalis, Leiden.

MOL, D. and LANGEVELD, B. 2014. Wat determinatiesessies aan nieuwe gegevens kunnen opleveren: nieuws van het strand van Maasvlakte 2, *Afzettingen WTKG* **35**-2, 40-59.

MOL, D. and VAN DER PLICHT, H. 2012: Een haas (orde Lagomorpha, familie Leporidae, geslacht Lepus) van de Laat-Pleistocene fauna van de Noordzeebodem. *Cranium* **29**(2), 33-35.

MOL, D., POST., K. and VAN DER PLICHT, H. 2012. Fossielen van bosneushoorn (*Stephanorhinus kirchbergensis*) en bosolifant (*Elephas antiquus*) uit het Eurogeulgebied. *Cranium* **29** (2), 20-25.

MOL., D., DE VOS, J., BAKKER, R., VAN GEEL, B., VAN DER PLICHT, H. and POST, K. 2008. *Kleine encyclopedie van het leven in het Pleistoceen. Mammoeten, neushoorns en andere dieren van de Noordzeebodem*, Van Veen Magazines, Diemen.

POST, K. and BRAND, D., 2016. Melding van een fossiele kaak van een baardrob *Erignathus barbatus* (Erxleben, 1777) van de Noordzee. *Cranium* **33**(2), 25-29.

REUMER, J. and MOELIKER, K. 2014. Een makaak (*Macaca florentina*) op de Tweede Maasvlakte levert vragen op, *Cranium* **31**(2), 46-47.

SCHOUTEN, S., 2016. Een overzicht van de pleistocene en holocene herpetofauna (reptielen en amfibieën) van Nederland met aandacht voor vondsten langs de Nederlandse kust, *Cranium* **33**(2), 11-24.

VAN DEN BOSCH, M., and JANSSEN, A.W. 2013. Oerhistorie van de WTKG. *Afzettingen WTKG*, **34**(4), 99-105

VAN DER KORST, J.K. 2008. *Het rusteloze bestaan van dokter Petrus Camper (1722-1789)*, Bohn Stafleu van Loghum, Houten.

VAN HOOIJDONK, K. 2013. Eerste vondsten van het nijlpaard (hippopotamus) van de 2de Maasvlakte, *Cranium* **30**(1), 13-17.

VAN MARUM, M., 1790. Beschrijving der beenderen van den kop van eenen visch, gevonden in den St. Pietersberg bij Maastricht, en geplaatst in Teylers Museum, *Verhandelingen uitgegeeven door Teyler's Tweede Genootschap* **8**, 383-389.

VAN REGTEREN ALTENA, C.O. 1937. Bijdrage tot de kennis der fossiele, subfossiele en recente Mollusken, die op de Nederlandsche stranden aanspoelen, en hunner verspreiding. *Nieuwe Verhandelingen van het Bataafsch Genootschap* **10**, 1-184 [also published as dissertation of the University of Leiden].

VAN REGTEREN ALTENA, C.O. 1954. Description of four new species of Plio-Pleistocene Prosobranchia from the Netherlands, and proposal of a new name for a fifth species. *Basteria* **18** (4), 45-49.

VERVOENEN, M., 1995. Taphonomy of some Cenozoic seabeds from the Flemisch Region, Belgium. *Belgische Geologische Dienst, Professional paper* **1994/5 N.272: I-VII**, 1-115.

WESSELINGH, F.P., RIJKEN, R., VAN NIEULANDE, F., JANSE, A.C. and POUWER, R. 2012. De fossiele schelpen van de Nederlandse kust II. De *Cerithium*-achtigen (deel 2). *Spirula* **385**, 37-47.

“THE EXTREME ALWAYS SEEM TO MAKE AN IMPRESSION"*: CONFLICT IN PALAEONTOLOGY AND SUGGESTIONS FOR A SOLUTION (*WATERS 1988)

by Anthony Maltese

Maltese, A. 2018. "The extreme always seem to make an impression"*: Conflict in palaeontology and suggestions for a solution (*Waters 1988). *The Geological Curator* 10 (10): 585-589.

Now routine, increased conflict between academic and commercial palaeontologists is a fairly recent phenomenon. It is important to compare the history of the science with its modern treatment to determine how the relationships have become strained and for what motivation. A simple proposal for accountability provides a framework to ensure some minimum following of documentation and ethical standards in order to both improve work in palaeontology as well as reduce needless fingerpointing and blame. Without a concerted effort to work together better, chaos will reign, and chaos is what killed the dinosaurs, darling.

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Introduction

Palaeontology has a relatively short history compared to many other scientific disciplines, with its birth in the early 19th century. Widely recognized as the first person in the modern era dedicated to the discovery and collection of vertebrate fossils, Mary Anning is held in esteem as a trailblazer in palaeontology, a female working in the domain of males at a time when such an action was extremely uncommon (Wikipedia 2017). The narrative of Anning collecting these fossils for display and study in Great Britain is, however, a flawed one. She was not an altruist interested in solely protecting the discoveries for future generations. She had bills to pay and mouths to feed. She sold her discoveries to museums and individuals who could compensate her for her time, effort, knowledge and supplies. Nowadays, academic palaeontologists are often fortunate enough to have institutional support to get this compensation, as we should rightly not expect experts to work for free, however this model is not how the science was founded.

The latter part of the 19th and the early 20th century is filled with scientists and institutions in both Europe and North America hiring 'avocational' but otherwise expert collectors to conduct field work, sending their discoveries back to museums for study. Many of these early workers, including Benjamin Mudge, Samuel Williston, John Bell Hatcher, and the Sternberg family, made the discoveries that formed the basis of vertebrate palaeontology programmes that are still powerhouses today. Once these workers left their positions through death or retirement, attitudes of their successors became increasingly hardened against the independent collectors that the museums once relied so heavily upon. This attitude has seemed to increase upon successive generations.

How did this animosity start and why does it persist? One source is uninformed opinion pieces by non-palaeontologists published as a call for action in mass media. This sort of sensationalist editorial work, while good for publicity, advocates for an extremist position on the disposition of vertebrate fossils. Switek (2013) presents the false dichotomy that "it would be better to let a *Triceratops* skull fall to pieces than have that specimen mangled by amateurs who ignore basic scientific data collection and then try to sell that skull to private buyers, hiding it away from researchers and fueling a market that makes significant specimens inaccessible", presenting these as the only possible outcomes to a specimen being excavated by non-museum professionals. He portrays greed on the part of non-academics and implores "private landowners and commercial collectors to stop seeing dollar signs made out of dinosaur bones". This 'us versus them' stance does not represent the way that responsible commercial companies do business, let alone illustrate how people can work together and still make a living. In fact, it goes as far as panning the idea of responsible commercial collection as "disingenuous". Editorial works

such as this should be dismissed as fiction. Thomas Carr (2013) actually suggested using eminent domain laws to seize fossil-bearing land from ranchers in order to use them to collect for museums, with little-to-no public condemnation of the statement from other more rational palaeontologists. This sort of rhetoric only serves to alienate scientists from the general public, a move that is unneeded in modern political climates.

Academic palaeontologists sometimes fall down this wormhole. Shimada *et al.* (2014) touch on three main points in their editorial, claiming that commercial palaeontology is one of the greatest threats to the science in the 21st century: the poaching of fossils, the sale of fossils from public lands, and the sale of fossils from the collections of museums. Each point will be addressed individually to find common ground where commercial palaeontologists and academics can improve the science as a whole.

The first point is perhaps the easiest one to deal with and find common ground. Poaching is wrong. Period. Poachers are not 'Commercial Palaeontologists', they are criminals. Potential buyers of fossils, including fossil shops, have a responsibility to investigate the specimen and to ensure that it is what is claimed and actually came from where it was reported to have come. Commercial collectors can and do happily show documentation about the excavation and even take the customer to the dig-site, allowing them to conduct further research and verification. If a commercial collector cannot do this, then museums and individuals simply should not do business with them, no matter what the specimen. Furthermore, customers should not do business with convicted fossil poachers. On this, even the authors of the Shimada *et al*. 2014 editorial are not entirely in the clear. Professional paleontologist, and former president of the Society of Vertebrate Paleontology, Phil Currie had the luck to work with Francois Escuille, who located the poached elements of a Mongolian *Deinocheirus* specimen in Germany. Escuille was even made a coauthor on the 2014 description of the material. In 2015, a shipment of Tarbosaurus bones intended for Escuille was intercepted and seized by French customs. This shipment of Mongolian material originated from South Korea and was declared to customs at about 5% of its real value, likely in an attempt to conceal the true nature of the shipment. While Escuille claims he was just intending to mould the specimen before returning it to South Korea, the alleged actions still constitute smuggling black market fossils, an action worthy of condemnation.

Other recent instances of this have included the Museum für Naturkunde in Berlin working with Canadian fossil dealer Terry Ciotka on the 'Tristan Otto' *Tyrannosaurus rex* project. Ciotka was convicted in 2013 of trafficking Burgess Shale fossils to Japan (Ho 2013). Charlie Magovern of the United States toured a successful travelling exhibit on dinosaur eggs and babies but was convicted in 2015 of smuggling over $570,000 of Chinese fossils (Coffman 2015). Some collectors, like Canadian fossil hunter Wendy Sloboda, have repatriated Chinese fossils that they have purchased, all the while maintaining that no lines were crossed (Quan 2017). The Canadian government itself differs in its opinion on the matter, having declared the specimens "illegally exported cultural property" (quoted in Quan 2017). While it is unfortunate for science that this sort of activity occurs, it is equally unfortunate that public museums still agree to do business with these individuals when they have something that the museum desires.

The second point that Shimada *et al*. cover, is the proposal to sell fossil specimens from state-owned lands in the US (2014). Currently, each jurisdiction sets its own rules for fossil collecting on their property, which results in a sometimes-confusing patchwork of legal status. The infamous 'Tinker' *Tyrannosaurus rex* was collected by private collectors from county-owned property in South Dakota in the 1990s and has been in limbo from day one (Langford 2017). The collection itself appears to be legal, with all permissions in place, however the final disposition of the specimen has yet to be settled with its private excavators and owners. While this result might be seen as unsatisfactory to most palaeontologists, the only way to achieve clarity with these specimens is to have local and state governments develop more consistent regulations governing the specimens removed from their lands.

In 2013, the San Diego Natural History Museum attempted to sell off parts of its historic collection of Sternberg-collected specimens (Wagner 2014). The reasons why institutions might try to sell off parts of their collections are varied, ranging from financial distress to exhibit remodels to simply needing the room in collection stores for other purposes. The actions of the SDNHM were not without precedent, however a great outcry from the academic community halted the plan to auction them, and instead they were donated to various other institutions in the US and Canada for display. This worked out as a best-case scenario for academic palaeontology, however characterizing this as a "commercial threat" to palaeontology is a stretch at best. There was no commercial palaeontologist prodding the museum to sell their precious specimens; there was no buyer in line

waiting for the gavel to fall. If this was indeed a case of a dire financial need for a cash-strapped institution, the objective of raising funds was an abject failure as no money changed hands. The use of museum collections as a 'piggy bank' is a terrible idea all round, and is not the answer to many natural history museums' chronic problems with raising adequate funds for research and collections. Indeed, museums purchasing and holding specimens in perpetuity is actually in the best interests of commercial palaeontology by preventing a resale market and should be a goal supported by commercial palaeontologists.

That brings us to the question posed by the immortal words of Rodney King: "can we all get along?" (Wood and Fiore 1991). Much of the failure to do so stems purely from misconceptions that either side has about the work of the others. Sometimes, this may even be well-founded, as institutions and commercial company owners act as individuals on most occasions, perhaps not quite toeing the line of the overarching organizations for whom they work. Rumours fly and maxims are uttered that commercial collectors never record data. But, simply put, without data a specimen is worthless, and so it is in the collector's best interests to ensure that data is collected, recorded, preserved and transferred with the specimen to its place in a repository. Commercial collectors can be accused of putting a price on any and everything. Many academics try to claim the fossils they look after are both worthless and priceless at the same time. Unfortunately, this view is unrealistic, which can become painfully apparent when institutions attempt to come up with a value for insurance purposes. Many academics neglect to recognize that the world is full of singular specimens with tremendous monetary value, even if owned by museums or individuals who will never agree to sell them. The art market is a prime example of this, and while there is some fraud and theft, the private collectors and institutions generally work together for their mutual benefit, to the extent of publicly exhibiting and even publishing on privately-held works. The idea that a Picasso residing in a private collection does not exist, and cannot even be mentioned, is ludicrous in the art world. But in palaeontology that perspective is accepted by many researchers when applied to fossil specimens. Palaeontology does not exist in a bubble, there are real world factors at play.

A good portion of this animosity can be addressed by implementing some simple collection standards for fossils that both academic and commercial collectors are expected to follow. This sets a traceable and measurable baseline so that good work can be recognized and shoddy work may be called out for improvement. I propose that these standards include:

1) Permission to collect: A permit or contract to collect fossils is required. Lack of such a contract should be viewed as poaching, no matter who is doing the collecting. In this modern era of maps, GPS and GIS, there is no excuse to not know where you are digging and who owns the land, whether it be private or public.

2) Qualified supervised excavation: Many academic palaeontologists are rank amateurs when it comes to collecting or excavating fossils. Likewise, there are many non-academics who hack specimens out of the ground without proper training. If a project is to be considered truly well-executed, an experienced practitioner should supervise the employees or volunteers as they are doing the work. If an institution or company cannot provide that from their own staff, qualified professionals should be contracted.

3) Field data collection: When excavating a specimen, there are many data points that need to be collected and preserved, as they cannot be backtracked. For responsible collectors, a site will at minimum preserve matrix samples, 4-dimensional locality data (both geospatial and stratigraphic), photographs of the excavation, a field inventory of what is removed, documentation of who was there and a map of the fossils at the site. More data might also be taken, however fulfilling those 6 items should be seen as a basic minimum standard that every excavation should meet, even salvage operations.

4) Qualified preparation staff: Once back at the host facility, fossils must be prepared for study. Most labs have people interested in working on fossils to get projects done, but they are often people fresh off the street, so to speak (volunteers, undergraduate students, new employees). To be fair, everyone needs to start somewhere with their first fossils, however it is imperative that facilities have qualified and experienced preparation staff in a supervisory role to ensure that the fossils are being handled safely. The value of experienced fossil preparators cannot be overstated and are an expense that every facility should gladly fund.

5) Fossil preparation data: What happens to a fossil once it reaches the lab is important. Documentation of what is done is vital for current and future research, including who worked on it, when, for how long, what tools and chemicals were used, diagrams of the jacket, and notes. These forms become part of the permanent collection data for the specimen and follows the specimen wherever it may permanently go, whether between commercial and research facilities, or in trades between institutions. This type of data is necessary for future researchers

and conservation professionals.

6) Ancillary fossil disposition: While the main specimen in an excavation is important, they are rarely found isolated and alone. Other fossils found at the site add contextual data and are vital to understanding how the specimen existed in a broader ecological setting. Some commercial collectors may see these things (shed shark, crocodilian or tyrannosaur teeth at a site, for example) as an item to dispose of separately to enhance their revenues. Other fossils, like bits of turtle shell, leaves, invertebrates, fish fragments or coprolites might not be collected at all, or may not accompany the specimen to its eventual repository. I contend that it is really little or no extra effort to ensure they are collected, documented and stay with the main specimen, their final disposition being the choice of the customer or final repository.

7) Access to specimens: The tired mantra of 'the specimen will be forever lost to science' when a non-academic collects it, is without foundation in reality. Private collectors and commercial palaeontologists have for decades invited academics to work with them on specimens. Many academics, particularly in Europe, take up that offer and work on some extraordinary finds. In North America, however, a much more extreme view has been adopted by many academics who refuse to acknowledge the existence of any fossil that resides outside a public institution. They claim that a fossil must be ensured to be accessible to researchers in order to be published. In practice, though, this gets complicated. I myself have been denied access to public specimens by certain institutions simply because I work for a commercial organization. 'Public' specimens that are on decades-long 'loans' or are off-limits because a researcher called 'dibs' on them years ago are not, and should not, be considered accessible. Conversely researchers are often willing to continue publishing on specimens long since lost to war or natural disasters with unrepeatable data points. This is a classic 'do as I say, not as I do' maneuver (Bakker 1986), with specimens being 'lost so science' existing on the same spectrum. While it may not be feasible to ensure unfettered access to every specimen, private or public, I think with a little foresight and cooperation that private specimen access could easily be brought up to the level where academics believe their museum collections are.

In the end, we all need to look at fossil collecting in terms of what is best for the science and what is best for the specimen. Working with criminals, though it may further certain career goals, is not an acceptable answer. In fact, collaboration, or the famous 'public-private partnership' buzzword is an answer. Realizing that there are many qualified professionals that do not work inside a museum is the first step. Additionally, discerning between experienced practitioners and those amateurs who just stumble upon a big score through dumb luck is important. Extreme arguments from both sides of the academic/commercial rift are unhelpful. Finding common ground is vital for the science. All collectors need to police their own to ensure good standards are maintained, instead of turning a blind eye to shoddy work. Most importantly, applying these standards universally, and calling out those that do not strive towards them, is the best way to continue advancing palaeontology in the modern era.

Cooperation is the key to success. The first people in our science realized this, and it is about time that we all get back to our roots.

References

ANONYMOUS 2015. Un dinosaure illégalement sorti de Mongolie finit au Musée des Confluences à Lyon, Lyonmag.com, 6/4/2015 https://www.lyonmag.com/article/71909/un-dinosaure-illegalement-sorti-de-mongolie-finit-au-musee-des-confluences-a-lyon

CARR, T. 2013 How can we rescue the dinosaurs from Tuesday's auction? Tyrannosauroidea Central, 15/11/2013. http://tyrannosauroideacentral.blogspot.com/2013/11/how-can-we-rescue-dinosaurs-from.html

COFFMAN, K. 2015. Colorado man gets probation for smuggling Chinese dinosaur fossils, Reuters, 15/10/2015. http://www.reuters.com/article/us-usa-fossils-china-idUSKCN0S902E20151015

HO, C. 2013. Owner of Calgary-based fossil company convicted of trafficking fossils from Burgess Shale. *Calgary Herald*, 6/7/2013. http://www.calgaryherald.com/owner+calgary+based+fossil+company+convicted+trafficking+fossils+from+burgess+shale/8495854/story.html

LANGFORD, C. 2017. Big Fight Over Big Dinosaur Bones, *Courthouse News Service*, 14/3/2017. http://www.courthousenews.com/big-fight-big-dinosaur-bones/

QUAN, D. 2017. 'Nothing fishy': Canadian owners of ancient fossils repatriated to China deny any wrongdoing, *National Post*, 17/1/2017. http://news.nationalpost.com/news/canada/nothing-fishy-canadian-owners-of-ancient-fossils-repatriated-to-china-deny-any-wrongdoing

SHIMADA, K., CURRIE, P.J., SCOTT, E., and SUMIDA, S.S. 2014. The greatest challenge to 21st century paleontology: When commercialization of fossils threatens the science,

Palaeontologia Electronica **17**(1); 1E: 4 p; palaeo-electronica.org/content/2014/691-great-threat-in-21st-century http://palaeo-electronica.org/content/2014/691-great-threat-in-21st-century

SWITEK, B. 2015. Dinosaur skeletons aren't decor - they shouldn't be sold to the highest bidder, *The Guardian*, 16/9/2015. https://www.theguardian.com/commentisfree/2015/sep/16/wrong-auction-dinosaur-skeletons-allosaurus-fossil

WAGNER, D. 2014. Saved From Auction Block, San Diego Museum Fossils Headed To Kansas, KPBS, 12/5/2014. http://www.kpbs.org/news/2014/may/12/saved-auction-block-san-diego-museum-fossils-heade/

WATERS, D. 1988 "Heathers" shooting script http://www.dailyscript.com/scripts/heathers_shooting.html

Wikipedia 2017 https://en.wikipedia.org/wiki/Mary_Anning

WOOD, T. and FIORE, F. 1991. Rodney King says he obeyed police. Los Angeles Times, 7/3/1991 http://www.latimes.com/local/california/la-me-rodney-king-says-he-obeyed-police-19910307-story.html

FIGHTING ABOUT FOSSILS (AGAIN)? - A HISTORY OF SCIENCE VIEW OF A CONTEMPORARY CONTROVERSY IN PALAEONTOLOGY

by Elizabeth D. Jones

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Dinosaur fossils are a simultaneous source of interest to palaeontologists and the public for their scientific, educational, entertainment, and commercial value. They are also a serious source of controversy. Specifically, this article addresses the story of "Sue" - the most complete *Tyrannosaurus rex* ever excavated. Sue, discovered by the Black Hills Institute of Geological Research in 1990, was confiscated by the Federal Bureau of Investigation, then auctioned and purchased for over eight million dollars by the Field Museum of Natural History with finances from McDonald's and Disney. One of the most well-known legal scandals in palaeontology today, Sue has been widely discussed, debated, and written about over the decades. Although Sue is the epitome of a contemporary palaeontological controversy, she is not the final word, and her story serves as a departure point for examining the broader debate over fossil ownership in the United States throughout the twentieth and twenty-first centuries.

This paper's purpose is two-fold. First, this paper is from the perspective of a historian of science and explores the issues around the legal and illegal trading of fossils in contemporary palaeontology. In the process, I argue the importance of *celebrity* and the need to see it as an influential force in mobilising as well as destabilising scientific research. I also argue the importance of *assumptions of authority* in terms of who can access then analyse vertebrate fossil material, especially exceptional fossil finds like Sue with high media and monetary value. Overall, celebrity and assumptions of authority are underlying but unexamined causes of controversy that affect the production of knowledge in palaeontology, not only in the case of Sue, but throughout the history of palaeontology. Second, this paper only provides a snapshot of a complex issue. As such, it marks the start of a comprehensive historical, philosophical, and sociological project on what I view as a debate over fossil ownership that needs to be studied on both a national and international level.

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Introduction

Fossils, especially dinosaur fossils, are a simultaneous source of interest to paleontologists and the public for their scientific, educational, entertainment, and commercial value. They are also a serious source of controversy. A quick look at media articles showcases the ongoing debate and drama around the legal and illegal trading of fossils on an international level (Webster 2009; Robbins 2009; Bowley 2013; Gidda 2016; Meijer 2016). Thanks to media, the controversy is out in the open. Despite the publicity, however, the controversy has, for the most part, remained an untouched topic of discussion at academic paleontological conferences like the Annual Conference for the Society of Vertebrate Paleontology (SVP). Here, fossil ethics is a topic that everyone knows about but nobody talks about, at least not in an open collegial setting. But in 2016, this changed when the 14th Annual Conference for the European Association of Vertebrate Palaeontologists (EAVP) hosted a special symposium to address one of the most pressing but ignored issues in the field, namely the ethical collecting, buying, and selling of fossilised vertebrate specimens (Liston 2016). Jeff Liston, vertebrate paleontologist and vice president of the EAVP, organised the symposium for this exact reason: "Presentations on ethics have so far not been accept-

ed at SVP, meaning that this fundamental issue is not being widely discussed at the largest annual gathering in the vertebrate palaeontological community. Without airing it as an important issue, there will be no global debate or understanding, ensuring that divisions and issues will continue" (Liston 2016, p.29). So as a result, '*Fossillegal': a symposium on ethics in palaeontology* was planned with the goal that this would be the first step of many towards solving the problem at hand. Through a one-day workshop including twelve talks, a round table discussion, and this subsequent conference proceedings, '*Fossillegal*' tackled the topic of the legal and illegal trading of fossils with a focus on how palaeontology as a practice both influences and is impacted by this particular phenomenon.

In this article, I address the story of "Sue," the largest, most complete, and most expensive *Tyrannosaurus rex* ever excavated. Sue, first discovered by the Black Hills Institute of Geological Research in 1990, was later confiscated by the Federal Bureau of Investigation, then auctioned and purchased for over $8 million by the Field Museum of Natural History with financial assistance from the McDonald's and Disney Corporations. As one of the most high-profile legal cases in paleontology today, Sue has been widely discussed, debated, and written about over the decades. Nonetheless, her case deserves further dissection. While Sue is the epitome of a contemporary palaeontological controversy, she is not the final word, and her story serves as a departure point for examining the broader debate over fossil ownership in the United States throughout the twentieth and twenty-first centuries. In drawing on Sue as a case study, this article will address the social side of paleontology with attention to the role that both celebrity and authority play in the process and practice of science, especially in light of broader historical movements concerning the commercialisation and professionalisation of science.

The purpose of this paper is two-fold. First, this paper is from the perspective of a historian of science. Therefore, it will offer a unique but necessary point-of-view to these conference proceedings regarding discussions around the legal and illegal trading of fossils in contemporary paleontology. Second, this paper is only a snapshot of a very complex issue. My hope here is that this will mark the start of a comprehensive historical, philosophical, and sociological project on what I see as a debate over fossil ownership that needs to be studied on both a national and international level.

Searching for DNA in Fossils: The Role of Celebrity in Science

The science of paleontology is no stranger to press and public interest. Throughout the late-nineteenth and early-twentieth centuries, paleontologists worked hard to bring paleontology, especially dinosaur paleontology, into the public consciousness. From London's one-of-a-kind Crystal Palace Dinosaurs to Edward Drinker Cope's fossil feuds with Othniel Charles Marsh across the American wild west, dinosaurs have been strategically showcased and marketed to an international audience (Rudwick 1985; Rainger 1991; O'Connor 2008; Bowler 2009; Brinkman 2010; Rudwick 2014; Manias 2016). Ever since then, the study of fossils has existed and evolved as a public-facing practice. In the 1960s and 1970s, overall interest in dinosaur paleontology sky- rocketed again. This "Dinosaur Renaissance" - primarily stimulated by new research that questioned traditional views of dinosaur anatomy, physiology, evolution, and extinction - led to a resurgence of interest in these extinct creatures (Bakker 1975; Desmond 1975; Bakker 1986). Then in summer 1993, the much-anticipated Jurassic Park was released worldwide, and the blockbuster movie, accompanied by a colossal marketing campaign of nearly 65 million dollars, initiated the start of a globally recognised franchise (Gould 1996). The hunt and hype for the search for DNA from fossils, including dinosaur fossils, was in part born out of this fascination with prehistory and interest from professional and popular audiences alike in knowing more about the evolution of life on earth.

In this section, I briefly discuss the role of celebrity in the history of "Ancient DNA Research," which, broadly speaking, is the practice of extracting, sequencing, and analysing DNA from fossil material.[1] This argument and evidence for the role of celebrity in science comes from my former doctoral research and I mention it in this paper because it is this idea of celebrity that links my former research to this new work on the contemporary history of fossil collecting, buying, and selling. I mention the search for DNA from ancient and extinct organisms for two reasons. First, I want to make the point that the role of celebrity is not to be ignored or underestimated when it comes to understanding the process of science. Rather, my research reveals that celebrity can be incredibly influential in mobilising scientific and technological research. Second, I want to make the point that scientific practice both influences, and is in turn influenced by, press and public interest, and in exceptional cases, it can be influenced by celebrity.

[1] For a detailed account of the history of ancient DNA research, see Jones (2017), Jones (2018a), and Jones (2018b).

In other words, science is subject to the forces of the media, and if we are to understand science, we must understand it in relation to its cultural context.

When I started this project, my research objective was to trace ancient DNA's disciplinary development from an emergent to a more or less established practice from the 1980s to today. To do this, I used historical and archival methods as well as oral history interviews with over fifty scientists in this new research field. What my research revealed was that the search for DNA from ancient and extinct organisms developed into a discipline under the influence of intense press and public interest. Indeed, from the very beginning, the idea of extracting DNA from fossils attracted significant attention from the media, but the growing practice was catalysed into the spotlight in the 1990s especially as its emergence coincided with the release of *Jurassic Park*. In my account of the historical and sociological development of this discipline, I argued that celebrity was a crucial component in shaping the science of ancient DNA research over a thirty-year period.

But how do we define "celebrity"? The definition of the celebrity obviously requires a reference to celebrity studies. In this literature, however, there is no clear consensus on what constitutes celebrity. Indeed, the definitions of both celebrity and celebrity culture are debatable (Turner 2004; Evans and Hesmondhalgh 2005; Fahy 2015). Nonetheless, for the purposes of this paper, I want to draw on Graeme Turner's definition of celebrity which he sees as being both a process and a product. Turner, for example, considered celebrity to be "a *genre of representation*" and "*a commodity traded by the promotions, publicity and media industries that produce these representations and their effects*" (Turner 2004, p.9). Here, celebrity can be understood as having a sort of appeal to or authority over the public. This authority is attained through fame and the glamorous, even notorious, status that comes with it and is then reinforced by media interest in it.[2]

In the 1970s, science communication scholar Rae Goodell profiled a series of scientists from the anthropologist Margaret Mead and biologist Paul Ehrlich to the chemist Linus Pauling and astronomer Carl Sagan. Goodell called these scientists "visible scientists" (Goodell 1975). According to Goodell, these visible scientists shared personal and professional characteristics, (media-oriented characteristics), that helped them attain press and public visibility, which they then used as a platform from which to speak to the public not just about science, but also about science policy. More recently, Declan Fahy introduced the notion of "celebrity scientists" (Fahy 2015). For Fahy, this is a new type of scientist that has emerged in light of the rise of the new celebrity culture. These celebrity scientists, like the late cosmologist Stephen Hawking and late paleontologist Stephen Jay Gould, were credentialed experts in their professional sphere but had also attained fame, fortune, and influence in the public realm. As celebrity scientists, they used the media as a public platform to popularise science then influence public attitudes towards science. According to Fahy, however, stardom's influence cuts both ways. In fact, their stardom affords them influence outside *and* within science. In other words, stardom filters back into science, affecting the process of science. In my work, I am not talking about celebrity on the individual level. Rather, I am talking about the role of celebrity on the group level and the importance of understanding how a subject of science can be made into and marketed as a commodity. Thinking of celebrity on the group level requires us to ask and answer the following questions: How does the mass media represent a subject of science to the public? How do researchers respond to the media spotlight? What are the effects of this attention on the science itself? In the case of the history of ancient DNA research, my studies explored how celebrity works in relation to a subject of science, namely the practice of extracting DNA from fossils for studying evolutionary history and even potentially using that DNA to bring extinct species, such as dinosaurs, back to life.

The early to late 1990s is a decade full of examples of how the media mobilised, as well as destabilised, the practice of ancient DNA research during its earliest and most exploratory years.[3] In the early 1990s, a small but growing group of scientists began to test the limits of DNA preservation in ancient and extinct

[2] Here, I want to note a difference between publicity and celebrity, a distinction which is also not entirely easy to draw. According to the Oxford English Dictionary, "publicity" is defined as "[n]otice or attention given to someone or something by the media," whereas "celebrity" is defined as the "[t]he state of being well known." Although most science and technology enjoys publicity from time to time via media headlines, article features, or interviews, not all science falls subject to celebrity. In other words, all celebrity involves publicity, but not all publicity leads to celebrity. Indeed, celebrity is much more than intermittent promotion. In the case of this history, celebrity is both a process and a product of consistent science-media interactions. It is the outcome of prolonged publicity that is actively pursued and produced by both scientists and members of the media. Here, science-media interactions are more than episodic and individualistic. For a definition of publicity, see https://en.oxforddictionaries.com/definition/publicity. For a definition of celebrity, see https://en.oxforddictionaries.com/definition/celebrity.

[3] For examples of this interplay between science and media in the history of ancient DNA research, see Jones (2017), Jones (2018a), and Jones (2018b).

material with a new molecular biological technique called the polymerase chain reaction (PCR). Crucially, Jurassic Park coincided with these events, and its popularity placed ancient DNA research and its scientists in the spotlight. In the 1990s, the hunt for DNA from fossils evolved under the scrutiny of the press and public gaze as a series of studies, published in well-respected journals such as Nature and Science, reported the recovery of multi-million-year-old DNA from amber insects and dinosaur bone. Indeed, researchers raced to extract the first and the oldest DNA from some of the most iconic specimens. In the process, the media created opportunities for publicity. However, scientists and scientific institutions also fashioned their own opportunities for attention. Here, the interplay between scientists and the media, particularly around the idea of recovering multi-million-year-old DNA, influenced research agendas, publication timing, grant funding, professional recruitment, media visibility, and public perceptions of the science itself. During this decade, some scientists were savvy in capitalising on the celebrity of their fast-growing field in order to secure their success. In fact, capitalising on this attention at this time was extremely pragmatic.

However, as the discipline developed, researchers responded to its technological challenges as well as its status as a public-facing practice. In particular, researchers responded to concerns about "contamination" in both a technical and a social sense. To be clear, they were worried about ancient DNA authenticity and the celebrity that surrounded the science. They were namely concerned with the authenticity of research results, especially as several high-profile studies on multi-million-year-old DNA were shown to be irreproducible or the product of contamination. At the same time, however, some scientists also viewed popular interest and influence as a second source of contamination that challenged their credibility within evolutionary biology. In response to both these concerns, a handful of practitioners produced a strict set of scientific standards for how to properly practice the search for DNA from fossils at a time when the field's credibility was on the line. Although media mobilised the search for DNA from fossils in terms of generating scientific activity, scientists also felt that a disproportionate attention could be problematic in the face of credibility concerns.

The take-home-message from this very brief outline of ancient DNA's disciplinary development is that press and public interest is far from trivial. Rather, it can be an influential force in mobilising, as well as destabilising, scientific and technological research. Indeed, celebrity can be a crucial component in shaping the practice of science over time. It is important for science scholars and scientists alike to recognise this interplay if they are at all interested in understanding the reasons why, and ways in which, research is pursued. It is also important for understanding the production and presentation of scientific knowledge, especially in light of the rise of the mass media, celebrity culture, and modern science communication movement. In one way or another, our lives are impacted by the media, and the world of science is no exception.

Unfinished Business: The Story of Sue and Assumptions of Authority

Sue is all about superlatives. She is the largest, most complete, and most expensive *Tyrannosaurus rex* ever excavated. The story starts in 1990 in South Dakota, where her skeleton was first found by members of the Black Hills Institute of Geological Research (BHI) on a ranch belonging to a man named Maurice Williams. The BHI, owned and operated by brothers Peter and Neal Larson, bought the skeleton from Maurice Williams, writing him a cheque for $5,000. The BHI then excavated the skeleton and began preparing it for study and display at their private institution in Hill City. However, in 1992, the Federal Bureau of Investigation (FBI) confiscated the skeleton, claiming that the dinosaur was initially found on government land, namely federal land that was part of the Cheyenne River Indian Reservation which belonged in trust to the United States Department of Interior. After confiscation, Sue was "held hostage" at the South Dakota School of Mines and Technology in Rapid City while a court case over her ownership ensued. The story was broadcast across the mass media, drawing national attention particularly as the citizens of Hill City took to the streets in protest of the FBI's actions related to Sue's seizure. Indeed, other organisations from the Bureau of Indian Affairs (BIA) and Bureau of Land Management (BLM) to the Society of Vertebrate Paleontology (SVP) became involved. In 1997, Sue was sent to New York City, auctioned off, and purchased for over $8 million by the Field Museum of Natural History in Chicago with the financial assistance of the McDonald's and Disney Corporations. Peter Larson, one of the owners of the BHI who was primarily responsible for excavating Sue, was convicted of two felonies, two misdemeanors, and sentenced to eighteen months in prison. Interestingly, these convictions were for crimes related to fossil hunting and money laundering but in instances unrelated to Sue. While this is not the complete story, this brief synopsis highlights the complicated network of individuals and interests in this particular case.

From beginning to end, Sue can be physically traced from five different locations, moving between public and private possession along the way. At each location, there is a unique story to be told about values, ethics, politics, and their impact on scientific practice. And at each location, the debate over ownership becomes more complex and intense. Indeed, from the start, Sue's case caused controversy and a definite division amongst the palaeontology community (Browne 2016). The community still lives in Sue's shadow (Harrod 2014). Here, this case typifies the debate over fossil ownership regarding private and public lands, and the role of academic, amateur, and commercial fossil collectors (as well as other stakeholders such as members of the public) in excavating exceptional fossil finds that carry high media, monetary, and scientific value.

Throughout the 1990s, the media covered Sue's story with intent interest, but others have also attempted to outline their own version of events related to what is arguably one of the most controversial and costly scandals in palaeontology history. Peter Larson, for example, recounted his own side of the story in a book written with Kristin Donnan, a journalist who covered the case at the time (2002). And over ten years later, a documentary on the discovery of Sue, primarily from the perspective of the Larson brothers, was released to an international audience for viewing in theatres and on television (Miller 2014). Crucially, Steve Fiffer - a lawyer, journalist, and author - also took this case to task with a thorough interest in the many people involved and impacted by the dispute (2000). These works are invaluable testimonies of a scientific controversy and Fiffer's book in particular presents a clear view of the issues on the table.

Given this extensive coverage, is there anything interesting left to say about Sue? Before pursuing this project, I initiated some pilot study interviews with members of SVP. My goal was to assess their interest in a comprehensive study on the historical relationship between academic, amateur, and commercial fossil collectors. My goal was also to assess whether Sue deserves further dissection as a specific case study within this broader topic of vertebrate fossil ownership. Indeed, my first question to these interviewees was, "Is there anything interesting left to say about Sue?" Overall, interviewees warmly welcomed the idea of an academic account on the contemporary history of fossil collecting, and for the most part, they felt that Sue's story was not a closed case. On the subject of Sue, however, some thought that the controversy was all about fame, fortune, and ensuing jealousy. In fact, I agree. Others contended that the case was more of a one-off situation. Perhaps this too is true. Nonetheless, I am convinced that there is more to the story. In my work, I want to ask and answer the following question: "How did a such a controversial and costly court case happen in the first place and how has the verdict impacted the practice of palaeontology in the United States in terms of both the production and presentation of scientific knowledge?" Indeed, from a historical, philosophical, and sociological perspective, Sue's story and its broader impact on palaeontological practice is a case of unfinished business.

In examining Sue's story from a history-of-science point-of-view, I want to suggest that the controversy and its consequences are best understood with attention to the role of *celebrity* and assumptions of *authority*. Here, I suggest that the *celebrity* of this specific specimen played a part in this story in terms of heightening attention, then exacerbating the scale and scope in which this debate played out publicly. However, I further suggest that this controversy, although heightened by the celebrity of the specimen, was primarily motivated by assumptions of *authority*. Overall, it seems to me that assumptions of authority, regarding who has the ability to access and analyse vertebrate fossil material, were responsible for initiating, then sustaining, the debate over a prolonged period of time.

Although I have very briefly outlined the idea of celebrity in science, how might we make sense of the idea of assumptions of authority? In her work on the professionalisation of botany in the United States, Elizabeth Keeney drew on the idea of the professional scientist as one dependent on expertise (real or presumed), and she argued that it was this perception of expertise that then gave an individual authority over the creation and interpretation of certain types of scientific knowledge (Keeney 1992). Drawing on her ideas, I suggest that assumptions of authority are assumptions of expertise, which also includes assumptions about what qualifies as expertise. Expertise, for example, can be attributed to an individual based on his or her education or experience, particular employment position, or academic society affiliation. To be clear, assumptions of authority matter because they affect the production and presentation of scientific knowledge. Expertise, however it may be defined, can be used to grant authority to an individual or a group and in the case of palaeontology, this authority can then be used to give control over paleontological knowledge, including control over the fossils which provide evidence for that knowledge. In the case of Sue, assumptions of authority, and by extension expertise, were central to arguments regarding ownership. A large part of this research will be dedicated to sorting out the range of

assumptions held by academic and amateur paleontologists, commercial fossil collectors, special interest parties, government agencies, museum officials, business companies, politicians, and members of the public as it relates to this particular scientific controversy.

In taking on a scientific controversy as a case study, I want to make mention of two important points, both of which were actually introduced at the symposium, *Fossillegal*. First, it is necessary to note that focusing on a case of controversy might inadvertently distort the issue and distract from other less sensational but equally important areas of interest. David Unwin, Programme Director of Museum Studies at University of Leicester, made this precise point. In his talk, he argued that rare and extreme legal cases of fossil theft, such as Sue or the more recent case of the illegally transported four-legged-fossil-snake from Brazil, might distract us from potential discussion of other issues regarding museum studies and collection access (Unwin 2016). On this point, Unwin argued that even respected museum repositories that legally collect and conserve fossils can be nearly impossible for professional scientists to navigate in terms of being granted access to study specific specimens. Unwin's point was that the paleontological community should work to improve, not restrict, collection access in order to democratise scientific research and facilitate knowledge growth. Indeed, assumptions of authority, as well as their consequences, exist in the mundane day-to-day activities related to museum studies and collection access. I agree that it is important not to distort the issue by focusing too much on rare and high-profile scientific controversies. However, science studies scholars have demonstrated that using a scientific controversy as a case study can be a useful method for investigating the process of science as well as its interplay with and impact on society (Engelhardt and Caplan 1987; Nelkin 1992; Machamer *et al*. 2000). According to sociologists of science, "Controversy highlights social processes with particular clarity" (Collins and Pinch 1979). Although Sue is an extreme example of a wide-spread but nuanced issue, her story will shed light on the process of science in action.

Second, while controversy brings out the social side of scientific study, thus giving a glimpse into how scientific practice really works in the real world, it can also distract from instances of cooperation and collegiality. In other words, it is important to not let scientific controversy overshadow instances of scientific cooperation. The recent EAVP meeting is actually evidence of an instance of the latter. As the workshop organiser and mediator, Liston had prepared for heated debate given the focus on a contentious topic like the legal and illegal trading of fossils. To his surprise, however, the day ended with a productive and collegial conversation:

> "At the end of the presentations was a roundtable discussion with a group of such different individuals that it had the potential to become inflammatory. As such, I found myself in the role of an inverted Jerry Springer, trying to ensure open discussion while avoiding conflict. However, there was no antagonism whatsoever; instead the consensus coalesced around education as the default problem that everyone complained about, and agreed on" (Liston 2016, p.30).

As far as these participants were concerned, educating the right individuals with the right information is key. Here, they agreed that better educated legislators will make for better conceived legislation. On this point, Eberhard Frey, vertebrate paleontologist at the State Museum of Natural History Karlsruhe, suggested surveying EAVP members to determine what vertebrate paleontologists want fossil regulations to look like from both a scientific and commercial perspective. While this is a step towards potential consensus, such a survey would only capture the many voices of one group, namely the members of this vertebrate palaeontology community. To achieve a complete picture, we must work on identifying and involving all the individuals who participate, and therefore affect, the legal and illegal fossil market.

Boundary Objects, Boundary-Work

Palaeontology's history is full of characters and controversies. "The Bone Wars" of the mid-to-late 1800s, which involved a fierce rivalry between Cope and Marsh, was one of the most famous and vicious conflicts in the history of science (Wallace 1999; Jaffe 2001). As detailed in numerous articles and books, each resorted to theft, bribery, sabotage, and other tactics to outcompete one another in the race to find the most extravagant fossils from the American badlands. Cope and Marsh did much to advance the science of palaeontology, but their "Fossil Feud" remains a prominent part of their legacy. As Science Historian Paul Brinkman noted, Cope was a "brilliant and prolific American naturalist" but "notoriously combative" and is best known for his "bitter and embarrassing public feud" with Marsh which "aired on the front pages of the *New York Herald*" (Brinkman 2015, p.188). According to Brinkman, however, Cope did not fight exclusively with words or only with his colleague and competitor Marsh.

Indeed, Cope initiated a fist fight with a friend, Persifor Frazer, at a meeting for the American Philosophical Society which resulted in black eyes for both parties. As far as Brinkman was concerned, Marsh was no less innocent. Marsh was a dominant researcher in the field, but he was so "disliked" by so many that this made him and his work a "tempting target" for "criticism" (Brinkman 2006, p.126). Henry Fairfield Osborn, for example, intentionally set out to critique Marsh's contributions, and he did so by attacking one of Marsh's claims to fame, namely the identification of a specific sauropod specimen, Brontosaurus. But such feuds revolving around the search for fossils, fame, and fortune extended beyond these ivory tower rivalries. And to be sure, these fights over fossils were not just a thing of the past.

Today, one of the most heated debates in palaeontology is concerned with the legal and illegal trading of fossils. Broadly, this debate not only pits individuals against individuals, but it also engenders major divisions between and even within groups. Although the issue inevitably involves a complex network of various viewpoints, some might say the controversy is primarily, or most obviously, between professional academic paleontologists and the commercial fossil community (Liston 2016). Indeed, some paleontologists have declared "the battle against heightened commercialisation of fossils to be *the* greatest challenge to palaeontology of the 21st century" (Shimada *et al*. 2014).

Generally speaking, the science of palaeontology emerged from a tradition of amateur and commercial fossil collecting, then only later evolved into a professional academic practice. In the history of paleontology, Mary Anning (1799-1847) is often regarded as the first and best-known fossil hunter. Not only did she do much to contribute to the nascent science of palaeontology, but she sold the fossils she found off the southern coast of England for a living (Emling 2011). Moving forward in time and across the pond to the United States, Charles Sternberg (1850-1943) was one of the most notable commercial fossil collectors. He was one of the primary fossil collectors for Cope during his rivalry with Marsh (Sternberg 1931). These individuals, among many others, once sold fossils in exchange for money, and today independent fossil collectors, or commercial fossil collectors, claim to do the same.

Indeed, commercial fossil collectors are quick to draw on this history in defence of their own views of fossil ethics today. In an article, Neal Larson and colleagues harkened back to the very origins of fossil hunting, explaining: "Animosity directed toward commercial collecting is relatively new, but the sale of fossils is not. Commercial collecting predates the relatively young science of palaeontology and has been intertwined in modern palaeontology since at least the late 1700's with Mary Anning and her father, Richard" (Larson *et al*. 2017, p.2). On the same point, Michael Triebold noted the historical connections and scientific benefits of commercial fossil collection for the science of palaeontology:

> "Commercial fossil trading in the United States started with quarrymen in New Jersey selling fossils to Joseph Leidy during the mid-1800s. By the 1870s, professional collectors were busy filling museums with dinosaurs and other fossils, by accepting the risks of exploration, discovery and excavation, then selling their discoveries, and in some cases collecting fossils on a contract basis. Visit any number of prestigious institutions and you will see magnificent displays whose very existence is owed to professional collectors" (Triebold 2007, p.136).

However, throughout the twentieth-century, the tides have turned and some professional scientists feel that commercial fossil collecting is detrimental to palaeontology.

The debate around commercial collection is highly variable, but there are several examples in print of the positions that people take on this issue. Academics on one side of the debate, for example, argue that what is at stake is the loss of scientifically significant fossils from the public domain: "Where fossils are informative - because they can provide data on systematics, stratigraphy, morphology, function, ontogeny, paleoecology, and so forth - they are significant. The ethics of science dictate that these fossils - as nonrenewable natural resources and hence irreplaceable sources of data - be conserved in perpetuity. In order to avoid the ever-increasing loss of such fossils to commercialism, which undermines collections-based scientific research and leads to further cuts in funding and job opportunities, the scientific significance of fossils must be increasingly emphasized. We therefore consider the battle against heightened commercialization of fossils to be the greatest challenge to palaeontology of the 21st century" (Shimada *et al*. 2014).

In response to this, commercial collectors argued that these hostile feelings towards an open-market fossil trade is really the result of misunderstanding:

> "We believe, on the other hand, that the demonization and marginalization of a specific portion of the paleontological community is the result of misunderstanding, misplaced entitlement and simple intolerance. Such attitudes endanger the

> future of the very science of palaeontology and paleontological collections on which it is based. Through collaboration, education and constructive alliances, the fossil fuel that drives our discipline could be better managed and made more easily accessible to the scientists who work in both commercial and/or academic institutions, but more importantly, made equally accessible to the public" (Larson and Russell 2014).

Both these quotes indicate a serious "us-versus-them" mentality, but again, these positions, while important to understanding the issue, are really only a snapshot of the bigger picture.

In the sociology of science, researchers have introduced certain concepts to help make sense of these sorts of episodes in the history of science. One, for example, is the notion of a "boundary object" (Star and Griesemer 1989). Drawing on the history of the Berkeley Museum of Vertebrate Zoology as an example, sociologists of science Susan Star and James Griesemer introduced the notion of a boundary object to help explain the ways in which amateurs and professionals worked together at this specific museum in order to produce scientific knowledge. According to Star and Griesemer, a boundary object is a material object or theoretical concept that is shared by different communities but used or valued in different ways. In this case, there were various boundary objects from the collections and specimens themselves, to field notes, maps, and forms. They argued for the "importance of developing, teaching and enforcing a clear set of methods to 'discipline' the information obtained by collectors, trappers, and other non-scientists" thus "generating a series of boundary objects which would maximize both the autonomy and communication between worlds" (Star and Griesemer 1989, p.404). Star and Griesemer explained the nature and significance of boundary objects in these terms:

> "Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual site use. These objects may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds" (Star and Griesemer 1989, p.393).

In other words, a boundary object indicates a "shared space" of interests and can help the parties involved navigate their competing but not necessarily incompatible interests (Star 2010, pp.602-603). Speaking to the topic of this paper, Sue as a specimen, rather obviously, could be considered a boundary object.

In addition to the idea of boundary objects, scholars have also applied the concept of boundary-work in order to analyse especially controversial episodes in the history of science. Thomas Gieryn, science studies scholar, introduced the notion of "boundary-work" and to demonstrate this phenomenon, he drew on a number of instances throughout history of science in which various individuals or institutions employed boundary-work in order to establish their scientific authority over a particular domain or discipline (1983; 1999). For Gieryn, boundary-work is a process by which scientists construct, deconstruct, and negotiate definitions of what counts as science: "Put bluntly, a sociological explanation for the cultural authority of science is itself 'boundary-work': the discursive attribution of selected qualities to scientists, scientific methods, and scientific claims for the purpose of drawing a rhetorical boundary between science and some less authoritative residual non-science" (Gieryn 1999, pp.4-5). For Gieryn, there is no one and only way to do science but rather different ways of drawing or redrawing the boundaries of what we see as science: "The boundaries of science have not, historically, been set in amber because - in the first instance - nature does not allow but one order of understanding, and therefore those serving up discrepant realities can draw discrepant cultural maps to legitimate their claims as uniquely credible and useful" (Gieryn 1999, 17). According to Gieryn, credibility contests are essentially contests for control and boundary-work is part of this process: "Boundary-work becomes a means of social control: as the borders get placed and policed, 'scientists' learn where they may not roam without transgressing the boundaries of legitimacy, and 'science' displays its ability to maintain monopoly over preferred norms of conduct" (1999, p.16). Scientists build boundaries when they feel their authority has been threatened in one way or another. In many cases, scientists are seeking to defend their interests by demarcating their work from other interests they consider to be non-scientific at best or supposedly detrimental to science at worst.

At first glance, the concepts of boundary objects and boundary-work seem rather obvious. However, identifying how these concepts actually work in the real world of scientific practice is far from straight forward. My goal here is not to analyse the contemporary history of fossil collecting with regards to the

concepts of boundary objects or boundary-work, but it is my intention to introduce these ideas as potential analytical categories for examining the contemporary history of fossil collecting, particularly as it relates to Sue's story and within the broader context of paleontological practice in the United States.

Such concepts as boundary objects and boundary-work are especially useful when more multiple maps of interest, expertise, and activity need to be drawn out in order to understand the dynamics of a given situation. In the contemporary history of fossil collecting, there is no short and sweet answer to the controversy over fossil ownership. Indeed, such a history will need to draw out multiple maps of interactions to examine how academic, amateur, and commercial fossil collectors, as well as other interested parties including the public, come into contact and even conflict with one another. Liston put the point this way: "Pretending that the issues are one-way is not only simplistic, it is detrimental" (Liston 2016, p.27). In fact, the symposium's logo was an attempt to reflect an open-minded and multi-dimensional view of the issue at hand. According to Liston, "*the grey area in the middle*" is supposed to show that "*the subject is not as simple as black and white*" (Liston 2016, p.27). To be sure, the contemporary history of fossil collecting, on both a national and global scale, is in no way a binary controversy.

While serious historical scholarship is needed to understand the causes of these shifting attitudes towards amateur activity and commercial fossil collection, I suggest that much of it has to do with broader historical movements related to the commercialisation and professionalisation of science in general. In the early twentieth-century, natural history transitioned from an amateur tradition into an academic practice housed in research institutions like museums and universities (Allen 1975). With this transition, amateurs and commercial collectors in the fields of botany, ornithology, and of course palaeontology, had to work out new relationships with the rise of these new academics (Kohler 1982; Keeney 1992; Smocovitis 1996; Barrow 1998; Rainger 1991; Brinkman 2010; Rieppel 2012). In the history of palaeontology, there is certainly continuity between nineteenth and twentieth century debates over fossil ownership, but the debate today takes on a distinctly different dimension as fossils are being widely bought as cultural commodities in the marketplace (Fyfe and Lightman 2007). In his work on the history of palaeontology and anthropology, Peter Kjærgaard made this particular point: "Over the past two hundred years, the fossil trade has turned into a profession as well as a market, reflecting both science and commerce. The money involved in paleontological and paleoanthropological research is not on an industrial scale, but it is still considerable and of significant importance for individual household economies, the running of large field sites, philanthropic concerns, commercial interests, and the intricacies of science-funding politics" (Kjærgaard 2012, p.341). With this in mind, I suggest the need to radically reconstruct our idea of the meaning of fossils in light of the commercialisation and the professionalisation of science. With these movements have come new notions of ownership, assumptions of authority, and subsequent controversy. With an eye to the history of science, we can work towards an understanding of commercial fossil collection worldwide.

References

ALLEN, G. 1975. *Life Science in the Twentieth Century*. New York, New York: Wiley.

BAKKER, R. 1975. Dinosaur Renaissance. *Scientific American* **232** (4): 58-79.

BAKKER, R. 1986. *The Dinosaur Heresies: New Theories Unlocking the Mystery of the Dinosaurs and Their Extinction*. New York: William Morrow & Company.

BARROW, M. 1998. *A Passion for Birds: American Ornithology after Audubon*. Princeton: Princeton University Press.

BOWLER, P.J. 2009. *Science for All: The Popularization of Science in Early Twentieth-Century Britain*. Chicago: Univeristy of Chicago Press.

BOWLEY, G.. 2013. Dinosaur Skeletons Headed to Auction, Not Museum. *The New York Times*. July 29. http://www.nytimes.com/2013/07/30/arts/design/dinosaur-skeletons-headed-to-auction-not-museum.html.

BRINKMAN, P.D. 2006. Bully for Apatosaurus. *Endeavour* **33** (4): 126-30.

BRINKMAN, P.D. 2010. *The Second Jurassic Dinosaur Rush: Museums and Paleontology in America at the Turn of the Twentieth Century*. Chicago: University of Chicago Press.

BRINKMAN, P.D. 2015. Remarking on a Blackened Eye: Persifor Frazer's Blow-by-Blow Account of a Fistfight with His Dear Friend Edward Drinker Cope. *Endeavour* **39** (3-4): 188-92.

BROWNE, M.W. 2016. A Dinosaur Named Sue Divides Fossil Hunters. *The New York Times*. Accessed January 13. http://www.nytimes.com/1992/07/21/science/a-dinosaur-named-sue-divides-fossil-hunters.html?pagewanted=all.

COLLINS, H.M., and T.J. PINCH. 1979. The Construction of the Paranormal: Nothing Unscientific Is Happening. In *On the Margins of Science: The Social Construction of Rejected*

Knowledge, edited by Roy Wallis, 237-70. University of Keele.

DESMOND, A. 1975. *The Hot-Blooded Dinosaurs: A Revolution in Palaeontology*. London: Blond & Briggs Ltd.

EMLING, S. 2011. *The Fossil Hunter: Dinosaurs, Evolution, and the Woman Whose Discoveries Changed the World*. Palgrave Macmillan.

ENGELHARDT JR., H. TRISTAM and A.L. CAPLAN, eds. 1987. *Scientific Controversies: Case Studies in the Resolution and Closure of Disputes in Science and Technology*. Cambridge: Cambridge University Press.

EVANS, J., and D. HESMONDHALGH. 2005. *Understanding Media: Inside Celebrity*. Maidenhead: Open University Press.

FAHY, D. 2015. *The New Celebrity Scientists: Out of the Lab and into the Limelight*. Lanham: Rowman and Littlefield.

FIFFER, S. 2000. *Tyrannosaurus Sue: The Extraordinary Saga of the Largest, Most Fought over T. Rex Ever Found*. New York: W. H. Freeman and Company.

FYFE, A. and B. LIGHTMAN. 2007. *Science in the Marketplace: Nineteenth-Century Sites and Experiences*. Chicago: Univeristy of Chicago Press.

GIDDA, M. 2016. U.S. Returns Stolen Dinosaur Eggs and Fossils to Mongolia. *Newsweek*. April 6. http://www.newsweek.com/dinosaur-eggs-fossils-smuggling-mongolia-444427.

GIERYN, T.F. 1983. Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists. *American Sociological Review* **48** (6): 781-95.

GIERYN, T.F. 1999. *Cultural Boundaries of Science: Credibility on the Line*. Chicago: Univeristy of Chicago Press.

GOODELL, R. 1975. *The Visible Scientists*.

GOULD, S.J. 1996. Dinomania. In *Dinosaur in a Haystack: Reflections in Natural History*, 221-37. London: Jonathan Cape.

HARROD, H. 2014. The Curse of the $8 Million Dinosaur. *The Telegraph*. August 9. https://www.telegraph.co.uk/culture/film/11016945/The-curse-of-the-8-million-dinosaur.html.

JAFFE, M. 2001. *The Gilded Dinosaur: The Fossil War Between E.D. Cope and O.C. Marsh and the Rise of American Science*. Victoria, British Columbia: Crown Publications.

JONES, E.D. 2017. *The Search for Ancient DNA in the Media Limelight: A Case Study of Celebrity Science*. PhD Thesis. University College London.

JONES, E.D. 2018a. Ancient DNA: A History of the Science before *Tyrannosaurus rex*." *Studies in History and Philosophy of Biological and Biomedical Sciences*. Forthcoming.

JONES, E.D. 2018b. *Ancient Genetics to Ancient Genomics: Celebrity and Credibility in Data-Driven Practice. Biology and Philosophy*. Forthcoming.

KEENEY, E.B. 1992. *The Botanizers: Amateur Scientists in Nineteenth-Century America*. Chapel Hill: University of North Carolina Press.

KJAERGAARD, P.C. 2012. The Fossil Trade: Paying a Price for Human Origins. *Isis* **103**: 340-55.

KOHLER, R.E. 1982. *From Medical Chemistry to Biochemistry: The Making of a Biomedical Discipline*. Cambridge: Cambridge University Press.

LARSON, N.L., W. STEIN, M. TRIEBOLD, and G. WINTERS. 2017. What Commercial Fossil Dealers Contribute to the Science of Paleontology. *The Journal of Paleontological Sciences*, no. **11**.

LARSON, P. and K. DONNAN. 2002. *Rex Appeal: The Amazing Story of Sue, the Dinosaur That Changed Science, the Law, and My Life*. Montpelier: Invisible Cities Press.

LARSON, P and D. RUSSELL. 2014. The Benefits of Commercial Fossil Sales to 21st-Century Paleontology. *Palaeontologia Electronica* **17** (1).

LISTON, J. 2016. "'*Fossillegal*': A Symposium on Ethics in Palaeontology." *European Association of Vertebrate Palaeontologists Newsletter*. Vol. **91**.

MACHAMER, P., MARCELLO P., and A. BALTAS, eds. 2000. *Scientific Controversies: Philosophical and Historical Perspectives*. Oxford: Oxford University Press.

MANIAS, C. 2016. The Lost Worlds of Messmore & Damon: Science, Spectacle, & Prehistoric Monsters in Early-Twentieth Century America. *Endeavour* **40** (3): 163-77.

MEIJER, H. 2016. To Collect or Not to Collect: Are Fossil-Hunting Laws Hurting Science? *The Guardian*. July 27. https://www.theguardian.com/science/2016/jul/27/to-collect-or-not-to-collect-are-fossil-hunting-laws-hurting-science.

MILLER, T.D. 2014. *Dinosaur 13*.

NELKIN, D. 1992. *Controversy: Politics of Technical Decisions*. Newbury Park: Sage.

O'CONNOR, R. 2007. *The Earth on Show: Fossils and the Poetics of Popular Science, 1802-1856*. Chicago: University of Chicago Press.

RAINGER, R. 1991. *An Agenda for Antiquity: Henry Fairfield Osborn and Vertebrate Paleontology at the American Museum of Natural History, 1890-1935*. Tuscaloosa: The University of Alabama Press.

RIEPPEL, L. 2012. Bringing Dinosaurs Back to Life Exhibiting Prehistory at the American Museum of

Natural History. *Isis* **103**: 460-90.
ROBBINS, J. 2009. Instead of Glory, the Finder of a Rare Dinosaur Fossil Faces Charges of Theft. The *New York Times*. http://www.nytimes.com/2009/01/22/us/22fossil.html.
RUDWICK, M. 1985. *The Meaning of Fossils: Episodes in the History of Palaeontology*. Chicago: University of Chicago Press.
RUDWICK, M. 2014. *Earth's Deep History: How It Was Discovered and Why It Matters*. Chicago: Univeristy of Chicago Press.
SHIMADA K., P. CURRIE, E. SCOTT, and S. SUMIDA. 2014. The Greatest Challenge to 21st Century Paleontology: When Commercialization of Fossils Threatens the Science. *Palaeontologia Electronica* **17** (1).
SMOCOVITIS, V.B. 1996. *Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology*. New Haven: Princeton University Press.
STAR, S.L. 2010. This Is Not a Boundary Object: Reflections on the Origin of a Concept. *Science, Technology & Human Values* **35** (5): 601-17.
STAR, S.L., and J.R. GRIESEMER. 1989. Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science* **19** (3): 387-420.
STERNBERG, C. 1931. *Life of the Fossil Hunter*. San Diego, California: Jensen Printing Press.
TRIEBOLD, M. 2007. Fossils: New Journal Will Oppose Illegal Trade. *Nature* **446** (7132): 136.
TURNER, G. 2004. *Understanding Celebrity*. London: SAGE Publications.
UNWIN, D. 2016. Hands Off, It's My Collection! Fossils, Museums and the Problems of Access. Edited by David Marshall. *Palaeocast*. July 6. http://www.palaeocast.com/eavp-2016/.
WALLACE, D.R. 1999. *The Bonehunters' Revenge: Dinosaurs, Greed, and the Greatest Scientific Feud of the Gilded Age*. New York: Houghton Mifflin Company.
WEBSTER, D. 2009. The Dinosaur Fossil Wars. *Smithsonian Magazine*. April. https://www.smithsonianmag.com/science-nature/the-dinosaur-fossil-wars-116496039/.

FOSSIL LEGISLATION - PROTECTION OR DESTRUCTION?

by Raimund Albersdörfer

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Collecting fossils privately and unrestrictedly, possessing specimens and trading with them, has been a fundamental cultural activity since the time of the Enlightenment, setting bases for the scientific advancement of generations of palaeontologists. Goethe's mineralogical and palaeontological collection, for example , was worth the equivalent of one million euros. Recently, increasing numbers of countries have tried to protect fossils in general, or at least important specimens, to save these from private ownership and commercial activity, in the hope of securing their continuing accessibility for science. However, what seems reasonable at first glance has become a major force for fossil destruction. On a daily basis, important fossils are destroyed - by industrial activity, erosion, or by the restrictive laws. Only a fraction are saved - in most cases not by institutional field work, but by committed private collectors and serious commercial palaeontologists and dealers. This is not a situation of competition with institutions, for most specimens would be lost anyhow were it not for the private collectors. Each preserved piece, by whom it may be found , is better off being saved rather than being destroyed by stone crushing machines or erosion. Most collectors will cooperate with open-minded scientists who respect their efforts and the private ownership of their finds. Moreover, most specimens in public museums originate from private or commercial collecting, eventually having found their way to public collections by donation, purchase, or inheritance. So any law restricting private collecting and unlimited ownership will have undesired effects. Collecting will diminish and relentless destruction of millions of fossils by neglect, industrial activity or erosion will be the result. Private collectors unwilling to give up, nor willing to freely donate their energy and the money that the hobby consumes, will be driven into illegality such that none of their finds will be accessible for science. However, there are alternatives to draconian laws restricting collection and possession. In Bavaria, collecting and ownership has been basically unrestricted (with the exception of some specimens of *Archaeopteryx*). This has proved beneficial to all sides: scientists, museums, commercial dealers, and private collectors. Let us face the real problem of fossil destruction and not fight ideological wars against those who sacrifice time and energy to achieve what no public entity can ever deliver.

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Introduction

How can as many fossils as possible be saved and protected, and can legislation help this to be done? Whether one collects as a museum or university employee, as a private collector or as a commercial dealer, the common goal in the end must be to save as many fossils as possible from disappearance and destruction, and make as many fossils as possible accessible to science and museums (and of course, to make a living.. by selling fossils or being paid a wage).

With this intention, many countries have issued laws, forbidding private and commercial parties to collect and own important vertebrate, and in some cases, all fossils. But what looks reasonable at first glance has become a major force for fossil destruction.

So what are the real reasons for fossil destruction? Is it because of greedy dealers? Or because of collectors sacrificing their spare time and money to hunt for rarities? The true major forces for the mass destruction of million of fossils year by year are:

- Quarrying activity (which no-one dares to name, because industrial production has a gigantic political lobby)
- Construction (same as above)
- Erosion (shall we blame nature?)

Through these forces, more fossils are irreversibly destroyed every single day than there are in the entire contents of the Natural History Museum in London. So, whatever eventually happens to it, each single specimen collected privately or commercially is better off than if it is blasted or crushed to dust, dredged, or eroded away by the weather or the ocean.

This whole discussion originates in either the inability or unwillingness of some people to imagine and acknowledge all these millions of fossil specimens being destroyed by the forces mentioned above. What the eye does not see the heart does not grieve over.

In reality, almost no fossil specimen which, had a collector or dealer not excavated it and saved it from such destruction, would have been excavated by an institution or museum. So we are NOT in a situation of competition, but should support everyone who helps saving fossils from the forces of destruction.

A look at reality - three examples:

Example 1: a land with no restriction, Bavaria: Painten Quarry.

A commercial field campaign has been conducted there for 15 years, investing a very significant sum of private money. Before this was started every single fossil had been destroyed by the quarry operators - now everything is being saved, including many new taxa of pterosaurs, sphenodonts, turtles, sea urchins, plants etc. etc., and even Europe's best-preserved dinosaur, *Sciurumimus* (Rauhut *et al*. 2012).

What would have happened to these specimens had they not been excavated commercially? They would all definitely have been destroyed forever by the quarrying operations, and ended up as plaster on a wall, destroyed as all fossils have been destroyed in this quarry, under the eyes of our museums, for the previous 40 years. Statistics show the following: out of 100% of the original fossiliferous layer, 98% of this layer has been destroyed. From the 2% commercially dug and documented it can be calculated what was destroyed forever in that 98%: some 50 dinosaurs, 1,200 pterosaurs, about 1,800 turtles, around 8,000 important fish specimens, 600 sphenodonts, etc. etc. Nobody ever cared about all those lost pieces, but now some people dare to complain loudly that the few specimens now saved from destruction are owned privately. They indeed want to stop the excavation and have all further finds being once more destroyed by the quarry operations.

If legislation keeps the commercial entity from digging there, away from an unrestricted ownership including the right to sell specimens wherever and to whomever, then digging will stop instantly, of course. But then the body that issued this law, and everyone who helped to implement this law, has to either take over the expensive excavation (and has to come up with the knowledge - I dare say that no institution can compete here on this point), or else is directly responsible for the mass destruction of the finds that will be lost - (see above figures to calculate the likely losses to science).

Example 2: Holzmaden in Baden Wurttemburg.

Since 1972 a state law restricts the collecting and possession of important finds from the Posidonia shales .

No institution ever collected at this classical site. Collectors are discouraged, and have no guaranteed right to own finds of vertebrates and other important fossils. So who cares for the fossils in the quarries? The securing of fossils is entirely left to the uneducated and uninterested workers in the quarries, who usually have no love and no connection with our subject - and yet they are the government's agents. They are unable to recognize a pterosaur, a belemnite with soft tissue preservation, the thin skin of a shark or similar, and so they simply deliver another ichthyosaur or crocodile once in a while. The few collectors who break the law and do not care for the legislation have incredible specimens in their collections, all saved from the absolute destruction of the quarrying process. But collecting activity is low and illegal, due to these restrictions, and almost all the important specimens are scraped away.

There are even several collectors who would be willing to donate or sell such finds, but are afraid of being criminalised. That is the effect of the law.

Example 3: BLM (USA) land vs private territory:

A good example for fossil protection by commercial and private parties versus the natural destruction of a fossil by erosion, supported by a restrictive legislation, lies in Dana Quarry in Wyoming, USA., and the surrounding Bureau of Land Management (BLM) territory. Over vast areas of land owned and managed by the BLM, in the direct vicinity of the privately-owned area of the Dana Quarry, the fossiliferous

Morrison Formation is exposed - any collecting by dealers or private parties is strictly forbidden there. An allosaur skeleton is exposed here, a torvosaur and several sauropods. Every year there is a bit less - erosion takes its toll, and no-one cares. On the other side of the fence is private land, where digging is permitted. Here, some of the most complete sauropods ever found have been saved from erosion and destruction, skillfully excavated and well-documented. Most of them are now in museums around the world, but two of them were sold privately, one even to one of the most commercial places on Earth, the Dubai Mall. But is this worse than being destroyed? Tens of thousands of people who might never enter a museum admire the skeleton every day, are inspired and overwhelmed to find that there is a reality beyond 3D action movies and their iphones!

Of course, there are black sheep amongst collectors (as well as amongst scientists), but the vast majority of collectors have a deep love for fossils and for science - otherwise they would not sacrifice countless hours and much money to this hobby, and, if treated fairly and with respect, they will be happy to see their major discoveries finding a way into public collections and being worked on by scientists. A look into the stores of our museums shows that most specimens in most museums were not found by the institutions themselves, but were obtained by donation or purchase from dealers and collectors. Otherwise our museums would be almost empty, and the progress of science severely limited.

However, there are alternatives to draconian laws restricting collection and possession. As shown, so far in Bavaria collecting and ownership have been basically unrestricted (with the exception of *Archaeopteryx* - the state fossil). This has proved of benefit to all sides: scientists, museums, commercial dealers, and private collectors.

So the real problem of fossil destruction should be faced, rather than fighting ideological wars against those who sacrifice their free time and energy to achieve what no public entity can ever deliver. Let everyone collect and own and save from destruction fossils as much as possible, and let us try to motivate as many private and commercial operators to collaborate, by offering them respect and good cooperation.

References

RAUHUT, O. W. M.; FOTH, C.; TISCHLINGER, H. and NORELL, M. A. 2012. Exceptionally preserved juvenile megalosauroid theropod dinosaur with filamentous integument from the Late Jurassic of Germany. *Proceedings of the National Academy of Sciences*. **109** (29): 11746-11751. doi:10.1073/pnas.1203238109. PMC 3406838? . PMID 22753486.

DODGY FOSSILS: INTERNATIONAL LEGISLATION AND THE MEANING OF 'CULTURAL PROPERTY'

by John Martin

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In our small world of palaeontology, it has ended friendships and ruined careers. Important fossils are lost to science, or are in limbo. In the wider world, people get shot or imprisoned. Through it, fortunes are made by rich people in the West, while peasant farmers in the South lose the fortunes they never had.

'It' is UNESCO 1970: The *Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property*. This paper looks back at the ancestry of UNESCO 1970, to suggest that its ethically-inspired progenitors probably would not have wanted it to turn out the way it did. The wrong turn seems to have been in the ambiguity (perhaps intentional, certainly not articulated) of the meaning of 'cultural property' in the 1970 *Convention*.

Merryman (1986) reviewed 'cultural property'; he explained that it has two almost-opposite meanings, whose complex bases, in semantics, nationalism and money, are explored in this paper. I ruminate on how differently the word 'culture' might be understood in the minds of legislators (and politicians) in the Signatory Countries to the 1970 *Convention*, and speculate about how their interpretations might, from one point of view, be inadvertently ('culturally', 'lost in translation') mistaken and how, from another point of view, they might coincide neatly with national interests.

Maybe UNESCO 1970 itself did turn out the way its authors intended. The purpose of the Convention's Articles was to police international trade in *national* and *personal* property, arguably in support of the principles of capitalism, as variously applied in the signatory counties - and now, nearly 50 years on, globally.

Finally, I question whether fossils should be in the *Convention* at all; I ask: except possibly for fossil hominins, whose 'cultural' property are they?

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Dodgy

This word was included in the title of the presentation deliberately. It is a nice example of the challenges of communication in a multi-language world, where dictionaries and translation services do not capture the nuance of the meanings of words (semantics) across languages and cultures. The EAVP audience was not necessarily expected to know what 'dodgy' meant, in this context (or at all).

The English verb 'to dodge' appeared in the 16th century, with unknown etymology, meaning 'to move quickly sideways to avoid something'. By the 19th century in British and American English the adjective 'dodgy' had taken a metaphorical, informal meaning as 'dubious, unreliable, stolen'; the 'Artful Dodger' was Fagin's pick-pocketing accomplice in Oliver Twist (Charles Dickens, 1838), suggesting that 'dodgy' was criminals' slang.

So dodgy fossils are the kind of fossils a reputable collector, researcher or museum might not wish to deal with. Semantic challenges inevitably also apply to words like 'culture' and 'property', both in English and after translation into other languages.

UNESCO 1970 in international law

The United Nations *Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property* (hereafter UNESCO 1970) is an international Treaty. Like all such documents, it is a form of contract by which willing parties assume specified obligations

and agree to be liable under international law if they fail to comply with these obligations. To become effective, UNESCO 1970 needed signatories (nations agreeing, after discussion in their home legislatures, to the terms of the Convention) and for these signatory nations to create their own laws interpreting and implementing the objects and purposes of UNESCO 1970 in their own countries. The Vienna Convention (itself a UN Treaty, in force since 1980) says that international treaties must be interpreted 'in good faith … according to the ordinary meaning given to the terms of the treaty in their context.' This is the top level of international law, and it is where the ambiguous semantics of fossils as 'cultural property' has been validated, by allowing the words to be interpreted in whatever ways the signatory nations choose.

It has taken 46 years to get here, but by March 2016 there were 131 signatories to UNESCO 1970, and the number of countries or legislative entities (for example, the European Union) with legislation implementing or complying with it was about 165. Of particular relevance to this paper is the number - 59 - of pieces of national legislation explicitly about import, export or transfer of ownership of fossils.

Case Studies

The effects of UNESCO 1970 (and other national and international legislation restricting or controlling collection, trade, import or export) on fossils is a problem that will not go away. Long 2002 is a book-length commentary, using a selection of more notorious or spectacular cases. Its author leaned toward favouring the status quo: people who do not stick to the rules are bad for palaeontology. In Britain, the Geological Curators' Group (following publication of the Museums Association's updated Code of Ethics in 1996) organised a seminar on 'The Commercial Trade: Ethics versus Science' and published the papers as *Geological Curator* Vol. 7 No.6, 2001. This also followed a contribution (Martin, 1999) to a seminar 'Museums and the future of collecting' organised by the Museum Studies Department of Leicester University. Other authors (referenced below where discussed) have also published on the topic, from legal and philosophical, as well as palaeontological, points of view.

I was peripherally involved in some cases, too. They are summarised here as they affected my point of view: this is not necessarily the conventional one, but I believe it provides a balance to the status quo view and may help the EAVP devise a more progressive approach to legislation about fossils for future promulgation across Europe.

'*Plesiosurus' megacephalus* at Leicester Museum

A near-complete plesiosaur skeleton was collected from a Leicestershire limestone quarry in 1849, presumably by quarrymen. It was offered for sale by quarry owner William Lee, purchased by the Leicester Literary & Philosophical Society (for £150) in 1851, and donated by the Society to Leicester Town Museum. Another specimen, apparently the same species, had been collected in Somerset in 1846; this one became the type specimen of *Plesiosaurus megacephalus* Stutchbury, but was destroyed by the bombing of Bristol Museum in 1940. Research in 1989 - 1994 showed that the Leicester specimen was the same taxon as the Bristol type, and it was designated as the neotype of *Rhomaleosaurus megacephalus* (Stutch.) in Cruickshank 1994. More recently, the phylogenetics of this group of plesiosaurs has been reviewed (Smith and Dyke, 2008) and the Leicester specimen has become the neotype for *Atychodracon megacephalus* (the lost Bristol skeleton would have been the type). Because of its excellent preservation, the Leicester specimen has also been the subject of research on plesiosaur biomechanics and physiology (e.g. Cruickshank, Taylor and Small 1991).

The 1851 purchase secured this phylogenetically and anatomically important specimen in a public museum, where it has been safeguarded and studied ever since. As the curator of the specimen and head of the department where the research was done in the 1990s, it occurred to me that, had Leicester Town Museum been constrained in 1851 by the Museums Association Code of Ethics as it was in the late 20th century (e.g. Museums Association 1977, updated 2015) - accredited museums should not trade in natural history (including palaeontology) to avoid clashing with UNESCO 1970 - the specimen would almost certainly have gone into private hands and possibly lost to science. I should probably add that Leicester Museum would not now be able to contemplate paying the asking price for a complete plesiosaur, but that would be part of a different argument.

Therizinosaur eggs and babies

This case is now more than 25 years old and circumstances have changed, but at the time, as above, it seemed to show how UNESCO 1970 and national enabling legislation did not work for palaeontology. A large collection of unprepared dinosaur eggs from the Nanyang Valley, Henan Province, arrived, privately, in Leicester. At the time there was no strictly legitimate way these specimens should have left China: export of fossils, as 'cultural objects' (or

'relics'), was effectively prohibited (Murphy 1995) under China's interpretation of UNESCO 1970 (PRC 1982 etc.). But arrive they did, via Beijing, Hong Kong and the USA, with a paper trail seeming to show how legal loopholes (and perhaps smuggling) could be used by dealers and people in authority to get round the problem - and make money.

The specimens were prepared, and out came a treasure trove of fabulous palaeontology: unhatched embryos at various developmental stages, sequences of pre-natal teeth, soft tissues, yolk sacs, even pupae and 'frass' of infesting Cretaceous insects. The embryonic skeletons themselves suggested a need to revise systematic relationships within the Dinosauria. All these findings had to be ignored by the palaeontology community, because British interpretation of UNESCO 1970 meant that the specimens could not be acquired by an accredited institution and, as a corollary, the research would not be accepted for publication by professional journals. The eggs and their contribution to knowledge languished in scientific limbo for over 20 years, until reinterpretation and revision of Chinese regulations allowed new paperwork to be provided, after which publication could finally proceed (Kundrät *et al.* 2008).

Brazil

Fossils from the Cretaceous of northeast Brazil have been prized worldwide as scientific specimens, collectors' items and décor since the mid-20th century. Largely in response to the resulting international trade, Brazil used UNESCO 1970 to design its own restrictive laws about fossil collecting, dealing and export. The attractiveness of the fossils, their scientific value and the new law had the inevitable effect of raising the price, and the stakes - there was a black market, and weapons were sometimes involved. The mark-up in price between the $1 a local farmer might get for a good Santana Formation fish, the $150 in a local sale and the $5000 in a New York auction room shows that local people were not the ones making money.

Palaeontology suffers in this situation, too. Local collectors become producers in response to market demand for 'special' fossils; specimens are 'improved' or faked. And, human nature being as it is, palaeontologists compete to be the first to publish and name a new taxon. Two dinosaur specimens from the Santana Formation were described in the mid-1990s: one, a partial skeleton plus a fragment of premaxilla, the other, a skull. The second specimen was sent from Stuttgart to Leicester Museum for preparation. It was soon discovered that the real front of the snout was missing - the skull had been 'improved' by use of epoxy car-repair putty and rock dust to fake the front end. On removing the fake parts, it was noticed that the broken front of specimen two would fit nicely on the partial pre-maxilla from specimen one.

Unfortunately one group of workers were in the process of erecting a new taxon for specimen one while group two were doing the same for theirs. Hence *Angaturama limai* and *Irritator challengeri* are two taxa, apparently one animal, with *Irritator* having priority following the rule of date of first publication. Group one (see Kellner and Campos 1996) (and probably still are) very mad with group two (see Martill, D. M.; Cruickshank, A. R. I.; Frey, E.; Small, P. G.; Clarke, M. 1996) ; while it is also known that - in unrelated cases - palaeontologists have variously been arrested and denied a visa to return to the country as a consequence of Brazilian fossil laws.

Two more cases

The following quotes speak for themselves:

> "For paleontologists, the *Confuciusornis sanctus* is one of the newest pieces of information about the early history of birds. For Chinese legislators … this fossil and others like it are 'cultural relics'." (Schmidt 2000)

> "Nicolas Cage has agreed to return a stolen rare dinosaur skull to Mongolia. The Hollywood actor bought the *Tyrannosaurus bataar* (or *Tarbosaurus*) skull in good faith in 2007 for $276,000. Glenn Sorge, acting head of the US Immigration and Customs Enforcement Manhattan office, [said] that fossils like Cage's belong to the people of Mongolia. "These priceless antiquities are not souvenirs to be sold to private collectors or hobbyists," he added." (New York Times, 2015)

> "*The guy who said fossils are* "just basically rocks, it's not like antiquities where it's somebody's heritage and culture and all that" *can't turn round now and say* 'I sincerely love fossils'. *He doesn't love fossils, he loves money*." (Mark Norell, Chair, Division of Paleontology at the American Museum of Natural History and team leader of the joint AMNH/Mongolian Academy of Sciences annual expedition, on the sale of *T. bataar*, 2014)

Attributable effects of UNESCO 1970

The case studies above touch on or mention a number of peripheral effects of national legislation that interprets the 'ordinary meaning given to the terms of

the treaty [UNESCO 1970] in their [national] context' and applies it to fossils.

A few more are also known to this author; they include:

- Termination of employment (irreconcilable difference of opinion about an institution's interpretation of regulations and codes of conduct)
- Ending of professional and personal friendships
- Impounding, confiscation etc. of scientifically important specimens
- Publication embargo on scientifically important specimens or ideas
- Deportation of visiting collectors/scientists
- Creation of a black market
- Inflation of price of specimens above public institutions' budgets
- Loss of specimens from science and the public realm to private collections
- Exploitation of indigenous people
- Corruption of State employees and officials

The topic is also the subject of continuing debate in the profession in North America, Europe and Britain - a debate that never seems to get much closer to agreement. In England, the Geological Curators' Group organised a seminar in 2001 and published the papers in a special issue of the *Geological Curator*, the Society of Vertebrate Paleontology has run several meetings and seminars and its Government Affairs Committee has issued guidelines, and the European Association of Vertebrate Palaeontology has discussed it before the meeting at which this paper was presented. Like society's at large, the palaeontologists' debate seems to polarise - progressive versus the status quo - 'how can we change this for the better?' versus 'if we challenge this [because it is the establishment's point of view] we might regret it'.

Why is it so difficult?

Cultural relativism We do not want to offend people from other countries and cultures. This is an admirable change from the cultural imperialism of the past. Also, we appreciate that it is not possible (because of language, customs and other cultural factors) for us to be sure we know what other people think is 'normal', or how their concepts of words like 'culture' and 'property' might differ from ours. We are also reluctant to appear to be guilty of implicit racism: is it wrong for us to criticise a nation's customary ways of doing business, for example 'baksheesh' (a tip or bribe, a small sum of money changing hands to facilitate a transaction or to secure an official document), or, more seriously, a nation's human rights record? Challenging UNESCO 1970 could mean confronting issues like these.

Ethics What is right or wrong? Whose rights are we talking about when we legislate against collecting and selling fossils in poor areas of the 'Developing World'? (a term that is in the process of being phased out because of cultural relativism, see above). This is a difficult topic that many palaeontologists might think was better dealt with by philosophers and intellectuals.

Politics The challenge is inevitably political. It is about much more than what is best for fossils - which is a subjective question anyway. The unresolved debate is, at its heart, an argument between progressives and the established order, between the old 'left' and 'right', powerless and powerful.

Semantics What do the words in UNESCO 1970 mean to Americans, Britons, French, farmers in Araripe municipality, Chinese customs officials? What did the men who drafted the Convention mean when they wrote them? What happens when the words are translated from, for example, English to Mandarin, then back to English in translations of Chinese regulations derived from UNESCO 1970? The topic of the meanings of the key words in the Convention is explored further below.

The origins of UNESCO 1970

Understanding where the 1970 Convention came from gives a possible insight to its intended objectives and the choice of words to express them. There are two key precursor documents to UNESCO 1970 and one later; together they provide a precis of 20th century history. The wording of their introductory *Articles* demonstrates how their objectives - and probably their underlying ideologies - changed over the century in response to wider changes in culture, economics and politics.

The real pioneer of cultural protection was the Russian painter, philosopher and amateur archaeologist N.K. Roerich. Nicholas Roerich's personal experiences, first of excavation at Russian archaeological sites, later of the destruction and looting of cultural and archaeological sites during the Russo-Japanese war of 1904-5, alerted him to the danger of internationally significant archaeological heritage - sites and artefacts - being lost in time of war. Roerich began promoting the idea of an international convention for the protection of such heritage as early as 1899. The eventual outcome, after the Russian Revolution and his permanent move to Europe, was the **Roerich Pact**, 1935 'for protection of artistic and scientific institutions, historic monuments, missions and collections'. The text was drafted in Paris, submitted to the League of Nations (founded at the Paris Peace

Conference that ended the First World War), and was approved both by the *Committee for Museum Affairs* of the League of Nations and by the committee of the Pan American Union.

Article 1 of the Roerich Pact says:

> *The historic monuments, museums, scientific, artistic, educational and cultural institutions shall be considered as neutral and as such respected and protected by belligerents. The same respect and protection shall be due to the personnel of the institutions mentioned above. The same respect and protection shall be accorded to the historic monuments, museums, scientific, artistic, educational and cultural institutions in time of peace as well as in war.*

Even as the Roerich Pact was being discussed and eventually ratified, the economic and political turmoil of the 1920s was raising new concerns about the danger of another war. The League of Nations had been founded in 1920 with 39 member states (Germany and Russia were not included). Among its subcommittees had been a Committee for Museum Affairs, and this was subsumed into the League's International Museums Office in the 1930s. This organisation was working on drafts of a new, more comprehensive and inclusive, treaty for the protection of cultural heritage when World War II began in 1939.

The League of Nations was replaced by the United Nations (UN) after the Second World War. The UN started in 1945 with 51 members (193 in 2016); its subgroups included the United Nations Educational, Scientific and Cultural Organization (UNESCO). UNESCO picked up the work of the International Museums Office, issuing the **Hague Convention**, **1954** 'for the Protection of Cultural property in the Event of Armed Conflict'. Article 1 of the Hague Convention says (my emphases):

> *The term 'cultural property' shall cover,* ***irrespective of origin or ownership*** *... movable or immovable property of great importance to the cultural heritage of* ***every people****, such as monuments of architecture, art or history, whether religious or secular; archaeological sites; groups of buildings which, as a whole, are of historical or artistic interest; works of art; manuscripts, books and other objects of artistic, historical or archaeological interest; as well as scientific collections and important collections of books or archives or of reproductions of the property defined above…*

It could be argued that, of the four key Treaties, this is the most progressive; it appeared when the economic and political effects of two world wars had produced, certainly in 'the West', the lowest levels of inequality of wealth and power, and the most left-leaning of Governments, in modern history. The Hague Convention is still in force, although its effectiveness in early 21st-century conflicts (for example Palmyra in 2016) is debatable.

The Hague Convention was essentially a League of Nations draft taken to completion, and adopted formally in 1956, by the United Nations. During the 1960s, thefts were increasing both in museums and at archaeological sites, particularly in the 'developing world' (see above for the terminology). In the 'the West' ('the developed world'; 'the North'), private collectors and, sometimes, official institutions, were increasingly offered objects that had been fraudulently imported or were of unidentified origin. It was in this context, and to address such situations, that UNESCO itself began work on protection for cultural entities more generally - not only at time of war - during the 1960s. UNESCO appointed experts from some 30 states, and a draft of a new treaty was prepared (by a principal expert and four consultants) for agreement by delegates in April 1970. The final **Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property** was adopted in November 1970. While acknowledging that its purpose is broader than that of the Hague Convention, it is evident that between 1954 and 1970 something had changed. This is what *Article 1* of UNESCO 1970 says (my emphases):

> *For the purposes of this Convention, the term `cultural property' means property which, on religious or secular grounds, is specifically* ***designated by each State*** *as being of importance for archaeology,* ***prehistory****, history, literature, art or science…*

It is instructive to compare the emphasised text here with the equivalent in the Hague Convention.

Also of note is what follows in Article 1:

> *... and which belongs in the following categories:*
>
> *(a) Rare collections and specimens of fauna, flora, minerals and anatomy, and objects of paleontological interest…*

There are 11 categories in the Convention, of which only (a) includes any reference to fossils. The text is also ambiguous, because of the comma (,) after 'anatomy'; American English, which is the language of the Convention, as shown by the use of 'z' for 's' in some words and 'paleontology' (no 'a'), conventional-

ly has a comma (called an 'Oxford comma') before the last item in a list, before the final 'and'. This would mean that 'objects of paleontological interest' only qualify if they are parts of 'rare collections'. British English, however, only uses a comma here if the last item stands separately from the main list - in which case the 'items of paleontological interest' are just that, and do not have to be parts of collections. The point is important when considering the meaning of 'cultural': collections may have cultural significance because they are artificial entities - a collection may have been assembled by an eminent German thinker, or be a record of a key expedition to Antarctica - while individual fossils are culturally neutral (see below for a discussion about the relevance of 'culture' to fossils). The ambiguity means that national lawmakers have been able to create their own interpretations of this section of UNESCO 1970 - as we know, modern application of UNESCO-based laws routinely regards all fossils as being covered by the terms of the Convention.

UNESCO 1970 was followed by the UNIDROIT, 1995, **Convention on stolen or illegally exported cultural objects**. Article 1 says:

> *This Convention applies to claims of an international character for:*
>
> *(a) the restitution of stolen cultural objects;*
>
> *(b) the return of cultural objects removed from the territory of a Contracting State contrary to its law regulating the export of cultural objects for the purpose of protecting its cultural heritage (hereinafter "illegally exported cultural objects").*

It adds nothing else new to UNESCO 1970 from the point of view of this paper, so can be seen simply as a move toward an even stronger emphasis on the concept of State (*territorial*) cultural property. Recent cases since 1995, like that of *Tarbosaurus bataar*, show that fossils are being categorised, confiscated and restituted under this Convention as though they were national cultural property.

'Culture' and 'Property'

The two key questions in the debate about fossils in UNESCO 1970 are:
What did the Convention's authors mean by the words 'cultural property?
Are fossils 'cultural property?
If we can answer them we will have the basis of a rationale for either:

- Accepting the constraints on palaeontology and human rights UNESCO 1970, as applied in national legislation, produces; or
- Having fossils removed from the Convention and creating a new international treaty that is appropriate for the special case of palaeontology

Meanings of words - semantics

Culture. n.
1 [mass noun] The arts and other manifestations of human intellectual achievement regarded collectively: *20th century popular culture*

> 1.1 A refined understanding or appreciation of culture: *men of culture*

2 The ideas, customs, and social behaviour of a particular people or society: *Afro-Caribbean culture; people from many different cultures*

> 2.1 [*with modifier*] The attitudes and behaviour characteristic of a particular social group: *the emerging drug culture*

3 *Biology* The cultivation of bacteria, tissue cells, etc. in an artificial medium containing nutrients: *the cells proliferate readily in culture*

> 3.1 A preparation of cells obtained by culture: *the bacterium was isolated in two blood cultures*

4 The cultivation of plants: t*his variety of lettuce is popular for its ease of culture*
(Oxford English Dictionary, online)

> *"**Culture** is one of the two or three most complicated words in the English language. This is so partly because of its intricate historical development in several European languages, but mainly because it has now come to be used for several important concepts in several distinct intellectual disciplines and in several distinct and incompatible systems of thought"* (Williams 1976).
>
> *One way of thinking about cultural property - i.e., objects of artistic, archaeological, ethnological or historical interest - is as components of a common human culture ... Another way ... is as part of a national cultural heritage.* (Merryman 1986)

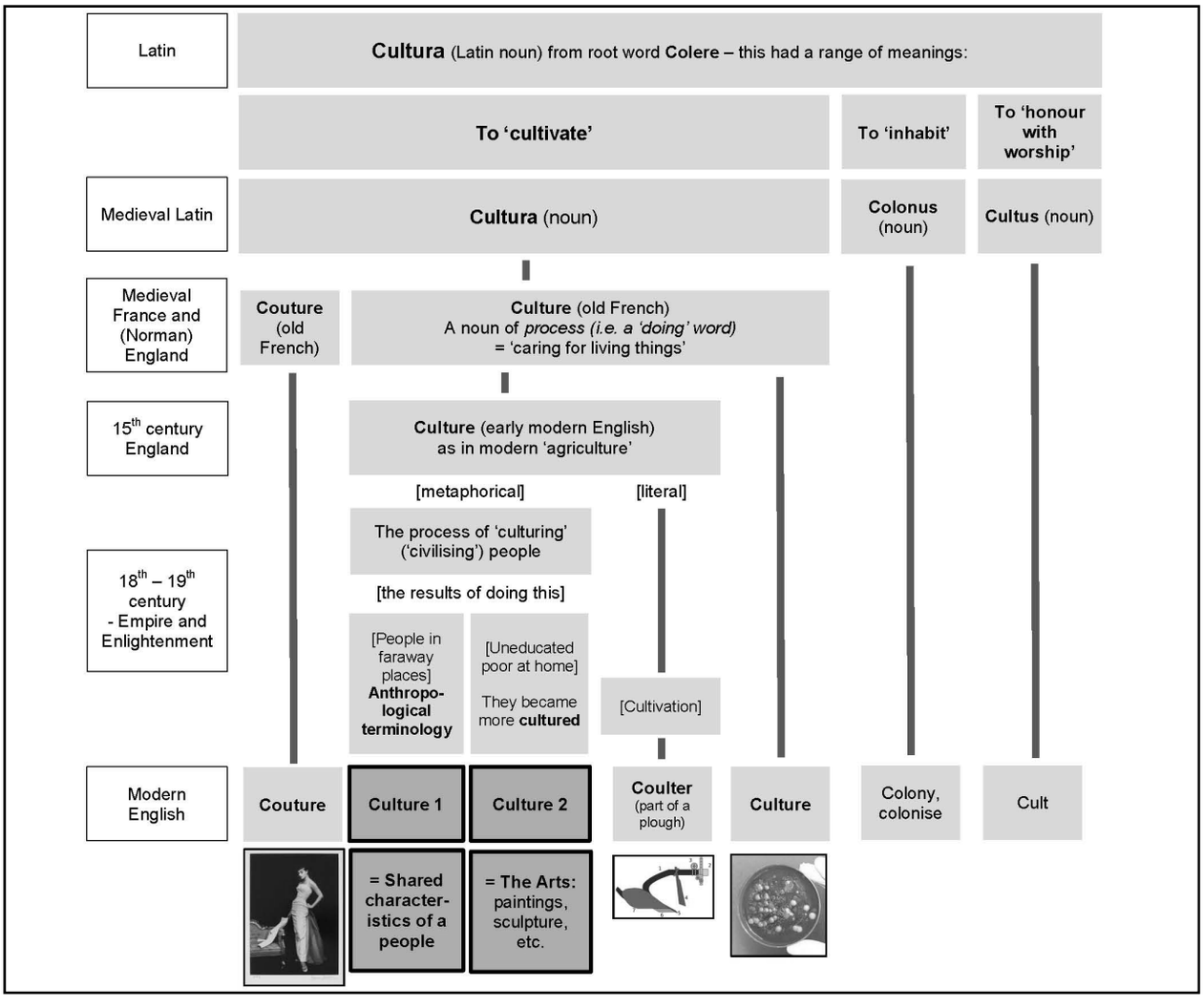
The etymological origin of *culture* is a Latin (perhaps 200BCE) or older root word *colere-* . This had a range of meanings of high significance to an early farming and civic society like Latium, including 'to cultivate', 'to inhabit' and 'to honour with worship'. From the last two meanings came the Latin words *colonus* (from which comes modern English *colony, colonise*) and *cultus* (modern *cult*). From the first meaning came the Latin noun *cultura* 'cultivation, managing domesticated plants and animals'. The word was carried across the Roman Empire, persisted in 'vulgate' (common) Latin after the collapse of the Western Roman Empire, and transferred with modification into European 'Romance' languages, including medieval French and English.

Clearly, there is something inherently rich and various in the semantics of the root word, because the three meanings of *colere*- listed above have maintained their subtle differences into the various derived modern words. '*Culture*' is, as Williams noted, complicated (Fig. 1). It has also, crucially, been demonstrably influenced by western European, particularly British, history and ways of thinking. One could indeed say that the word *culture* has been culturally influenced, except that to do so would mean assuming an uncomplicated meaning of the word.

Old French had *couture*, which survives as the specialised 'expensive dress-making' word in French and English, and *culture*, which either survives in modern French with its diversity of meanings or has been re-adopted there from English (see below). Medieval English farmers used Norman French-derived *coulter* (from its 'cultivation' meaning) for part of a traditional plough. *Culture* was borrowed from classical Latin by 19th century scientists to describe the cells in a petrie dish.

The main word *culture* in medieval English, however, retained the 'cultivation' meaning, as in modern 'agriculture'. During the Renaissance, and later in parallel with the Enlightenment and the establishment of European colonies (a related word, see above) and empires, it took on a range of metaphorical meanings - semantically related to, if not derived directly from, the several root-word meanings of *cultura.*

'Cultivation' shows that *culture* 'managing plants …' is a noun of process (a 'doing' word); the new semantics gave it the more abstract sense of 'culturing' or 'civilising' groups of people who, in the minds of the rich and powerful in British society, needed culturing. There were two target groups: poor, working people in Britain, and subjugated, non-Christian people in the new colonies. The first group needed to be shown how to be clean, polite, to attend Church and to know their place in society - they would become more 'cultured'. The second group would be converted to Christianity and forced to adopt British *culture* in preference to theirs. By extension, non-British *cultures* in this sense took on a curiosity value, and became the basis of traditional anthropology. This is what was referred to above where *culture* was characterised as a culturally-influenced word.
So here are the 'two ways of thinking about cultural



property' discussed by Merryman 1986. One modern meaning of *culture* refers to the objects produced by cultured societies - paintings, sculptures, decorative items - while the other refers to the shared characteristics of a people. The first comprises things that can be owned (property), the second may be characterised by such things but is essentially an abstract concept whose essence cannot be owned. Both meanings were adopted into American English - and into other (mainly European) languages, directly or via translation - during the 18th and 19th centuries, as Enlightenment attitudes and intercontinental trade spread around the world. The semantic complexity of *culture* in British English is also present in these other languages.

It is also very important, when discussing the topic of fossils in UNESCO 1970, to notice that both meanings are categorically limited to *human* endeavour or society.

Property

There is no real difficulty with the meaning of the word *property*:

> *Mass noun: A thing or things belonging to someone*. (Oxford English Dictionary, online)

It only becomes difficult when included in the noun phrase *cultural property*, because of contamination by the difficult word *culture*. As above, the 'two ways of thinking' about *cultural property* produce two main senses:

Sense 1: objects produced by 'cultured' societies' - especially fine and decorative art, antiques and 'collectibles'.

These objects are, in the modern global economy, highly commodified (they are regarded as investments to be traded; their price bears little or no relationship to the cost of their production). They can be the rightful property of individuals (producers initially, buyers subsequently). National institutions can have property rights by buying such objects on the open market.

Objects in this group are routinely claimed as cultural property, sense 2, by nation states when applying the terms of UNESCO 1970, although they are also widely believed, because of their quality and significance, to be humanity's shared property ('commonwealth').

The use of market value as a criterion for deciding whether national legislation based on UNESCO 1970 should be applied (there is a price threshold below which an item need not be subject to the law) demonstrates that sense 1 is interpreted nationally as being as much about money as about intrinsic cultural value.

Sense 2: anything (objects or otherwise) that a group of people believes to characterise them, their territory, customs and way of life (their 'culture').

A case can be made, because they are components of the people's identity, that objects in this group are the property of the people and that their eligibility is partly defined by the national borders. However, objects in this group are routinely claimed to be cultural property, sense 1, by nation states when applying UNESCO 1970, because commodification, and market forces, gives such objects a monetary value that can be counted in the nation's Gross National Product (GNP) and Balance of Trade.

Fossils' treatment under UNESCO 1970 legislation is justified by nation states under sense 2 but judged as if via sense 1. Fossils are by no means the only class of object to be treated in this way, however, so their inclusion at all needs to be challenged, as a special case (see below).

Whose property?

Because the legislation is about property, it might be instructive to ask: who, of a range of possible human agents in palaeontology, in a range of scenarios, has the strongest claim to property rights over fossils?

- A family who accidentally finds a nest of *Dromornis* eggs and takes them home
- A poor farmer in a developing country who spends several hours each day collecting fossils to supplement his livelihood
- An amateur fossil-hunter and her bag of ammonites
- The guys with rifles who control local trade in a developing country and act as middle-men for profit
- A skilled preparator who acquires unprepared dinosaur eggs and devotes hundreds of hours to their preparation with a view to making them available for research
- As above, but for sale
- A European university- or museum-based academic/curator who collects fossils in South America with a view to pursuing a research topic and publishing the results at home
- An American fossil dealer with a dinosaur skeleton priced at $250,000
- A rich, private, American purchaser of a specimen of high scientific value from Mongolia
- A state official who charges a 'fee' for legitimising paperwork to permit a fossil's export (or confiscates the specimen)

- A national administration, in the case of a fossil claimed to be part of the nation's cultural property

One's point of view on these scenarios depends on personal ethics, politics and experience. There is an inherent polarity in the responses - reflecting the same polarisation in society at large - primarily between the 'establishment' view and the 'progressive' one. Are property rights strongest for the farmer or for the rich American, and, ethically, should there be any correlation between relative wealth and relative power?

Lost in translation

It is clear from the preceding discussion that UNESCO 1970 is inherently ambiguous regarding the meaning of *cultural property*. The question of what the delegates' and drafters' intention was is unanswerable here, although we can speculate that the evolution of the statements of scope (Article 1 in all three) between Roerich, Hague and UNESCO, from general inclusivity, via 'irrespective of origin or ownership' and 'every people' to 'property … as designated by each state' shows that the drafters of UNESCO 10970 had a different agenda from Nicholas Roerich's in 1935. Could the ambiguity have been deliberate? The muddling of sense 2 cultural 'commonwealth' (shared human heritage) with sense 1 'cultural' commodities arguably assists the transfer of property rights from ordinary people to the establishment, many to few, poor to rich, matching the general trend of increased inequality worldwide since 1970.

As mentioned previously, the ambiguity of meaning of *cultural property* is largely shared across Romance languages (French, English in part, Italian, Spanish, Portuguese, Catalan and Romanian), because of their common etymological origins, and across Germanic languages (German, Dutch, English in part, and Scandinavian languages), largely following adoption during the Enlightenment period. The same issues regarding interpretation of UNESCO 1970 in the drafting of compliant national legal instruments therefore apply. Add the Vienna Convention's rubric that national laws must be drafted 'in good faith … according to the ordinary meaning given to the terms of the treaty in their context' and we can infer that there is plenty of scope for national legislation to both comply with UNESCO 1970 and be made advantageous for the local establishment and sympathetic to local custom.

For palaeontologists in the West, there is one further complication to be mentioned, with trepidation (cultural relativism). National UNESCO-compliant laws about fossils almost certainly use the ambiguity and the 're-interpret the words in your local context' Vienna Convention rubric to build in local advantage. But when local laws are drafted in a language - Mandarin for example - with which we are entirely unfamiliar, and that has an etymological history, orthography and 'ways of thinking' entirely different from those of UNESCO 1970's American English, how can we know what their drafters and national administrations mean by *cultural property* or any of the other apparently equivalent words? Again, the main problem is with *culture*. How is this concept - assuming there is an exact match for either or both of its variants - expressed in Chinese? It comes back to us, in Mandarin-to-English translation, as 'culture' but we probably can't know for sure what it means to a peasant fossil collector in Hunan or a customs official in Shanghai. How, therefore, can European and American palaeontologists (collectors, dealers etc.) or lawyers interpret Chinese laws respectfully, safely and accurately?

Are fossils ever cultural property?

Perhaps the simplest way to resolve the UNESCO 1970 problem for palaeontology is to take fossils out of it and devise a new international Treaty that is suitable for their special case. Simplest, but probably not easiest.

All dictionary definitions of *culture* confirm that, in all its manifestations of meaning, it is concerned with human creativity, beliefs, art, customs and society. UNESCO 1970 refines this further by being about export, import and trade between nations, thereby creating a large number of *cultures*, whose property is to be regulated, with national geopolitical boundaries.

With a few exceptions, fossils do not fit with this definition:

- They have no connection with human societies (not made by people, neither in the past or now) or individuals. The argument that fossils represent earlier twigs on the 'tree of life' of which *Homo sapiens* is part is spurious. Fossil hominins, unless of modern *Homo sapiens* and demonstrably ancestral to an extant and genetically-distinct, geographically isolated, group, have no cultural significance
- Archaeological specimens are not fossils (sometimes conflated in legislation)
- Geopolitical boundaries did not exist when the organisms preserved as fossils were alive, so fossils have no national identity

The exceptions are:

- Fossils used in the creation of religious, ritual or

decorative objects

- Collections of fossils (technically, one fossil or more) assembled and curated by significant historical figures in national or international life (natural philosophers, palaeontologists and other scientists), which survive more or less intact and now provide a historical record of their research and/or published works

Exclusions

This paper is not concerned with international and national legislation about protection of geological heritage sites, regulation of large-scale commercial fossil collecting, private dealing in fossils by public museum employees, etc. These regulations and codes of practice are all laudable and should be supported (and complied with) by palaeontologists.

Conclusions

Current international legislation (specifically The *Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property* UNESCO, 1970) is inherently ambiguous and unclear. This is a result of poor drafting, in that the two main meanings of the phrase *cultural property* in American English (the language of the Convention) and most other languages of European origin are incompatible, but are conflated in the document and also, consequently, in its interpretation and application worldwide.

It is also notable that the original intentions of the Roerich Pact (and, largely, the Hague Convention) were changed in UNESCO 1970 from protection of the inherent value of heritage objects to protection of the property value of 'cultural' objects.

UNESCO 1970 includes fossils in its defined scope of *cultural property*, and at least 59 pieces of national legislation designed to apply its aims to fossils are now in force. With two possible specific but relatively minor exceptions, the inclusion of fossils in the Convention is inappropriate and illogical.

Together, these three failings mean that UNESCO 1970 is a bad piece of international legislation, both for palaeontology and fossils, for many of the people involved in collecting and working on them, and for society in general because it tends to increase worldwide inequality.

References

LONG, John. *The Dinosaur Dealers*. Allen & Unwin, 2003, 240pp.

MARTIN, John. 1999 *All legal and ethical? Museums and the international market in fossils* pp 155-164 in Knell, S.J. (ed.) Museums and the future of collecting, Ashgate (1st edn.)

SMITH, Adam S. and DYKE, Gareth J. (2008). The skull of the giant predatory pliosaur Rhomaleosaurus cramptoni: implications for plesiosaur phylogenetics. *Naturwissenschaften* **95**, 975-980

CRUICKSHANK, A.R.I., TAYLOR, M.A. and SMALL, P. 1991. Dorsal nostrils and hydrodynamically driven underwater olfaction in plesiosaurs. *Nature* **352**, 62-64

CRUICKSHANK, A.R.I. 1994. Cranial anatomy of the Lower Jurassic pliosaur *Rhomaleosaurus megacephalus* (Stutch) (Reptilia, Plesiosauria), *Phil. Trans. R. Soc. London, Series B*, **343**, 247-260

KUNDRÄT, M., CRUICKSHANK, A.R.I., MANNING, T.W. and NUDDS, J. 2008. Embryos of therizinosauroid theropods from the Upper Cretaceous of China: diagnosis and analysis of ossification patterns. *Acta Zoologica* **89** (3), 231-251.

MURPHY, J. D. 1995. *Plunder and Preservation: Cultural Property Law and Practice in the People's Republic of China*, Oxford University Press, Hong Kong, Oxford etc., pp 119, 160

PRC STANDING COMMITTEE, 1982. Articles 27, 28 of *Cultural Relics Law of the People's Republic of China*; together with subsequent adapting Regulations (1985, adopted 1987) and *Prohibited Import and Export Goods Lists* (1989 -1993)

KELLNER, A.W.A.; CAMPOS, D.A. 1996. "First Early Cretaceous dinosaur from Brazil with comments on Spinosauridae". *N. Jb. Geol. Paläont. Abh.* **199** (2): 151-166

MARTILL, D. M.; CRUICKSHANK, A. R. I.; FREY, E.; SMALL, P. G.; CLARKE, M. 1996. A new crested maniraptoran dinosaur from the Santana Formation (Lower Cretaceous) of Brazil. *Journal of the Geological Society* **153**, 5-8

SCHMIDT, Anne C. 2000. The *Confuciusornis sanctus*: an examination of Chinese cultural property law and policy in action. Boston College International and Comparative Law Review, 23, 2

WILLIAMS, RAYMOND 1976. *Keywords: A vocabulary of culture and society*. Revised edition, 1976. Oxford University Press, p.87 et seq

MERRYMAN JOHN H. 1986. Two ways of thinking about cultural property *American Journal of International Law* **80** (4), pp.831-853

MUSEUMS ASSOCIATION, 2015 (current edition) *Code of Ethics for Museums.*

SITE-SPECIFIC LIMITATIONS ON THE USE OF PALAEONTOLOGICAL RESOURCES

by Charlie J. Underwood and David J. Ward

Underwood, C.J. and Ward, D.J. 2018. Site-specific limitations on the use of palaeontological resources. *The Geological Curator* 10 (10): 617-631.

Palaeontological resources are used by many people for diverse purposes, and in generating a best practice model for utilisation and conservation of these sites, the requirements of all of these interested parties should be taken into account. Fossil-bearing sites vary tremendously, especially in rates of depletion of the rock and fossils, frequency of visits by interested parties and the scientific significance, size and distribution of fossils therein. We argue that it is these criteria that should dictate best practice for any particular site, and in doing so a far more rational conservation strategy can be achieved.

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Introduction

The use of fossil resources has become an issue that provokes strong emotion in many palaeontologists. The perceived best practice for conservation of fossil resources has frequently been used to guide changes in the legal status of fossil collecting of various types within a country or other province. This is despite palaeontological and other geological sites being highly variable. The degree and application of legal protection of fossil sites varies tremendously with geopolitical boundaries, at least in part due to the experiences and perceptions of advisors contributing to the discussion from which the legal 'protection' derives. Where legal protections for palaeontological resources exist, as is the case for most of the World, the laws often lack flexibility and are thus inappropriate in a large proportion of cases. Many fossil protection laws, especially in countries with a rich archaeological heritage, are based on archaeological heritage laws which mostly inappropriate to palaeontological resources. While the legal protections of fossils should be adhered to, if these laws are detrimental to the optimum utility of fossil resources, pressure should be applied where possible to gain improvements made to laws.

Shimada *et al.* (2014) rightly point out that the last few decades represent a golden age for palaeontology. We would like to suggest, however, that this would be better be described as a second golden age, with the mid-late 19th Century representing the first. The 19th Century saw great advances in palaeontology and vast numbers of specimens being acquired by museums around the World. This early blooming of palaeontology occurred when there were very few professional palaeontologists, and contributions from amateurs and commercial collectors were essential. Despite this, there is often a reluctance today to replicate the cooperation that allowed so much palaeontological progress in the past.

Overall ethos

We strongly consider that a fossil that has been of benefit to society, be it through scientific advancement, education, bringing pleasure and stimulation or helping to financially support a community, is vastly preferable to one destroyed and lost forever.

Uses of field palaeontological resources

Field based palaeontological resources are extremely varied, and no two exposures, or even parts of the same exposure, are exactly alike. They vary in size, lithology, rate of erosion and weathering, as well as fossil content, all of which will profoundly influence the best practice for the optimum utilisation of the resource. In addition, it should be acknowledged that the use or utilisation of these palaeontological resources is highly variable, with different parties having a greater or lesser interest in different palaeontological sites.

Academic research

Academic research is typically considered the prime use of palaeontological resources, with material being either studied *in situ* or, more commonly, removed for study in museums or other academic institutions (commonly universities and geological surveys). This focus on academia may be to the extent that other users and interested parties are, or may perceive they are, ignored, marginalised or otherwise prevented from use of the resource. From the standpoint of the gaining of scientific information, it is generally acknowledged that academic use of fossils and the sites from which they were obtained is of paramount importance, and other uses should be regarded as secondary. Results of these academic studies, and often the specimens themselves, may subsequently be available to the general public but this is rarely the primary aim. Despite this, it must be realised that research collection by workers from research institutions does not exist in isolation, and the divisions between categories of usage of fossil sites are rarely clear cut. Failure to acknowledge this has the potential to do palaeontology as a science a great disservice, denying it potential contributors, data and funds. This even has the potential to alienate academic palaeontologists from the general public who have a vested interest in their research, not least considering that most palaeontology is funded, directly or indirectly, by the general public.

Hobbies and continued outreach

Finding, observing and collecting fossils can be a very significant hobby or pastime amongst adults and children who are not directly linked to academia. This is especially so in Europe and North America, where collecting of this sort has remained well established since the days of 18th Century curio collections, pre-dating organised scientific research on fossils. This mode of use of palaeontological resources can vary in scope from the occasional collection of fossils when the collector is in a suitable area, to a major life direction with the collector spending uncounted hours collecting, preparing and curating material. In some cases, often for reasons of access to field sites or interest in fossils that may be rare, collectors may supplement their own activities with, or specialise in, purchased or traded material.

There are benefits of this as a hobby for the individual and for society at large. Whilst the individual benefits from the stimulation of collecting or working with fossils, society and academia may benefit in many ways. A large number of non-academic palaeontologists contribute greatly to the science of palaeontology. Many such people donate specimens (often collected at great personal cost) to museum collections. Some individuals may even publish scientific studies on material they have collected and may provide field and lab assistance to academic researchers. Consequently, some non-academic palaeontologists have publication rates rivalling those of museum and university workers, and may also rival them in the number and significance of fossils received by museums. In addition, many chose to specialise on particular field sites, often local to them, and as a result have far greater opportunity to find newly exposed specimens than academics who are unable to spend the same amount of time on the ground. Combined with this, some collectors have a specialisation in a site to an extent that academics would be unable to replicate, and this allows some non-academic palaeontologists to develop the specialised skills for finding, collecting and preparing fossils from a site that exceed those of any less frequent visitor (e.g. Steve Etches in the Kimmeridge Clay).

Whilst the argument can easily be made that a fossil in a private collection is useless to science, and may even be considered as 'lost' by more extreme academics, in many cases this is not the case, at least not in the long term. Many, although certainly not all, collectors are happy to collaborate with academics as long as they are made to feel welcomed on equal terms, and many will donate the most scientifically useful specimens to public collections (often at financial loss to themselves). Furthermore, specimens in private collections are rarely destroyed, and even when material is not donated by the collector, there is always the potential that specimens will be donated after their death. It should however be acknowledged that many collections 'disappear' after the death of the collector, being discarded or sold as décor items without data. The failure for specimens to be correctly donated to museums may commonly be seen more as a failure on the part of academia to publicise their willingness to work with the estates of collectors, than the estates themselves.

Non-academic palaeontologists or collectors thus constitute a vast reservoir of manpower, expertise and specimens (e.g. Catalani 2014, Sole 2007, Sole and Etches 2005, Underwood *et al.* 2016). They commonly have collections that include scientifically important material, but many collectors are willing to work with academia and donate this material. Whilst important specimens may be lost after the death of a collector, these specimens would not have otherwise been collected and so it can be argued that even if some specimens are lost to science, the net gain far outweighs the loss.

Education and science outreach

The importance of education and outreach should never be underestimated. Many children have a great interest in science and the natural world, and palaeontology can be seen as one of science's public relations successes. Not only can it be regarded as a gateway to natural history, earth science and science in general, but it is of great importance in its own right. Many academic or other professional palaeontologists acquired their interest at a very young age and a large proportion probably collected fossils as a child.

Palaeontology can form an important forum for challenging some of the main sociological problems associated with science. At a time where denialism of scientific facts is commonplace, palaeontology can play an important role. Whilst we are unaware of any data on the subject, it would be expected that children exposed to palaeontology, especially in the field, would be far more likely to be able to critically evaluate the natural world and thus less likely to accept non-scientific concepts such as creationism and anthropogenic climate change denial. There is also a major issue with gender inequality in both research and applied science. The authors' experience with outreach activities with children suggests that amongst primary school-age children, interest in palaeontology is equally prevalent amongst boys and girls. As such palaeontology may be regarded as a 'gateway' into science for girls and encouragement at an early age may have the potential to influence subject preferences later in the school career.

Whilst there are invaluable learning opportunities with fossils in museums and other collections, field palaeontology adds an extra dimension and adds a contextual awareness of fossils. At some field sites, fossils are clearly displayed in the rock and may provide an exceptional visual teaching and learning resource. At other sites fossils are small and found loose and thus are most readily accessed by collection of small specimens (see case studies of Charmouth and Abbey Wood, below). This taps into the love of collecting that is demonstrated by many children (and adults) and provides material that can be kept as a reminder of the visit, or to form the basis of subsequent work in the classroom. In most cases these fossils will be common and of already known scientific value and the outreach and educational importance of these specimens vastly outweighs their (perceived) loss to science. Experienced oversight of collections made may identify any rarities discovered and alert the finder to the potential for donating them to a museum.

Tourism

Fossils can add greatly to a local economy in a variety of ways. This may be through geotourism, with geological heritage, including fossils, as the main aim of the visit, or in the form of less focussed visits where fossils are an added attraction to people primarily in the area for other reasons. While geotourism focuses on palaeontological and other geological resources, often for a period of a number of days, this tends to be the domain of a relatively small number of people in specialist interested groups. Casual interested parties are potentially far larger in number and, in areas otherwise open to tourism, can provide a far greater income. Whilst seeing impressive fossils *in situ* is clearly an attraction for both groups, the ability to collect fossils may be equally important, and if *in situ* fossils are not suitably impressive to the general public, the ability to collect and keep fossils may be the sole draw to these people. Indeed, whilst there are few holiday destinations that use the presence of *in situ* fossils or other geology as a selling point, the availability of fossil collecting is listed as part of the main attractions for a number of holiday destinations (see case study of Charmouth, below). While the draw of being able to collect fossils cannot easily be given a monetary value, if the presence of fossils is considered sufficiently important for tourist authorities to use as promotion material, it is likely that they contribute significantly to the attraction of the venue. Casual fossil hunting can therefore be regarded as contributing significantly to the economy of some towns and regions.

Commercialisation of fossils

The collection of fossils for sale alone is a highly controversial issue amongst palaeontologists. Hostility towards all commercial fossil collecting and dealing has commonly been expressed (e.g. Shimada *et al.* 2014, and in many bar-room discussions at palaeontological conferences), but palaeontology as a science also benefits from this trade (e.g. Larson 2001, Larson and Russel 2014, Martill 2001, Nudds 2001). The collection of fossils for sale has a very long history and has played a pivotal role in palaeontology. Fossils have been collected for sale since the start of palaeontology as a science, and the vast majority of collections of fossils from 19th Century Europe were largely or entirely from commercial sources. To this day many research institutions regularly purchase fossils, which in many cases allows them to obtain specimens to which they would otherwise fail to have access; indeed, commercial collecting could be regarded as outsourcing of specimen collection, which could be far more

financially viable than organising excavations, particularly in the current political climate for institutional funding.

The outcomes of individual acts of collection of fossils for sale may vary from very negative to the science of palaeontology (such as removal of known specimens before they could be scientifically excavated) to very positive (collection of fossils that would otherwise be destroyed and allowing a research institution to purchase them). Less well understood are the wider implications of making fossils into a commodity. It has been suggested that giving fossils a monetary value encourages all collectors to view fossils as a commercial resource rather than for their scientific value, and this may prevent specimens from being donated that would have been donated otherwise. To our knowledge there is no data to demonstrate that this is the case. It is possible that this idea may be more prevalent amongst those inheriting fossil collections than those who accumulate them, but again data is lacking. It has also been suggested that trade in smaller fossils, such as shark teeth from sites where they are common, has increased collection pressure on more vulnerable sites by making such fossils more desirable. Again there is no data for or against this, and there has been a counter suggestion that, for example, large scale sales of Moroccan fossil shark teeth has depressed the price of fossil shark teeth to the extent that ad hoc commercial collection of more vulnerable sites is not financially viable. Indeed, in this case there is a suggestion from sales of shark tooth jewellery that low cost fossils have made use of modern teeth unviable, potentially reducing hunting pressure on modern sharks.

Shimada *et al.* (2014) quote the Society of Vertebrate Paleontology bylaw "The barter, sale, or purchase of *scientifically significant* vertebrate fossils is not condoned, *unless* it brings them into, or keeps them within, a public trust" (our emphasis). We would agree that this is a very desirable position but even this would be best not taken as an inflexible rule. There are situations, for example, where funding from sale of some (possibly potentially important) fossils allows continued excavation or rescue allowing more specimens to become available for research, so the 'loss' of some fossils provides a net gain overall (e.g. see the Oued Zem case study below).

Exposure, collection and destruction

Maximising the utility of palaeontological resources, and allowing the greatest degrees of freedom to a range of interested parties, is largely dependent on the rate at which fossils are being destroyed versus the frequency of visits to the site. It is only by weighing up the relative importance of these criteria, as well as taking into account the types and sizes of fossil present, that an ideal model for usage of a site can be arrived at. Variations in these criteria may result in any optimisation of usage model being not only site specific, but bed or exposure specific (Edmonds *et al.* 2005, Larwood 2001).

Rates of fossil exposure and destruction

The rate at which rocks are destroyed by natural or anthropogenic processes varies tremendously, as does the degree to which this destruction is episodic. Whilst it may be useful to separate natural or anthropogenic destruction (Edmonds *et al.* 2005), in terms of overall optimum recovery of fossils, it makes little difference other than that the former is more predictable. As rocks are destroyed, fossils are initially exposed and then they too are destroyed. If fossils are relatively large and/or more robust than their enclosing rock, there is likely to be a period between exposure and destruction of a fossil when it can be seen on the rock surface. The exposure of fossils for collection or *in situ* study is therefore controlled by the rate of exposure due to erosion and weathering and the timing and rate of destruction of the fossil. The period between exposure and destruction represents the residence time during which the fossil is accessible. The fossil may have a lower rate of destruction than the surrounding rock and erode from it intact. The fossil is then subject to both continued destruction by erosion and weathering, but also to transport, removing the fossil from its geological context. In general, the longer that a fossil has been exposed, the more information has been lost from it, through destruction or damage of exposed parts of the fossil, removal of contextual information in surrounding rock or, in the case of fossils freed from the matrix, loss of data on stratigraphical position. For these reasons, newly-exposed fossils typically yield more palaeontological data than those that have been exposed for a long period.

Collection and destruction rates (see Fig. 1)

Unless collected by directed mining, fossils can only be collected or studied once exposed by erosion, weathering or human activity, and prior to their destruction by the same processes. Different fossil sites, and different exposures and beds within specific sites, are thus subject to a series of variables that will dictate the likelihood of a fossil being destroyed prior to collection or study; rate of exposure, rate of destruction of fossils and frequency of visit by palaeontologists or other interested parties. When destruction of the rock precedes destruction of the

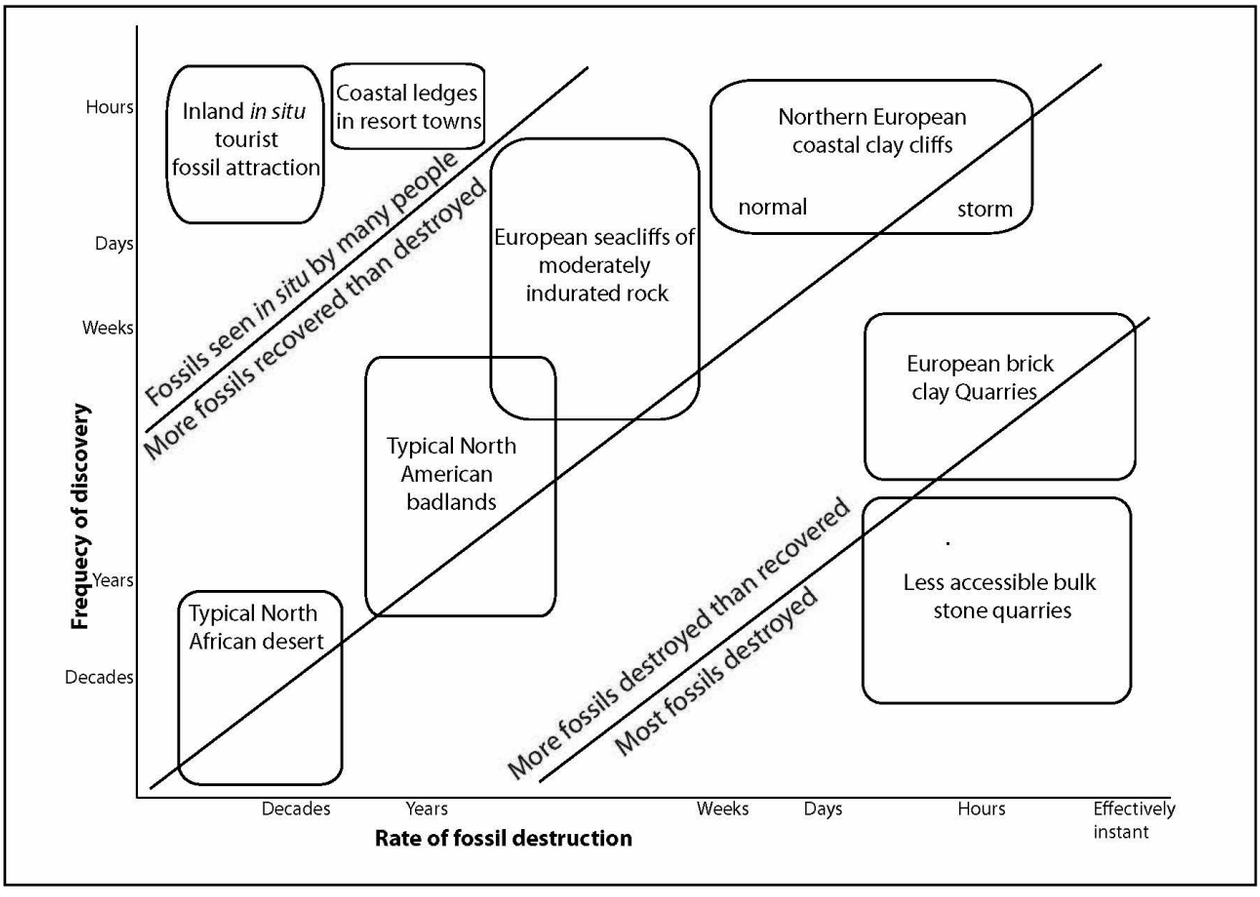

Figure 1. Plot of rates of fossil destruction and fossil discovery, showing fields where most fossils are destroyed and where most are retained.

fossils, an additional variable is introduced, namely the time between removal of the fossil from its matrix and its destruction. During this period the fossil is still accessible but is of vastly reduced scientific value.

The rates of exposure and fossil destruction vary dramatically between fossil sites. Coastal cliffs of non-indurated mudstone may erode at a rate of several metres a year, with much of that erosional loss often being during a relatively brief period of storms and/or exceptional tides with loss reaching rates of many tonnes per hour during these events. Well indurated rocks on the same piece of coast by contrast may undergo essentially no destruction for many decades, before catastrophic failure by erosional removal of large rocks. Natural inland exposures typically have lower destruction rates, but unconsolidated rocks within badlands that undergo relatively high rainfall may erode at relatively high rates, especially near drainage courses. In contrast, lithified rock in highly arid areas may be destroyed at extremely low rates with little appreciable change over millennia. Man-made exposures also typically have very high rates of fossil exposure and destruction. In bulk rock quarries, rock may be removed as it is exposed and as such the residence time (time between their exposure and destruction) for fossils is effectively zero, at least in working faces. In exposures such as road and other cuttings, the initial extraction of rock and enclosed fossils may be extremely rapid, with almost no subsequent exposure. In addition, many such cuttings are ephemeral and may be backfilled, covered or otherwise obscured almost immediately after their excavation.

Not only is the time that fossils are available extremely variable between different sites, so is the frequency of visits (of people actively engaged in palaeontology) to the site. Whilst there are large areas of potentially fossiliferous exposure that have never been prospected for their palaeontological content, there are tourist destinations where there may be thousands of person/visits to a particular area each year. Where the residence time of fossils is less than the frequency of visits, more fossils will be destroyed than available for examination. Where residence time of fossils is considerably greater than the frequency of visits, conspicuous fossils have a very high probability of being noticed. As a fossil destroyed is of no use to academia or any other potentially interested parties, we suggest that it is on these variables that best practice for maximising utility of fossil sites should be based. As these variables are likely to be

such that no two sites are identical, the application of inflexible 'one size fits all' codes of practice or laws are likely to be harmful to maximising use of fossil resources in more sites than they are beneficial. As a result, attempts to produce generic codes of conduct for fossil sites fail when (for example) indurated Palaeozoic and unconsolidated Cenozoic rocks are covered together (DJW Personal observation).

Maximisation of utility of exposures

As small and slowly eroding exposures of fossiliferous rock are most prone to damage, it is important that damage is minimised. Whilst sensitive sites of this type *could* be the most likely to be considered the preserve of directed research collecting, there may be cases where even this may be regarded as inappropriate, where the scientific gains are more than offset by the damage to the site and the reduction of the utility of the site to other interested parties at that time or in the future. As exposures become progressively more fragile and prone to damage, it becomes more important that maximum scientific outcomes are to be obtained for any damage caused. Collection that requires the removal of considerable quantities of rock, such as digging out a particular fossiliferous bed or excavation of a large vertebrate fossil, can be particularly destructive, not only in the damage caused to the exposure but also in the obscuring of other parts of the exposure by spoil. In these circumstances, care should be taken to remove the minimum amount of rock and try to prevent other parts of the exposure being obscured by spoil. In the case of large scale, and damaging, excavations, the onus should be on the collector to maximise the data from the excavated material. Matrix of large specimens, as well as spoil, should be considered as important resources and treated accordingly. Where the lithology allows, matrix and spoil should be thoroughly investigated for additional, small, fossils. In many cases this could be best done by passing unconsolidated or chemically treated sediment through appropriate sieves. This may yield large samples of smaller ("meso") fossils such as microvertebrates, small molluscs and disarticulated echinoderms. Smaller samples should be processed, where appropriate, for microfossils and can also be used for sedimentological study. Whilst less spectacular than the large, targeted specimen, these collections may prove to be more scientifically significant.

Microfossils and bulk sampling

As noted above, a large amount of important information from any site is in the form of very small specimens. These commonly yield large amounts of palaeontological data, and may be very species rich and thus are likely to add significantly to the importance of a site. As such, fossils are too small to be readily collected without specialist methods, all fossils of this type would ultimately be destroyed unless bulk sampling is used. As well as microfossils in the classically accepted sense, this includes what could be referred to as mesofossils; specimens too small to be readily collected individually in the field but too large to appear in meaningful numbers in microfossil residues. Collection of samples for microfossil processing typically causes very little damage to a site as the quantity of material is generally very small. There are probably relatively few sites where the integrity is likely to be damaged by microfossil sampling and so this should often be regarded as acceptable even when collection of larger specimens is not. Samples for mesofossils are typically larger, and may range from a few kilogrammes to well over a tonne. As these fossils are not readily seen in the field, removal of mesofossil-bearing rock may occur with little information as to the yield of the samples. Careful sampling will not harm the utility of the site for those interested in macrofossils as long as the sediment is removed in such a way as to not damage the integrity of the site itself. If mesofossils are disseminated through a rock and samples can be collected without influencing the appearance of the site, quite large samples can be extracted from even potentially vulnerable sites without lasting damage. If these fossils are concentrated in a particular targeted level, such as a thin shell or bone bed, then extraction of even a relatively small sample can adversely influence the utility of the site by cutting into a particular horizon, or generating quantities of spoil. Greater care must thus be taken in sampling these levels. It could therefore be considered that sampling for microfossils, and careful sampling for mesofossils, should be encouraged for a large proportion of sites as there may be very high scientific gain for little or no visible damage to the site.

Retention of specimens and data

The scientific utility of palaeontological specimens is only as good as the data associated with them. Without collection data a specimen has use as a taxonomic specimen, or for studies related directly to the morphology of the specimen, but there is little more applied study that can be performed. In contrast, a specimen with full collection data may be in addition used for study of the geological context (such as biostratigraphy and palaeoenvironmental analysis) as well as palaeobiological context (such as palaeoecology). This data is also essential in placing the taxonomic study into an evolutionary timeframe. Data should therefore be collected as fully as possible, and also stored in such a way that there is redundancy to cover data loss in the future. Full data

should ideally therefore be kept with the specimen, but also published alongside any description of the material to allow for the potential of loss from the museum. ***Publication of full field data, including precise stratigraphical and geographical information, thus not only insures reproducibility, an essential cornerstone of all science, but also acts as a data storage backup***. We consider that full disclosure of this data must be regarded as the default situation, and retention of some of this information only be considered in very exceptional cases.

Long term specimen storage is an essential part of care of palaeontological resources. Storage of specimens should ideally allow both ready access and long term safety. It has been argued (Besterman 2001) that fossils may be regarded as part of the heritage of a country or region, and as such there is also an argument for storage of specimens close to their site of collection. A more pragmatic, and probably scientifically valid, reason for retaining specimens close to their source is that it is far easier for researchers to be able to visit a locality and the fossils from it within a single trip. The preferred institution for storage may therefore have to be a compromise between locality, access and safety. As the primary scientific concern should be for the safekeeping of the specimen, safety of the specimen should be considered an overriding criterion if such a choice is possible. Even the best museums, however, may lack permanency. Whilst closure of public institutions should not place specimens at risk if contingencies for removal to another institution are in place, destruction of an institution and/or its contents are possible, as was the case for many European palaeontology collections during 1939-45, and archaeological collections in Iraq and Syria in the early 21st century. The 2018 destruction of the National Museum of Brazil in Rio de Janeiro by fire clearly demonstrated that war is not a prerequisite for destruction of entire museum collections. Smaller scale events such as minor fires or floods may also destroy specimens and/or the data associated with them. It should therefore be considered that, where duplicate specimens exist, some should be kept at a second institution, preferably in another country. Whilst this may directly contradict commonly held notions of sovereignty of heritage, it is suggested here that palaeontologists should place the wellbeing of specimens above geopolitical dogma. For example, the loss to science of palaeontological specimens in the National Museum of Brazil fire was made far worse by the absence of duplicate specimens within other museums elsewhere due to heritage laws preventing fossil export.

Case studies (see Fig. 2)

While the range of different parameters influencing the best practice exploitation of palaeontological sites are seemingly infinite, the situations at some well-known and classic sites provide a good range of case studies. The sites below vary in their rate of destruction, frequency of visit and access. In each case, criticisms can be made but also some best practice can be seen. Similar critiques of other sites can be seen in Edmonds *et al.* (2005). Several of the sites are in the UK, where what we consider to be good practice is widespread; it has been noted before that "a congenial and civilized working relationship still exists today in England [presumably referring to all of the UK] between commercial "professional" collectors and museum and university academics" (Larson and Russell 2014).

Active bulk rock quarries; Oued Zem phosphorite mines, Morocco.

The phosphorite deposits of northern Morocco comprise some of the largest reserves of sedimentary phosphate known, and form the basis for a vast industry in phosphate extraction and fertiliser manufacture. The phosphorites are highly condensed and range in age from Maastrichtian to Ypresian. While the majority of shelly fossils have been taphonomically lost, vertebrate fossils are exceptionally abundant and sometimes well preserved. Tetrapod remains comprise both isolated teeth and bones and partial to complete skeletons. Mosasaurs, crocodilians and chelonians dominate, but many other groups including pterosaurs, birds, mammals and dinosaurs are also known. Fish and shark remains are most commonly preserved as isolated teeth and bones, but some partial skeletons of both chondrichthyans and osteichthyans are known. At most stratigraphic levels, small teeth of sharks and rays are the dominant fossils, and may be present in the rock at frequencies of many tens of teeth per kilogramme.

The open cast quarrying of phosphate concentrates on levels which have little lithification (known locally as Couches), with intervening calcite-cemented horizons being largely stockpiled. Phosphorite is sent for milling and processing very soon after extraction. The vast tonnage of fossiliferous material extracted contrasts with the very small number of visits to the site by palaeontology researchers. The majority of visiting researchers are based outside Morocco, and historical agreements between the mining company (OCP) and a small number of research institutions has effectively prevented access to most workers from outside these agreement institutions. Whilst the current situation allows only a tiny proportion of sig-

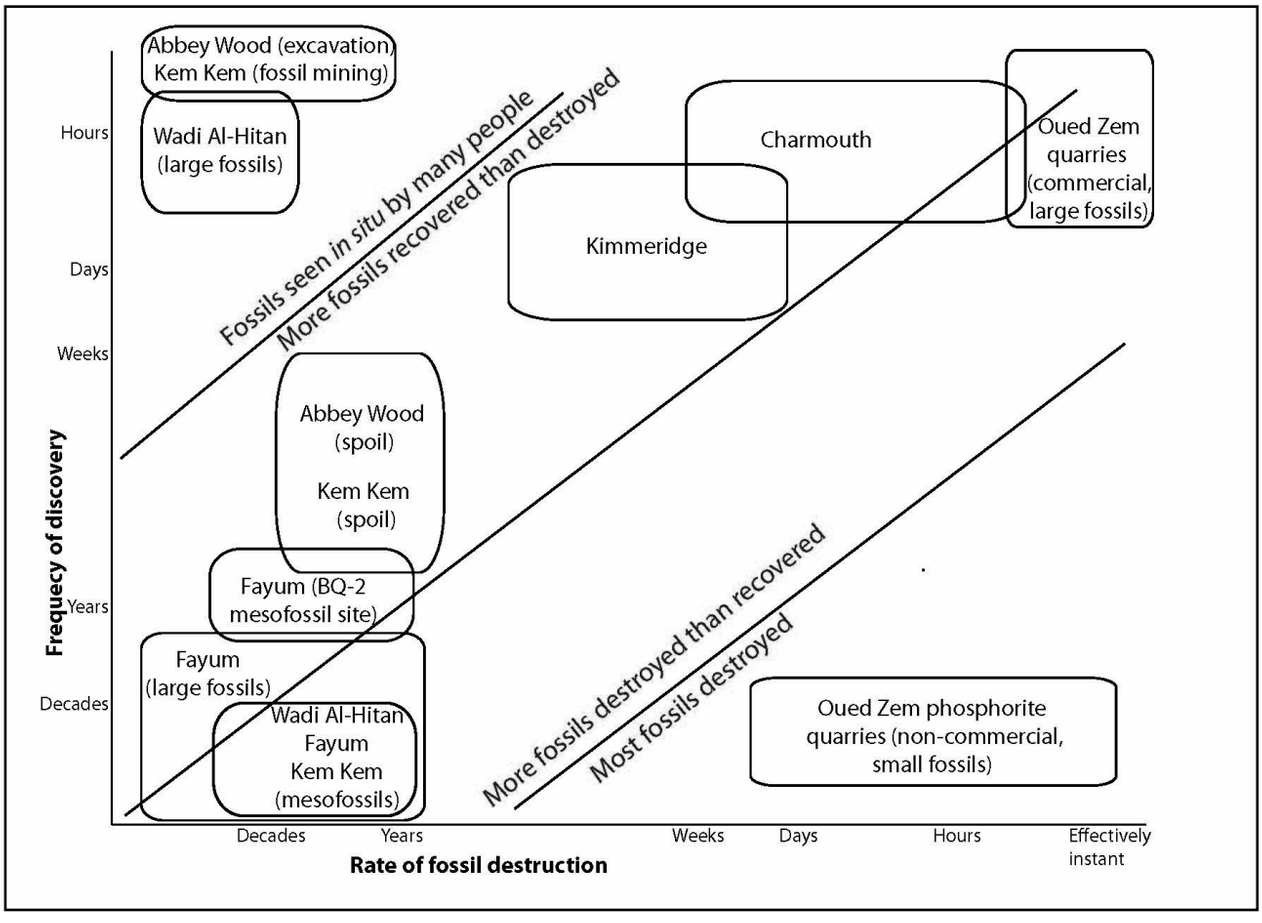

Figure 2. Plot of rates of fossil destruction and fossil discovery as in Figure 1, with case study sites superimposed. Note that only at Abbey Wood and Fayum site BQ-2 are mesofossils regularly sampled for.

nificant fossils exposed to be directly collected by researchers, a flourishing local market in fossils has allowed vast numbers of specimens to be made available through private enterprise and fossil shows around the world. It is these commercial routes that have been the source of the great majority of scientifically described tetrapod and large fish specimens, rather than through the cartel of French institutions.

Commercial exploitation focuses on fossils with a monetary value; tetrapod remains, especially skulls, are especially sought after, with some small scale adits being dug in disused parts of the mines to exploit mosasaur rich levels. There is also a large, and possibly larger, market in shark teeth, from both the Cretaceous and Paleogene. Where levels are suitable for dry sieving, sediment is passed through coarse (8-10mm mesh) sieves to recover lamniform shark teeth along with some ray, fish and tetrapod bones and teeth. The bulk of this material is initially sold by weight, later being graded and the most attractive specimens removed, many to be used in jewellery production. The teeth of *Otodus* are targeted due to their size, whilst teeth of the rare Paleocene genera *Palaeocarcharias* and *Notidanodon* are targeted for the collector market. A strongly lithified level at the base of the Eocene is discarded by the phosphate mining operation, but is especially rich in large *Otodus*, and so is manually broken up in the search for these teeth. In the process, this collecting has yielded a large proportion of the rare bird and even rarer mammal fossils known from the site.

There is no dedicated natural history museum in Morocco, and so specimens retained within the country have been deposited in a few university collections, the long term curation of which is uncertain. There is currently a museum owned by the OCP being developed to host fossils from the phosphorites, but again the long term status of such a private museum is open to question. The legal status of the fossils is somewhat vague and currently in a state of flux. The fossil industry clearly supports a large number of people in the otherwise impoverished area, and supplies vast numbers of fossils to researchers and enthusiasts alike. There are rules in place preventing the export of some significant specimens, but we have never been able to get these adequately explained. All shipments of fossils from Morocco are currently checked and signed off by the Ministry of Mines, and so in theory at least all specimens are legally exported as long as they are in a registered shipment. However, in 2016 a specimen of a plesiosaur offered for sale in Europe got a lot of

press interest both within and outside Morocco. This has led to calls for a change in the legal status of fossils, and meetings have been helpful to that end, but the outcomes are currently unknown. We strongly consider that any change in the law would be disastrous for palaeontology, both scientific and aesthetic, as well as the local economies of parts of Morocco, and would ultimately result in fossils that would otherwise have been collected being turned into fertiliser.

Slowly eroding remote inland cliffs; Kem Kem escarpment, Morocco.

Alongside the phosphorites, the most significant source of important vertebrate fossils from Morocco is the so-called 'Kem Kem Beds'. The Kem Kem Beds comprises fossiliferous fluvial sandstones of mid Cretaceous age (Albian-Cenomanian) that crop out beneath an escarpment along the north, east and south sides of the Tafilalt basin. The name Kem Kem refers to the southern hamada, but is generally used by palaeontologists to refer to the rock unit that is present there. While the outcrop is extremely extensive, relatively few sites are exposed due to landslips and rockfalls of the overlying Akrabou Formation limestones, with large areas inaccessible due to proximity with the Algerian border. The erosion rate is extremely slow, with rain being a rare occurrence and the overlying limestones forming a very resilient cap to the succession, protecting the softer sandstones and mudstones below. Fossils of fish, aquatic tetrapods and dinosaurs have been known from these rocks since 1938 (Choubert *et al.* 1952), but it is only in the 1990's that extensive commercial exploitation began. Some large fossils, generally of dinosaurs, have been collected by academic field parties from remote areas not easily accessed by local people (e.g. Sereno *et al.* 1996). It is probable that initial discoveries, both academic and commercial, were of specimens weathered out of rocks or preserved *in situ*, but these were quickly exhausted. From that point, the vast majority of fossils have been excavated by small scale mining. The majority of fossils are disarticulated and isolated bones and teeth, typically preserved within channel lag deposits. Mines are up to three metres vertically or 100 metres horizontally. They are unsupported and fatal accidents have occurred. Some mining operations, such as the commonly visited sites near Begaa in the south, target smaller and more robust dinosaur teeth and *Onchopristis* rostral denticles within coarse channel lags, with other fossils being a bonus. The majority of the fossils collected are thus of little scientific importance (as opposed to the smaller number of highly significant finds excavated alongside), but allow collectors of all ages and types to own some dramatic specimens without endangering more sensitive sites. It is from one of these mines that the supposedly associated bones of *Spinosaurus* (Ibrahim *et al.* 2014) originated. In all sites, more scientifically significant finds (as opposed to dinosaur teeth and *Onchopristis* denticles and indeterminate crocodile and turtle material) occur at very low frequencies, and it is very unlikely that these would justify the time and costs of a researcher-led excavation.

The Kem Kem area is frequently visited by academic researchers as well as geotourist and undergraduate groups, but most visits are brief, in part due to the remoteness of the area (two days of driving from any international airport). Whilst finds of large fossils were initially made, the small amounts of exposure within the more readily accessed eastern area suggest that these would soon have been removed, and not replaced by erosion, even if there had been no commercial collecting. The mining activity has been the source of virtually all of the fossils described in numerous publications from the site. In addition, the spoil of the mining operation is rich in commercially valueless fossils (due to size or preservation) and collecting these is a major attraction and resource for researchers (looking for small rarities), geotourists and student groups alike. Sieving of some spoil material (CJU and DJW personal observation) has yielded important specimens of hitherto unknown sharks, fish and tetrapods. Wholesale dealers in the area are generally very knowledgeable about the fossils and will actively seek out particular specimens on request if they are required for research.

The excavations of the Kem Kem are a dramatic boost to the local economy, both through fossil sales and through visitors attracted, in a very impoverished desert area. Sites that have been dug will not 'repair' through erosion for a considerable period of time, though seasonal heavy rains can erode rapidly. However, exposed sites are small whereas the area of outcrop is vast and so any damage is spatially very limited. Despite this, the scientific benefits of the fossil industry are vast, with many people benefiting in one way or another from the fossils being available on the open market and locally.

Coast with rapid erosion; Charmouth cliffs, Jurassic Coast World Heritage Site, UK.

The coastal cliffs of western Dorset, on the British South Coast, have become justifiably famous for their fossils over the centuries. It is from this area that Mary Anning collected fossils and became probably the most famous commercial fossil collector of all time. The combination of the diversity of geology, rich palaeontological heritage and coastal scenery of

this area earned it UNESCO World Heritage Site status in 2001. The Jurassic Coast World Heritage Site produces large numbers of important fossils and has been referred to as "the only World Heritage Site you can hit with a hammer" (Page 2006; the quote presented in a negative manner).

The lithologies, and rates of erosion of different parts of the Jurassic Coast vary dramatically, but the cliffs either side of the town of Charmouth represent the most rapidly eroding part of the Dorset coast. The cliffs are high and comprise Early Jurassic (Sinemurian-Pleinsbachian) mudstones capped by unconformable Cretaceous sandstones. Along this section of coast, foreshore exposures of mudstones are largely limited to brief periods of storm removal of beach sediment and exposures are largely limited to very low spring tides. Rapid erosion is caused by a combination of removal of soft mudstone by marine erosion, and landslides of higher horizons. Removal of fossiliferous rock thus occurs as direct erosion by waves at the cliff base and foreshore and of landslipped higher units at beach level before rapid erosion of the slipped material. In both cases, there is some concentration of fossils loose on the beach (especially dense, pyritic specimens) before their final destruction. Net erosion rates are high, but extremely episodic, with the majority of loss of cliff volume occurring during brief periods of extreme weather and large tides.

The beaches and cliff base are visited by very large numbers of people each year, but much of the potential loss of fossils occurs during autumn and winter storms when casual visitors/collectors are largely absent. Rescue and collection of significant fossils occurs largely during these times, when weather conditions are typically poor. It requires highly skilled and dedicated people to be on the beach collecting during these brief periods of rapid erosion. As a result, very few finds of larger fossils are made by casual collectors or academic palaeontologists, who lack the opportunity (or willingness) to be on the beach during extreme weather and tide events. Whilst many significant fossils are found by enthusiasts, the majority are recovered by professional, commercial, collectors. In the Charmouth area, commercial collectors are largely local and are therefore able to be on the beach at short notice, and also have developed the skills required to extract large fossils, such as vertebrate skeletons, very rapidly (typically within a single tide) and within extreme conditions. The area local to Charmouth supports several professional fossil collectors who make a significant proportion of their income from local fossils. Vertebrate skeletons are relatively rare and as such are not a reliable source of income, whereas ammonites are abundant and often spectacularly preserved in coloured calcite. Ammonites are clearly important, but the majority of commercially-collected specimens comprise a small number of species, most of which are well represented in museum collections and cannot be regarded as scientifically significant.

Upon establishment of World Heritage Site status, a system of recording of significant finds was established (Larwood 2001, 2007; Townley and Larwood 2012). This system provides a mechanism for all major finds to be recorded, and allows museums or other research organisations a chance to purchase commercially collected material. It has been stated (Page 2006) that many specimens were not recorded, but this was based on a comparison with an inland site yielding a rather different fauna and so these criticisms are best regarded as invalid (Sole 2007). Whilst there clearly is the potential for non-reporting of specimens, and uncertainty as to what constitutes a significant fossil, the system appears to work extremely well.

The Charmouth coast represents an example of a site that demonstrably benefits from uncontrolled, but recorded, fossil collecting. The scientifically important fauna only exists due to collecting, and the nature of the erosion of the site necessitates commercial as well as other forms of collecting. Indeed, despite the intense collecting that currently exists, the presence of water-worn fragments of large vertebrate bones on the beach suggests that despite this, skeletons are still lost to erosion.

Coast with moderate erosion; Kimmeridge Bay, Jurassic Coast World Heritage Site, UK.

Towards the eastern end of the Jurassic Coast World Heritage Site is Kimmeridge Bay. This area exposes mudstones and thin dolomitised limestones of Late Jurassic (Kimmeridgian and Tithonian) age. While the fauna of abundant ammonites, fish and marine reptiles is broadly similar to that of Charmouth, the nature of the exposures is rather different. The mudstones are hard and fissile, and are exposed in relatively low vertical cliffs and very extensive foreshore ledges. Erosion is far slower than at Charmouth, comprising both rockfalls from the cliffs and gradual marine erosion of the ledges. Erosion is also less episodic than at Charmouth, and large expanses of the foreshore ledges are only accessible on exceptionally low tides. It is often only after storms that the rock is not obscured by marine algae or beach sediment. Kimmeridge Bay is visited by large numbers of geologists as well as tourists, but palaeontology is

generally of secondary interest to geologists, with much research being focussed on the sedimentology of this important hydrocarbon source rock. Despite being frequently visited, Kimmeridge Bay is more remote than Charmouth, with no large towns nearby, so few people are on site to take advantage of new exposure as it becomes available. In addition, the preservation of ammonites as crushed and flattened films on the mudstone rather than three dimensional within nodules does not lend them to commercial collection. Consequently, commercial collecting has been very limited.

Reptiles have been recorded since the 19th Century (e.g. Hulke 1871, Mansel-Pleydell 1888) but these have generally been isolated finds. While occasional finds have continued (e.g. *Kimmerosaurus* Brown 1981), *in situ* fossils have been few in number and many of the vertebrate fossils from the region have comprised isolated loose large bones collected from the sea floor by scallop divers. This situation changed in the late 20th Century when a local collector, Mr Steve Etches, started to amass a large collection, including many previously unknown vertebrates, from Kimmeridge Bay and the surrounding area. Living close to the site and having ready access to exposures, a single dedicated collector was able to collect more significant fossils within three decades than the total diversity collected by all other people combined over the preceding 150 years. In 2016, a Heritage Lottery Fund funded museum, The Etches Collection, was opened in Kimmeridge Village to house the collection. This museum allows the fossils to be available for research and provides an important local source of tourist revenue as well as providing a local community hub. Whilst unfounded criticisms were previously raised about the unavailability of fossils in a private collection to research, it could be argued that having all of the specimens available in a single site now benefits the community and provides a learning resource local to the original fossil site. Given the particular circumstances of the site, we consider that the situation in Kimmeridge Bay could be regarded as a superb example of the benefits that a non-professional collector can provide, and the impact that a single dedicated person can have on palaeontology. A ban on fossil collecting would have prevented the Etches Collection from ever existing.

Very slowly ablating remote desert; Fayum, Egypt.

The fossiliferous parts of the Fayum area of Egypt, west of Cairo, cover a large area of stony desert to the north and west of Birket Qarun Lake. Rocks comprise shallow to marginal marine Late Eocene units overlain by fluvial Early Oligocene. The area is very arid and has virtually no vegetation or modern soil cover. The topography comprises small escarpments and large areas of intervening flat, bedding-parallel desert floor. Whilst some of the flat areas have exposure or near exposure, with rock below a veneer of desert sand, much has a more extensive cover of regolith, Holocene lake margin sediments and, in places, dune sand. Several archaeological sites are present in the eastern part of the region. Erosion is very slow, as evidenced by the good preservation of archaeological sites. Wind ablation is probably largely limited to areas close to Birket Qarun where dune sand is present. Erosion of higher parts of the area is probably largely restricted to physical weathering by heating and cooling, and rapid erosion during rare but violent precipitation events. Net destruction of rocks and fossils is consistently very slow. Fossil vertebrates have been known from both the Eocene and Oligocene units since the expedition of Schweinfurth in 1886, but study has been discontinuous and the remoteness of the area has necessitated that fieldwork take the form of extensive expeditions. There is robust legal protection for fossils in the area, with the legislation appearing to be a variant on the protection and conservation legislation that has been applied to archaeological material.

Early expeditions in the early 20th Century focussed on larger fossils, especially Oligocene mammals. A resurgence of interest in the latest 20th and earliest 21st Century has focussed more on Eocene cetaceans (mostly at Wadi el-Hitan; see below) and Eocene and Oligocene non-marine mammals, in particular primates (e.g. Simons 2008). Early exploration involved extensive surveys of the flat areas, with development of some particularly bone-rich quarries in addition to excavation of individual specimens. More recent study has involved less exploration, consisted largely of areas previously surveyed in the eastern parts of the region, and has concentrated more on development of particularly fossil-rich sites, with extensive use of sieving, such as at the well-known site BQ-2.

Although many fossils have been collected over the decades, vertebrate fossils are still abundant in the field. It is unclear which of these are specimens that have been seen previously and not collected, or have not previously been recognised. Some almost certainly fall in the former category; as an example a small cetacean skull is well exposed and conspicuous on a ledge on the top of the hill referred to as "Zeuglodonberg" by Dames (1894) (*Zeuglodon* being a generic name previously applied to many early cetaceans). Considering the large area of exposure in the Fayum and the relatively small number of

expeditions, it is probable that large proportions of the area have not been adequately surveyed, whilst the time since the initial expeditions will probably have allowed exposed fossils to have been destroyed and new ones to become exposed. In addition, there is no evidence that large areas at the western part of the area have even been systematically surveyed for fossils. Brief visits to this region revealed abundant cetacean and other vertebrate fossils within the Eocene parts of the succession (CJU and DJW personal observation).

The low frequency of exploration and slow rates of destruction of the rocks and fossils of the Fayum suggest that while many larger fossils have been discovered, others are likely to have been destroyed. Despite this, the very extensive exposure yields many fossils to interested researchers, and fossils may be regarded as an effectively unlimited resource. Within this setting, the small number of known non-marine microvertebrate sites may be regarded as sensitive sites of extensive interest. Even though fossils have strong legal protection, the full locality details of some of these sites, such as the famous mammal site BQ-2, have never been published, presumably to protect them from unauthorised collection. In contrast, marine microvertebrates are widespread in the Eocene parts of the succession (CJU and DJW personal observation) and have never been sampled to any extent. We therefore consider that the conservation status of the Fayum has allowed for extensive discoveries to have been made, and there is great potential for further discovery in poorly explored areas or amongst poorly known microvertebrate assemblages.

Despite the fact that the conservation criteria for this region are unlikely change in the future, there are changing impacts on the site that may influence its conservation. The completion of a road along the north side of Birket Qarun has allowed far easier access to the area. There has been a suggestion that major development was planned for the northwest shore of Birket Qarun. This would destroy exposures rich in fossils, including cetacean skeletons; rescue excavations would be needed, but this might require changes in the conservation laws. There have also been some cases of fossils being lost due to illegal activity. After political upheaval in 2010, illegal excavation of antiquities became widespread in Egypt. Whilst there is no evidence of illegal excavation of fossils, we know of at least one case of fossil destruction with a cetacean skeleton being destroyed when a pit was dug through it. A likely explanation is that palaeontologists were observed studying the skeleton and, thinking that archaeological material was the source of the interest, local people dug the site looking for antiquities, inadvertently destroying the skeleton.

Very slowly ablating accessible desert; Wadi-Al Hitan World Heritage Site, Egypt.

At the southwestern extremity of the Fayum is the UNESCO World Heritage Site of Wadi Al-Hitan. Originally far less accessible than the rest of the Fayum area, the extreme concentration of cetacean skeletons and other fossils, along with dramatic scenery, saw this site developed for tourism and an access road constructed. One reason that this protected status was requested was that a number of bones had been removed from skeletons by visitors (Gingerich pers. comm.) The area close to the access point has been developed with paths, and fossils are presented both in the open and within an on-site museum. The public area of the site is within shallow marine Eocene sandstones, but the north and north-eastern parts of the World Heritage Site fall outside the public area and have exposures of deeper marine facies and overlying marginal marine rocks. Within the public area, several partial cetacean skeletons are exposed either *in situ*, or on the desert surface, where they have been removed from rock by erosion. In addition, some specimens have been excavated and exhibited close to their site of discovery. The specimens on display in the public area are spectacular, but typically incomplete and/or poorly preserved examples of well-known species, and thus of relatively low scientific value. Some better preserved specimens have been excavated and studied, and are now present in a museum at the entrance to the public area. As in the rest of the Fayum, erosion rates are very low, and many of the specimens are strongly mineralised and resistant to damage. There are, however, exceptions; a rostrum of the sawfish *Pristis* beside one of the paths was relatively complete in 2008, but by 2012 had been reduced to weathered shards. There is also evidence that some damage may have been done by visitors; a rostrum of *Propristis*, which originally had rostral denticles (probably from elsewhere) placed alongside it, had none of these in 2009, they presumably having been stolen. Most of the larger specimens excavated from this area were removed before World Heritage Site status was given, but some specimens, now in the site museum, were collected after this time. In addition to large tetrapods, small and microvertebrates, especially shark and ray teeth, are well represented (Underwood *et al.* 2010). Some of these were collected in 2008-11 by both surface collecting and sieving, in each case aiming to collect away from paths. Outside the public area, large areas of exposure yield fossils ranging from microvertebrates to cetacean

and other tetrapod skeletons. Excavation of a number of the latter has taken place, but a large proportion have been logged and left *in situ*. It is evident that even in this region, some areas of exposure in the northeast remain to be surveyed in detail for large vertebrates, let alone smaller fossils.

Wadi Al-Hitan thus represents a site where visitor numbers have gone from very low to high with the influx of tourists (though current numbers have collapsed due to safety concerns). Fossils left *in situ* are of great educational benefit, whilst those removed have been able to be a focus of scientific study and are now also visible, even if as a result there are less fossils to be seen in the field. Outside the public area, there is still great potential for new finds, including cetaceans within the oldest parts of the succession, and non-marine vertebrates within the uppermost parts. Marine small and microvertebrates and some (typically non-aragonitic) invertebrates are abundant and diverse throughout the succession. The legal protection for fossils in Egypt is very much geared towards large fossils, where individual specimens can be documented. The legal protection status of small fossils, and particularly microvertebrates and other mesofossils is less clear, as a sieved residue of fossil-rich sand is collected in the field, rather than individual fossils.

Artificially-maintained inland site; Abbey Wood, UK.

The conservation of the palaeontological site at Abbey Wood, SE London, offers an example of how non-professional and academic palaeontologists, as well as the general public, can work together to maximise the utility of a small, sensitive site. The presence of shells and sharks' teeth coming out of rabbit burrows was first published by Whitaker (1872: 254). Following this discovery, the woodland was surveyed, with fossil collections being made in the 1920s by two local amateur naturalists F. J. Epps and St. J. Marriott (Marriott, 1925) and the significance of the site became apparent. The vertebrate fossils, mainly fish, were published by White (1931). Subsequent work at the site has yielded a considerable number of tetrapods, especially mammals.

The site at Abbey Wood comprises a small excavation where exposure is only available during temporary digs, with the site being backfilled for reasons of safety for the majority of the time, due to its position within a public park. The rocks comprise an unlithified shelly sandstone lens of basal Eocene age, containing very abundant fossils. It represents an estuarine facies which contains a unique biota, dominated by shallow water marine organisms with some transported terrestrial elements. The fauna is dominated by a very rich, but low diversity, assemblage of gastropods, bivalves and chondrichthyan teeth, and a number of holotypes of these groups have been sourced from this site (White, 1931; Frost in White, 1931; Wrigley in White, 1931; Stinton, 1965). In addition, there are examples of a number of other groups, with the remains of terrestrial mammals being of special interest and being the focus of a number of scientific papers. Since 1975 Abbey Wood has been a Site of Special Scientific Interest (SSSI) for its palaeontology (e.g. Cooper, 1932; Kühne, 1969, Walker and Moody 1974 and Hooker, 2010), but also sits within a woodland that is itself a botanical SSSI. The locality is in a well-used wood within the outskirts of London, which is itself heavily visited for recreation.

Prior to the 1970s, with permission of the park authorities, deep excavations into the shell bed were relatively uncontrolled. Once the site was designated as a geological SSSI, access to the *in situ* shell bed was regulated by Natural England and its predecessors. Excavation was only permitted for recognised organisations, generally museums, universities and geological societies. Currently the site remains unexposed for most of the year, but there are annual excavations undertaken by the Tertiary Research Group in collaboration with the Natural History Museum, London. Excavations require use of a mechanical digger, the costs of which are met by a combination of grants, TRG funds and by donations from private collectors. The fossil-bearing sediment is excavated and made available for sieving by those present. In general, non-professionals attending the excavations can keep all of the material they collect via sieving the shelly sands other than the rare tetrapod remains, which go to the Natural History Museum, London. All sediment has to be sieved down to a mesh size of 500 microns, so that small and significant mammal teeth are not accidentally discarded. As space is limited, the numbers sieving cannot exceed 40 people. The shell bed is wet sieved with the coarse fractions sorted in the field and the fine, generally less than 10mm, sorted at home. Researchers who have a legitimate need to see the deposit *in situ*, or wish to collect elements of the fauna, are directed by Natural England to contact the excavation organisers. Those who wish to study the material, but not necessarily collect it, are directed to the Natural History Museum, London, or the private collection of one of the regular collectors.

In addition to sieving on site, large amounts of sediment are removed for sieving elsewhere. This is dried and larger shells and pebbles are removed, along with any larger bones. Some of this (approxi-

mately 350 kg per year) is taken to the Lyme Regis Fossil Festival where it is used in a closely supervised sieving and fossil collection/identification exercise for children, who are similarly allowed to keep the (non-tetrapod) fossils that they find. During the rest of the year, large numbers of individuals and school parties visit the site and search the surface spoil left by recent and historical diggings to find shells and sharks' teeth. Over the 12 years until now, we estimate that about 6,500 childrens' sieving exercises have been performed at Lyme Regis fossil fair and elsewhere.

We therefore consider that this small and potentially very sensitive site has shown how thoughtful management has enabled a considerable range of people to benefit from the fossils present, and that by using material from this site for outreach, large quantities of material is searched for fossils, greatly increasing the probability of recovering rare and important specimens, most coming from bulk sampling for mesofossils.

Recommendations for best practice.

Fossils in the field, and the fossiliferous rocks within which they occur, are a valuable resource for many different interest groups, of which sadly only academic palaeontologists usually get considered when best practice is discussed. Consequently, whenever legal protection is given to fossils, it is commonly only with academic palaeontologists of the country in question in mind. Ultimately, this allows the construction of legal frameworks that are often at best inflexible as far as optimal utilisation of palaeontological resources are concerned, and at worst restrict more or even all interested parties from accessing fossils. The ultimate end point of many laws striving to protect fossils thus is that fossils are destroyed and are lost to not only science but all other interested parties.

We would like to suggest that the conservation and protection of palaeontological resources should include a far greater degree of pragmatism and take into account the rate of exposure and destruction of the rock and fossils, type and size of fossils present and the frequency of visits by interested parties. Whilst it is not expected that it would be possible to use these variables in constructing a legal framework or even rigid code of conduct, these should inform any decisions made. We consider that as long as an overriding principle that a fossil collected is more useful to someone than one destroyed is maintained, that fossils of scientific importance should be placed in the most appropriate museum(s), all data associated with a fossil should be made available to allow reproducibility of science and that no one should have the right to damage a site to render it unusable to other interested parties, little other detail should be needed in any code of practice.

Whilst we do not aim here, to challenge laws regarding fossils, we would suggest that some are unfit for purpose and ideally a more pragmatic approach could improve their utility. One regularly discussed example is the influence of laws covering Brazilian fossils, in particular in respect to the vertebrates from the Santana and Crato formations. Besterman (2001) argues that these laws should be adhered to; we do not deny this, only that the laws are unsuitable. Martill (2001) notes that at the time of writing that a ban on fossil export was frequently ignored and many fossils left the country, but, because these were illegal, they were tehnically not available for research. Subsequently, more stringent application of fossil export laws has stopped the excavation and trade in these fossils. This has dried up the supply of fossils, both common and rare, and we are unaware of any scientific papers based on specimens collected subsequent to these laws being rigorously applied. Thus, the application of laws has prevented rare and important fossils being discovered and all potential beneficiaries, including those in Brazil, have been denied potentially important material.

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References

BESTERMAN, T. 2001. Frontiers to science: Free trade and museum ethics. *The Geological Curator* **7** (6), 199-209.

BROWN, D. 1981. The English Upper Jurassic Plesiosauroidea (Reptilia) and a review of the phylogeny and classification of the Plesiosauria; *Bulletin of the British Museum (Natural History), Geology* **35**, 253-347.

CATALANI, J.A. 2014. Contributions by amateur palaeontologists in 21st Century paleontology. *Palaeontologica electronica* **17**, **2, 3E**

CHOUBERT, G., CLARIOND, L. and HINDERMEYER, J. 1952. Livret-guide de l'excursion C36 Anti-Atlas central et oriental. *Congres*

Geologique International, XIXe Session (Alger 1952), Serie: Maroc, **No. 11**. Rabat, 1-89.

W. DAMES. 1894. Über Zeuglodonten aus Aegypten und die Beziehungen der Archaeoceten zu den Übrigen Cetaceen. *Palaeontologische Abhandlungen* **1** (5), 189-221.

EDMONDS, R., LARWOOD, J. and WEIGHELL, A. 2005. Identifying sustainable management regimes for fossil collectingon palaeontological sites, 1-25. http://charmouth.org/chcc/images/pdf/Sustainable_fossil_collecting.pdf

HULKE, J.W.1871. Note on an *Ichthyosaurus* (*I. enthekiodon*) from Kimmeridge Bay, Dorset. *Quarterly Journal of the Geological Society* **27**, 440-441.

IBRAHIM, N., SERENO, P.C., DAL SASSO, C., MAGANUCO. S., FABBRI, M., MARTILL, D.M., ZOUHRI. S., MYHRVOLD, N. and IURINO, D.A. 2014. Semiaquatic adaptations in a giant predatory dinosaur. *Science*, Sep 26; **345 (6204)**,1613-6.

KÜHNE, W.G. 1969. A multituberculate from the Eocene of the London Basin. *Proceedings of the Geological Society of London*. **1658**, 199-202.

LARSON, N.L. 2001. Fossils for sale: is it good for science? *The Geological Curator* **7** (6) 219-222.

LARSON, P.L. and RUSSELL, D. 2014. The benefits of commercial fossil sales to 21st-century paleontology. *Palaeontologia electronica* **17, 1, 2E**.

LARWOOD, J.G. 2001. Commercial fossil trade: Good or bad for sites of special scientific interest. *The Geological Curator* **7** (6), 223-227.

LARWOOD, J.G. 2007. Politics and fossils in the UK - another view, Geoconservation report. International Subcommission on Jurassic Stratigraphy Newsletter 34, 33.

MANSEL-PLEYDELL, J.C. 1888. Fossil reptiles of Dorset. *Proceedings of the Dorset Natural History and Antiquarian Field Club* **9**, 1-40.

MARRIOTT, ST. JOHN 1925. *British Woodlands as illustrated by Lessness Abbey Woods*. London (George Routledge & Sons, Ltd), 72 pp.

MARTILL, D. 2001. The trade in Brazilian fossils: One palaeontologist's perspective. *The Geological Curator* **7** (6), 211-218.

NUDDS J. 2001. Ethics, Science and the trade: Let's get together. *The Geological Curator* **7** (6), 191-198.

PAGE, K. 2006. Geoconservation Working Group report. *International Subcommission on Jurassic Stratigraphy Newsletter* **33**, 21-25.

SERENO P.C., DUTHEIL D.B., IAROCHÈNE M., LARSSON H.C.E., LYON G.H., MAGWENE P.M., SIDOR C.A., VARRICCHIO, D.J. and WILSON J.A. 1996. Predatory dinosaurs from the Sahara and Late Cretaceous faunal differentiation. *Science* **272**, 986-991.

SHIMADA, K., CURRIE, P., SCOTT, E., and SUMIDA, S. 2014. The greatest challenge to 21st century paleontology: When commercialization of fossils threatens the science. *Paleontologia Electronica* **17, 1, 1E**.

SIMONS, E. 2008. Eocene and Oligocene mammals of the Fayum, Egypt. *In* FLEAGLE, J.G. and GILBERT, C.C. (eds.). *Elwyn Simons: A search for origns. Developments in primatology: Progress and Prospects*. Springer. 87-105.

SOLE, D. 2007 A hostile analysis of the West Dorset (UK) fossil collecting code - was it justified? Geoconservation report. *International Subcommission on Jurassic Stratigraphy Newsletter* **34**, 24-27.

SOLE, D. and ETCHES, S. 2005. Controls on the collecting of fossils. *International Subcommission on Jurassic Stratigraphy Newsletter* **32**, 20-21.

TOWNLEY, H. and LARWOOD, J. 2012. Managing geological specimen collecting: *Charmouth case study. Natural England Technical Information Note TIN114*. P1-4. www.naturalengland.org.uk

UNDERWOOD, C.J., WARD, D.J. and GUINOT, G. 2016. Development of understanding of the Mesozoic and Cenozoic chondrichthyan fossil record. *Arthur Smith Woodward: His Life and Influence on Modern Vertebrate Palaeontology*, in the Geological Society, London, Special Publications series. **430**, 155-164.

UNDERWOOD, C. J., WARD, D. J., KING,, C., SAMEH M. ANTAR , M., ZALMOUT, I. S. and GINGERICH, P. D. 2010. Shark and ray faunas in the Late Eocene of the Fayum, Egypt. *Proceedings of the Geologists' Association* **122**, 47-66.

WALKER, C.A. and MOODY, R.T.J. 1974. A new trionychid turtle from the Lower Eocene of Kent. *Palaeontology* **17**, 901-7.

WHITAKER, W. 1872. The Geology of the London Basin. Part I . The Chalk and the Eocene Beds of the southern and western tracts. *Memoirs of the Geological Survey U.K*. 4, 619 pp., 89 figs.

WHITE, E.I. 1931. The Vertebrate Fauna of the English Eocene: Volume I. From the Thanet Sands to the Basement Bed of the London Clay. London (Brit. Mus. (Nat. Hist))., 123 pp.

WRIGLEY, A. 1931. The Lower Eocene Mollusca of Abbey Wood and of High Halstow Kent. Appendix II, pp. 110-112, in WHITE, E. I., 1931, The Vertebrate Faunas of the English Eocene. Vol. I. From the Thanet Sands to the Basement Bed of the London Clay. London (Brit. Mus. (Nat. Hist))., 123 pp., 1 pl., 162 figs, 3 tables

PALAEONTOLOGICAL HERITAGE: WHY LEGISLATE FOR IT?

by Jalusa Prestes Abaide

Abaide, J.P. 2018. Palaeontological heritage: why legislate for it? *The Geological Curator* 10 (10): 633-639.

The current emergence of new legal situations arising from the arising of new rights which, in turn, bring new interpretations to the discussion of concepts and theories relating to ethical values that involve humans and a modern capitalist society. The legal relationship between the state and the property included in its field in the past have been easily identified. Today, as government intervention in the economy contracts, questions arise about the relevance of their essential presence in the administration of this estate. So, in the list of new rights, environmental law comes with its various nuances. Standards have been studied that involve environmental protection in an almost coded manner, and arise because of an individualized area of study. However, as it is necessarily involved in other areas of law, this must lead again to rethinking and revisiting for a new theory.

The enrichment of minorities to the detriment of the loss of public goods involves the loss of portions of national sovereignty and the citizenship of individuals. From the new Brazilian Constitutional Charter, whose state will be more vigilant compared to the assets that constitute their heritage, however, there is still no law regulating the updated protection and/or fossil trade, the consequences and reasons for which are explored. After consideration of the relevant legal articles pertaining to fossils, a classification scheme of fossils as public domain assets is proposed.

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Introduction

To begin with, it is important to clarify that this study includes the method of comparative law and the classical doctrine used in Brazil for matters of administrative law, whose juridical system is unique, unlike some European countries, such as Spain.

Conflicts involving the Administration are resolved by a Court or Tribunal common to all conflicts in which the State is involved, namely, the Brazilian Supreme Court (*Tribunal Superior Federal* - STF). This occurs mainly because the Brazilian Government is a federal republic, similar to the US model.

As previously mentioned (Abaide 2009), we are experiencing a historical period of new legal scenarios, which arise from the emergence of new rights. Such rights, in turn, bring new interpretations of concepts and theories to the discussion, such as those arising from the information technology with overlaps that affect fundamental rights and/or copyright; branching out of discussions on ethical values involving humans and modern society. All these matters are grounded in the law. The legal relationship of the State and the goods that are integrated as its domain used to be easily defined. Nowadays, the State intervention in the economy is shrinking, thus, the relevance of its indispensable participation in the Administration of its goods is being questioned. Moreover, the list of new rights includes environmental law with its various hues. The norms that comprise the protection of the environment have been studied in a practically codified manner. As a result of that, a new individual field of knowledge emerges. It is, however, important to point out that such a field of knowledge is embedded in other areas of law, which again leads to reconsidering and rethinking new theories.

This is the case with the cultural environment, especially when it comes to natural spaces protected for their value or cultural interest, which gives rise to new environmental goods, here referred to cultural interest, such as the works of nature used for contemplation or for scientific research. They become the subject of culture by nature or intrinsic value, as hills that make landscapes widely known, caves, some minerals, and fossils, our object of study; especially plant fossils, popularly known as petrified wood.

This is an extremely important topic, since it is necessarily considered to have an economic perspective, as a public domain good and/or underground wealth. And from a legal perspective, this type of research keeps gaining relevance, based on the prospect of the consequences that entail the non-regulation of the instruments of use and protection of such goods, along with the need to legally categorize them.

Small groups benefit from public property loss, jeopardizing state sovereignty and citizenship, which normally occurs when material or intangible wealth is not regulated by law. Based on the new Brazilian Constitution, the State shall be more attentive to the assets of its heritage. However, no updated law has been enacted to match the content of the new Constitution, which governs fossil protection and/or trade. We invite readers and researchers to find the reasons for such a situation through the reading of this paper.

Background

Since the beginning of the second Republic the Brazilian constitution has sought to subject cultural heritage to the special protection of the government, as shown in several schemes within the Brazilian Constitutions, namely: 1) Article 10, III, of the 1934 Constitution; 2) Art. 128 of the 1937 Constitution; Art. 4 of the 1946 Constitution; 4) Art. 172 sole paragraph of the 1967 Constitution; 5) Art. 180, sole paragraph, of the 1969 Constitutional Amendment No. 1. And, with 6) Art. 216 of the Brazilian Constitution of 1988, for the first time palaeontological sites were included in the list of assets comprising the (intangible?) Brazilian cultural heritage, *in verbis*:

> Title VIII - The Social Order, Section II, which addresses Culture:
>
> *Art. 216 - "Brazilian cultural heritage includes material and intangible goods, taken either individually or as a whole, that refer to the identity, action and memory of the various groups that form Brazilian society, including:"*
>
> .....
>
> *"V - urban complexes and sites with historical, landscape, artistic, archeological, palaeontological, ecological and scientific value".*

Here is a small theoretical approach so that the jurist can better understand the problem reflected in law:

Palaeontology (Foucault and Raoult 1985) has been referred to as the subject of Geology that studies fossils belonging to any of the Kingdoms, and the fossils discussed hereby predate the age of humans. However, they are often part of our current environment, and can thus be used as scientific instruments to determine paleoenvironments and transformations in the history of the Earth, as described by the Digne Declaration in 1991, which has acknowledged all the legacy or memory of planet Earth as an integral part of our cultural heritage. Fossils also serve to diagnose climate change[1] and to aid in the search for oil, among other things.

According to the UNESCO nomenclature for the fields of Science and Technology, Palaeontology does not constitute part of the "Earth and Space Sciences" (item 25), but is a sub-discipline of the Life Sciences, that is nonetheless more associated with Geology. For this reason, it is more commonly applied to the Earth Sciences than to the Life Sciences. The concept of fossils used by palaeontology as a field of the Life Sciences has a more historical rather than cultural application, in the context used up until now, that is, an anthropocentric conception, which is used by most legal systems. Hence, it should never be a commercial matter (although it may indirectly generate wealth through museum exhibitions, or other types of activities that may arise from legal administrative law instruments while drawing up a legal status).

Thus, the objects of palaeontological interest are useful to both Geology and Paleobiological research. In Paleobiology, research will focus on their cultural and historical aspect. But once taken as a matter of culture, in the anthropocentric conception, the legal definition of fossil becomes complex, because its double conceptual application by the Life Sciences or Earth Sciences entails a double legal definition.
Brazil, by constitutional force and through being a signatory of the Digne Declaration in France, has come to acknowledge palaeontology as part of the Brazilian cultural heritage. Therefore, it agrees with

[1] With strict scientific and legal criteria, they could perhaps be transformed and harnessed as new materials at a technological level.

the UNESCO nomenclature, which includes it in the list of the Life Sciences, making it a part of the works of art created by humans (and for this reason, it should lie under the management of the Brazilian Historic and Artistic Heritage Institute - Instituto do Patrimônio Histórico Artístico Nacional - IPHAN).

It should be noted that Decree 25/37 (Listing and Preservation Orders) could be applied to regulate this matter, but it would be more precise to have a heritage law that could objectively categorize fossils and/or palaeontological sites as legal properties under judicial supervision. The current law does not include new techniques for the use of modern instruments of administrative law (concessions, permits, expropriation, plans, catalogues, zoning) and if they could be established on a regulatory level, we would be able to know which fossils would be considered material or intangible goods. For instance; according to article 1 of the Law of Listing and Preservation Orders, considering the tenure an intangible component of the concept of culture , the concept of culture that the Brazilian Federal Constitution refers to, has an anthropocentric character, which excludes works of art built by nature. Wilhelm Dilthey, in his Psychology and Theory of Knowledge (Dilthey 1945, p.xx), says that "the nature is explained and the culture is understood". Abaide (2009, p.40) concludes that the fossil phenomenon is a natural fact that becomes cultural in the sense that the scientist recognizes it, possessing a social, cultural aspect independent of its intrinsic value, which in the case of fossils, comprises a whole physical-chemical process - in which case, this law suggests that this would be the component to include sites and / or fossils:

> *Art. 1 - The Brazilian cultural heritage includes material and intangible goods, taken either individually or as a whole, that refer to the identity, action and memory of the various groups that form Brazilian society, including archeological, ethnographic, bibliographic and artistic values. (emphasis added)*
>
> *Paragraph 1 - The assets referred to in this article shall only be considered as an integral part of the Brazilian historical and artistic heritage, after being individually or collectively added to one of the four books of Listing and Preservation Orders, referred to in art. 4 of this law.*
>
> *Paragraph 2 - Natural monuments, as well as sites and landscapes which are important to conserve and protect for remarkable features endowed by nature or organized by humans, are equal to the goods referred to in this article.*

The Law of Listing and Preservation Orders would require the expropriated land to be indemnified. That would lead to the question of whether the public authorities would be able to indemnify the entire area where fossils can be found (in the state of Rio Grande do Sul, for example, there is an area of approximately 800 km2 of such occurrences), or if a prior legal definition of fossil and/or palaeontological site would be necessary, in order for them to be protected by law (of cultural heritage?), under penalty of not receiving the protection the constitution had determined.

Another legal aspect regarding fossils that should be interpreted systematically is including them as the Union's assets. Chapter II of Title III, in article 20, of the Federal Constitution, lists the assets owned by the Union, but is unclear regarding the palaeontological heritage. Although it can be understood that they are the property of the Union under the terms of art. 20, I, IX and X, and, depending on which category they are framed under, more than one protection agency might get involved, as in verbis:

> *Art. 20 - The following constitute property of the Union:*
>
> *I - property presently belonging to it, **as well as that which may be granted to it**; (emphasis added);*
>
> .....
>
> *IX - **mineral resources, including those in the subsoil**; (emphasis added)*
>
> *X. natural subterranean cavities and archeological and pre-historic sites;*

The property of the Union is part of the public domain, and mineral resources including those in the subsoil also require environmental protection. Thus, it is possible to state that the palaeontological heritage can also be referred to as a mineral resource. Therefore, according to the UNESCO nomenclature, it can be considered a study object of the Earth Sciences, under the regime of the law of mines, and under the control and inspection of the Brazilian Department of Mineral Production (*Departamento Nacional de Produção Mineral* - DNPM, today called the National Mining Agency - ANM). This is in fact so consistent, that the mining code itself supports this concept when establishing the need to legislate in a special manner the "fossils destined to Museums ... or other scientific purposes."

> *Article 10 - Such will be governed by special laws:*
>
> .....

III - mineral specimens or fossils destined for Museums, Educational Institutions and other scientific purposes;

Furthermore, such a construction should be regulated by a special law that would resolve the issues of administrative competences between ANM and IPHAN, which would replace the current regulation (Decree-Law No. 4146/42). However, that would not exclude the recommendation of this matter having its own federal law.

Since 1942 a special law has been addressing fossil issues, and it is still applied by the Brazilian Federal Public Ministry (*Ministério Público Federal* - MPF), by the Judiciary and the legal prosecutor of the administrative bodies involved, since it has been approved by the Federal Constitution, registered as Decree- Law 4146 / 42, which deals with the protection of fossiliferous deposits, and which has not been included in environmental legislation, but this is a relevant matter to consider. Article 1. of Decree-Law No. 4146/42 provides that:

Article 1 - The fossiliferous deposits are owned by the Nation, and, as such, the extraction of fossil specimens depends on previous authorization and inspection by the Ministry of Agriculture's National Department of Mineral Production.

Sole paragraph - Exempt from this authorization and inspection are extractions from fossiliferous deposits made by national and state museums, and similar official establishments, in which case, prior notice must be given to the National Department of Mineral Production.

However, neither Decree Law 25/37 (Listing and Preservation) nor Decree-Law 4146 / 42 appear to be sufficient to acknowledge the public domain of fossils as cultural heritage, at least in the terms provided by art. 216 of the Federal Constitution. However, as property of the Union, established in item IX, that is, as mineral resource and subsoil wealth, fossils are part of the geological heritage and therefore applicable to Earth Sciences. This allows an understanding that the natural assets or wealth of the subsoil - fossils - may entail many other interests and destinations, in the cultural, scientific, environmental and/or economic contexts, if we take into account the new institutes of administrative law.

Fossils may rather be related to economic activity provided they are NOT COMMERCIAL. Since it is known that their production need not to be measured only by economic structural aspects, there are other economic factors that involve society, such as the cultural, historical, and natural factors that must be observed, even though they do not generate any income. When assessing economic production, social production as a whole must be taken into account, and not exclusively the elaboration and circulation of goods (Foucault and Raoult 1985, p.136) since not all assets generate economic wealth from the model set by the market, and there are *extra commercium* goods that also produce wealth (Abaide 2009). Although we could interpret fossils as a NON-COMMERCIAL wealth of underground nature, there is still the problem of protection lacking a special legal regime. Moreover, another relationship of fossils arises not only with the culture and/or the economy, but also with the environment, to the extent that the principles of economic activity shall harmonize with the social function of property, with the preservation of the environment and eco-development.

It is common knowledge that the public domain legal regime may affect fossils of public interest, such as those destined for museums, educational establishments and/or to be preserved by any other general interest, since the doctrine on the domain regime allows the application of the criterion of public interest beyond the criterion of destination and ownership of the property.

Based on the doctrine and comparative law, we can think of a criterion according to the "species" (plant fossils or petrified wood) and according to the "territory" (location, type of property), with the intention to use them for purposes of public interest. Protected fossils, according to species, could be destined for public use or purpose, based solely on their scientific or cultural value or interest. As for fossils protected by territory, these could be declared on the basis of spatial interest, because they arise in large numbers, such as the case of the Araripe fish and the *Araucaria* trunks in Rio Grande do Sul, where the attention overcomes that of scientific research, and could still be declared for urban, environmental or mineral reasons.

In Spain, the Catalan law for the protection of natural spaces of special attention allows for the inclusion of fossils. Thus, they are protected based on a territorial criterion: in such circumstances, the places where fossils are found are defined as zones or spaces of special interest. Back in Brazil, the form of protection of zones or spaces of special interest, if compared to the Catalan law that governs according to a territorial criterion, then so the zones of occurrence of fossils can be considered Conservation Units.

Proposals for more appropriate fossil-related legislation

Authorization for any palaeontological "extraction" should only be granted through a planning project, which should follow previously established norms and be subjected to the evaluation of an Interdisciplinary Scientific Committee (ICC), integrated with the national mining agency (ANM), the Historic and Artistic Heritage Institute (IPHAN), and the Brazilian Institute of the Environment (IBAMA).

Some fossils could still be "decommissioned"[2], these would intrinsically be integrated within the "nonrenewable natural resources" category, and the "environmental cultural good." The public domain nuance, originating from nature and multiple interests on fossil "goods", allows the protective norm to dispose of, using mechanisms that take into account their scientific aspect or interest by natural means, but also by mineral means (therefore, with economic non-commercial outcomes, see Abaide 2009, Chapter VI), possibly being characterized as "property or public-related good that does not have a designated use", the (public domain goods express an exorbitant regime of overprotection, occupying the 'res publica' of Roman law, assigned to public use or public service, however in the case of fossils this is not exclusive, because there is the possibility of decommissioning, and private use through permissions, licenses, concessions). Fossils defined as heritage (those considered as "residue") would go to free-trade, in particular for the purpose of boosting local tourism, but their release should impact on commercialization and/or industrial transformation; a criterion similar to that established in the "Denominations of origin" that assists in the economic development of the region in which they are found.

Based on the above and on the current legislation, we may infer briefly on a possible classification of fossils as public domain assets, based on some administrative law instruments:

The fossils that are made part of so-called palaeontological "sites" constitute some form of public good[3] which may be under the natural public domain (countryside) and/or under artificial public domain (urban area), available to the general public and/or for special use. Some could still be considered as heritage assets or part of the available heritage of the State, under the condition that they must be decommissioned and regulated, because fossils have multiple scientific applications, as previously demonstrated.

The Listing and Preservation law (decree-law 25/37) defines national historical and artistic heritage as "the set of movable and immovable property whose conservation is supported by public interest". When fossils are thought of as elements that are integrated within this heritage (under the terms of article 216 of the Federal Constitution), all concepts added to the legal precept must be examined more carefully, which leads to new inferences:

- Fossils that cannot be removed from the place they were found, for instance, because of deterioration risks, would be part of the natural public domain and would be considered immovable. The "site" where they remain deposited could be declared a "zone of interest affected by common use", i.e., a Conservation Unit, just as is the case with the Catalan law. They could also be managed by the Administration itself for special use, such as for Amusement Parks or Natural Monuments, with tourist objectives, for example, in which public Administration or private businesses could manage the forms of access (if under private ownership).
- Fossils that could be removed would be integrated within the artificial or natural public domain, and would be considered mobile. If they are moveable, they may also be in common use, such as special use, depending on their destination or attention.
- In the case of use by private businesses, they may be assigned to museums or educational institutions, in these cases they must have a license, authorization or permission to use part of the public domain. In the case of special use, the State may allocate them for private businesses but with restrictions on their provisional uses. (Abaide (2009, p.219) elaborates on a regime of protection

[2] 'Decommission' means withdrawing it from a destination conferred to the public good, transforming it into a public-domain good, by means of a law or administrative act.

[3] The Civil Code provides that:

Art. 99. Public goods are:

I - those used by the general public, such as rivers, seas, roads, streets, and public squares;

II - those of special use, such as buildings or lands destined to provide services or installations to the national, state, regional or city administration, including their entities; (emphasis added)

III - public-domain assets that entail the heritage of legal entities of public law, as personal law object, or real, of each of such entities.

Sole paragraph. If not otherwise stated by law, public-domain assets shall be considered as those belonging to legal entities of public law to which private law structure has been provided.

for fossils based on the administrative doctrine and the Brazilian legal system, which grants to the public property different forms of use: a) to the public domain itself, b) direct by the Administration, such as the reserves without a designated use; and (c) the use by individuals. Here the goods may be of common use, c.1) private, c.2) normal use, c.3) abnormal and c.4) patrimonial goods. Goods as a kind of public good, generally in common use, are governed by the principle of transience and provisionality, that is to say, not being able to be used by some, prevent them to be used by others, except in special cases of use by the Administration for the emerging public interest, which can also be classified as special use when integrating private museums. They may be destined for private use through authorizations, or concessions, and will rarely be integrated into the private domain of the State (see Abaide 2009, p.220). However, care must be taken so that no legal instrument is owned for common use, on the pretext of circumventing the legal regime of goods. Depending on the regime, there will be formal requirements, as Ruiz Ojeda warns when addressing the infrastructure and new rights arising therefrom (Ruiz Ojeda 1999).

- Fossils not allocated for a public purpose, of common use, or to a public service, would be part of the private domain of the State, that is to say, that they would be available heritage of the State. Decommissioned or heritage fossils would be those categorized by the "interdisciplinary scientific technical committee" as, for instance, "*residue*", *for not providing relevant information to science, to culture or to promote some kind of local or regional development*.

The State could, in fact, allocate these residual assets to third parties even if for commercial purposes under private law institutions (a controversial issue, see Abaide 2009, p.281), but yet for the common good; that is, by placing conditions on the exploitation or transformation (of the 'fossil residue'), by including some type of seal of authenticity of origin (see Abaide 2009, p.255), for example. However, the technical release for commercial use would not imply the release of the new owner from presentation for the Environmental Impact Study with the inclusion of the seal of authenticity. When any activity could imply damage to the environment, the seal would be a regulatory means of enhancing the development of the local area from where fossils were extracted.

Therefore, fossils would only be integrated into the State's available assets when: a) they did not meet the requirements that the State considered should exist for protection purposes, or b) when released by the technical committee[4], but this should entail decommission (the *Principle of Decommission* allows the private use of the property by private individuals, fossils that are considered restricted by the ICC can be integrated as private property for provisional uses including commercial purposes, see Abaide 2009, p.290). The exercise of the public-domain functions[5] would be under the jurisdiction of the Ministry of Mines and Energy and the Ministry of the Environment.

Conclusions

The systematic interpretation of articles 20, I, IX and X; Article 23, III, IV; and Article 216 of the Constitution, in accordance with Article 225, leads to the acknowledgment that fossils may be protected by the public domain and may be used by different holders, as long as it benefits the public.

The concept of acknowledging fossils as property of the Nation, under Decree-Law 4146/42, has been embraced by the Federal Constitution, by means of the mineral route; they were included among the properties of the Union, as well as mineral properties, by the interpretation of section IX of Article 20 of the Constitution of 1988 (as "mineral resources including underground"), although the possibility of creating a new category is not excluded - specifically for goods, as described in item I of this same art. 20. Thus, fossils would always be governed by the public domain in the case of protecting underground wealth (not necessarily commercial) or even an environmental good.

Not all fossils would be integrated within the Brazilian cultural heritage, but only those defined as movable or immovable property, containing information of palaeontological interest (i.e., scientific-cultural interest; fossils that interest the field of Geology would not follow this classification). Cultural heritage should include fossils registered by official agencies in charge. While not registered, in theory, fossils would not be protected under cultural her-

4 The technical committee should be composed of an interdisciplinary and interinstitutional group, from which specialized technical (CTCII) opinion can be heard, such as the arguments of the Administration involved, as well as directors of the Federal Administration, the culture, environment and mining agencies.

5 Ownership or Sovereignty - lands with no specific public destination. Examples: returned lands, abandoned buildings, useless mobile goods, etc.

itage, they would simply be part of the mineral wealth or subsoil assets that make up the Union's domain, which should be governed by special laws, the mining code and/or environmental laws.

There is a need to regulate the matter relating to palaeontological heritage. This need has been intimated at a level below the Constitution, by the Ministry of Mines and Energy (MME), as shown in Part III of Art. 10 of the law of mines. From 1988, this heritage is introduced into the Constitutional Content as part of the programmatic standard, requiring the ordinary legislator to order the matter or amend the Constitution to give the desired effectiveness of its constituents, because according to Hans Kelsen's Pure Theory of Law, "minimum efficiency is the condition for the validity of a norm" (Kelsen 1960). If it has no efficacy, the norm pragmatically does not exist.

The silence of the legislator or the "will to not legislate" can be translated as unlawful if it causes, even if indirectly, damage to property, for example, through piracy (copyright infringement) or unauthorized extraction. At a formal level, omissive conduct could also translate into unlawfulness by non-regulation of higher standards over a very long period of time. I understand that the ordinary legislator should not give up their regulatory power by transferring typical tasks to the administrative bodies, even when these bodies should also statutorily adjust to provisions of the federal law.

The normative void, or inactivity of the legislator, associated with little use of administrative police power, produces patrimonial damages, because they allow for the plundering of fossils, since they are part of the Brazilian cultural heritage. This fact involves financial liability that can lead to the unfair enrichment of the Administration, when, for example, they authorize mining concessions whose contract is silent to the occurrence of fossils.

The recent opinion No. 107/2010 / FM / PROGERE / DNPM shows that this authority follows striving to join efforts to address the gaps with respect to matters involving fossils, but there is still what we call "negative conflict of powers between the administrative agencies": that is, DNPM, IPHAN, and IBAMA seem to hesitate in jointly undertaking effective protection duties and regulating the palaeontological heritage.-.

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References

ABAIDE, Jalusa Prestes 2009. *Fósseis: Riqueza do Subsolo ou Bem Ambiental?* 2nd edition, Curitiba, ed. Juruá, 2009. 348 pg.

DILTHEY, W. 1945. Psicología y Teoría del conocimiento. México: E. Imaz, FCE, 1945

FOUCAULT, A.; RAOULT, J. F. 1985. *Dicionário de Geologia*. Barcelona. Massons. 1985. p. 136.

KELSEN, H. 1960. Reine Rechtslehre, Pure Theory of Law, 2nd edition, Verlag O¨sterreich. 900 pages.

RUIZ OJEDA, A. 1999. *Dominio Público y Financiación Privada de Infraestruturas y Equipamentos. Un Estudio del Caso Francés y Análisis Comparativo de la Reciente Regulación Española*. Prologue of Luiz MORELL OCAÑA. Barcelona, Marcial Pons. 1999, 150 p.

WHY PALAEONTOLOGISTS MUST BREAK THE LAW: A POLEMIC FROM AN APOLOGIST

by Dave Martill

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This essay, opinion piece - rant, even - is my personal protest about ill-conceived legislation enacted by national governments to 'protect' fossils (e.g. Germany, Brazil, Australia, Canada and China to name but a few). Legislation that renders fossil collecting illegal is not actually about protecting fossils because it rarely achieves this aim. What it does do is curtail people's freedom to collect and own fossils… surely a thoroughly harmless pastime. Such legislation also stifles the assembly of aesthetically appealing, and potentially scientifically important collections that, over time, become part of the fabric of our scientific and cultural heritage (e.g. the fabulous Etches collection on the UK's Jurassic Coast World Heritage Site (Williams 2017)), and it surely stifles scientific endeavour: the fewer fossils that come out of the ground, the fewer there are for palaeontologists to work on, or the public to admire (in museums or in their own collections). Fossils are not part of any nation's heritage, palaeontological or cultural while they remain undiscovered in the ground. As a jobbing palaeontologist I want fossil collecting to be a pastime enjoyed by all, and it will only do so if everyone is permitted to collect, not just a privileged few.

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Introduction

I must state at the beginning, I am absolutely not against protecting some sites, and making that protection secure in law. What I am utterly opposed to is legislation that (perhaps unwittingly) makes it illegal to pick up a single fossil, whoever you are. Fossil collecting (sometimes called fossiling, or fossicking even) has been going on for hundreds of years (more than 300 years for palaeontology collections in, for example, the Oxford University Museum, where fossils figured by Edward Lhuyd (1699) remain in the collection today). Collections have been assembled, privately I hasten to add, by the great and the good (Lord Enniskillen, Gideon Mantell to name but two of many) (see a detailed historical review by Evans (2010) on fossil reptiles for example). Blanket fossil legislation also pushes fossils 'underground' (from whence they came!). Fossils from Brazil, China and elsewhere remain freely available on the internet, despite legislation in those countries banning collecting. They are still often offered for sale on internet sites, sometimes with the added caption "from an old private collection", or are traded behind closed doors at larger fossil fairs, and of course, through private collectors and buyers operating independently as a dealer's client base. You cannot police fossil collecting... so why have a law you can't enforce? Note that many countries have failed to control the illegal market in marijuana and indeed have given up trying. Consequently, many nations have now legalised a trade in marijuana.

My experience of over thirty years in this profession suggests that readers of this essay will likely fall into one of two camps - those who enthusiastically agree with me, and those who will never agree with my sentiments and will express themselves quite vehemently in this regard. The former are usually fossil collectors and many academics and museum curators; the latter have been mainly academics. I suspect there may be some in between views too, but my experience is that opinions on this subject are usually highly polarised. Of course, some palaeontological sites are of immense significance and there is justification for trying to protect them within a legal framework, and I am a big supporter of controlled and considered protection for certain sites. And I absolutely see the logic of preserving sites where the integrity and amenity value would be destroyed if collecting were to occur. Dinosaur trackways in situ would be utterly ruined if a footprint or two were removed, and sadly such acts of vandalism occur, even when sites have "legal protection" (see www.walesonline.co.uk/

Figure 1. A very significant portion (>15%) of the K/Pg phosphate deposits of Morocco is composed of fossils. Presently, Morocco produces annually 10 million tonnes of fertiliser, signifying a minimum of 1.5 million tonnes of destroyed fossils - mostly vertebrates. This figure does not take into consideration fossils in the overburden layers.

news/wales-news/fossils-dinosaur-footprints-stolen-south-2083167 for a site in Wales where Triassic dinosaur footprints were removed). And here I reiterate my earlier point about the law: if it is not enforceable, it surely does not exist (Abaide 2018). Prosecutions are always after the event, and by then the damage has been done. It seems to me, that unless we massively increase the size of the police force, there is little that can be done to deter the sort of people who do this. But blanket bans on fossil collecting are not a deterrent. There are huge penalties and even gaol sentences for egg thieves in the United Kingdom, but still the law does not deter the most hardened of collectors.

I should be careful about mixing some related issues. One is that of commercial fossil dealing, with some dealers buying and selling fossils, often adding value by carefully preparing fossils to an extremely high standard, or (shock, horror!) polishing them to look extremely attractive, but rendering them spoiled in some people's minds (not mine though... I bought my mum a lovely and very kitsch soap dish created from a polished goniatite). Another is the right to be able to collect fossils for one's own enjoyment, let's call it hobby collecting (like many people did with birds' eggs or butterflies just half a century ago), a wonderful pastime (the fossil collecting, that is, and not the stealing of birds' eggs or the killing of beautiful butterflies) that puts you in often spectacularly scenic places with the added thrill of discovery, and connects you with the natural world (arguably egg collecting and butterfly collecting may have been many a naturalists' start). There is another category… the person who, perhaps walking their dog on the beach, sees a stone with a pretty pattern on it or, as in the case of two children (independently, and both aged 7) on the Isle of Wight, who each found a new species of pterosaur (see Steel *et al.* 2005, Naish *et al.* 2013). Up they pick it and march off to the local museum for an identification. So much wonderful material finds its way into museum collections along this well-trodden path, and long may it continue. Signs on beaches saying 'no fossil collecting' are not conducive to this. Then there are the research and professional palaeontologists. Such folk need fossils as the raw data to answer all sorts of fascinating questions from 'what is the biggest dinosaur?' to 'how fast does morphological evolution proceed?' as well as 'how old is this rock, and will there be some oil or gas in it for my multi-national to make billions of petrodollars?'. Basin analysis is utterly dependent on palaeontology for high precision biostratigraphy. So, if you have a blanket ban on fossil collecting, to whom does it apply? And should a multi-national oil company have any more right to obtain a licence to collect fossils than a commercial fossil collector, scientist or hobbyist? Should a quarrying company have an automatic right to destroy a hundred, a thousand, a million or even billions of fossils annually (ichthyosaurs in the Jurassic Posidonia Shale are destroyed by the hundreds as they are crushed for cement manufacture; shark teeth in the Moroccan phosphates (Figure 1) are destroyed by the millions daily to fertilise the planet's agriculture) As the blasting and bulldozing of stunning fossil Lagerstätte continues unabated, hobbyists are excluded from collecting, and scientists are compelled to fill in endless forms to obtain a licence to do something that their predecessors did freely.

To put all this destruction, natural or man-made, into perspective, today, and every day forever, the tide will come in, and a few million fossils will be destroyed around the World by marine erosion, especially where storms are in full spate. In spring and summer, as the rising sunshine warms frozen ground at high latitudes, many more millions of frost-shattered fossils will crumble to dust, while deep in the Sahara Desert the hot sand continues to blast away at the myriad of fossils protruding temporarily from exposed strata, polishing them to oblivion. The relentless mining of ever-dwindling mineral resources destroys fossils by the millions of tonnes

(and I suspect my estimates are very conservative), dynamiting them to pieces and crushing them to fine powder. All this destruction, both natural and man-made, is on a colossal scale, and nobody bats an eyelid. Fossil collectors intercept these destructive processes and discover amazing things about the history of life on Earth as a consequence. And what is great about this, is that you do not need a university education to do it or a government licence, at least not in the United Kingdom. Anyone, of almost any age and any persuasion can collect fossils. It is utterly egalitarian.

And yet, consider the events when, with colleagues, I recently described a fossil snake with four legs (Martill *et al.* 2015) (Figure 2) (http://www.nature.com/news/four-legged-fossil-snake-is-a-world-first-1.18050). This remarkable fossil named *Tetrapodophis* came from Brazil, where it has been illegal to collect fossils without permission since 1942 (Carvalhao 1993). Some have claimed that the specimen was illegally obtained and exported - who can tell? Apparently, it came from 'an old private collection' and was permanently deposited in Museum Solnhofen, in Germany, where I 'discovered' it on exhibition. The specimen's matrix matches that of Brazil's Crato Formation perfectly, and I have no reason to believe that the little fossil snake came from anywhere other than Brazil.

Some Brazilian palaeontologists would have the fossil returned. What a good job it was not returned to Brazil's Museu Histórico Nacional in Rio de Janeiro, where it would now be a pile of ashes. Some say it should not have been described, and some say there should have been a Brazilian scientist on the paper. I asked a Brazilian colleague what she would feel like if I had invited her on the paper just for being Brazilian. To say that she was not impressed is putting it mildly. To the best of my knowledge, it is not illegal to describe a fossil, collected legally or illegally (although perhaps handling stolen goods could be invoked if you were to pass it to a third party) nor unethical (Who gets hurt?), nor immoral (thou shalt not describe fossils). Indeed, the illegal *Tyrannosaurus* smuggled from Mongolia and auctioned in a famous New York auction house was *described* in considerable detail in newspapers and on websites by many an eager journalist (see BBC News web site at: https://www.bbc.co.uk/news/world-asia-22431009

Often laws banning fossil-collecting are ill-conceived and counterproductive for palaeontology. When so many fossils are destroyed by natural processes and mining activities, our profession should be encouraging as many people as possible to collect, and thus rescue from imminent destruction, as many fossils as possible. Better to lose some contextual data than to lose the fossil completely. A point that is sometimes raised, is that of a fossil belonging to Brazil, or Canada or wherever. Well, yes, I guess *Tetrapodophis* was a very tiny part of Brazil's territory. Suppose for a moment that the *Tetrapodophis* fossil was collected illegally, and even more illegally sold to a dealer, and criminally, smuggled abroad. What a good job it was. Because without that illegal trade making the fossil worth a few dollars, the fossil would not have been sold to a dealer, and the dealer would not have exported it to Europe or the United States or Japan and what is much more likely (as I have seen happen) is that it would have attracted no attention at all, and been tossed on the stone quarry spoil dump. The market meant that the fossil was collected, and it ended up being seen by a palaeontologist who recognised that it might have some significance.

Some countries have laws protecting their fossil heritage so draconian that no one dares to collect fossils. Such laws are almost always blanket bans, as with Brazil, Italy and China. In Brazil, collectors may face

Figure 2. **Tetrapodophis.** ***A four-legged snake from the Early Cretaceous Crato Formation of Brazil. Some have suggested that this fossil was smuggled from Brazil. If that is the case, then thank goodness, because otherwise it may well have been thrown on a spoil dump as it had no commercial value as a flawed piece of stone. If there is no commercial value for a Crato Fm. fossil the quarry workers simply discard them. Had it been deposited in the National Museum of Natural History in Rio, it would now be reduced to ashes.***

20 years in gaol. Two years ago, well-known Brazilian palaeontologist Alexander Kellner, along with French colleagues were put in gaol just for possessing fossils in Brazil. They had not even removed them from the country, and in any case, they were (are) palaeontologists simply doing what palaeontologists do (see: https://www1.folha.uol.com.br/internacional/en/scienceandhealth/2013/12/1389325-accused-of-international-trafficking-paleontologist-wants-us-420000-from-brazilian-government.shtml

See also: http://g1.globo.com/rio-de-janeiro/noticia/2015/12/pesquisador-do-rio-preso-com-fossil-no-ce-devera-ser-indenizado.html)

Professional palaeontologists, hobbyists, and indeed the general public should not have to risk a gaol sentence simply for picking up a fossil. Fortunately sense prevailed, the imprisoned palaeontologists were released the following day, and the arresting agency was found to have overstepped its remit.

There are billions of fossils of no value - scientific, commercial or otherwise. Why protect these? Surely, palaeontologists only need to protect very pretty (spectacular perhaps) fossils or scientifically very important fossils (who assesses that?). And we cannot know these things about a fossil until it is out of the ground, prepared and studied. Certainly, no nation should protect all of its fossils: what is the point?

Returning to a point I touched on earlier, I am never quite sure of the aims of legislation for protecting fossils. Is it to protect them for scientists to study? Because, if so, these laws actually add tremendously to the bureaucracy of pursuing our science. And there is no point in protecting fossils unless you are going to make huge sums of money available for scientists to both collect *and* then study them. Perhaps legislators are lacking in imagination. Could it be that laws are enacted that require fossil collections to be donated to the state on the death of the collector? Make the collector a steward rather than an owner?

How does any palaeontologist know that a fossil was collected legally? Is the museum register date really the year that a fossil left Brazil, Morocco, China or Italy? Could all of the thousands of Brazilian fossils in museum collections all over Europe, the USA (especially the American Museum of Natural History in New York who have one of the finest collections of Santana Formation fossils in the World)), Japan and the Middle East, be illegal? Should palaeontologists not study any of these specimens until this question can be answered by the curatorial team? Should researchers ask if each specimen among extensive collections was obtained legally, and can curators even hope to know? The laws protecting fossils in Brazil were, apparently, conceived as far back as 1942 (see Carvalhao 1993). Most Japanese and German museum collections were acquired after that date.

I find it odd that, when in the hands of ordinary people, fossils become contraband, but in the ground, being destroyed by weathering or mining machinery, they seem to be of no concern to anyone. In many countries, the UK included, any civil engineering project has to have an archaeological survey before the ground is broken. Only in Switzerland is this done for palaeontology.

For many years, Brazilians in rural Ceará State could earn a living digging for fossils from the famous Santana Formation Fossil Lagerstätte. This rich deposit yields fossil fishes by the millions. In former times they were sold in boutiques and gem shops in Rio de Janeiro. The Ipanema Sunday market was a great place to obtain specimens of extremely high quality in the 1980s. Today, nobody dares sell a fossil in Ipanema for fear of arrest. And few dare dig for them, so now these fossils stay in the ground until they are quarried to destruction. The legislation is deterring fossil collecting and fossil trading.

The law banning fossil collecting that is now strictly implemented (see the URLs listed above) has affected scientific palaeontological output. As fossil diggers mined fishes for bread and butter income, they discovered real rarities. Among these were pterosaurs and dinosaurs, often fully-articulated and preserved in 3D, that spawned a new wave of palaeobiological research, especially on pterosaurs (see Kellner and Campos 2002, 2007). The source of these wonderful specimens has now almost dried up, and many destroyed in the fire that engulfed the National Museum.

In the 1980s, stone-quarrying began in a finely layered limestone stratum beneath the Early Cretaceous Santana Formation. Called the Crato Formation (source of *Tetrapodophis*), this is also rich in exceptionally well-preserved fossils: huge numbers of fossil insects, but also fishes, pterosaurs, turtles and, of course, the small, four-legged snake (Figure 2). I visited often in the 1980s and 1990s, and saw that quarrymen levering up the slabs find fossils continuously, as do the stone masons in the cutting yards. They would put them to one side to sell on to dealers, a small increment to their meagre wages. These fossils now stay in the ground, or are even thrown away, dis-

Figure 3. In this quarry near Ipubi, Ceará State, Brazil, the Santana Formation Fossil Lagerstätte with its fossil-bearing nodules is removed to expose the valuable gypsum beds of the Ipubi Formation. The fossiliferous nodules are simply thrown on to the spoil dumps. No one makes any effort to collect them.

carded as valueless, or simply too hot to handle (Martill *et al.* 2007).

I also visited mines where thick beds of gypsum are quarried on a massive scale (Figure 3). The entire Santana Formation stratigraphy was stripped off as overburden, along with millions of fossils in nodules within it. A mining company can destroy all the fossils it wants to, but a scientist without a licence cannot pick up even a broken fossil from the company's spoil dump.

A permissive society

Contrast this with the United Kingdom, where no national law protects fossils (except at specific sites). Anyone can collect with a landowner's permission. A small army of collectors garner bits and pieces from

Figure 4. On the left, Mary Anning, a poverty-stricken fossilist desperately trying to make a living through the illegal 21st century act of selling fossils, is looked down on by her alter ego, Mary Anning, regarded as the inspirational heroine for 21st century palaeontology and for women's contribution to science.

beach, field and quarry. Courtesy of commercial, amateur, academic or casual collectors, UK museums are filled with palaeontological treasures as a result of this permissiveness. It has served palaeontology well.

This collecting, and fossil dealing too, has a long and well-documented history in the United Kingdom. Famously, the fossilist Mary Anning collected from the cliffs of Dorset (Figure 4). Her fossiling grounds are now the World Heritage Jurassic Coast, and her specimens have become icons of the history of palaeontology, and a source of much palaeontological detective work (Massare and Lomax 2014).

The Surrey fish-eating dinosaur *Baryonyx* was found by an amateur collector, William Walker in 1983 (Charig and Milner 1986, 1997). This exciting discovery became a 'Rosetta Stone' for understanding the enigmatic theropod genus *Spinosaurus*, so thoroughly destroyed by Allied bombing in World War Two. The earliest European tetrapods were found in Scotland by commercial fossil hunter Mr Stan Woods of Edinburgh, who, incidentally, used part of his ill-gotten gains to fund students of vertebrate palaeontology to attend the SVPCA meetings around the UK, and still does via a legacy to the Jones Fenleigh fund, and through a posthumous recurrent research grant from the Palaeontological Association. In Dorset, the 30-years-in-the-making collection built up by 'amateur' palaeontologist Mr Steve Etches MBE received more than £3 million in Heritage Lottery funding allowing it to be housed in the UK's first purpose-built fossil museum. The Steve Etches Collection now available for scientific research is open to the public and extremely popular. The Palaeontological Association of London, ostensibly the professional body for palaeontology in the UK even awards an annual prize to amateur collectors. Would it not be a shame if legislation prevented such people from collecting?

From dinosaurs to pterodactyls to ammonites, fossils found by amateurs, casual collectors and commercial dealers are brought to the attention of UK museums and scientists, almost on a daily basis (ask any museum curator). Some collectors donate their fossils, some want to keep them, and a few will want to know their value and sell them. Palaeontology can cope with all of these attitudes.

Palaeontology needs collectors -- lots of them. So, Brazil, China, Italy, Spain *et al.*, liberalise or repeal your fossil laws, encourage fossil collecting and offer incentives for people to donate to your state collections. Give medals, give tax breaks, give cash rewards. Do deals with commercial collectors on important sites. You will expand your collections - and you may even collect some taxes too.

Some examples

Canada and the ivory ban

While CITES bans the sale and export of all ivory, the price for contraband ivory has gone through the roof. So much so, that it is well worth the risk of shooting elephants, as the financial rewards are life-changing. It is not difficult to see why CITES bans the trade, as the aim is to preserve a rare and endangered species (or three), and so the sentiment is supported. But the action has had the reverse effect, and now elephants are in even more danger of extinction than ever before. It would have been much better to allow ivory to be traded and then it might be farmed… like crocodiles are in Florida or Thailand.

I am guessing that a similar sentiment was employed by the Canadian Government in protecting its palaeontological heritage. As far as I can tell, fossil collecting and fossil export is illegal in Canada (Canadians, do please correct me if I am wrong). Canada has one of the most spectacular fossil deposits of Cambrian age anywhere in the World: the Burgess Shale (I exclude China here… which seems to have the best fossil sites of pretty well everything palaeontological). With its exceptional soft-bodied biota the Burgess Shale is protected night and day by armed (yes, armed) wardens. Licences to collect are issued only to a few lucky researchers, and these licences are extremely restrictive. So much so that a Portsmouth PhD student working on the Burgess Shale taphonomy was not licenced to pick up fossils, only rock samples. She saw hundreds of trilobites in the scree, all weathering away, and was not allowed to rescue any of them. Her bags were checked by the rangers to make sure no illicit fossils were hiding among her rock samples. This approach is not conservation of a dwindling resource, it is just plain stupidity. Another approach would be to mine the Burgess Shale and treat it as any other minable commodity. Get the fossils out of the ground, record the horizon and sell them to any number of institutions. What great teaching resources the more common fossils would be, and what a great number of discoveries would be made if there were some serious mining going on. Canadians would do well to learn from the Moroccan fossil diggers of the Atlas Mountains and the Tafilalt. These guys dig every day, and turn up some amazing things... and much faster than a bunch of peely-wally academics can dig. In the Ordovician Fezouata Konservat-Lagerstätte of southern Morocco the commercial diggers have revealed a biota better preserved and more diverse than the Burgess Shale in a fraction of the time it has taken to

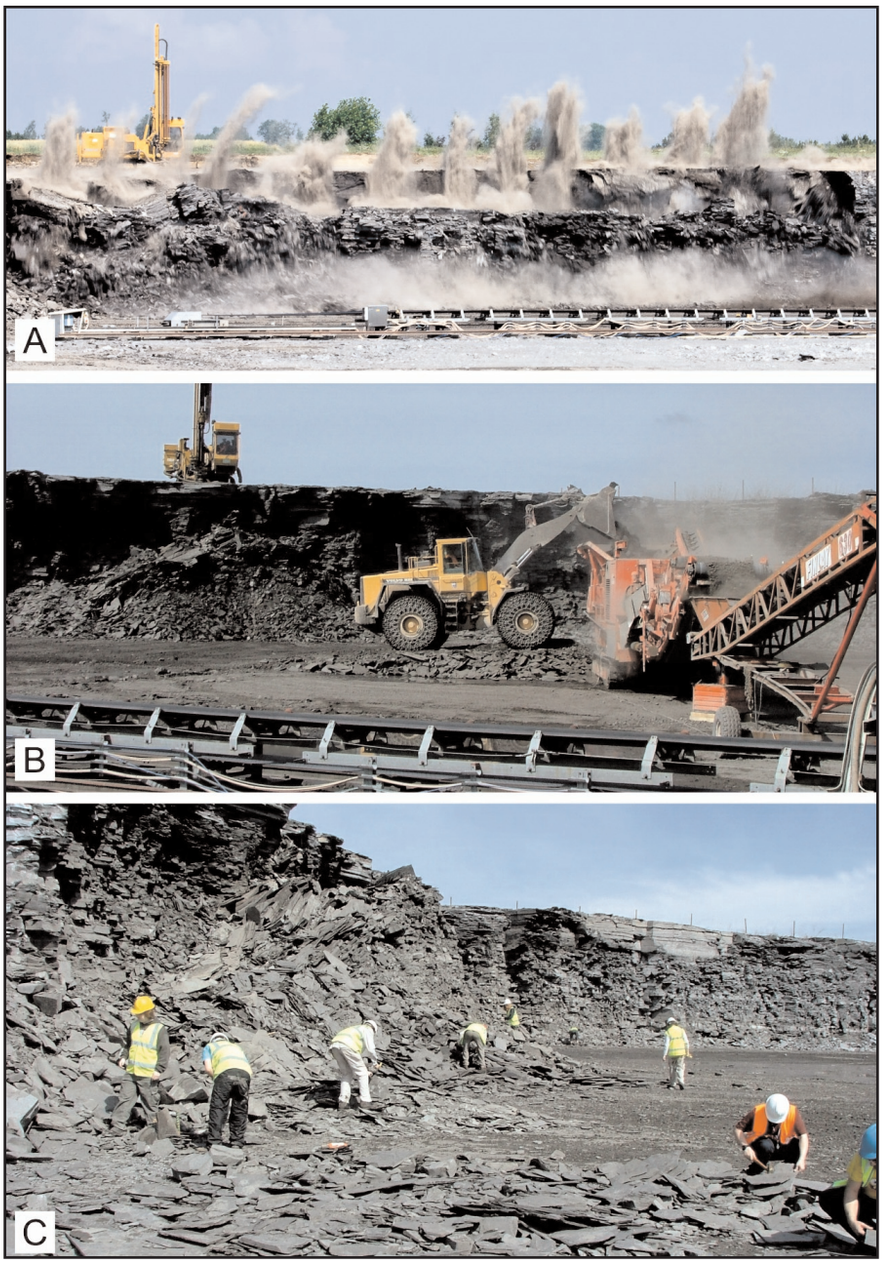

Fig. 5. A quarry in the Lower Jurassic Posidonia Shale of Germany. A, the man pressing the detonator is not breaking the law, although he is destroying several ichthyosaurs in this blast. B, the man shovelling the shale into the crusher is making sure that the ichthyosaurs are crushed into little pieces. He is not breaking the law either. C, my palaeontology students here are breaking the law by collecting fossils to rescue them before they go into the crusher. But at least they are all wearing hard hats (though the pillock to the left is under an overhang I now notice. oi! get away from the quarry face NOW).

investigate the Burgess Shale (Van Roy *et al.* 2010). They dig continually, but will never exhaust the deposit. These fossils can be bought at reasonable as well as ridiculous prices, and plenty of academic palaeontologists have done so. The literature now blossoms with stunning Fezouata fossils (check out the amazing filter-feeding anomolacarid *Aegirocassis* described by Van Roy *et al.* (2015)).

The most recent Burgess Shale fossil I found for sale on line (20th May 2017) was a 2.5 cm (1 inch) long example of *Leanchoilia superlata* for the bargain price of US $3650.00. Why not mine these little shrimps and put some tax revenue into the government's dwindling coffers? They could be used to fund scholarships in palaeontology. Every *Leanchoilia* that weathers away on the Canadian scree slopes is money down the drain and, importantly, another fossil lost too.

Don't collect the fossils. I did, but I think I got away with it (well, at least this year [2018]).

For the last 25 years I have been visiting German fossil localities, initially as a student of (the wonderful) Leicester University Geology Department, and also as a researcher with German colleagues in Karlsruhe and Solnhofen, and more recently as leader of Portsmouth University and various geological society field trips. I start the tour in the World Heritage site of Grube Messel (Eocene), pop into quarries in the Posidonia Shale (Early Jurassic), and then descend (ascend stratigraphically) into the Solnhofen and Mornsheim plattenkalk quarries (Late Jurassic) of the Altmühltal. What fun we have, collecting ichthyosaurs in the Posidonia Shale rescued from quarry blasts at the Dotternhausen cementworks (an enlightened cementworks that takes its palaeontology seriously - they have a fossil museum and a collecting area for schoolchildren). We (my students and I) have discovered all manner of Solnhofen fossils, many of which are now in the teaching collection at Portsmouth, where they are employed to demonstrate exceptional preservation. At Grube Messel we have discovered birds with feathers, and a pair of turtles on the job - pure palaeopornography. The Messel fossils were (instantly) passed over to the Darmstadt Museum as Messel is a World Heritage site with a very active research programme by Senckenberg and Darmstadt teams. But times, they are a changin'. The

Figure 6. A wonderful specimen of* Sinopterus*, presumably from the Jiufotang Formation of China. This beautiful complete example is held in a private collection.

'Kulturschutzgesetz' was introduced in 2016. This is a law designed to protect the natural cultural heritage of Germany, and its introduction has caused panic among German collectors and fossil dealers. Despite some (hollow) guarantees that it is not intended to stop collecting, it has had an impact on education and science. In essence, this law bans fossil collecting and trading. Fossil collecting has always been an important pastime in Germany, and trading of fossils too, has been a minor industry. Famously, Krantz of Bonn supplied the world with German minerals and fossils in the 19th and early 20th centuries, and I believe the company still does (Mayor 2000). In more recent years the Munich Fossil and Mineral show has become famous around the world, and as important as the Tucson gem, mineral and fossil show of Arizona in North America. In Munich I saw plenty of museum curators (German and from elsewhere) when I attended two years ago, all on the lookout for new accessions, and all with a fat cheque book.

In 2018, for the first time, a licence was not issued to Darmstadt Museum for excavations at Messel. Leaving fossils in the ground in Messel is utterly criminal. What is the point of bestowing Messel with World Heritage site status if you do not issue licences to collect there? Anyone who knows anything about Messel understands only too well that each winter the wet and friable oil shale decays, and as the woodland developing within the quarry spreads, the tree roots penetrate the ground and destroy the fossils. Soon there will be no fossils to dig: nice own goal, Germany! Meanwhile, quarrying companies in Germany are allowed to destroy fossils to make cement (Figure 5).

A final thought

Commercial palaeontologists I have spoken to have often related stories of quite nasty abuse from academic palaeontologists, making me feel quite uncomfortable about being a part of this exciting line of work. No doubt there will be some who will be aghast and waving their fists about, banging on the table and accusing me of being utterly unethical, a philistine, or even cavalier. I have a stack of e-mails from people who have criticised me previously for publishing on material from Brazil (Brazilian fossils for Brazilian palaeontologists is just one theme) or working on fossils held in private collections (a good friend with a collection of pterosaurs far better than London's NHM means I do not have to fly to China to examine either *Darwinopterus* or *Sinopterus* (Figure 6) - how convenient is that?). These people will refuse even to examine their stance, and seem to think that fossils are only for scientists to study...and no one else seems to matter. They tend to be privileged white middle- and upper-class academics and museum curators with vested interests, and have never known what it is like to live on the edge of starvation in a land where crop failure leads to infant mortality, and even basic medical treatment is out of reach. So, when any suburban academic tells me that fossil collecting should be banned, I simply ask if they would ever consider selling a fossil to save their children from starvation, or to pay their medical bills. I know I would. Some scientists have accused those who point out that fossil collecting provides employment in areas where employment is almost non-existent of being apologists. Then that is what I am.

Although some argue that such material is not available for scientific study, so what? Why should

palaeontologists have first 'dibs' just because they call themselves professional palaeontologists? Lots of things are not available for scientific study. The bones in my skeleton are not available for scientific study...hopefully not for a while, anyway. If you hear of a specimen in a private collection that you want to study, go ahead and study it. Forget the rule about not publishing - just learn something from it. This specimen will almost certainly end up in a 'recognised' collection - it just is not available now. It has been in the ground for 125 million years unavailable for study, a few more years will not hurt. The next generation can play with it, like we are doing with Gideon Mantell's (previously private) collection now.

And if you are in a country that bans fossil collecting and you find a really nice ichthyosaur jaw lying on the beach…are you going to leave it there for the tide to wash it away? The hell you are.

Acknowledgements

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References

ABAIDE, J.B 2018. Palaeontological heritage: why legislate for it? *The Geological Curator* **10** (10), 633-639.

EVANS, M. 2010. The roles played by museums, collections and collectors in the early history of reptile palaeontology. *In* Moody, R.T.J., Buffetaut, E., Naish, D. and Martill, D.M. (eds) *Dinosaurs and other extinct saurians: a historical perspective*. Geological Society of London, Special Publications, 343, 5-29.

LHWYD, E. 1699. *Lithophylacii Britannici Ichnographia sive Lapidum aliorumque Fossilium Britannicorum*. Distributio Classica (London).

CARVALHAO, I. de S. 1993. *Aspectos legais da comercialização de fósseis e sua influência na pesquisa e no ension da palontologia no Brasil*. Cadernos IG/UNICAMP, 3(1), 91-105.

CHARIG, A. J., MILNER, A. C. 1986. *Baryonyx*, a remarkable new theropod dinosaur. *Nature* **324** (6095), 359-361. Bibcode:1986Natur.324..359C. doi:10.1038/324359a0

CHARIG, A. J., MILNER, A. C. 1997. *Baryonyx walkeri*, a fish-eating dinosaur from the Wealden of Surrey. *Bulletin of the Natural History Museum of London* **53**, 11-70.

KELLNER, A. W. A., CAMPOS, D. A. 2002. The function of the cranial crest and jaws of a unique pterosaur from the early Cretaceous of Brazil. *Science* **297** (5580), 389-392. doi:10.1126/science.1073186.

KELLNER, A.W.A., CAMPOS, D.A. 2007. Short note on the ingroup relationships of the Tapejaridae (Pterosauria, Pterodactyloidea. *Boletim do Museu Nacional* **75**, 1-14.

MARTILL, D. M., BECHLY, G. AND LOVERIDGE, R.F. 2007. *The Crato Fossil Beds of Brazil: Window into an Ancient World*, 236 pp. Cambridge University Press. ISBN 978-1-139-46776-6

MARTILL, D.M., TISCHLINGER, H., LONGRICH, N.R. 2015. A four-legged snake from the Early Cretaceous of Gondwana. *Science* **349** (6246), 416-419.

MASSARE, J.A., LOMAX, D.R. 2014. An *Ichthyosaurus breviceps* collected by Mary Anning: new information on the species. *Geological Magazine* **151**, 21-28. DOI: 10.1017/S0016756813000241

MAYOR, A. 2000. *The first fossil hunters: Dinosaurs, mammoths and myth in Greek and Roman times*. Princeton University Press, Princeton and Oxford, 360 pp.

NAISH, D., SIMPSON, M., DYKE, G. 2013. A new small-bodied azhdarchoid pterosaur from the Lower Cretaceous of England and its implications for pterosaur anatomy, diversity and phylogeny. *PLoS ONE* **8** (3), e58451. doi: 10.1371/journal.pone.0058451

STEEL, L., MARTILL, D.M., UNWIN, D.M., WINCH, J.D. 2005. A new pterodactyloid pterosaur from the Wessex Formation (Lower Cretaceous) of the Isle of Wight, England. *Cretaceous Research* **26**, 686-698.

Van ROY, P., ORR, P. J., BOTTING, J. P., MUIR, L. A., VINTHER, J., LEFEBVRE, B., HARIRI, K. E., BRIGGS, D. E. G. 2010. Ordovician faunas of Burgess Shale type. *Nature* **465** (7295), 215-8. Bibcode:2010Natur.465..215V

Van ROY, P., DALEY, A. C., BRIGGS, D. E. G. 2015. Anomalocaridid trunk limb homology revealed by a giant filter-feeder with paired flaps. *Nature 522* (7554), 77-80. doi:10.1038/nature14256. ISSN 0028-0836

WILLIAMS, M. 2017. The Etches Collection, Kimmeridge, Dorset. *Museums Journal* **117** (2).

COLLECTING DINOSAURS ON ERODING COAST - CASE STUDIES FROM THE ISLE OF WIGHT

by Martin C. Munt

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The Isle of Wight is world famous for its Lower Cretaceous dinosaurs, collecting and keeping these dinosaurs on the Island comes with challenges. This short paper presents four case studies where the museum has worked with landowners, collectors and agencies to bring extraordinary finds into local public ownership, and therefore available for scientific study. Each of the selected case studies highlights the importance of due diligence and the sensitivities of working together for the public benefit. It emphasises the importance of funding acquisitions and a positive viewpoint by museum professionals towards the public, and towards commercial palaeontology.

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Introduction

The Isle of Wight lies off the south coast of England, separated from Hampshire by the Solent. The Island comprises Cretaceous to Oligocene rocks, brought to the surface by a monocline formed during the Alpine orogeny over reactivated Hercynian faulting. With most of the Island's coastline bounded by cliffs, there is extensive exposure of most of the sequence, providing, if not the most complete, certainly the most continuous exposure of Cretaceous and Paleogene rocks in the United Kingdom. Being fossiliferous throughout much of the sequence, the Island has attracted geologists and fossil collectors for well over two hundred years. As one of the top ten dinosaur localities in the world, most attention is now given to the 12 kilometre stretch of Wealden on the south-west coast and a short exposure of Wealden at Yaverland on the east coast.

As mentioned above there has been a long history of interest in the Island's geology and palaeontology, the first popular writing being that of Englefield (1816) and later Mantell (1854). In the 1820's a local collection of fossils and antiquities was formed in the main town, Newport, with smaller less well known collections at Ventnor and Ryde, these collections were subsequently dispersed but with a core forming the extant Isle of Wight County Museum Service collection focused on Dinosaur Isle Museum at Sandown, which replaced the former Museum of Isle of Wight Geology, also at Sandown. More information on the history of the collection can be found in Peaker and Bingham (2016), and Blows (2015) provides some interesting insights on the early collections.

Today Dinosaur Isle Museum is the sole accredited museum, there have however been a number of private museums formed, and most notably Dinosaur Farm Museum located on the south-west coast near Brighstone. Dinosaur Isle Museum holds over 30,000 specimens, including many type and figured specimens of dinosaurs, insects, spiders, molluscs, mammals and pterosaurs, perhaps most notably the types of the dinosaurs *Neovenator salerii* and *Eotyrannus lengi*. Dinosaur Isle Museum is a fully self-funding museum, welcoming typically 70,000 paying visitors per annum, it is managed arms-length from the Isle of Wight Council, it views itself as a *muddy-boots museum* with an active acquisitions policy with staff and volunteers engaged in collecting.

Fossil Collecting on the Isle of Wight

Fossils draw many visitors to the Island each year and are a major contributor to the local economy, the impact of fossil collecting is summarised in Munt (2008, 2016). The story of fossil collecting on the Island has been one of mixed fortunes. The Island has lost many of its historically significant collections. Notably the Fox collection (see Martill and Naish 2001) of dinosaurs was sold to the then British

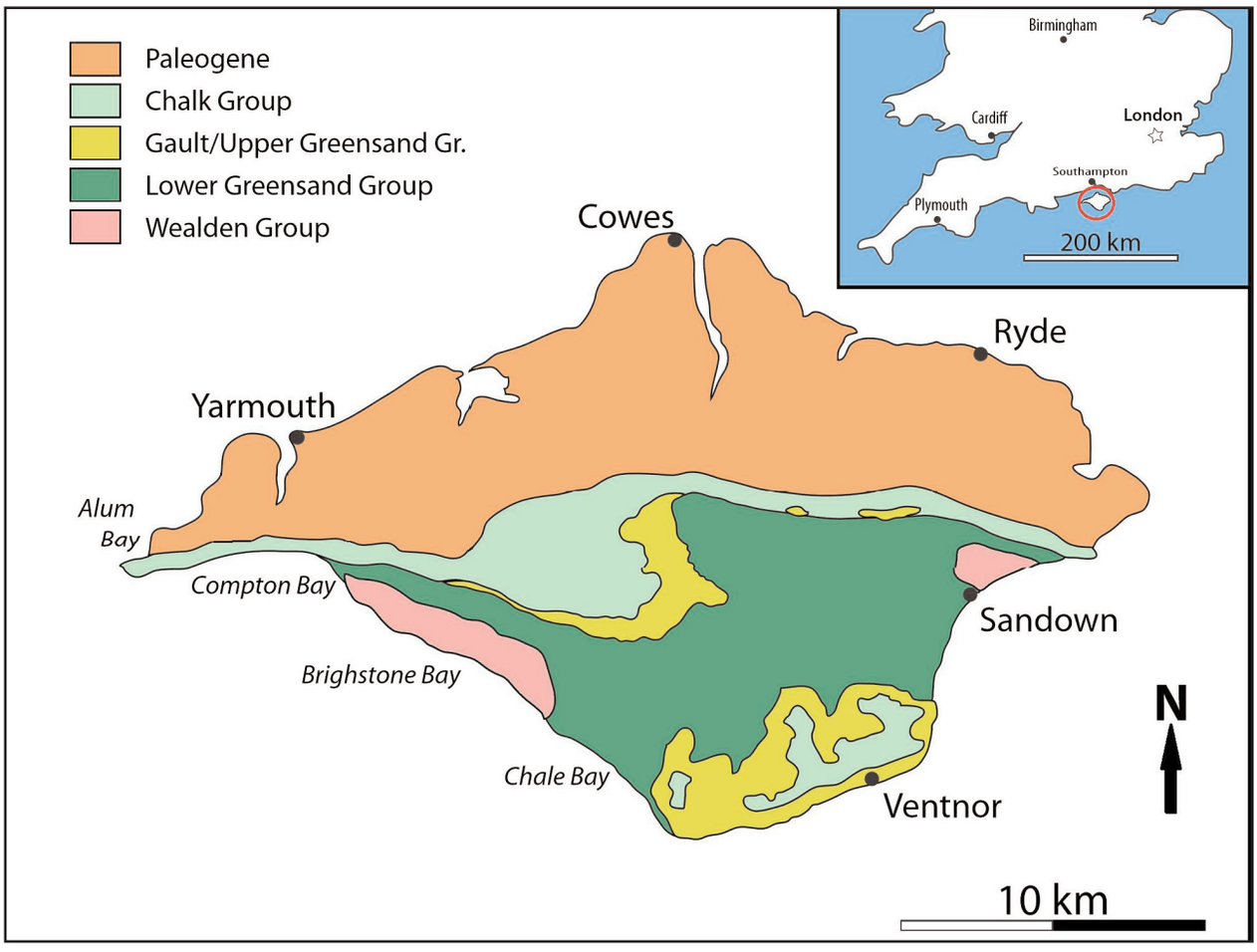

Figure 1. Map of the Isle of Wight, Yaverland, the site of case studies 1 and 2 is just north of Sandown, Chilton Chine is located at the northern end of Brighstone Bay.

Museum (Natural History) now the Natural History Museum (London), Blows (2015) and Peaker and Bingham (2016) provide some background to the dispersal of the Newport Museum collections, and the latter to the significant systematic unauthorised removal of specimens from the Museum of Isle of Wight Geology in the late 1940's through to the 1960's.

The Isle of Wight was a significant focus for attention within the palaeontology community throughout the 1980's and 1990's when tensions flared up between local commercial collectors, amateur collectors and the museum, these are summarised in Munt (2001). The last decade has seen much more positive relations develop, some examples of which are given herein. The fossil collecting and commercial scene today is far more developed than at the end of the last century. There are five commercial outlets on the Island; however the commercial scene has only a limited footprint on the heritage. A number of collectors operate on a semi-commercial basis, and fossils enter the trade with very small numbers at major fossil shows such as Tucson and Munich, usually limited to fossil lobsters from the Lower Greensand Group, and low quality dinosaur bone, frequently cut and polished. The one impact this collecting does have, is that some of the bone comes from actively eroding sites of scientific importance, meaning that some data and potentially new taxa, or specimens that enhance our understanding of existing taxa, are being lost in the immediate and short term.

The Isle of Wight, like the rest of United Kingdom is covered by the Coastal Protection Act (1949), section 18 paragraph 1, whereby it is "unlawful to excavate or remove any materials….on, under or forming part of any portion of the seashore…." It would therefore be down to any local authority, landowner or agent to determine the extent to which this is applied and act accordingly. In practice in the UK the Act is rarely applied. Local bylaws can also be enforced which could restrict fossil collecting, additionally; trespass could be used for private beaches and cliffs preventing access. On the basis of the 1949 Act it is therefore unlawful to remove any fossil from the beach, from the cliff it would be subject to landowner's permission. In practice very few people, including local authorities, take notice of either.

Case studies

The following are four case studies that show generally positive outcomes for keeping heritage preserved locally, yielding benefits to science and the local economy.

Case study 1 The second specimen of *Yaverlandia*

In 1923 F.G.M Abell, a regular donor of specimens to the Museum of Isle of Wight Geology donated a small dinosaurian skull cap he found at Yaverland a short distance from the museum. Eventually the name *Yaverlandia bitholus* was given to the animal. Being based solely upon the single skull cap, and lacking associated or any subsequent associated material, it remained a single enigmatic type fossil. In 2011 a young girl taking part in a school fieldtrip led by Dinosaur Isle Museum to Yaverland, just north of Sandown, asked what she had found? What she had found turned out to be the second find of *Yaverlandia*, a near identical piece, which had been on the beach long enough to be rounded-off a little. The museum operates a general policy of participants in such fieldtrips being able to keep what they find. The beach and cliffs belong to the Isle of Wight Council, and beach finds do tend to be rolled by the waves and largely out of context, therefore of little scientific importance. This discovery was however the exception. Discussions between the family of the finder, the school and the museum resulted in the specimen coming back permanently to the Island in 2012, a happy ending for the specimen, now available for study.

Commentary: In the first case study ownership of the land is clear, it is the property of the Isle of Wight Council; the Council has never publicly expressed control over items found on the beach or indeed the cliff. As such, important discoveries which the museum would like to retain for the Council are the subject of negotiation and agreement. The second case study is more challenging, and also focuses on Yaverland beach.

Case study 2 *Caulkicephalus*, the pterosaur with a local nickname

In late 2002, staff at Dinosaur Isle Museum started finding fragmentary pieces of pterosaur bone on Yaverland Beach. Yaverland is a very rich source of bone fragments, as uniquely for the Island's Wealden (Wessex Formation) it has a bone bed, whereas most dinosaur remains on the Isle of Wight are derived from plant debris beds. The frequency of finds was notable but not exceptional: with bone common on the beach, staff are highly selective as to what they pick up. However, it was a local collector who brought in the first skull elements, again found loose on the beach, they were first placed on loan to the museum, and then were subsequently purchased from the collector. Attempts were made to locate the source of the material in exposures on the beach, but without success. It was then that another local collector claimed to have some material. This proved to be the case, and he had further skull elements, crucial for the scientific study of the specimen.

Discussions began with the second collector, who also claimed to know the exact point on the beach where the pterosaur was eroding out. At the time Channel 4 Television were working on the series called the Big Monster Dig. Discussions then began with the researchers for the programme, the second collector and the museum. The result was a television programme being filmed featuring the collector and his family, and the specimens were purchased by the museum. Regrettably, the filmed excavation was completely fruitless, the source of the bones not being located. However, the specimen was brought together and published as a new species of pterosaur. *Caulkicephalus* is a play on the name for people born on the Isle of Wight, known as caulk heads.

Commentary: As with the first case study, land ownership was clear, however the delicate balance of relationships between collectors and the museum are a clearly influential factor. The museum as a representative of the land owner found it essential to purchase specimens off its own land. With hindsight it is uncertain what influence the coinciding television exposure played. Evidently the availability of funds for specimen purchase was a key factor, and land ownership was 'parked' to facilitate the desired outcome.

Case study 3 Three (or more) dinosaurs from Compton Bay

Compton Bay is a picturesque bay on the west coast of the Island where the Cretaceous forms spectacular cliffs, dominated by imposing Chalk cliffs, which whilst being large and inaccessible is also the most continuous exposure of Chalk in southern England. Back into the bay, the Wealden rocks, whilst being truncated by faulting, form one of the most famous dinosaur localities on the Island. With easy access, commercial palaeontologists lead regular public walks to visit the famous dinosaur footprint casts found there. The cliffs and foreshore is Crown Estate, managed by the National Trust, however the farmland behind is in private ownership, and the cliffs are a geological SSSI.

Plant debris beds are the main source of dinosaur

remains, less frequently associated and partial articulated skeletons are found. The last ten years has seen frequent finds, most notably (within a kilometre) have come the most complete *Mantellisaurus* for many years, an articulated *Valdosaurus* and a multi-taxa, multi-individual sauropod site, the latter is still an active site, eroding away. Whilst the first two sites are subject to mass movement, the sauropod site is so heavily disturbed by mass movement that it is spread from the top to the bottom of the cliff, over a number of terraces.

From the landownership perspective, the sites do seem to all be under the ownership, or guardianship of the National Trust. The finder, an amateur collector, has formal permission to collect from the site (as does the museum), and reported each find to the museum when it became apparent that the finds were not of isolated specimens. Thankfully, the *Mantellisaurus* and *Valdosaurus* specimens were isolated in the cliff and permission to excavate was given, the specimens, plus associated fauna, being recovered and now in the Dinosaur Isle Museum collection.

Much more complicated is the mixed sauropod site: having been spread from both top to bottom of the cliff in a series of slumps, excavation has been difficult and spread over a number of locations. It is also visible to the public and therefore other collectors. It has therefore been regularly visited by collectors, some of whom have placed material with Dinosaur Isle Museum, however much has been dispersed, sold on E Bay and to local commercial palaeontologists, and has undoubtedly appeared at international fossil shows. On the plus side, all of the material seen has been typical large pieces of broken sauropod bone. Much of this multi-taxa site has come to the museum and, as sauropods are poorly understood, this material may be of great significance in unravelling the Wealden sauropods.

Commentary: The third case study, as with the previous two, highlights the issue of collecting dinosaurs on eroding coasts in England. Land ownership has to be recognised by the museum as part of its due diligence, permissions have to be obtained from land owners, and where the site is a SSSI, and permission is also required from Natural England, all in writing. Where there is just one finder it is relatively easy, and where the National Trust is involved permissions to excavate accompany appropriate gifting to the museum. The issues here relate primarily to the sauropod: if land ownership changed with mass movement, multiple land ownership could be involved. The big issue here, though, is that whilst the museum must operate with due diligence, individual collectors do not necessarily recognise the need to follow suit, with the potential to lose specimens and data. In the final case study, the opportunistic nature of fossil collecting is highlighted; the common threads of land ownership and the need for a realistic approach are recognised as essential to secure the specimens. How could this be done better? If funds were available, the landowners and Natural England agreeing, a thorough excavation could be undertaken, ensuring the bones were recovered and brought into the care of the museum.

Case study 4 *Baryonyx* and friends

Right up to the early 1990's, the dinosaur fauna of the Isle of Wight, in particular the theropod fauna, was really poorly understood. With the new century came a fresh look, and what popped-out for the first time, and continues to be found to this day, is that the enigmatic carnivore *Baryonyx* was present in the Wessex Formation of the Isle of Wight. South and east of Compton Bay is Brighstone Bay, which had been the focus of many important dinosaur finds towards the end of the last century. What has been found over the past five years near to Chilton Chine has been nothing less than extraordinary, the remains of at least two *Baryonyx* skulls, mixed with a *Mantellisaurus*, a large *Iguanodon* and a possible sauropod. All this material has come from the foreshore, and was found in this case, on Isle of Wight Council land.

This find represents the first significant finds of *Baryonyx* from England, beyond the original type specimen now held at the Natural History Museum (London). Finds indicate the clear presence of a minimum of two skulls of *Baryonyx*, then subsequently numerous tail vertebrae. Most of the known material has come to the museum, via staff and volunteer finds and purchases from collectors. However, some material is in private hands and has left the Island. As a mixed jumble, it will remain unclear what has gone, and the museum continues to try to locate and bring finds home to the Island. Despite being unlawful under the 1949 Act, foreshore collecting in the UK is generally uncontested and collecting widely considered as legitimate, all that the museum can do is to ensure that collectors have the opportunity to bring together a spectacular assemblage of fossils, for the benefit of all.

Commentary: The fourth case study is the everyday turned critical: the finds are exceptional, but this reflects the nature of fossil collecting; ownership is considered fluid, coming from public property. Collectors find fossils on the beach, material is collected simultaneously both at random and systematically by collectors in-the-know, the fossils are dis-

persed, and the museum challenges itself to bring the parts back together. As with Case study 2, here is a clear case where the application of the 1949 Act could be seen as for the wider public benefit ensuring that these important finds were brought under the care of the museum. However, in a culture of not applying the law, it could be also be highly counter-productive affecting relationships between the museum and collectors.

Summary

Dinosaurs fascinate us, they excite us all, in particular fossil collectors: the Isle of Wight gives collectors the opportunity to seek out and find dinosaur remains, many of which are well-represented in museums both national and local. The almost unregulated nature of fossil collecting in the UK is a precious thing, which means we can all enjoy our prehistory, and maybe find something extraordinary. The commercial palaeontologist can earn a living and contribute to the local economy, through tourism and employment.

For the local museum, due diligence is essential, and it needs to work with landowners, agencies and collectors. A positive working relationship with commercial colleagues is also key to success. Financial resources for acquisition and the realisation of the need for purchase is essential, as new finds will not stop, but will go away if not acted on. Strong positive relationships have led to great finds staying where they belong on the Isle of Wight. Lessons learnt do not just apply to dinosaurs, but to all groups of fossils. However, because of the time it takes for a dinosaur to erode out of a cliff, maybe tens of years, the examples given herein probably apply more to larger vertebrates.

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References

BLOWS, W. T. 2015.*British Polacanthid dinosaurs*. Siri Scientific Press, Manchester. 223pp.

ENGLEFIELD, H C, 1816 *A Description of the Principal Picturesque Beauties, Antiquities and Geological Phaenomena, of the Isle of Wight. With additional observations on the strata of the Island, and their continuation in the adjacent parts of Dorsetshire, by Thomas Webster, Esq*., Payne and Foss, London. 308pp.

MANTELL, G A, 1854 *Geological Excursions round the Isle of Wight and along the adjacent coast of Dorsetshire; illustrative of the most interesting geological phenomena and organic remains*, Henry G Bohn, London. 428pp.

MUNT, M.C. 2001. Fossil collecting on the Isle of Wight: past, present and future. *In* BASSETT, M. G.,KING, A. H., LARWOOD, J. G., PARKINSON, N. A. & DEISLER, V. K. (eds) *A Future for Fossils*. National Museums & Galleries of Wales, Cardiff. 51-54.

MUNT, M C, 2008 A history of geological conservation on the Isle of Wight, in The History of Geoconservation: Special Publication 300 (eds C V BUREK and C D PROSSER, The Geological Society of London, London, 173-179

MUNT, M.C. 2016. Geoheritage case study: the Isle of Wight. *In* HOSE, T. A. *Geoheritage and Geotourism A European Perspective*. The Boydell Press, Woodbridge. 195-204.

MARTILL, D M and NAISH, D, 2001 *Palaeontological Association Field Guides to Fossils, No.10: Dinosaurs of the Isle of Wight*, The Palaeontological Association, London

PEAKER, A. and BINGHAM, P. 2016. Museum of Isle of Wight Geology. *Proceedings of the Isle of Wight Natural History and Archaeological Society* **30**, 65-78.

ACQUIRING FOSSILS: A COMPLEX PICTURE

by Janet Ulph

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This article explains why museums should avoid acquiring fossils which lack sufficient provenance and where the circumstances are suspicious. It argues that, regardless of whether one considers fossils to be cultural property or not, the Museums Association's Code of Ethics should be followed not only in order to maintain public trust in museums but also to ensure compliance with current laws

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I: Introduction

The concept of heritage has been expanded by different academic disciplines to the extent that 'almost anything' has the potential to fall within a definition of heritage.[1] In any legislation applying to 'cultural' objects, it can therefore be challenging to provide a definition which is sufficiently precise and appropriate.[2] It could be based upon the special cultural significance or rarity of objects.[3] Even so, should there be further restrictions, requiring a link to human creativity? Antiquities and works of art would satisfy this restriction but fossils would not. Nudds has suggested that fossils should not be regarded as cultural objects given that,

> '… fossils are not part of the developed culture of the country in which they happen to have been preserved … The evolution of life did not take cognizance of today's political boundaries.'[4]

The argument is that fossils are not the product of a particular culture:[5] first and foremost they provide evidence of an earlier geological age and are therefore worthy of scientific study.[6]

One difficulty in drawing clear bright lines is that objects can be seen in different ways.[7] Many traders and collectors may view fossils primarily as items of commerce. As regards museums, collections were often built up from chance donations over a long period of time. In the nineteenth century, fossils would have been accessioned along with many other scientific objects, and might well have been used to assist in providing a science-based evolutionary narrative. However, since then, museums have made efforts to engage the public in different ways and to provide less directed and more multi-sensory approaches to collections.[8] Consequently, as members of the public are encouraged to make their own decisions in interpreting and responding to collections, some may well be attracted to fossils on an emotional level because they are linked in their minds to a particular community or country. These people may well see fossils in collections as cultural objects.[9] As museums reach out to new sectors of the public, there is a serious risk of a conceptual blurring of 'heritage' with science.

In judging any definition of 'cultural' objects, it is surely best to take account of the context. Writing in 2001, Nudds discussed the wonderful fossils which were for sale at trade fairs but which often lacked details in relation to their provenance. Nudds suggested that museums should be able to purchase fossils even where there might be reason to suspect that they had been smuggled out of their source countries.[10] He objected to a wide definition of cultural

1 Harrison 2013, p. 3; Forrest 2011, p. 1.
2 For discussion relating to defining 'cultural property' and 'cultural heritage,' see Visconti 2015, pp. 264-266; Blake 2000, p. 64.
3 Merryman 2005, p. 11.
4 Nudds 2001, p. 193.
5 Martin 2004, p.158.
6 For further discussion, see Martin 2004, pp. 158-159.
7 Loulanski 2006, p. 209.
8 Macdonald 2007, pp. 186-187.
9 Cross 2001. For a wider discussion, see Besterman 2001, p. 203.
10 Nudds 2001.

property which included fossils because, in his view, this meant that fossils automatically became subject to cultural property laws which restricted their export and dealings with them.

Some strong arguments are made by those who suggest that the law and museum ethics should permit an unrestricted trade in fossils. For example, a thriving market in fossils will induce local people to 'rescue' fossils which may be revealed by coastal erosion and this will prevent the fossils from disintegrating.[11] Furthermore, few would disagree with the idea that the information which fossils carry belongs to the international scientific community, to be held in trust for everyone.[12] In pursuing the argument that fossils should be easily traded, Nudds criticised the 1999 version of the Museums Association's Code of Ethics for muddling 'the fossil trade with the trade in antiquities' and that 'looted material is not a major constituent of the fossil trade in the way that it is for antiquities.'[13] In his view, ethical principles which dictate that museums should reject suspicious objects which may have been illicitly traded, could result in catastrophe from a scientific perspective, with vital knowledge lost to the scientific community. Nudds argued that palaeontologists working for museums should disregard the Code of Ethics and acquire objects which have left their countries 'by whatever means' so that they could be researched properly and the results published.[14] Nudds assumed that museum palaeontologists would remain within the law if they did so.

Yet, if legal regulation is not excessive, it can serve to protect and preserve cultural objects for the benefit of all mankind. And, despite Nudds' protests, it is not uncommon for fossils to be stolen or looted. For example, a UNESCO Information Kit noted that, 'In the United States, a survey conducted in 1991 shows that in Nebraska 28% of sites of particular importance have been damaged by illegal excavators looking for fossils.'[15] When a fossilised elephant's tooth and bones were stolen from the Joint Mitnor cave in Devon in 2015, the site was badly damaged in carrying out this theft.[16] There are reports of theft and looting in Mongolia and China by organised gangs of criminals.[17] Thousands of smuggled fossils have been seized in China in recent years.[18] Although the development of scientific knowledge is of the utmost importance, there are other policy considerations. Fossils such as dinosaur skeletons can fetch millions of pounds at auctions.[19] Transnational organised criminal groups may become involved in the illicit trade in fossils because of the huge profits which can be made. There is a risk that these groups will invest the profits in other criminal activities. If there is an unregulated market where people can easily buy and sell unprovenanced fossils, this will encourage traffickers to carry out more looting in order to satisfy demand. This will undermine the development of scientific knowledge because fossils which have been unlawfully excavated will usually have been stripped of their context: information of their stratigraphic location is invaluable to the scientific community but will be lost forever. Furthermore, if it is easy to sell unprovenanced objects without any questions being asked, it will facilitate the sale of fakes. These policy concerns support Besterman's argument that good science can only be founded on sound ethical practice at every step 'from specimen origination, research and curation to interpretation and publication.'[20]

Was Nudds correct to assume that palaeontologists who acquire objects which they suspect may have been smuggled out of a source country are safe from being prosecuted? And does the Museum Association's Code of Ethics go too far? The ethical principles in the Code are intended to maintain the public's trust.[21] As a minimum, they cannot encourage conduct which contravenes English criminal laws. This article therefore considers not only ethical principles but also the law in relation to dealings in fossils, introducing the discussion by examining the international context. In doing so, this article questions whether the debate in 2001 regarding the classification of fossils continues to be significant in the light of new legal developments affecting acquisitions. This article will seek to demonstrate that anyone, whether a museum employee or not, who suspects that certain fossils have been smuggled out of a source country, will acquire them at their peril.

11 Martill 2001, p. 214; Nudds 2001, p. 194.

12 Martin 2004, p. 159.

13 Nudds 2001, pp. 192-193.

14 Nudds 2001, pp. 193-194.

15 'The Fight Against the Illicit Trafficking of Cultural Objects; The 1970 Convention: Past and Future' Information Kit (UNESCO, 2013) 4.

16 'Thieves steal 100,000-year-old elephant tooth fossil' BBC News 23 September 2015.

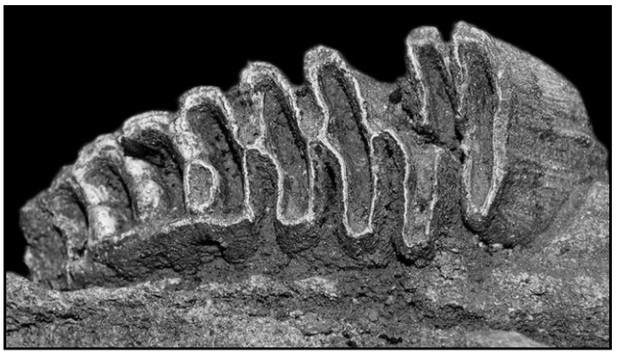
17 A Hannaford, 'The Trade in Stolen Dinosaur Fossils' The Telegraph 30 October 2013.

18 Schmidt, 2000, 215.

19 H Samuel, 'Forget Old Masters, New Trend in Art is Prehistoric' The Telegraph 13 April 2018.

20 Besterman 2001.

21 See Ulph 2016.



A fossilised elephant's tooth stolen from the Joint Mitnor cave in Devon in 2015. Photo: William Pengelly Cave Studies Trust., Buckfastleigh, Devon, UK.

II: THE INTERNATIONAL CONTEXT

The 1970 UNESCO Convention

International conventions do not give private individuals the right to sue and they do not create criminal offences. Consequently, although there are a number of international resolutions and Conventions which are concerned to protect cultural heritage, their principles are often vaguely stated and it is left to governments to inject more detail in implementing their ideas into domestic law. However, they may provide a powerful moral message and they may prompt governments to create new domestic laws before ratification. For example, in 2002, the UK Government ratified the United Nations Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property 1970 ('1970 UNESCO Convention').[22] The Convention declared that governments should accept a general obligation to combat the illicit trade in cultural property. The UK Government did not need to create any new laws before ratifying the Convention but accepted that it was desirable to add one further criminal statute (which became the Dealing in Cultural Property (Offences) Act 2003, discussed below). But the Convention's key strength has arguably been its ethical stance: it has been responsible for raising public consciousness of the importance of protecting cultural property.

The 1970 UNESCO Convention put forward a series of social, ethical and civil measures. It encouraged governments to protect their own heritage by recording information and educating its people to respect the special values inherent in cultural objects. Article 6 required Contracting States to establish a system whereby any object which was exported needed to be accompanied by an export certificate; by Article 3, any object which was imported without an export certificate would be viewed as 'illicit.' Article 5(e) called upon Governments to establish rules for museums and traders which were in conformity with the ethical principles in the Convention. This provision encouraged the development of ethical codes of conduct which would inhibit trafficking in heritage objects.

The Convention does apply to fossils and other palaeontological material.[23] Article 1 makes this clear. It provides a list of different types of objects which are designated as 'cultural property.' This long list begins with a category of objects which have scientific value: 'Rare collections and specimens of fauna, flora, minerals and anatomy, and objects of palaeontological interest.' However, not every such object is necessarily cultural property: they must be specifically designated by the Contracting State (whether on religious or secular grounds) as being of 'importance for archaeology, prehistory, history, literature, art or science.' It is left to Contracting States to decide what property is worthy of special protection. If a State wishes to do so, it can treat all objects falling within each category enumerated in Article 1 as designated objects. This makes the scope of the Convention potentially very wide. But blanket bans upon the export of all of the objects listed in the 1970 UNESCO Convention are controversial for various reasons; for example, it is argued that it is best if museums can display objects from different countries in order to encourage the public to learn about other cultures.[24]

Although Article 1 permits Contracting States to opt for all-encompassing designations, the UK has not taken this approach. The UK Government stated, when it ratified the UNESCO Convention in 2002, that it would interpret the term 'cultural property' as limited to those objects listed in Directive 1993/7/EEC (now Directive 2014/60/EU) on the return of cultural objects unlawfully removed from the territory of a Member State, and the definition contained in Regulation 3911/1992 (now Regulation 116/2009) on the export of cultural goods. The narrow definitions mean that only the most important objects are protected. The objects must be 'national treasures' which possess 'artistic, historic or archaeo-

22 14 Nov 1970 (1971) 823 UNTS 231.

23 The same approach is taken by the UNIDROIT Convention on Stolen or Illegally Exported Cultural Objects 1995, Article 2; this Convention has not been ratified by the UK Government.

24 For discussion of the views of cultural internationalists, see for example, Merryman 1998, at pp. 9-12.

logical value' under national legislation. The listed categories cover objects of palaeontological interest. But the Annex adds a further requirement which is that these objects must be worthy of inclusion in a collection and must therefore be relatively rare, not normally used for their original purpose, and should be the subject of special transactions outside the normal trade in similar utility articles and of high value.[25]

Although the UK Government has restricted the scope of 'cultural goods,' other governments have taken a different approach. The 1970 Convention created universal principles but stated them in manner which provided considerable flexibility in relation to how they were implemented at a local level. Thus Article 5 encouraged States to take steps to make laws 'as appropriate' to combat this trade. Some variation in domestic laws from one Contracting State to another was therefore permitted. This means that anyone concerned with whether they can legally export fossils will need to check the export laws of the country in which the fossils are located; anyone wishing to purchase an object will need to ensure that they comply with their domestic laws. English museums, dealers and collectors will need to ensure that they act in a manner which avoids any violation of English criminal laws and which does not leave them exposed to a civil action for recovery of the objects concerned.

Convention against Transnational Organised Crime 2000

International cultural property conventions such as the UNESCO Convention have primarily concentrated upon the in situ protection of cultural objects, encouraging respect for their provenance and facilitating the forfeiture and return of stolen items.[26] But there are also international conventions and resolutions concerned with drug trafficking, corruption, and other forms of serious crime. The most significant is the UN Convention against Transnational Organised Crime 2000, which requires Contracting States to create criminal offences to deter participation in an organised criminal group and to combat money laundering.[27] General Assembly Resolution 55/25 of 15 November 2000 was linked to the 2000 Convention and it expressly recognised the need for an international response in relation to heritage crime. It can be argued that, in doing so, it placed an emphasis upon the monetary value of cultural objects, rather than their intrinsic worth to science and/or humanity. It stated:

> 'Strongly convinced that the United Nations Convention against Transnational Organised Crime will constitute an effective tool and the necessary legal framework for international co-operation in combating, inter alia, such criminal activities as money-laundering, corruption, illicit trafficking in endangered species of wild flora and fauna, offences against cultural heritage and the growing links between transnational organised crime and terrorist crimes.'

In the years following the 2000 Convention, the UN discussed strategies to deter the illicit trade in cultural property, such as developing the capacities of the police and the customs services.[28] Yet, in 2010, the UN Economic Council acknowledged that serious problems remained, not least because traders showed little interest in carrying out proper checks on the provenance of cultural objects.[29] An Information Kit, The Fight Against the Illicit Trafficking of Cultural Objects, published by UNESCO in 2013, commented that 'It is estimated that 98% of the final market price of an object remains in the pocket of middlemen.'[30]

Although there has been international concern to prevent trafficking in any cultural objects, it is antiquities which have been the main focus of attention recently. This is because it is feared that antiquities are being looted on a large scale by terrorists in countries where law and order has broken down, such as Syria. On 24 March 2017, the UN Security Council focused upon cultural property and unanimously adopted Resolution 2347. The Security Council deplored the theft of cultural objects from museums and sites during armed conflicts. Resolution 2347 encouraged governments to take appropriate steps to counter the illicit trade in cultural property. It listed among other items those of 'rare scientific' impor-

25 See *Collector Guns GmbH v Hauptzollamt Koblenz,* European Court of Justice, Case 252/84 at [24].

26 Nafziger 1985. p. 846.

27 15 November 2000, 2225 UNTS 209. http://www.unodc.org/unodc/treaties/CTOC/ This Convention was ratified by the UK Government in 2006. See Borgstede 2014.

28 Resolution 2010/19 entitled, 'Crime prevention and criminal justice responses to protect cultural property, especially with regard to its trafficking.' See further, Resolutions 66/180, 68/186 and 2011/42, 'Strengthening crime prevention and criminal justice responses to protect cultural property, especially with regard to its trafficking.'

29 *Discussion Guide for the Thematic Discussion on Protection against Trafficking in Cultural Property: Notes by the Secretariat*, E/CN.15/2010/6 (para 25), May 2010.

30 'The Fight Against the Illicit Trafficking of Cultural Objects; The 1970 Convention: Past and Future' Information Kit (UNESCO, 2013) 2.

tance and which would therefore include certain fossils. It called upon governments to engage with the museum sector and art trade on standards of provenance documentation and due diligence measures.[31] There is therefore pressure upon the UK Government to scrutinise the acquisition procedures adopted by museum professionals and dealers as part of a much broader strategy to combat terrorism.

III: GENERAL CRIMINAL LAWS AFFECTING ALL MOVABLE PROPERTY

Introduction

There are a number of criminal laws which apply to any moveable object; the fact that this object has a special intrinsic value to science or the arts will not determine whether an offence has been committed but may well affect the length of sentence handed down. Some laws, such as theft, purport to cover a broad spectrum of economic criminal activity. There are also laws which focus upon protecting cultural heritage. Enforcement agencies will consider all of the relevant laws before choosing which ones are the most appropriate in relation to the facts before them.

Theft and handling stolen goods

The Theft Act 1968 creates offences which cover all movable property, including cash. As it includes items severed from the land,[32] fossils are capable of being stolen. Section 1(1) of the Act states,
'A person is guilty of theft if he dishonestly appropriates property belonging to another with the intention of permanently depriving the other of it;'

Property is therefore only capable of being stolen if someone owns it, or has some property interest in it, so that it can be described as 'belonging to another.'[33] If the accused has taken a fossil from a museum, or storage facilities, or a private home, this requirement is clearly satisfied. What if the accused goes on to someone's land to dig up fossils? He can normally be charged with theft because the fossils are presumed to belong to the owner or occupier of the land[34] (under the current definition, they will not be viewed as treasure which would belong to the Crown[35]). What if a fossil is simply lying on the ground? Normally, any fossils lying on the ground will belong to the land owner provided he has shown an intention to control the things which might be found on his land.[36] But could someone who picks up a fossil argue that it has been abandoned? If it was abandoned, no charge could be brought not only because it would not belong to anyone but also because the finder would not be dishonest in taking it.[37] Yet it is very difficult to prove that an object has been abandoned and this analysis is unlikely to apply in these circumstances: it would need to be shown that the previous owner has given up any intention to own the fossil and has not transferred ownership to anyone else.[38]

The position is more complex where the object has been excavated in another country and sent to England. The domestic law of the state of origin will need to be examined in order to discover whether an offence had been committed. A number of governments claim ownership of undiscovered objects which lie buried in the ground (often described as a 'patrimonial law'). In order to determine whether a fossil can be described as 'stolen,' the terminology of the particular law will need to be studied very carefully. It must extend to palaeontological objects and not just to antiquities.[39] Furthermore, the law must assert ownership of unexcavated fossils. It is not enough to declare 'state protection' of fossils or to attempt to control the export of fossils. But, where the patrimonial law states that the government owns the fossils then, if they are removed and taken abroad, they can be said to belong 'to another' and can therefore be viewed as stolen objects.[40]

31 Resolution 2017/2347, art 17(g). Available at; http://unscr.com/en/resolutions/doc/2347 (accessed 26 July 2017).

32 Theft Act 1968, s 4. The Theft Act 1968 does not extend to Scotland or Northern Ireland,

33 Theft Act 1968, s 5(1).

34 *Waverley B.C. v Fletcher* [1995] QB 334 (CA); *Parker v British Airways Board* [1982] QB 1004 (CA); *Webb v Ireland* [1988] IR 353 (Sup Ct).

35 For a definition of 'treasure,' see Treasure Act 1996, s 1. For the position in Scotland, see MacFayden, C.C.J. 2008. Scottish Fossil Code, Scottish Natural Heritage, 82 pages.

36 *Parker v British Airways Board* [1982] QB 1004 (CA); *Costello v Chief Constable of Derbyshire* [2001] EWCA Civ 381, [2001] 1 WLR 1437 (CA); Ulph and Smith 2012, p. 176.

37 Theft Act 1968, s 2(1)(c) provides that a person is not dishonest if the property is taken in the belief that the person to whom the property belongs cannot be discovered by taking reasonable steps.

38 *R (Rickets) v Basildon Magistrates' Court* [2010] EWHC 2358 [2011] 1 Cr App R 15 (Admin).

39 See the interesting discussion by Liston in relation to whether dinosaur eggs fall within the definition provided by China's Cultural Relics Protection Law 1993: Liston 2013, p. 549.

40 For example, the Chinese Government passed the Cultural Relics Protection Law in 1982 asserting ownership over fossils of scientific value remaining underground: Liston and You 2015.

If a fossil has been stolen, then anyone who dishonestly receives the fossil or assists someone in, for example, smuggling the fossil into England, could be charged with handling stolen goods.[41] In *R v Tokeley-Parry*,[42] Tokeley-Parry arranged for an associate, Mark Perry, to bring Egyptian antiquities to England. Egyptian law declared that all antiquities belonged to Egypt and it was therefore clear that the antiquities were stolen: Tokeley-Parry had dishonestly assisted Mark Perry in their removal and was duly convicted of handling stolen goods.

Dishonesty is assessed objectively, and the conduct of the accused will be judged by the standard of 'ordinary decent people.'[43] The prosecution must also show, in relation to handling, that that the accused knew or believed that the goods were stolen. Where the market is secretive, it is inevitably going to be difficult to bring forward sufficient evidence of dishonesty.[44] If a dealer has failed to make sufficient enquiries, this evidence is not sufficient to demonstrate dishonesty. There have been relatively few convictions for cultural property offences which require proof of dishonesty because of the difficulty in collecting convincing evidence. In *R v Tokeley-Parry*,[45] the prosecution was assisted in its task of proving dishonesty by the evidence of the dealer's assistant Mark Perry, together with notes which the accused had kept of artefacts which he had smuggled out of Egypt.

If it could be shown (as Nudds argued) that fossils are rarely if ever stolen, it would be difficult to convict a collector or trader who did not make sufficient enquiries: he could argue that he did not believe that the fossil was stolen. Furthermore, it would be difficult to prove that the collector or trader was dishonest. Even so, it is in the interests of purchasers to be able to show that they have exercised due diligence because, if they can, they are protected from civil claims as well. In England, according to section 4(2) of the Limitation Act 1980, legal title to an object such as a fossil may be lost six years after the stolen object has been acquired by a good faith purchaser.[46] This means that the fossil will no longer be regarded as stolen;[47] the purchaser will own it outright. But, in order to demonstrate that he had acted in good faith under the 1980 Act, the purchaser must show that he had made all necessary and appropriate enquiries before acquiring the object.[48]

The three main money laundering offences

Money laundering is the process of making money or objects which were once part of an illegal activity (such as theft) appear legitimate. In order to do this, the objects will usually be exchanged with other property. The Proceeds of Crime Act 2002 tackles money laundering by creating three offences which can apply to anyone, whether they are museum employees, professional dealers or private individuals. They are wide in scope and to an extent overlap with each other. Offenders may be jailed for up to 14 years. However, there must be an antecedent offence.[49] Where a foreign government asserts ownership over fossils and bans their export, the antecedent offence would be theft. But this is not the only possibility. If a dealer bribes public officials in order to take fossils out of a source country and to bring them to the UK, bribery would be the antecedent offence. Where a dealer creates false documents, or makes false statements (such as in stating the location from where they had originated), fraud would be the antecedent offence.[50] In these circumstances, the fossils and any proceeds of sale would be viewed as criminal property.

The three money laundering offences are set out in sections 327-329 of the Proceeds of Crime Act 2002. Section 327 makes it an offence to conceal, disguise, convert or transfer criminal property or remove it from the jurisdiction. Consequently, a dealer who buys and sells objects which he knows or suspects could be looted is at risk. Section 328(1) makes it an offence for a person to become involved in an arrangement which he knows or suspects will facilitate the laundering of criminal proceeds. This section is directed in particular at those 'middlemen' who never own the criminal property concerned, such as auctioneers.[51] It could also apply to academics or

41 Theft Act 1968, s 22; *R v Bloxham* [1983] 1 AC 109 (HL), 113.
42 [1999] Crim LR 578 (CA).
43 *Ivey v Genting Casinos* [2017] UKSC 67 [2018] AC 391 at [74].
44 *R v Forsyth* [1997] 2 Cr App Rep 299 (CA).
45 *R v Tokeley-Parry* [1999] Crim LR 578 (CA).
46 A good faith purchaser will not be guilty of theft: Theft Act 1968, s 3(2).
47 Theft Act, s 24(3).
48 *Nicole de Préval v Adrian Alan Ltd* (QB, 24 January 1997).
49 *R v GH* [2015] UKSC 24, SC [20].
50 Fraud Act 2006, s 2. The Fraud Act 2006 does not extend to Scotland. The Customs and Excise Management Act 1979, ss 167,168, also creates various offences relating to making untrue statements or counterfeiting documents and this Act extends to Scotland.
51 *R v Griffiths* [2006] EWCA Crim 2155.

museum professionals who suspect that a fossil is looted but nevertheless go on to provide an opinion which helps to authenticate it, as this will facilitate its sale.

Section 329 is concerned with those who acquire, use or have possession of criminal property. An offence will be committed where the item was obtained for inadequate consideration; in other words, the price was 'significantly less than the value of the property.'[52] The burden of proof is on the prosecution to show this.[53] Finding proof of inadequate consideration may not be a significant obstacle: it is likely that any surreptitious purchase of stolen fossils will be at a price which is significantly lower than its true value.

If a fossil is stolen from a museum overseas, and purchased by a dealer to ship to the UK, the dealer may be prosecuted for money laundering. It is no bar that the theft occurred abroad: criminal conduct is defined as conduct which constitutes an offence in any part of the UK or would constitute an offence if it occurred in the UK.[54] There is a statutory defence available which can be pleaded where the accused knew or reasonably believed that the criminal conduct was legal under the criminal law applying in that country.[55] However, the conduct must be of such a minor nature that, had it occurred in the UK, it would have been punishable with a maximum of 12 months' imprisonment.[56] This defence would not assist someone who suspected that he was purchasing looted objects.

It is much easier to prosecute someone for money laundering than for offences which require proof of dishonesty (such as handling stolen goods) because the police only need to show that the accused knew or suspected[57] that the property was derived from crime.[58] As regards 'suspicion,' it was suggested in the case of *R v Da Silva* that, 'the defendant must think that there is a possibility, which is more than fanciful, that the relevant facts exist. A vague feeling of unease would not suffice.'[59]

The court will consider the state of mind of the accused, taking account of any expertise which he might have and whether there were suspicious circumstances. A person may be convicted where he appears to have deliberately closed his eyes and failed to ask questions. It is a matter of looking at all the facts. For example, anyone dealing in fossils from China should expect to be provided with a unique Ministry of Land and Resources number;[60] if this is not supplied, further enquiries should be made.

It is tempting to acquire important objects at a bargain price and to avoid posing difficult questions about their provenance - particularly where other people seem confident about purchasing them. However, the scope of English money laundering offences contained in the Proceeds of Crime Act 2002 is wider than their equivalent in some other countries, where the threshold for a prosecution may involve proof of knowledge and intention rather than mere suspicion. Principle 2.5 of the MA's Code of Ethics, which demands that museums reject any item where there is any 'suspicion' that it was wrongfully taken, could be seen as sensible advice in these circumstances.

Money laundering: obligations imposed upon 'high value' dealers

Since 1993, there have been a series of money laundering regulations. At their core has been a requirement of due diligence, which includes verifying the identity of customers, monitoring transactions, training staff and keeping records. A failure to exercise due diligence could lead to criminal charges. Originally, these regulations only applied to banks and financial businesses but they have been expanded over the years to include solicitors, accountants, high value dealers and others. 'High value' dealers are defined as dealers who accept cash of 10,000 euros or more in respect of a transaction or linked transactions.[61] Until now, these regulations have not affected most auction houses and dealers in the UK because they only applied to those who accepted cash transactions. However, this is all set to change. There is a 5th EU Directive (2018/843) which requires governments to take action to improve transparency in commercial dealings by January

52 POCA 2002, s 329(2)(3).

53 *Hogan v DPP* [2007] EWHC 978, [2007] 1 WLR 2944 (Admin) at [27]-[30]; *R v Davis (Craig)* [2008] EWCA Crim 2756 [18], *R v Rahila Kausar* [2009] EWCA Crim 2242 [8].

54 POCA 2002, s 340(2).

55 POCA 2002, s 327(2A), s 328(3), s 329(2A). .

56 The Proceeds of Crime Act 2002 (Money Laundering: Exceptions to Overseas Conduct Defence) Order 2006 (SI 2006/1070).

57 POCA 2002, s 340(3)(b).

58 POCA 2002, s 340(9); *Prosecution Appeal (No 11 of 2007) R v W* [2008] EWCA Crim 2 [15].

59 *R v Da Silva* [2006] EWCA Crim 165, [2007] 1 WLR 311 (CA), at [16]. A fleeting thought would not be sufficient: at [17].

60 Liston and You, 2015; Liston, 2014.

61 Money Laundering, Terrorist Financing and Transfer of Funds (Information on the Payer) Regulations 2017, Reg 14.

2020. One of the proposed changes is to widen the scope of the regulated sector to include all 'persons trading or acting as intermediaries in the trade of works of art, including when this is carried out by art galleries and auction houses' in transactions (or linked transactions) valued at 10,000 euros or more, irrespective of the payment method (such as a credit card or inter-bank transfer). Although the Directive refers to 'works of art,' it may well be that, in implementing the Directive, the UK Government will fall back on standard definitions contained in Directive 2014/60/EU and Regulation 116/2009.[62] This would mean that transactions involving rare palaeontological material valued at over 10,000 euros would be included.

The Money Laundering, Terrorist Financing and Transfer of Funds (Information on the Payer) Regulations 2017 impose a series of obligations upon high value dealers and others. They require risk assessments to be carried out. For example, do the countries from where the goods originate pose special risks?[63] Any cash dealer in fossils should be suspicious where fossils come from countries where it is well known that there have been unlawful excavations, such as China. Dealers will also need to examine the purpose of any transaction and to consider whether it appears to make commercial sense. Questions will therefore need to be asked where, for example, someone wishes to do a deal quickly, with split invoices, using large bundles of cash.[64] The dealer must also consider the characteristics of the other contracting party, such as whether he is a politician or part of a politician's family. The Regulations expect high value dealers to create systems to identify risks and to keep a check on transactions.[65] Regulation 86(3) provides a defence where the accused took all reasonable steps and exercised due diligence to avoid committing an offence.

These Regulations will pose enormous difficulties for dealers at trade fairs. They will be expected to demand proof of identification of the other party, such as a passport and utility bill. If they fail to identify the person properly, they risk committing an offence. This could be particularly frustrating at an international fair because some participants may be resident in countries which do not have the equivalent laws to these Regulations; these people may recoil at the prospect of providing detailed information about themselves or the transaction.

The Regulations herald a transformation in the market, putting pressure upon auction houses and dealers to ask questions rather than to assume that all is well. They only apply to traders and therefore will not apply to museums, even when they are extended further. However, the Regulations may have a broader impact in relation to all acquisitions because banks will be subject to the Regulations and they may require more information in relation to proposed purchases. Although the MA's Code of Ethics has been criticised for placing so much emphasis upon carrying out due diligence checks before purchasing objects, or accepting them as gifts, one can see that these ethical principles are in harmony with modern professional practice. Indeed, once the Regulations apply across the board, they will be at least as stringent as the ethical guidelines.

IV: CRIMINAL LAWS SOLELY CONCERNED WITH CULTURAL PROPERTY

Dealing in Cultural Objects (Offences) Act 2003

When the Ministerial Advisory Panel recommended in their report that the UK Government should ratify the 1970 UNESCO Convention, it was suggested that an additional law would help to reinforce the obligations created by the UNESCO Convention.[66] In particular, the Panel recommended legislation to deal with situations where artefacts were dug out of the ground or forcibly removed from buildings or other structures. There was a gap in the law because it is not always possible to charge someone with theft or handling. For example, a government may not be able to claim that the object belongs to the state if it does not have a patrimonial law. The object may be ownerless or, where there is an identified owner of a site, that owner may have consented to its removal. The UK Government therefore passed the Dealing in Cultural Objects (Offences) Act 2003.[67]

The 2003 Act made it an offence to dishonestly import, deal in or be in possession of any cultural object which has been unlawfully excavated or removed and which was therefore a 'tainted' object. Although the Ministerial Advisory Panel had includ-

62 See n. 25 and accompanying text above.

63 2017 Regulations 17, 18. High value dealers are also subject to reporting requirements under the Proceeds of Crime Act, s 330.

64 *S L Wines Limited v The Commissioners for Her Majesty's Revenue & Customs* [2015] UKFTT 0575 (TC) at [42-43].

65 2017 Regulations 19, 28.

66 *Illicit Trade in Cultural Objects*, Report of the Ministerial Advisory Panel, London, December 2000.

67 The Act took effect on 30 December 2003. It does not extend to Scotland.

ed palaeontological material in the recommendations,[68] section 2(1) of the Act defined 'cultural object' to mean 'an object of historical, architectural or archaeological interest.' Is palaeontological material included? Archaeology involves the study of human activity in past times through analysis of artefacts, monuments and other remains. Palaeontology is different: it is a science concerned with the study of fossils. Yet it could be the case that the drafters used this phrase because it is to be found in Directive 1993/7/EEC (now 2014/60) on the return of cultural objects unlawfully removed from the territory of a Member State, and Regulation 3911/1992 (now 116/2009) on exports. But the Explanatory Notes to the Act do not clarify the scope of the Act, merely noting that 'organic material' would be included. Guidance issued by the Department of Culture Media and Sport (DCMS) suggested that the Act covered objects 'excavated contrary to heritage legislation.'[69] An unsatisfactory degree of uncertainty has been created as a consequence.

It is surprising to have such a vague definition of 'cultural object' because the Act was intended to facilitate the implementation of the 1970 UNESCO Convention. Unfortunately, there is no further guidance provided by the courts. There has only been one conviction so far, perhaps because of the difficulty of proving that the accused was dishonest and knew or believed that the object was tainted. In 2016, the police seized statues, bibles, and other religious relics from the address of Christopher Cooper: these relics had been taken from churches in England and Wales. Cooper was convicted of dealing in tainted cultural objects under the 2003 Act, as well as theft and fraud. However, as he pleaded guilty to the charges, the parameters of the 2003 Act were not tested. The application of the 2003 Act to those who acquire fossils in suspicious circumstances therefore remains unclear. Due to this uncertainty, it is unlikely that any charge will be brought under the Act alone; enforcement authorities will seek evidence to enable them to bring charges under other legislation as well.

Iraq (United Nations Sanctions) Order 2003

In August 1990, after the invasion of Kuwait, trade sanctions were imposed upon Iraq by the United Nations Security Council in Resolution 661. As the country became poorer, looting of archaeological sites became widespread. The subsequent invasion of Iraq in 2003 led to increased illegal excavations, as well as the theft and destruction of collections in the National Museum of Iraq in Baghdad.[70] As a consequence, the United Nations Security Council adopted Resolution 1483 of 22 May 2003 which required governments to take appropriate steps to create criminal offences and facilitate the return of cultural property.

The Iraq (United Nations Sanctions) Order 2003 created criminal offences where a person either dealt with illegally removed cultural property or if, being in possession or control of such property, there has been a failure to transfer it to a constable. The property itself was defined as follows:

> 'Iraqi cultural property and any other item of archaeological, historical, cultural, rare scientific or religious importance illegally removed from any location in Iraq since 6th August 1990.'[71]

The Order therefore applies to fossils where they can be categorised as of "rare scientific importance.' As fossils have been discovered in Iraq, such as marine fossils, the 2003 Order is of some relevance to museums, as well as dealers.[72]

The Order places pressure upon museums, collectors and dealers, to be suspicious and to ask questions. They will be guilty of an offence under the Order unless they can prove that they 'did not know and had no reason to suppose that the item in question was illegally removed Iraqi cultural property.' In order to ensure that any prosecution does not violate the right to a fair trial,[73] the prosecution will still be expected to produce evidence that the accused should have known that the object was Iraqi cultural property removed after 1990; the burden would then shift to the accused to rebut that evidence. There have been no convictions so far under the 2003 Order. One problem is that it may be very difficult to show that the cultural object has been illegally removed from Iraq since 6 August 1990. Even so, the 2003 Order can be seen as a legislative intervention which puts pressure upon acquirers to carry out due diligence.

68 *Illicit Trade in Cultural Objects* (2000) Annex E: 'Collections of historical, palaeontological, ethnographic or numismatic interest' valued at over £39,600.

69 DCMS, 2004, 4.

70 George, 2008.

71 SI 2003/1519, as amended by SI 2004/1498, Article 8(4). The Order came into force on 14 June 2003.

72 S. Pappas. Marine Reptile Fossil Found in Iraq Shows Prehistoric Creature's Unlikely Survival. *Live Science*. 16 May 2013.

73 Human Rights Act 1998, Sch 1, Art 6.

Export Control (Syria Sanctions) Order

There has been continuing internal conflict in Syria since 2011. Archaeological sites, museums and religious buildings have been severely damaged and there has been extensive looting of archaeological material.[74] In response, the Order creates an offence of dealing in cultural objects exported from Syria on or after 15 March 2011 'where there are reasonable grounds to suspect that the goods have been removed from Syria without the consent of their legitimate owner or have been removed in breach of Syrian law or international law.'[75] Unfortunately, the drawback of a law which has such a country specific focus is that it may be easy for traffickers to label objects as having originated elsewhere.

It is an offence to import, export or transfer Syrian cultural property 'of archaeological, historical, cultural, rare scientific or religious importance, including those listed in Annex XI." This Annex defines cultural property to include:

(a) Collections and specimens from zoological, botanical, mineralogical or anatomical collections;

(b) Collections of historical, palaeontological, ethnographic or numismatic interest.[76]

Although the main concern has been the looting of antiquities by terrorist groups, this Order does apply to those who receive or deal in fossils. Yet although the definition of cultural property appears to have a wide scope, it is restricted by the condition that the collections referred to must be 'relatively rare.'[77] Consequently, items such as fragmentary bones of dinosaurs which may be found in the rocks of Syria should not fall within this definition.

Cultural Property (Armed Conflict) Act 2017

The Cultural Property (Armed Conflict) Act 2017 came into force on 12 December 2017. It enabled the UK Government to ratify the Convention for the Protection of Cultural Property in the Event of Armed Conflict 1954 (the 'Hague Convention') and to accede to its two Protocols. The Convention aims to safeguard cultural property during armed conflicts. It creates offences in relation to intentional acts of destruction and theft of cultural objects by armed forces and terrorist groups.

Section 17 creates an offence where someone deals in unlawfully exported cultural property 'knowing or having reason to suspect' that it has been unlawfully exported.[78] The Act could apply to unlawfully exported palaeontological material but only in the narrowest of circumstances. Section 2 of the 2017 Act defines 'cultural property' as having the meaning given in Article 1 of the Hague Convention. This includes scientific collections 'of great importance to the cultural heritage of every people.' It would therefore only be relevant if a museum, dealer or collector was in possession of very rare and scientifically important fossils. Furthermore, the section 17 offence only applies to property exported from territory unlawfully occupied by the government of another state such as Northern Cyprus (and not by a militant group). Thus, although the offence adds further protection for cultural property and provides an additional reason for acquirers to carry out due diligence checks, it has a very limited application in the context of palaeontological materials. Even so, the objective test of 'having reason to suspect' in the section 17 offence is further evidence that criminal laws applying to dealings in cultural property are becoming stricter thereby moving into line with the ethical principles set out in the MA's Code of Ethics.

IV: ETHICAL CODES

Museums and ethical standards

The development worldwide of ethical codes of conduct was prompted by the 1970 UNESCO Convention. From that year museums and traders were expected to exercise 'due diligence' in making searches or verifying facts before acquiring cultural objects. DCMS guidance for museums, Combating Illicit Trade, reflects this view, stating that 'Museums should acquire or borrow items only if they are certain they have not been illegally excavated or illegally exported since 1970.'[79] The year 1970 has no particular significance for criminal legislation. However, the DCMS guidance is referring to an ethical rather than a legal standard of conduct.

74 Cunliffe, 2012, 11.

75 Export Control (Syria Sanctions) Order 2013/2012, article 12A, as amended by the Export Control (Syria Sanctions) (Amendment) Order 2014 SI No 2014/1896. Article 11c was inserted by EU Council Regulation No 1332/2013. See further Regulation 2015/827.

76 Annex XI can be found in EU Council Regulation No 1332/2013.

77 *Collector Guns GmbH v Hauptzollamt Koblenz*, European Court of Justice, Case 252/84 referred to in EU Council Regulation No 1332/2013.

78 DCMS 2017. As regards the mental test for the offence, the Supreme Court has ruled that the plain words of a slightly different phrase 'reasonable cause to suspect' involved an objective test: R v Lane (Sally) [2018] UK SC 36, [2018] 1 WLR 3647.

79 DCMS, 2005, p. 4.

The International Council of Museums (ICOM) Code of Ethics asserts that a museum must not acquire a cultural object unless it is satisfied that the object has not been stolen or illicitly obtained. Principle 2.2 states that 'Evidence of lawful ownership … is not necessarily valid title.' This is an example of where law and ethics divide. Governments of countries such as China, Mongolia and Brazil may assert ownership of fossils but there are various countries where the law allows good faith purchasers to obtain a good title to a stolen object without difficulty. A museum must not acquire an object with this type of provenance because of ethical principles which hold it to a higher standard in acting for the benefit of the public. Principle 2.3 of the ICOM Code suggests that, in exercising due diligence, every effort should be made and museums should 'establish the full history of the item since discovery or production.' A 'full history' is far more than is required by law. It might seem that a comprehensive history should reduce any risks posed by an object to zero; even so, there is always the possibility that false documents have been created by a seller to make the fossil appear legitimate.

The final provision in the ICOM Code on the illicit trade is Principle 2.4 which states that,

> 'Museums should not acquire objects where there is reasonable cause to believe their recovery involved the unauthorised, unscientific, or intentional destruction or damage of monuments, archaeological or geological sites, or species and natural habitats.'

Principles 2.4 and 2.5 of the MA's Code of Ethics 2015 similarly emphasise the need for due diligence steps and rejection of any item where there is 'any suspicion' that it was wrongfully taken. Museums may well have their own collections policies which flesh out these principles.[80]

Although the ethical codes contain very simple statements of principle, more detail can be found in DCMS guidance on *Combating Illicit Trade*.[81] The guidance sets out 'due diligence' steps which museums should take, such as examining the object and any labels or markings for the purposes of identification; assessing risks by considering the nature of the object and the likely source country from where it originated; scrutinising evidence of lawful export of the object; and assessing the seller (or donor) and evidence of provenance (such as auction catalogues and receipts of purchase).[82] External sources, such as obtaining the advice of experts or undertaking searches of databases are encouraged where appropriate. The guidance briefly acknowledges the ICOM's Red Lists,[83] which alert dealers and collectors to looting; these Red Lists include references to fossils and palaeontological material from Peru and Colombia. The guidance is reinforced by the checklist available from the Collections Trust which reminds museums to check the Red Lists and note their findings accordingly.[84] By encouraging museums to be cautious, to ask questions and to assess risks, the guidance is consistent with money laundering legislation.

Where a fossil has immense scientific value, but where there are suspicious circumstances, the decision to refuse it will be a painful one. The rejection may involve the loss of a fossil which might complete a gap in a museum collection; that fossil might disappear into a private collection forever, never to be seen again. However, the ethical codes make it clear that, in order to uphold public trust in museums, this must be done.

Collectors and dealers

There has been a long history of fossil dealers, such as Mary Anning, supporting and promoting scientific discoveries.[85] Sale of fossils by dealers to museums is not uncommon. Yet dealers are not restricted by ethical codes in the same way as museum professionals. Traders of cultural property do not form a uniform group because cultural property is so diverse. Typically, traders specialise and have their own codes of conduct. Major auction houses support the Code of Practice for the Control of International Trading in Works of Art,[86] which has a vague statement to the effect that members undertake to the best of their ability not to deal in stolen objects or objects which have been unlawfully imported or exported. But there is little guidance aimed specifically at fossil dealers in England and Wales. This may reflect the fact that the position is not a simple one. In some areas, fossils may be common and of low financial

80 Accredited museums in the UK will also adhere to the Collections Development Policy Template, which emphasises the importance of due diligence procedures in deterring the illicit trade.

81 DCMS 2005.

82 DCMS 2005, p. 6.

83 Available at: http://icom.museum/programmes/fighting-illicit-traffic/red-list/

84 'Acquiring Objects - Due Diligence Checklist:' http://collectionstrust.org.uk/resource/acquiring-objects-due-diligence-checklist/

85 Larson 2001; Torrens 1995.

86 Available at: http://collectionstrust.org.uk/resource/the-code-of-practice-for-the-control-of-international-trading-in-works-of-art/.

and scientific value. They may be located in areas which face rapid erosion, such as coastal cliffs, where retrieving fossils may save them from destruction. There is a voluntary code of conduct aimed at amateur fossil hunters which encourages them to take their finds to museums and conservation groups. There are also regional codes, such as the Fossil Collecting Code of West Dorset. Both the UK Fossils Network's Code of Conduct and the West Dorset Code sensibly warn collectors of the need to obtain landowners' permission in order to avoid being prosecuted for theft. There may be pressure in the next few years to develop more demanding ethical guidance for dealers, due to international concerns regarding the illicit trade in cultural property.[87] However, the current position is that museum staff should be aware that in their dealings with others, such as academics, commercial palaeontologists and amateur collectors, that these people are not necessarily held to the high ethical standards set by the Museums Association's Code of Ethics, although they will be restrained by the general law.

V: CONCLUSIONS

A number of palaeontologists have argued that fossils, such as dinosaur skeletons, should be seen solely as objects for scientific study. They therefore object to any approach which categorises fossils as cultural objects or as financial assets. These arguments would be particularly forceful in the context of a repatriation claim, where a foreign government is attempting to recover an object from a museum and a decision needs to be made on ethical grounds. However, the main focus of this article has been upon the law and the issue of whether museums can justify acquiring objects which they suspect have been looted on the basis of their scientific worth and importance. I would suggest that the question over how one classifies fossils serves as a distraction in this context. No-one would dispute the scientific value of excavated fossils: they can reveal astonishing information about the world's eco-system millions of years ago. But this article has sought to demonstrate that times have changed significantly since 2001, when Nudds and others were discussing the expected ratification of the 1970 UNESCO Convention and the Convention's inclusion of fossils in its list of protected cultural property. In my opinion, the debate over whether fossils should be regarded as cultural objects or not may appear dated in this context. There are new laws which are policy driven: they have been made in response to the threats posed by transnational economic crime and terrorism and as a result they emphasise the commercial value of objects.

This article reveals a complex picture not only in relation to English law but also in relation to international conventions and resolutions. From its inception, the 1970 UNESCO Convention was concerned with protecting cultural objects from theft and looting by encouraging governments to protect their own heritage and to facilitate the return of looted items. However, the Convention can now be viewed as playing a vital part in deterring transnational organised crime. The fossil-selling industry is worth at least £100 million a year;[88] there is no reason why criminal syndicates would not be attracted to this trade, in the same way as they are to other trades such as antiquities. Equally, conventions which bring governments together to co-operate in fighting crime, such as the UN Convention against Transnational Organised Crime 2000, can help to protect cultural heritage by discouraging looting and thereby avoiding the degradation of important sites. A combination of strategies is required to effectively combat trafficking in fossils and other objects.[89]

The inclusion of fossils in UNESCO Convention's list of cultural property may well have influenced the definitions contained in criminal laws which started life in the international arena, such as those relating to Syria and Iraq. However, it is source countries' patrimonial laws and the details of our domestic criminal laws which are most likely to affect acquisitions. The cultural property laws discussed in this article do not cover every type of fossil but are confined to those which are relatively rare and valuable. These restrictions can be justified on policy grounds: these are the fossils which are most important in scientific or cultural terms and therefore most in need of protection; they are also the fossils most sought after by criminals because they are so profitable. But what of the fossils which fall outside these restrictions? Depending upon the circumstances, acquirers will still need to be careful to avoid committing an offence. Long established offences such as theft have required proof of dishonesty which can be exceptionally difficult to establish where a market is secretive.[90] In contrast, recent legislation creates offences where proof of suspicion will suffice. The best advice is therefore that anyone should refuse to accept objects where there is a suspicion that they

87 See Resolution 2347 of 2017.

88 C Milmo, 'Fossil Theft: One of our Dinosaurs is Missing' The Independent, 25 November 2009.

89 Schmidt 2000, 185.

90 Transparency International, 2015, p. 63.

have been smuggled in to the UK, regardless of whether the law considers them to be cultural property or not.

The law has therefore largely caught up with the MA's Code of Ethics, which has required museums to carry out due diligence and to reject objects where there are suspicions that they have been wrongfully traded. The concerns underlying ethical principles differ to an extent from the law. Both are based upon a desire to deter people from acquiring illicit objects because this is likely to encourage a trade which involves damaging sites and puts money into the hands of criminals. However, the MA's Code of Ethics is also intended to bolster public trust in museums. Newly acquired fossils can be an opportunity to reach out to new sections of the public and to inspire them, but museums must avoid the risk of sharing objects which are so tainted that the public loses faith in the museums concerned.

References

BESTERMAN, T.P. 2001. Frontiers to science: free trade and museum ethics. *The Geological Curator* **7** (6), 199-209.

BLAKE, J. 2000. On Defining the Cultural Heritage. *International and Comparative Law Journal* **49** (1) 61-85.

BORGSTEDE, G. 2014. Cultural Property, the Palermo Convention and Transnational Organized Crime. *International Journal of Cultural Property* **21** (3), 281-290.

CROSS, T. 2001. Dinosaur Isle Pulls 'Em In!: Dinosaur Isle, Sandown, Isle of Wight, England. *The Geological Curator* **7**(6), 231-232.

CUNLIFFE, E. 2012. *Damage to the Soul: Syria's Cultural Heritage in Conflict*. Palo Alto: Global Heritage Fund. http://ghn.globalheritagefund.com/uploads/documents/document_2107.pdf (accessed 14 September 2018)

DCMS 2017. DEPARTMENT FOR DIGITAL, CULTURE, MEDIA & SPORT, *Dealing in Unlawfully Exported Cultural Property; Guidance on the Cultural Property (Armed Conflicts) Act 2017*.

DCMS, 2005. DEPARTMENT FOR CULTURE, MEDIA & SPORT, *Combating Illicit Trade - Due diligence guidelines for museums, libraries and archives on collecting and borrowing cultural material.*

DCMS, 2004. DEPARTMENT FOR CULTURE, MEDIA & SPORT, *Dealing in Tainted Cultural Objects - Guidance on the Dealing in Cultural Objects (Offences) Act 2003.*

FORREST, C. 2011. *International Law and the Protection of Cultural Heritage*. Routledge: New York, 480 pages.

GEORGE, D. 2008. The Looting of the Iraq National Museum. *in* STONE P. and FARCHAKH BAJJALY J (eds.) *The Destruction of Cultural Heritage in Iraq* (The Bodell Press, 2008) 97.

HARRISON, R. 2013. *Heritage - Critical Approaches*. Routledge: London and New York, 272 pages.

LARSON, N.L. 2001. Fossils for Sale: is it Good for Science? *The Geological Curator* **7**(6), 219-222.

LISTON, J. and YOU, H.-L. 2015. Chinese Fossil Protection Law and the Illegal export of Vertebrate Fossils from China. *Journal of Vertebrate Palaeontology* **35** (2), 1.
https://doi.org/10.1080/02724634.2014.904791

LISTON, J. 2014. Fossil Protection Legislation: Chinese Issues, Global Problems. *Biological Journal of the Linnean Society* **113** (3), 694-706.

LISTON, J. 2013. Out of China: Dinosaur eggs and the Law on 'Kong Long Dan.' *The Geological Curator* **9** (10), 545-555.

LOULANSKI, T. 2006. Revising the Concept for Cultural Heritage: the Argument for a Functional Approach. *International Journal of Cultural Property* **13** (2), 207-233.

MACDONALD, S. 2007. Exhibitions of Power and Powers of Exhibition: An Introduction to the Politics of Display. Chapter 10 *in* WATSON, S (ed.) *Museums and their Communities*. Routledge: London and New York. pp. 176-196.

MARTILL, D. 2001. The trade in Brazilian fossils: one palaeontologist's perspective. *The Geological Curator* **7** (6), 211-218.

MARTIN, J. 2004. All legal and ethical? Museums and the International Market in Fossils. Chapter 13 *in* KNELL, S.J. (ed.) *Museums and the Future of Collecting*. 2nd ed, Routledge. pp. 155-164.

MERRYMAN, J.H. 2005. Cultural Property Internationalism. *International Journal of Cultural Property* **12** (1), 11-39.

MERRYMAN J.H. 1998. The Free International Movement of Cultural Property. *New York University Journal of International Law and Politics* **31**, 1.

NAFZIGER, J.A.R. 1985. International Penal Aspects of Protecting Cultural Property. International Law (19) 835.

NUDDS, J.R. 2001. Ethics, science and the trade: let's get together. *The Geological Curator* **7** (6), 191-198.

SCHMIDT, A.C. 2000. The *Confuciusornis Sanctus*: An Examination of Chinese Cultural Property Law and Policy in Action. *Boston College International and Comparative Law Review* **23** (2) 185-227.

TORRENS, H.S. 1995. Mary Anning (1799-1847) of Lyme; 'the greatest fossilist the world ever

knew'. *British Journal for the History of Science* **28**, 257-284.

TRANSPARENCY INTERNATIONAL. 2015. *Don't Look, Won't Find: Weaknesses in the Supervision of the UK's Anti-Money Laundering Rules*.

ULPH, J. 2016. The Museums Association's Code of Ethics 2015 XXI *Art Antiquity and Law* **XXI** (2), 143 -156.

ULPH, J and SMITH, I. 2012. *The Illicit Trade in Art and Antiquities*. Hart Publishing.

VISCONTI, A. Cultural Property Trafficking. BOISTER, N. and CURRIE, R.J. (eds). 2015. *Routledge Handbook of Transnational Criminal Law* (Routledge: London and New York.

IVORY TOWERS OF ENTITLEMENT?: THE COMMERCIALISATION OF ACADEMIC PALAEONTOLOGISTS

by J.J. Liston[a,b,c,d,e]

Liston, J.J.. 2018. Ivory Towers of Entitlement?: The Commercialisation of Academic Palaeontologists. *The Geological Curator* 10 (10): 671-680.

Palaeontology suffers from divisions amongst its community, along an ostensibly motivational division between academic and commercial palaeontologists, the former not being motivated financially, unlike the latter. These divisions are particularly polarised in the United States of America. In order to discuss why this attitude exists, even when the financial division is no longer so clear, two factors are addressed: 1, latent entitlement attitudes inherent in the academic culture; 2, the commercialisation of academic palaeontology through the incentivisation of publishing, using the Chinese experience of scientific publishing as a microcosm for palaeontology globally. These factors are then dealt with as underpinning patterns of unethical - and sometimes even illegal - behaviour by academic palaeontologists.

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Introduction

Fossil protection legislation is drafted for a variety of different reasons by different states, but usually protection of the finite palaeontological resources available is a key - if not always the main (Schmidt 2000) - driving force. 'Protection from what - or whom?' would be a reasonable question to ask, as much as 'protection for whom?'. A glance at some of the literature pertaining to this subject (e.g. Shimada *et al.* 2014, Montanari 2015) might lead one to believe that private and more particularly 'commercial' collectors were the greatest threat to fossil resources, veritably the scourge of the science. But neither of those tenets are supportable: although fossils can certainly be lost through private trade, it is far from the major cause: industrial quarrying of fossil-bearing rock for construction and road surfacing is (Martill 2018; Albersdorfer 2018; both give illustrative figures for what has been lost through commercial quarrying of the Holzmaden and Solnhofen lagerstätten for these purposes - see also, Underwood and Ward 2018). Industrial usage is unquestionably the main threat to fossils (contra Shimada *et al.* 2014), but the dimension of political will and vested interest lobbying groups cannot be ignored, as so tragically witnessed in the recent presidential move to remove protection from the national monuments of Bears Ears and Grand Staircase-Escalante in the USA, reducing them by between 50 and 85%, which shows how ephemeral legal protection of fossil resources can be by the state (Underwood 2017). Palaeontology as a science is still trapped in a dance with politics and money (Kjærgaard 2012).

Setting aside the construction and building industry, if fossil protection laws are not giving an absolute protection to the fossil resource, then who are they reserving access for, or restricting it from?

As already noted, some articles might give the impression that the fossil trade sector, which unquestionably governs the market, are universally the villains of the piece, though this does not bear close scrutiny. Montanari notes the standpoint (stated as not her own) of opposition to "the entire private fossil sale industry"/fossil trade, but even the act of referencing that as a theoretically defensible (ergo legit-

imate) position simply reinforces an unhealthy polarisation within the palaeontological community (Montanari 2015: 52).

Examples of this polarisation are not uncommon throughout the history of the science (Jones 2018). Over twenty years ago, while working at the Hunterian Museum, I was approached by the family of a fossil bird collector, looking for an institution that would take his collection. Over the course of an hour, they relayed - with remarkable anger - the degree to which the collector had met with problems from respected institutions such as the NHM (London), being informed that he should not have this material, and should hand it over to the resident academic specialist forthwith. The upshot of this was that, if the family could not find an institution to take on the whole collection, then following the demise of the collector, the collector's wife was planning to invite said academic from said institution to a meeting, and would then proceed to smash every single coveted specimen in front of him.

Such righteous destruction is not only the prerogative of the private sector. Around the same time, a national heritage officer organised a joint museum collecting trip to a SSSI locality. At the end of the day's collecting, the specimens were assessed and divided amongst the museums, with a remaining group that neither institution wanted. The heritage officer then destroyed those specimens, in order that they did not fall into the hands of others. Although the aforementioned private collector's family had their actions affected by anger, the cold decision-making of the heritage officer was not. Again, it seems that destruction of the palaeontological resource - whether by industrial aggregate quarrying, or field hammer - is preferable to the possibility of the material going to individuals outwith recognised institutions. Private collectors can be seen as problematic because their private collections can have a measure of uncertainty over the ultimate destination and fate of the specimens, as demonstrated by the preceding anecdote about the bird collector. If you have taken public enquiries at a museum, then you may well have had the fairly common experience of a public enquiry where the fossil is not that special, or is in fact merely a simulacrum (I experienced a couple of enquiries where the individual concerned was convinced that their garden rockery of glacial erratics in fact represented a dinosaur). In these circumstances, sometimes even the offer to retain the specimen overnight in order for someone else to have a look at the specimen can be met with suspicion - if the individual believes that what they have has value, then such a reaction from museum staff appears to be a sign that the staff are wanting the specimen solely for themselves, and are thus attempting to mislead the person making the enquiry. I even experienced an individual have this paranoia over a model they had made for use by the museum, convinced that the museum was going to sell it on at some astronomical profit after we had finished with the exhibition that it was intended to support. So it can be remarkably easy for the trust between external member of the public and the museum to break down.

However, sometimes a private collection does not go to a public depository for other reasons: I examined Helmut Leich's rich and extensive private collection of Solnhofen material while he was alive (Liston 2012), and was later asked to comment on what should be done with it when it came time for his family to settle his estate. Helmut had already sold a large portion of his collection to the Tiergarten in Bochum, where it has been beautifully displayed to the public. But no-one had tried to retain a relationship with Helmut in order to obtain the rest of his collection upon his death. Sometimes the executors of an estate are under instructions to realise the maximum value of the estate, regardless of what the wishes of the collector might have been (Underwood and Ward 2018). Another private collector - from Austria - ended up buying the rest of this exceptional collection. This cautionary tale serves to remind us that if a private collector goes 'unwooed' by formal institutions, then they are under no obligation to put an agreement in place for the final disposal of their collection to an official public depository.

In principle, public depositories are seen to be preferable, because private museums can be seen as by their nature not being guaranteed to be a permanently accessible store, the collections always having the potential to be rendered inaccessible for viewing for purposes of scientific reproducibility, regardless of any mission statements to the contrary. Despite the surrounding controversy, the *Tetrapodophis* ('4-legged snake') is still on display and accessible for researchers (contra Reisz and Caldwell 2016) at the Solnhofen Museum, for example (Figure 1). But, as Unwin (2016) demonstrated in Haarlem, this can happen in public institutions too (Liston 2016a; Unwin 2016; Jones 2018). Although public collections are seen as stable and safe in the long-term, due to not being privately- owned, a number of public bodies have demonstrated that that security can be illusory (whether through policy e.g. Northampton Council [BBC 2016; and Brown 2018], disaster (e.g. the recent fire at the Brazilian Museu Nacional in Rio de Janeiro) or bombing, e.g. Liston and Gendry 2015; Rauhut 2018). Conversely, institutions such as the Marshall Field Museum of Natural History and the American Museum of Natural History are private

Figure 1. Not all controversial fossils have to be as large as Sue the tyrannosaur or Ty the tarbosaur: the holotype of* Tetrapodophis*, on display in the Solnhofen Museum, following damage by a researcher, with Brazilian palaeontologist Mario Bronzati for scale, in September 2017.

institutions, yet are seen as equivalent to public ones as far as being respectable depositories. If the criteria regarding repository suitability are not about ownership, or funding, or access, then they should be revisited more clearly with this in mind, rather than utilising archaic labels that give the misleading impression of a simple black and white binary choice. If there are exceptions, the reasons for those exceptions must be clear, rather than appearing to be part of some 'old boys network' of large and highly-funded institutions.

But commercial collectors can also be regarded as a valuable outsourcing of collection (and preparation) for many museums that are neither large nor wealthy enough to regularly mount expeditions or excavations to acquire material (Underwood and Ward 2018). In a science that relies on the private sector for the majority of its major discoveries, alienating the commercial community is self-destructive, verging on scientifically suicidal. Even while private individuals retain the material, they can show researchers specimens that can solve particular evolutionary riddles, and thus alter your perception of what you should be looking for in the field - even if it is just to duplicate what you have privately seen in their collection. In that sense, they can guide the direction of your research towards something more practical to publish on. Once seen, not forgotten: as scientists we seek answers, not to deny the evidence of our senses. Scientific objectivity is distinct and separate from ownership.

Some of the pieces noted at the start of this article are particularly unhelpful for the science, akin to 'dog whistle' journalism, whereby an 'us and them' mindset is established, in which academics only do good work (however, see 'An Innocent Academic Abroad?' www.palaeocast.com/eavp-2016 Liston 2016b and Liston 2013a) and non-academic/private or 'commercial' palaeontologists only do bad (however, see Siber 2018). This unhelpful false dichotomy does little more than reinforce pre-existing senses of entitlement which have dogged the science for many decades (and, indeed, could be read as underlying the scientists charitably reaching out to 'rehabilitate' private collectors by relieving them of their specimens and taking ownership of their collections (e.g. Reisz and Caldwell 2016).

Long overdue museum loans can similarly testify to this attitude of entitlement: one of my core tasks during my time at the Hunterian Museum was to 'repossess' long overdue loans (some up to 40 years outstanding). One problem that the Hunterian had had with such overdue loans had been a bulk loan of fossil fish material to Stanley Westoll of Newcastle University, who then proceeded to ignore years of requests to have the material returned. The matter was ultimately only resolved when one of his PhD students (Mahala Andrews, who, having good relations with the palaeontologists at the Hunterian, was aware of the situation) took the opportunity when she graduated of accessing his office and removing the material while he was not around, and spiriting it back to Glasgow (J.K. Ingham, pers. comm.).

These - albeit historical - anecdotes display an element of elitism, which although not the norm, dates back a long way in academia. It involves the presumption that all specimens should be accessible to academics primarily, not in private collections, and that they should be conveniently located with reference to a given academic's own city (e.g. see Charles Combe in Liston 2013b) if not directly in the personal office of the academic in question.

Going beyond a simple entitlement to possess specific specimens, there have been occasional attempts to demonise the whole of the private/commercial fossil sector, despite the fact that there is nothing fundamentally wrong in the existence of the commercial trade for fossils. In that sense, it was interesting to note that in survey returns from 11 different countries responding to the EAVP questionnaire that resulted from the FossilLegal symposium at EAVP 2016 in Haarlem (see FossilLegal Roundtable 2016), there was a common call for the commercial trade in fossils to continue (albeit with greater transparency).

At this point, it might be worth considering the definition of the term 'commerce', and see how applicable it is to individuals engaged in palaeontology. Merriam Webster (https://www.merriam-webster.com/dictionary/commerce) defines *Commerce* as the fundamental action that takes place in every transaction involving money and/or trade, their legal definition being 1: the exchange or buying and selling of goods, commodities, property, or services. If people are going to collect and prepare fossils (that will usually otherwise be lost), then it is not unreasonable to expect them to be paid for their work. In that, they are no different to academics, selling their palaeontological skills for financial recompense - despite the fact that one is seen as more 'respectable' than the other. Acquisition of specimens as commercial intellectual assets can be similarly lucrative to the academics who get to utilise them. Academics may not like the idea that they work for money when they perform their science, yet in that sense they are as 'commercial' a palaeontologist as those that actively trade in fossils. Although this may seem like a semantic exercise in wordplay, its intention is to indicate that there is no 'clean' in this, no ideal where the science is being performed purely and clearly for its own sake: these are, after all, not the early days of the science, where so many early palaeontologists were 'men [sic.] of independent means' and so did not economically require remuneration for acquisition or preparation of fossils .

Franck once stated that "Scientific information even seems to escape valuation…the output of scientific production is not sold on markets: it is published…The performance of knowledge production can therefore not be assessed by comparing inputs and outputs in monetary terms." (Franck 1999: p.53). Separately, Merton noted (1957) "even today, when science is largely professionalised… the pursuit of science is culturally defined as being primarily a disinterested search for truth and only secondarily a means of earning a livelihood." (Merton 1957, p. 659). This paper asserts that the assessments used for financially rewarding both institutions and individual researchers are in opposition to Franck's assertion, and show Merton's cultural definition to in effect no longer be true (Mitroff 1974; Mulkay 1979), and thus that this process is in large part responsible for the warping of academic behaviour as a result of the financial incentivisation of unethical practices.

China as a Case Study: Financial Rewards for Scientific Performance

The history of financial rewards for scientific performance dates back three hundred years, even predating the Enlightenment, when the first academic prize was initiated by the Académie des Sciences in France in 1719, to recognise scientists who had contributed to the advancement of knowledge in Astronomy (Quan *et al.* 2017). The most recent surge in financial rewards for scientific departments or individuals came in the wake of 1986's Earth Science Review (Liston 2011) and the introduction of the Research Assessment Exercise in the UK, placing peer review and past performance with publications at the core of allocating funds to university science and engineering departments (Franzoni *et al.* 2011). Other countries followed suit (Quan *et al.* 2017), some giving cash bonuses to individuals rather than institutions for each article published. Franzoni *et al.* (2011; p.702) noted that in North America "Promotion and tenure, as well as compensation, depend to a considerable extent on a faculty member's publication record" (p.702), and that Germany and Spain have also introduced incentive schemes targeted at individuals rather than institutions - tying "access to university careers, promotion, and salary, linking them more tightly to international publications" (2011: p.702). Academics are thus susceptible - if not directly dependent on - a financial temptation (and a competitive one) that commercial collectors are not. And academics do indeed respond strongly to financial incentives: for its fifth anniversary, the open access biological sciences journal PeerJ waived its $800 dollar publishing fee, resulting in an overwhelming surge of over 1,500 manuscript submissions in the single month of February 2018. Similarly, the general science open access journal Royal Society Open Science achieved a peak level of submissions in December 2017, their final month without article processing charges: at the end of their first year charging for article handling, their monthly submission figures for December 2018 showed around a 40% drop in numbers of manuscripts submitted, compared to the previous December.

In this regard, it is instructive to look more closely at the situation in China. China offers a high chance of palaeontologically novel specimens, with a large landmass with comparatively limited past palaeontological exploration, yielding many exceptional palaeontological lagerstätten over the past 40 years that have rewritten several evolutionary models, and continue to do so (Liston 2014). Thus, as a nation, it has a large source of material of interest to high impact journals, and a community of palaeontological scientists in an environment utilising a financial reward system for individuals. Following the pattern of other countries, Nanjing University first used Science Citation Indexing (SCI) as part of their academic evaluation in the 1980s (Shao and Shen 2011), their Department of Physics offering a monetary reward to individuals of 25 US dollars per paper in

1990 (Quan *et al.* 2017). Their entrepeneurial approach led to them topping the list of institutions with the most Web of Science papers for seven years in a row - this policy was quickly copied by other institutions (Quan *et al.* 2017), with the number of SCI papers being used to evaluate the research performance of individuals and institutions across the country. The subsequent enthusiastic adoption of SCI publications as a benchmark has resulted in the production of such a publication often being a precondition of receiving a PhD (Hvistendahl 2013).

The use of SCI as an academic indicator for its institutions by China is slightly counter-intuitive, as very few Chinese journals are included: in 2009, Journal Citation Reports noted that out of 4,800 journals published in China, only 114 (or 1.5%) make it into the list of 7,387 SCI journals worldwide, and only three of those 114 have an impact factor (IF) greater than 3.0 (Shao and Shen 2011). As a result, there has been a wholesale dismissal of Chinese journals as a place to publish, by what should be their natural constituency - Chinese scientists. Cyranoski (2010: 261) noted "Approximately one-third of the roughly 5,000 predominantly Chinese-language journals are 'campus journals', existing only so that graduate students and professors can accumulate the publications necessary for career advancement". As an example, the campus *Journal of Zhejiang University-Science* which was designated as a key academic journal by the National Natural Science Foundation of China, found 31% of the papers (692 of 2,233 submissions) submitted to it over the preceding two years contained plagiarised material (Zhang 2010), a quality problem that has led the Chinese Government to criticise the quality of its country's scientific journals (Cyranoski 2010).

The range of financial rewards available at universities in China (over 1,200, which between them provide 83% of the SCI papers that workers in China produce) have increased significantly since Nanjing University pioneered the policy in 1990 (Quan *et al.* 2017). By 2016, the funds provided extended anywhere from 30 to 165,000 US Dollars for a single SCI paper (Quan *et al.* 2017). Out of 168 different cash reward policies offered by different institutions, 118 only awarded money to the first author (22 of those policies required them to be both the first and corresponding author) (Quan *et al.* 2017). Others, such as the aforementioned Zhejiang University, offered the equivalent of 30,000 Euros to the first author of a *Nature* or *Science* paper, with 50% for each subsequent author (Shao and Shen 2011).

From 2008-2016, the average paid for a publication in *Nature* (IF around 41) and *Science* (IF around 34) went up from 26,212 USD to 43,783 USD. PNAS (*Proceedings of the National Academy of Sciences of the United States of America*, IF around 10) was more or less static at just over 3,100 US Dollars on average, with *PLoS One* around 1,000 US Dollars. There are indications that the policy has been refined in order to encourage applications to high impact journals, with payments to lower impact journals having decreased over the past ten years (thus encouraging impact over quantity) (Quan *et al.* 2017).

These figures are consistent with what I experienced during my time as Head of the Vertebrate Palaeontology Research Group of the Yunnan Key Laboratory of Palaeobiology in Yunnan University. One of China's oldest universities (albeit less than 100 years old), it is a Tier 2 university (Quan *et al.* 2017). The tiers result from a focused attempt in the late nineties to target university funding in order to create world-leading institutions, so that amongst the more than 1,200 universities in China, 112 universities occupy Tiers 1 and 2, with 70% of the national research funding (Quan *et al.* 2017). In 2015, the average annual budget of a Tier1/Tier 2 university was 113 million US Dollars, but only 9.27 million US dollars for the remaining 1,124 average Tier 3 institutions. University funding also comes from local government, so is reflected in the relative wealth of the economic development of the different provinces, so that a regional differential occurs. At Yunnan University in 2013-2014, there was a pot of 3 million Yuan/RMB per year to pay researchers for publications. To qualify, the journal had to be SCI-listed, and the staff member had to be the first or corresponding author. Although in principle the fund was divided up amongst all the staff that qualified in the preceding year, there was a caveat: any paper published in *Nature* or *Science* would mean that the author received ten percent of the pot automatically - the equivalent of 30,000 sterling or 45,000 Euros or almost 50,000 US Dollars (broadly 2013-2014 exchange rates). This mean that if ten papers were published in *Nature* or *Science*, the pot could be completely wiped out, with nothing left over for authors with other SCI publications. Thus, the incentive was that if you wanted a guaranteed income, you had to try for *Science* and *Nature* at all costs, or risk another researcher taking 'your share of the pot' for the year.

It should be noted that, as much as this is using China as a model with which to explore the more global effects of financial incentives in palaeontology, the incentives in China are truly transformational sums of money for the individual scientists concerned: academics in China are highly likely to be on a salary

less than 10,000 US Dollars annually, with the prospect of an equivalent sum between 30 and 165,000 US Dollars for a single publication in *Nature* or *Science* (Quan *et al.* 2017). Quan *et al.* (2017) report the average basic salary of university professors as the equivalent of 8,600 US Dollars (in line with the 5,000 RMB per month, equivalent to 6,000 sterling or 9,000 US Dollars per annum that I was paid), with newly-hired professors being on 3,100 US Dollars per annum. With such a low salary (the cost of accommodation in China is often at western levels) relative to the publication bonuses, the institutions in China are adopting a very similar model of incentives to that used in many diners in the USA, in that the basic salary for the staff waiting tables is less than adequate, and it is inherent in the employment contract that the staff will top that basic salary up to a more acceptable level through tips (Tarantino 1994).

The cash reward policy has therefore been an unsurprising success, in an environment where a single paper can earn 20 times a professor's annual salary (Quan *et al.* 2017). In the early 1990s, China produced only around 6,000 SCI/Web of Science indexed papers per year (Shao and Shen 2011); this escalated to 13,134 in 1995 (Quan *et al.* 2017), 41,417 in 2002 (Hvistendahl 2013), 95,500 in 2008 (Shao and Shen 2011), 193,733 in 2012 (Hvistendahl,2013), and 232,070 in 2013 (Quan *et al.* 2017). Since 2009, it has been the second largest (16.3%) producer by nation of SCI/Web of Science papers in the world (Quan *et al.* 2017). In order to support this, China's national research expenditure has increased by more than 32 times between 1995 and 2013 (from 5.23 billion US Dollars to 177.70 billion US Dollars) (Quan *et al.* 2017).

Unsurprisingly, the universities in China have enthusiastically embraced this behavioural trend: the academic level of an institution is evaluated on the number of SCI papers it produces, as well as the grants that it receives (and, given the reduced level of external grant access that will be available with 2017's implementation of the 'Law on Management of Domestic Activities of Overseas Non-governmental Organizations', which means that other sources such as National Geographic grants will also be out of reach, there is likely to be an even greater emphasis on publications for Chinese institutional income, Gan 2017; Huang 2017). It therefore makes economic sense for institutions to offer monetary incentives for staff to publish more SCI papers. Noting that money is a "universal reinforcer", Shao and Shen noted that "greed, pride, and envy will all work to get academics eagerly and enthusiastically publishing in the best journals" thus meaning the status of the institution will rise, enabling it to charge higher fees (Shao and Shen 2011; p.95). This metric is also used for job promotion.

This encouragement was clear from my time in Yunnan: not only were the journals *Nature* and *Science* explicitly stated in my contract as destinations to publish within (with an attached penalty of 5,000 US Dollars for failure to submit there), but on the day in 2013 that the revised journal impact factors were released, the deputy head of department sent an Excel spreadsheet around to all staff, with all journals listed next to their new impact factor, to indicate where they should submit their research to. This financial incentivisation led to something of a distortion to the process of journal selection: the selection process that a scientist in such an environment goes through in terms of deciding which journal to try and publish in tends to be based on 'which pays the most' rather than 'which is most appropriate or likely to publish this work', leading to one colleague submitting his research on China's Chengjiang biota to the journal *Gondwana Research* (purely because it had an impact factor of 8.122) in spite of it being clearly outwith the scope of the journal. Thus a 'food chain of papers' is entered into, heavily overweighting top journal reviewers and editors (and, presumably, with concomitant rises in journal fees in the longer term). It is thus unsurprising that the study of Franzoni *et al.* (2011) noted that in China, although cash bonuses to individuals were positively correlated with submission rates, they were negatively correlated with acceptance rates.

However, while China's policy has resulted in Chinese scientific output being driven up, until it is only second to the USA in global ranking, the incentives have, in the process, warped the science.

Cash For Consequences

In the twenty years since 1996, corrections to papers by Chinese authors have increased from 2 to 1,234 (Quan *et al.* 2017), representing an increase an order of magnitude greater than the increase in the number of SCI papers published from China over a similar period. In 2015, an editorial in The Lancet (Lancet 2015) noted that 42 papers by Chinese authors had been retracted by BioMed Central in a single week in March 2015. The associated investigation had revealed systematic manipulation of the peer-review process through third party agencies. This seems to echo Franck noting perhaps presciently in 1999, that "There are ways of accumulating citations that have little to do with scientific value. The simplest way of circumventing the hurdle of productivity enhancement is the formation of citation cartels. One's

account of citations can also be augmented without enhancing one's productivity by playing off one's power as an editor or referee…The formation of citation cartels is a way of organizing monopoly power on the part of the producers." (Franck 1999: p.54). Of greatest concern was the fact that the papers had come from a series of respected medical institutes in Beijing, Shanghai, Xi'an and Chengdu, suggesting a widespread infiltration into the country's research culture (Lancet 2015). This article certainly appeared to reveal the 'gaming' of the system that Franck (1999) had referred to. This was further support for findings from a previous investigation by Hvistendahl for *Science*, who noted the selling of authorships for a thousand dollars and upwards: "The options include not just paying for an author's slot on a paper written by other scientists but also self-plagiarizing by translating a paper already published in Chinese and resubmitting it in English; hiring a ghostwriter to compose a paper from faked or independently gathered data; or simply buying a paper from an online catalogue of manuscripts-often with a guarantee of publication." (Hvistendahl 2013, p.1036).

It is interesting to note that the majority of feathered bird/dinosaur specimens from Liaoning Province (whether destined to be smuggled out of China or worked on at research institutions) are excavated illegally by peasant farmers (Liston 2013a), despite the fact that the Chinese government has declared that no non-government agency may excavate these bird fossils. The farmers are willing to risk severe consequences (Liston 2013a; Liston and You 2014) because the price smugglers are willing to pay for these birds is equal to the pay gained after two years (Liston 2014) of farm work. In this economic respect, Chinese farmers are in a very similar position to Chinese academics, in terms of the pressure to massively increase their income. The extremity of the Chinese experience is likely driven by the extremity of their policy in terms of the salary:cash bonus ratio, but this is not to dismiss the impact of similar - if less overt - incentives in other territories, whether pursuit of tenure in the US or fulfilling the requirements of academic departments (as modelled in the Earth Science Review, Liston 2011, and executed similarly in the Research Assessment Exercise for 1986-2008, and thereafter in the Research Excellence Framework from 2014, next scheduled for 2021) in the UK.

What is true internationally is that where you publish your work, and how it affects your job security, or the grants given to your department, all have major implications as financial incentives. The similarity of the pressures leads to similar unethical behaviours globally, in the pursuit of publication in high impact journals. Monetary remuneration both directly and indirectly affect academics in palaeontology, and to pretend otherwise is to understate the risk of professional standards being compromised by the lure of this universal rewards system. When money affects career progression as a scientist, it will distort science, leading to risks of falsified data or the obtaining of fossils from compromised sources. This has particularly high risks in vertebrate palaeontology, where access to unique specimens can significantly enhance or accelerate a career trajectory. Larivière and Sugimoto (2018) have noted that a journal's impact factor is used to assess individuals for recruitment and promotion, and the attendant distorting factors on science, echoing the findings of Abbott *et al.* (2010) on how 71% of academics believed that impact factor affected their chances of promotion (and that they will likely affect the letters of recommendation that people submit for tenure application), with the result that they had altered their research behaviours accordingly. As Franck (1999; p.53) noted: "Scientists are turned into citation-maximizers when they expect those deciding on scientific careers to consult the SCI above anything else."

Unsurprisingly, it is all about money (Kjærgaard 2012). Although the scale may differ, the financial pressures exist in a global context, and the impacts and consequences of this policy can best be seen in China, where the system of financial remuneration for publications is at its most extreme (the simple choice to researchers being 'publish, or become impoverished', Quan *et al.* 2017), and the most research has been done on its effects. But the important effect here is the inducement to compromise professional ethics and break the law. In this, there has often been a complicity of publishers, as not only are they required to ask few questions of the author in order for novel specimens of questionable provenance to be published, but journal publishers will actively benefit from publishing the novel specimens in a very similar way to the authors themselves. The Museums' Association's ethics statement declares that: (Section 2.5, page 15, see Brown 2018) all those who work in and with museums should: "Reject any item for purchase, loan or donation if there is any suspicion that it was wrongfully taken during a time of conflict, stolen, illicitly exported or illicitly traded, unless explicitly allowed by treaties or other agreements, or where the museum is co-operating with attempts to establish the identity of the rightful owner(s) of an item.", but there is no similar body regulating publishers to have a similar approach for objects that they publish on, each journal instead being relied on to produce its own policy. As an example of this, until recently, *Nature* did not put great emphasis on authors having to prove the legiti-

mate provenance of specimens that they wished to publish on (e.g. Hirayama 1998) even when queries were raised during their own review process regarding fossil material from China (Liston 2013a; 2016b). However, at the end of 2015, following the lead of PLoS One (Liston and You 2015; Stead 2016), *Nature* changed its policy, requiring a specimen to have full provenance disclosure, responsible collecting and deposition in a recognised depository, as well as complying with local legislation and presentation of permits. Evidence of legal export would also be useful, for any other journal looking to adopt suitable and responsible policies.

Similarly, the international Society of Vertebrate Paleontology revised their ethics statement in 2015, containing in part a very specific response to incidents involving academics publishing specimens that had been illegally excavated and/or exported (Liston 2016b; 2017). Under Section 2, 'Adherence to regulations and property rights', is stated:"It is the responsibility of vertebrate paleontologists to assist national government agencies in the development of management policies and regulations pertinent to the collection of vertebrate fossils, and shall comply with those policies and regulations during and after collection. The necessary permits on all lands administered by federal, state, and local governments must be obtained from the appropriate agency(ies) before fossil vertebrates are collected and/or exported. Collecting fossils on private lands must be done only with the landowner's explicit consent. Members found in breach of the Code could face action that includes being expelled from the Society, being prohibited from publishing in the society's journals, and excluded from all society activities including the annual meeting." The need for this step to be taken is perhaps a reflection that the academic sense of entitlement (for which, one can read Jones' 'assumptions of authority', 2018) from a former age persists in a less than harmless way in the twenty first century.

This is an important step, as until the academic palaeontological community demonstrates that it will not turn a blind eye to academic malpractice (or "academic imperialism" Liston 2014: p.705) in favour of condemning the commercial sector, it will appear to be hypocritically acting to 'defend its own' as somehow beyond reproach, and preserve special access to specimens for itself alone. Not only does the private sector - who were the origin of vertebrate palaeontology and continue to be its lifeblood, providing the vast majority of the most important specimens for our science - sustain often unfair criticism, but it is frequently vilified as a whole for the actions of a minority in a way that academics are not. When academic publications have financial significance, illegal fossil excavation and transport cannot be so easily dismissed as solely a problem of part of the 'commercial' fossil trade (Liston 2017). Until SVP and other bodies have been seen to act strongly to ensure that its own membership adheres to regulations, regardless of whether the member is an academic or from the private/commercial sector, it will be hard to see an approach that fails to bring academics to book as anything other than hypocritical and a sign of a perpetuated academic entitlement (with reference to restricted access, see also Underwood and Ward 2018).

Conclusions

In the strict sense of commerce - that is the provision of goods or services for money - academic palaeontologists are indeed commercial - they are providing their paid-for services, and have to play the publication game in order to increase their financial take for those services, whether in absolute funds or promotion and career progression. In that sense, the pressures evident in China are present everywhere, even if the sums involved do not represent many times the individual's annual salary. The financial incentives for high impact publications on both the sides of the researchers AND the publishers fuels the academic sector as well, distorting the outcome priorities for the science. Celebrity has been noted by Jones (2018) as having a distorting effect on science, and I would similarly argue this for money. This has implications for the commodification of science as a whole (whether one can commodify fossils or not is a separate question from whether or not they should be). So, in a perhaps similar way to Heisenberg's uncertainty principle (where the act of measuring or paying 'scientific attention' to an object directly affects its measurable properties), media attention and 'financial attention' will also distort science (whether for good or for ill might be subject to debate), whether through facilitating promotion, high ranking publications, prestige for the hosting institution, increased profile for the publishing journal, cash payments for individual investigators, or publication fees demanded by journals.

In an environment where the increasing pressure for high impact factor publications in exchange for career progress (and academic survival) compels moral compromises, the world of academic palaeontology is increasingly just as much fuelled by money as the commercial sector is. The Chinese situation should thus not be viewed as something unique, as similar resource pressures apply worldwide in a time of legislation that tends to be obstructive - because that is cheaper to implement than facilitative - and in

a time of increased pressure on the productivity of researchers. As such, there are more economic incentives now for academics to publish on illegally excavated and illicitly exported palaeontological specimens than ever before. This is what tempts the European student trying to create that publication record that should secure their first post, or the established North American palaeontologist that wants to stay relevant and believes that they can get away with it, because they are beyond reproach, part of an elite that noone would question. People will turn a blind eye to academics complicit in illegal export where they will not for private or commercial collectors. In this way, through the twin factors of latent entitlement attitudes inherent in the academic culture, and the commercialisation of academic palaeontology through the incentivisation of publishing, this pattern of unethical behaviour persists - and may even thrive - even if it is clearly illegal. One of the differences ushered in by the commercialisation of academic palaeontology is the degree to which a sense of entitlement to fossils can be driven financially as a new manifestation of the old syndrome of entitled behaviour.

Franck's scientific production outputs no longer escape valuation, and have now become commodities with a monetary value. In short, although we may marvel at the extremity of its cash-for-publications system - and the corrupt black market practices that surround it - China's approach may well prove to be an indication of the shape of things to come in a more global sense for palaeontology, with greater pressure to publish on more questionable specimens in order to advance - or even just tread water - in an academic career.

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References

ABBOTT, A., CYRANOSKI, D., JONES, N., MAHER, B., SCHIERMEIER, Q., and VAN NOORDEN, R. 2010. Metrics: Do metrics matter? *Nature* **465** (7300), 860-862 DOI: 10.1038/465860a

ALBERSDORFER, R. 2018. Fossil legislation - protection or destruction? *The Geological Curator* **10** (10): 603 - 605.

BBC - 2016 Northampton Sekhemka statue sale: Council 'warned by lawyers'. http://www.bbc.com/news/uk-england-northamptonshire-37338390

BROWN, A. 2018. Introducing the revised Code of Ethics for Museums. *The Geological Curator* **10** (10), 681 - 686.

CYRANOSKI, D. 2010. Criticism by Chinese Government of Chinese scientific journal quality: *Nature* **467** (7313): 261.

FOSSILLEGAL. 2016. Roundtable discussion. https://youtu.be/4SUVYuyqkm4 Part of the FossilLegal Symposium at EAVP Haarlem, 2016.

FRANCK, G. 1999. Science communication - a vanity fair? *Science* **286** (5437):53-55.

FRANZONI, C., SCELLATO, G., STEPHAN, P. 2011. Changing Incentives to Publish. *Science* **333** (6043):702-703.

GAN, N. 2017. Why foreign NGOs are struggling with new Chinese law. South China Morning Post. http://www.scmp.com/news/china/policies-politics/article/2097923/why-foreign-ngos-are-struggling-new-chinese-law

HIRAYAMA, R. 1998. Oldest known sea turtle. *Nature* **392** (6677): 705-708. doi:10.1038/33669

HUANG, Z. 2017. NGOs are under threat in China's latest crackdown against "foreign forces" Quartz Media. https://qz.com/873489/ngos-are-trying-to-stay-alive-in-chinas-latest-crackdown-against-foreign-forces/

HVISTENDAHL, M. 2013. China's Publication Bazaar. *Science* **342** (6162):1035-9. doi: 10.1126/science.342.6162.1035.

JONES, E. 2018. Fighting about Fossils (again?) - A history of science view of a contemporary controversy in palaeontology. *The Geological Curator* **10** (10): 591 - 601.

KJÆRGAARD, P.C. 2012. The Fossil Trade: Paying a Price for Human Origins. *Isis* **103**:340 -355.

LANCET. 2015. China's medical research integrity questioned. *The Lancet*, Volume **385**, Issue 9976, 1365.

LARIVIÈRE, V. and SUGIMOTO, C.R. 2018. The Journal Impact Factor: A brief history, critique, and discussion of adverse effects. In the forthcoming: GLÄNZEL, W., MOED, H.F., SCHMOCH U., THELWALL, M. 2018. Springer Handbook of Science and Technology Indicators. Cham (Switzerland): Springer International Publishing.

LISTON, J.J., 2011. The Earth Sciences Review: Twenty Years On. *The Geological Curator* **9** (6): 363 - 369.

LISTON, J.J. 2012. *Leedsichthys*: A very private suspension feeder. *Deposits magazine* **29**, 36-40.

LISTON, J.J. 2013a. Out of China: Dinosaur eggs and the Law on 'Kong Long Dan'. *The Geological Curator* **9** (10): 545 - 555.

LISTON, J.J 2013b From obstetrics to oryctology: inside the mind of William Hunter (1718-1783) *In*: Duffin, C. J., Moody, R.T.J. & Gardner-Thorpe, C. (eds) 2013. *A History of Geology and Medicine*.Geological Society, London, Special Publications, 375, http://dx.doi.org/10.1144/SP375.21

LISTON, J.J. 2014. Fossil protection legislation: Chinese issues, global problems. *Biological Journal of the Linnean Society* **113**, 694-706.

LISTON, J.J. 2016a. 'Fossillegal': a symposium on ethics in palaeontology - *The Palaeontological Association Newsletter* **93**, 27-31.

LISTON, J.J. 2016b. An innocent academic abroad?: Easy fossils and hard choices, China as a microcosm of the challenges of 21st century palaeontology. https://youtu.be/WGkDq116i4o Part of the FossilLegal Symposium at EAVP Haarlem, 2016.

LISTON, J.J. 2017. Paleontological research in China in the context of the new SVP ethics statement. *Journal of Vertebrate Paleontology, Program and Abstracts* 2017, p.151.

LISTON, J.J. and GENDRY, D. 2015. Le Python de Caen, les algues géantes d'Amblie, et autres specimens perdus de *Leedsichthys* d'Alexandre Bourienne, Jules Morière, Eugène Eudes-Deslongchamps et Alexandre Bigot. L'Écho des Falaises, 19:17-33

LISTON, J.J. and You, H-L 2015. Chinese fossil protection law and the illegal export of vertebrate fossils from China. *Journal of Vertebrate Paleontology* **35** (2):1-7. DOI: 10.1080/02724634.2014.904791

MARTILL, D.M. 2018. Why palaeontologists must break the law: a polemic. *The Geological Curator* **10** (10), 641 - 649.

MERTON, R.K. 1957. Priorities in scientific discovery: A chapter in the sociology of science. *American Sociological Review* **22** (6): 635-659.

MITROFF, I.I. 1974. Norms and counter-norms in a select group of the Apollo Moon Scientists: A case study of the ambivalence of scientists. *American Sociological Review* **39** (4): 579-595.

MULKAY, M.J. 1979. *Science and the sociology of knowledge*. Winchester, Massachusetts: Allen and Unwin.

MONTANARI, S. 2015, Ethics in palaeontology: problems and solutions, *PalAss Newsletter* **90,** 52-54.

QUAN, W., CHEN, B., SHU, F., 2017. Publish or impoverish: An investigation of the monetary reward system of science in China (1999-2016) https://arxiv.org/pdf/1707.01162.pdf

RAUHUT, O.M. 2018. Publish before they perish: Dealing with privately owned specimens in palaeontology. *The Geological Curator* **10** (10): 561 - 564.

REISZ, R.R. and CALDWELL, M.W. 2016. Harness passion of private fossil owners. *Nature* **537** (7620): 307

SCHMIDT, A.C. 2000 The *Confuciusornis sanctus*: an Examination of Chinese Cultural Property Law and Policy in Action. Boston College International and Comparative Law Review 23: 185-227. Article 3. Available at: http://lawdigitalcommons.bc.edu/iclr/vol23/iss2/3

SHAO, J. and SHEN, H. 2011. The outflow of academic papers from China: why is it happening and can it be stemmed?. *Learned Publishing* **24** (2): 95-97. doi:10.1087/20110203

SHIMADA, K, CURRIE, P. J., SCOTT, E., and SUMIDA, S. 2014. The greatest challenge to 21st century paleontology: When commercialization of fossils threatens the science. *Palaeontologia Electronica* **17** (1).1E palaeo-electronica.org/content/2014/691-great-threat-in-21st-century

SIBER, H.J. 2018. 40 Years as a fossil prospector, collector and exhibition maker. *The Geological Curator* **10** (10): 565 - 568.

STEAD, N. 2016. Fossils, Publishing and Open Access. *https://youtu.be/rKeeKkgmiT8* Part of the FossilLegal Symposium at EAVP Haarlem, 2016.

TARANTINO, Q. 1994 Reservoir Dogs, Faber & Faber p.7-10

UNDERWOOD, E. 2017. Q&A: Why fossil scientists are suing Trump over monuments downsizing. *Science Magazine* doi:10.1126/science.aar6856

UNDERWOOD, C.J. and WARD, D.J. 2018. Site-specific limitations on the use of palaeontological resources. *The Geological Curator* **10** (10): 617 - 631.

UNWIN, D.M. 2016. Hands off, it's my collection! Fossils, museums and the problems of access. https://youtu.be/se7r_ZecaMM

ZHANG, Y. 2010. Chinese journal finds 31% of submissions plagiarized. *Nature* **467** (7312): 153.

INTRODUCING THE REVISED CODE OF ETHICS FOR MUSEUMS

by Alistair Brown

Brown, A. 2016. Introducing the revised Code of Ethics for Museums. *The Geological Curator* 10 (10): 681-686.

The Museums Association consulted with the museums sector on changes to the Code of Ethics during 2014-5, and published a revised Code of Ethics for Museums in November 2015. The new version reaffirms 'core' ethical stances on disposal and acquisition of museum collections. It also expands the concept of museum ethics to include consideration of issues of public benefit, freedom of speech, institutional integrity and sponsorship.

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Introduction

It was a pleasure to speak at the Geological Curators Group conference in December 2016. I have set out in the short paper below a summary of the remarks that I made to introduce the revised Code of Ethics for Museums, which was adopted at the AGM of the Museums Association in November 2015.

The Code of Ethics for Museums is just that - a code for how we behave as representatives and ambassadors for museums and the museum professions. As well as bringing expertise in our respective specialisms, we are all ambassadors for museums, and it is only through our commitment to a set of shared ethical principles that we can maintain the good name of our sector. The code specifically addresses your work as museum professionals, and I want to look at how and when it might be useful to you in this context.

The Code of Ethics for Museums has a long history: The Museums Association has acted as the guardian of the Code of Ethics for Museums in the UK since the first formal code was drafted in 1977. We have a record of advising on and protecting the good conduct of the museums sector. The latest version of the Code of Ethics is a new step in making our sector's ethics updated and relevant to the issues that we face today, while maintaining the core of our ethics that has run through all previous codes. The new code introduces a three pillar structure which helps us to define the key areas of our professional ethics: Public Benefit and Engagement; Stewardship of Collections; and Individual and Institutional Integrity.

Let's look first at the issue of Stewardship of Collections. All versions of the Code have at their core our ethical responsibility to protect collections. Collections are what make museums unique and single us out from other public organisations. The preservation of our material culture and scientific collections differentiates the museum from libraries, archives, community groups, laboratories and other public organisations. In addition, our mission to use and preserve our collections for the public good distinguishes us from private collectors or antique dealers. Holding publicly accessible collections in perpetuity means that our collections are removed from the market, available for study and enjoyment, and held with other relevant collections.

This idea that we must preserve collections is just as important today as in decades past, and the new code reaffirms many of the ideas that have been developed in previous versions of the code. It states that we should: "treat museum collections as cultural, scientific or historic assets, not financial assets." In particular it sets out a strict set of criteria under which financially motivated disposal can be carried out ethically, including the need for thorough consultation, the need for the item in question to be outside the core collection, the need for the sale to be as a last resort and not designed simply to raise short-term revenue. These criteria are also supported by a substantial Financially Motivated Toolkit developed by the MA and other sector organisations and available on the MA website.

The need for such guidance was demonstrated by the high-profile sale in 2014 of the Sekhemka Statue by Northampton Borough Council . Their insistence on selling the statue, without any real consultation and in the face of bitter opposition from local interest

groups as well as the Egyptian government resulted in the loss of their membership of the MA and their ACE Accreditation.

But the Code is not anti-disposal. While previous versions of the Code were less flexible on this point, the new Code has a nuanced vision of what disposal can mean. It recognises that good collections management sometimes necessitates disposal, and states in para 2.8 that "Responsible disposal takes places as part of a museum's long-term collections development policy and starts with a curatorial review. [Museums should…] Ensure transparency and carry out disposal openly, according to unambiguous, generally accepted procedures." Those 'generally accepted procedures are summarised in another toolkit - the Disposal Toolkit - available on the MA website. They set out a process which essentially provides a hierarchy of methods of disposal. An important part of this is the MA's Find An Object scheme, which is accessible through our website and in the Museums Journal, allowing you to find a new museum home for objects that no longer fit in your collection.

If the code has much to say about disposal, it also has much to say about acquisition. In particular, it highlights the duty upon museums to conduct due diligence in establishing the provenance of items that are accessioned into museum collections. Paragraph 2.5 states the need to "Reject any item for purchase, loan or donation if there was any suspicion that it was wrongfully taken during a time of conflict, stolen, illicitly exported or illicitly traded."

Museums have not always been good at this. Historic documentation is not always what we would wish, and we know full well that much of what was brought to the UK in colonial times is highly contested. There is, I think, a wider societal conversation that we need to be alive to about calls for repatriation and the 'decolonisation' of our culture. The debate about Rhodes Must Fall at Oxford University at the start of 2016 points the way here, and we should be alive to it happening in the UK - even perhaps in relation to geological collections. The Code of Ethics cannot, by itself, resolve these issues, but it does recognise and support the case-by-case repatriation of objects - something that is actually happening fairly regularly, out of the spotlight of the media, across the country.

But if we cannot fully resolve the issues raised by historic acquisitions, we can at least ensure that contemporary collecting follows stricter rules. Hence, we expect museums to operate within the terms of the 1970 UNESCO Convention on Preventing the Illicit Trade in Cultural Goods, the CITES treaty, the Nagoya Protocol, and to act with transparency and honesty when collecting.

I am, of course, aware of some of the discussions that this group has had in the past about the problems posed by such rules in relation to the trade in geological and palaeontological specimens. In the past some curators have argued against the provisions of the Code of Ethics for Museums when it comes to the purchase of natural history specimens abroad. Some have argued that ethical rules that sought to prevent the acquisition of illicitly traded cultural goods was stifling our museums' ability to collect and research new specimens, and advocated 'rescue purchase'. Meanwhile, others have countered that existing rules, including the 1970 UNESCO Convention and the Code of Ethics are in place precisely to avoid the kind of collecting that can damage key source material, break the laws of the countries of origin and disrespect local knowledge, customs and expertise. I hope that these arguments are closer to being settled today than in the past - certainly the new Code of Ethics guidance document makes it clear that adherence to the UNESCO Convention is still important - and indeed, since its ratification into UK law, this becomes a legal issue as much as an ethical one.
Let's look at other another area of the new code - Public Benefit and Engagement. Acting as good stewards of collections only truly has value if those collections deliver a public good. Of course, providing a public good can take many forms, but the Code sees it as having a number of key aspects:

Access without discrimination, and working actively in partnership with communities to deliver a social good means that it is not ethical for us to rest on our laurels, to work in isolation from the public who benefit from - and, in many cases, own - our collections. We have a duty to work with and for audiences and communities - locally and thematically - and to include them in the discussions that we are having.
This also means that we have to be trusted by our public - trusted to generate accurate information, recognising that expertise can lie with museum users as well as curators, and working with them in partnership.

Being trusted to work for the public benefit also means maintaining our editorial or curatorial integrity. We increasingly see instances of interference - or at least the appearance of interference - in our museums, and we cannot be deemed to be working for the public good if we are seen to be working instead in the pay or under the influence of a particular group or business interest. There is always a fine line between partnership, interference and censorship - but we need to be careful when working in this area. The

example of Shell's involvement with the Science Museum was one recent example where the appearance of something not being right was potentially damaging to the entire sector.

And this brings me to the final pillar of the Code - the need for individual and institutional integrity. Upholding individual integrity means acting at the personal level in a way that does not bring the sector into disrepute. Hence, this section of the Code requires us to avoid providing financial valuations of works, to avoid collecting works privately in competition with the museum, and to avoid speaking on behalf of the museum in a private capacity. Much of this is inherited from the old version of the Code, though this makes it no less important.

An area that does differ from the old version is in the section on Institutional Integrity. This section responds to growing concerns about the influence of funders in the museum - not just in the curatorial sphere, but the institution as a whole. I'm sure most of you are familiar with the range of campaigns against the oil industry in the cultural sector that are ongoing. These and other campaigns have caused many to question the role of certain sources of finance in museums, and while I don't think the new Code would claim to have resolved these issues, it does encourage museums to take a more proactive stance in ensuring that their funding source is researched and deemed ethically compatible with the museum when it is seeking new sources of funds.

This is a whistlestop tour of the new Code and some of the key changes to it. However, I hope that this sheds some light on the set of shared principles that form the basis of the sector's ethics, and that we can continue to enjoy a productive dialogue on how these principles can apply across all specialisms.

APPENDIX - CODE OF ETHICS FOR MUSEUMS

Code of Ethics for Museums

Introduction

Museums are public-facing, collections-based institutions that preserve and transmit knowledge, culture and history for past, present and future generations. This places museums in an important position of trust in relation to their audiences, local communities, donors, source communities, partner organisations, sponsors and funders. Museums must make sound ethical judgements in all areas of work in order to maintain this trust.

This Code supports museums, those who work in and with them and their governing bodies in recognising and resolving ethical issues and conflicts. It sets out the key ethical principles and the supporting actions that museums should take to ensure an ethical approach to their work.

Ethical reflection is an essential part of everyday museum practice. This Code cannot contain all the answers to the ethical issues that museums face. Some actions that constitute a breach of the Code will be more clearly distinguishable than others. However, in all cases, practitioners should conduct a process of careful reflection, reasoning, and consultation with others, as well as consulting further detailed guidance on key areas of museum practice prepared by the Museums Association (MA) and other bodies.

Application of the Code

All museums are bound by national laws and international conventions relevant to museums (see Guidance for details). The Code supports this legal framework and sets a standard for all areas of museum practice.

The Code applies to governing bodies, those who work for museums, paid or unpaid, to consultants and those who work freelance, and to those who work for or govern organisations that support, advise or provide services to museums, including the MA. Those working in associated sectors such as archives and heritage organisations may also choose to adopt this Code. They should observe the spirit, as well as the letter, of the Code.

Museums should proactively champion ethical behaviour. All staff, volunteers and governing bodies should be introduced to the Code in order to integrate its principles into their daily work. Some museums will also wish to set up their own internal bodies to ensure a degree of ethical oversight, and can use this Code as a reference for decision-making.

The MA expects all institutional, individual and corporate members to uphold and to promote the Code of Ethics for Museums. To achieve Associateship of the Museums Association (AMA) members must demonstrate awareness of the code and the ways in which it is used. To achieve Fellowship of the Museums Association (FMA) members must show that they promote the wider application of the code within museums.

The Code of Ethics

Museums and those who work in and with them

agree to uphold the following principles throughout their work:

1. Public engagement and public benefit

Museums and those who work in and with them should:

- actively engage and work in partnership with existing audiences and reach out to new and diverse audiences
- treat everyone equally, with honesty and respect
- provide and generate accurate information for and with the public
- support freedom of speech and debate
- use collections for public benefit - for learning, inspiration and enjoyment

2. Stewardship of collections

Museums and those who work in and with them should:

- maintain and develop collections for current and future generations
- acquire, care for, exhibit and loan collections with transparency and competency in order to generate knowledge and engage the public with collections
- treat museum collections as cultural, scientific or historic assets, not financial assets

3. Individual and institutional integrity

Museums and those who work in and with them should:

- act in the public interest in all areas of work
- uphold the highest level of institutional integrity and personal conduct at all times
- build respectful and transparent relationships with partner organisations, governing bodies, staff and volunteers to ensure public trust in the museum's activities

1. Public engagement and public benefit

Museums and those who work in and with them should:

- actively engage and work in partnership with existing audiences and reach out to new and diverse audiences
- treat everyone equally, with honesty and respect
- provide and generate accurate information for and with the public
- support freedom of speech and debate
- use collections for public benefit - for learning, inspiration and enjoyment

Upholding the principle

All those who work in and with museums should:

1.1 Provide public access to, and meaningful engagement with, museums, collections, and information about collections without discrimination.

1.2 Ensure editorial integrity in programming and interpretation. Resist attempts to influence interpretation or content by particular interest groups, including lenders, donors and funders.

1.3 Support free speech and freedom of expression. Respect the right of all to express different views within the museum unless illegal to do so or inconsistent with the purpose of the museum as an inclusive public space.

1.4 Ensure that information and research presented or generated by the museum is accurate. Take steps to minimise or balance bias in research undertaken by the museum.

1.5 Acknowledge publicly that the museum benefits from all those who have contributed to the making, meaning and presence in the museum of its collections.

1.6 Work in partnership with communities, audiences, potential audiences and supporters of the museum.

1.7 Ensure that everyone has the opportunity for meaningful participation in the work of the museum.

2. Stewardship of collections

Museums and those who work in and with them should:

- maintain and develop collections for current and future generations
- acquire, care for, exhibit and loan collections with transparency and competency in order to generate knowledge and engage the public with collections
- treat museum collections as cultural, scientific or historic assets, not financial assets.

Upholding the principle

All those who work in and with museums should:

2.1 Preserve collections as a tangible link between the past, present and future. Balance the museum's role in safeguarding items for the benefit of future audiences with its obligation to optimise access for present audiences.

2.2 Collect according to detailed, published and regularly reviewed policies that state clearly what, how and why the museum collects.

2.3 Accept or acquire an item only if the museum can provide adequate, continuing long-term care for the item and public access to it, without compromising standards of care and access relating to the existing collections.

2.4 Conduct due diligence to verify the ownership of any item prior to purchase or loan, and that the current holder is legitimately able to transfer title

or to lend. Apply the same strict criteria to gifts and bequests.

2.5 Reject any item for purchase, loan or donation if there is any suspicion that it was wrongfully taken during a time of conflict, stolen, illicitly exported or illicitly traded, unless explicitly allowed by treaties or other agreements, or where the museum is co-operating with attempts to establish the identity of the rightful owner(s) of an item.

2.6 Discuss expectations and clarify in writing the precise terms on which all parties are accepting transfer of title. Exercise sensitivity towards donors when accepting or declining gifts and bequests.

2.7 Deal sensitively and promptly with requests for repatriation both within the UK and from abroad.

2.8 Acknowledge that responsible disposal takes place as part of a museum's long-term Collections Development Policy and starts with a curatorial review. Ensure transparency and carry out any disposal openly, according to unambiguous, generally accepted procedures.

2.9 Recognise the principle that collections should not normally be regarded as financially negotiable assets and that financially motivated disposal risks damaging public confidence in museums. Refuse to undertake disposal principally for financial reasons, except where it will significantly improve the long-term public benefit derived from the remaining collection. This will include demonstrating that:

- the item under consideration lies outside the museum's established core collection as defined in the Collections Development Policy;
- extensive prior consultation with sector bodies and the public has been undertaken and considered;
- it is not to generate short-term revenue (for example to meet a budget deficit)
- it is as a last resort after other sources of funding have been thoroughly explored.

2.10 Refuse to mortgage collections or offer them as security for a loan. Ensure the financial viability of the museum is not dependent on any monetary valuation placed on items in its collections. Resist placing a commercial value on the collections unless there is a compelling reason to do so, and for collections management purposes only.

3. Individual and institutional integrity

Museums and those who work in and with them should:

- act in the public interest in all areas of work
- uphold the highest level of institutional integrity and personal conduct at all times
- build respectful and transparent relationships with partner organisations, governing bodies, staff and volunteers to ensure public trust in the museum's activities.

Upholding the principle

All those who work in and with museums should:

3.1 Avoid any private activity or pursuit of a personal interest that may conflict or be perceived to conflict with the public interest. Consider the effect of activities conducted in private life on the reputation of the museum and of museums generally.

3.2 Avoid behaviour that could be construed as asserting personal ownership of collections.

3.3 Avoid all private activities that could be construed as trading or dealing in cultural property unless authorised in advance by the governing body.

3.4 Refuse to place a value on items belonging to the public.

3.5 Make clear when communicating personally or on behalf of another organisation that views expressed do not necessarily represent those of the museum in which you work.

In addition, museums and governing bodies should:

3.6 Carefully consider offers of financial support from commercial organisations and other sources in the UK and internationally and seek support from organisations whose ethical values are consistent with those of the museum. Exercise due diligence in understanding the ethical standards of commercial partners with a view to maintaining public trust and integrity in all museum activities.

3.7 Abide by a fair, consistent and transparent workforce policy for all those working in the museum, including those in unpaid positions.

3.8 Be sensitive to the impact of the museum and its visitors on natural and human environments. Make best use of resources, use energy and materials responsibly and minimise waste.

Additional information

The Museums Association

The MA is registered as a charity. It is a non-governmental, independently financed membership organisation providing services to and reflecting the interests of museums and those who work for, and govern them.

Development of the Code of Ethics

The MA has acted as the guardian of UK museum ethics since the first Codes of Practice and Conduct were introduced in 1977. These were updated in 1987, 1991, 2002 and 2007. This updated version of the Code of Ethics for Museums outlines ethical principles for all museums in the UK and was agreed following an 18-month consultation process during

2014-15. The development of this Code has been a collaborative process involving representatives from across the museum sector, funders, interest groups, members of the public and other stakeholders. This document represents the general consensus of the sector on the ethical standards that are expected of all museums and those who work in and with them.

Role of the Ethics Committee
The Ethics Committee of the MA is made up of a number of independent experts drawn from the museum sector and other experts. Its role is to:

- Develop and monitor the maintenance of sound ethical principles and behaviour within the museum sector.
- Give advice and guidance on ethical matters to the museum sector, including MA board and staff.
- Recommend to the board amendments to the Code of Ethics where deemed necessary.

Alleged breaches of the Code can be considered by the Ethics Committee. In some cases, where a museum or museum professional is alleged to have acted unethically, the Ethics Committee will investigate a matter in order to provide a considered opinion. The Committee is also able to report a breach to the director of the MA, who may in turn report the matter to the MA Board and Disciplinary Committee for further investigation and possible sanction.

The Code of Ethics and the law
The Code of Ethics for Museums defines standards that are often higher than those required by law. However, the Code cannot override the legal obligations and rights of those who work in or for museums, including those arising from any contractual relationship there may be with an employer or client. The Code of Ethics for Museums must be subordinate to the legal powers and obligations of governing bodies responsible for museums and the legal powers and obligations of individual members of such bodies. However, the MA believes this Code's provisions to be in the best interests of the public and therefore urges all museum governing bodies (and where appropriate, subsidiary, subcontracted or delegated bodies such as executive committees, contractors or managing bodies), formally to adopt it.

The Code of Ethics and other voluntary standards
Ethical standards developed in this document help to underpin the Accreditation scheme for museums in the UK at an institutional level. Accreditation is administered by Arts Council England in partnership with the Welsh Government, Museums Galleries Scotland and the Northern Ireland Museums Council. Consult Accreditation for further information.

The MA supports the work of specialist organisations in the UK whose members are involved in museum work and who may produce their own codes of ethics and ethical guidelines. The MA can help in cross-referencing to these codes and guidelines and in referring enquirers to appropriate sources of specialist advice.

The Code of Ethics for Museums is consistent with the Code of Ethics for Museums worldwide produced by the International Council of Museums (ICOM). The MA supports ICOM's work.

Glossary

Access - usually seen in terms of identifying barriers that prevent participation and developing strategies to dismantle them. Barriers come in many forms and may be physical, sensory, intellectual, attitudinal, social, cultural or financial.

Audience - individuals and groups who make use of the museum's resources or facilities.

Collection - a body of cultural and heritage material. Collections may be physical, intangible or digital.

Collections Development Policy - an internal policy document which shapes a museum's collections by guiding acquisition and disposal, and is led by the museum's statement of purpose.

Community - a group of individuals who share a particular characteristic, set of beliefs or attitudes.

Dealing - making a speculative acquisition with the intention of reselling for profit.

Due Diligence - ensuring that all reasonable measures are taken to establish the facts of a case before deciding a course of action, particularly in identifying the source and history of an item offered for acquisition or use before acquiring it, or in understanding the full background of a sponsor, lender or funder.

Governing body - the principal body of individuals in which rests the ultimate responsibility for policy and decisions affecting the governance of the museum. Legal title to the assets of the museum may be vested in this body.

Item - a physical, nontangible or digital object or material held by a museum.

Partner organisation - an organisation with which a museum has built up a formal relationship relating to museum activities or museum funding.

Source community - a group which identifies themselves as a community and would normally be expected to have a shared geographical location, shared cultural or spiritual and religious beliefs and shared language; or to share some of these facets; and which is recognised as the cultural source of items held in a museum collection.

DISCOVERY OF A WALRUS SKULL ON THE NORTH EAST YORKSHIRE COAST: A CALL FOR CLEARER GUIDELINES

by Jennifer Dunne and Jim Middleton

Dunne, J. and Middleton, J. 2018. Discovery of a walrus skull on the North East Yorkshire coast: a call for clearer guidelines. *The Geological Curator* 10 (10): 687-690.

In March 2018 the Collections Team at Scarborough Museums Trust was approached about a potentially exciting find; a possible walrus skull found by a member of the public *in situ* in the cliff face between Speeton and Reighton in East Yorkshire. After a preliminary investigation of the site and discussions with colleagues on the Continent the specimen was found to be of particular significance. On communication of its significance to the finder he requested the return of the specimen for sale despite the legal ownership being in question. The legal and ethical issues surrounding the discovery of such a specimen in situ by an amateur enthusiast and its subsequent removal without permission of the landowner need to be addressed. Also in need of acknowledgement are the difficulties faced by any museum professionals confronted with the potential donation of such specimens, or more complicated still, the refusal of the finder to accept lack of ownership and demand the return of material. Clear guidelines for museum professionals are essential to offer support and protection from negative publicity when the usual legal and ethical procedures are followed in such cases. No such guidelines currently exist, which we have found to our cost. The public also need to be better informed about legal ownership of material removed from our coastlines. We recommend that a dialogue should be instigated around the need for a regulatory system for geological and palaeontological material discovered by the public along the lines of the Portable Antiquities Scheme to better protect our scientific assets.

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Introduction

This brief account of the difficulties faced by the Collections Team at Scarborough Museums Trust (SMT) in the spring and summer of 2018 is intended to initiate a discussion about the need for clearer guidelines to tackle the issue of specimens brought to a museum for identification or donation after removal without permission of the landowner. Although the Museums Association Code of Ethics is clear about conducting due diligence before accepting an acquisition or loan and rejecting anything suspected of being obtained illicitly (Museums Association, 2015), specific guidelines regarding geological and palaeontological specimens recovered without permission from private land in danger of natural or artificial deterioration are either non-existent or difficult to track down. This paper also addresses the question of how we as museum professionals assuage the discontent of finders who when their legal ownership is called into question refuse to accept the legal and ethical procedures that must be followed to avoid breaching the law.

Our particular case concerns the discovery of a walrus skull (Figure 1) in East Yorkshire, which was found in a cliff face in the Flamborough Head Site of Special Scientific Interest and brought to the SMT Collections Team for identification. In such cases, members of the public may not be aware that what appears to be a public beach does in fact belong to a private landowner and, consequently, not realise that permission must be sought to excavate and remove fossilised material. However, how do we police chance finds that may have been lost to the next high tide? How do we also convince finders that they are not the legal owner of finds discovered *in situ* on private land when the current guidance is ambiguous?

For the purposes of this article the Scarborough

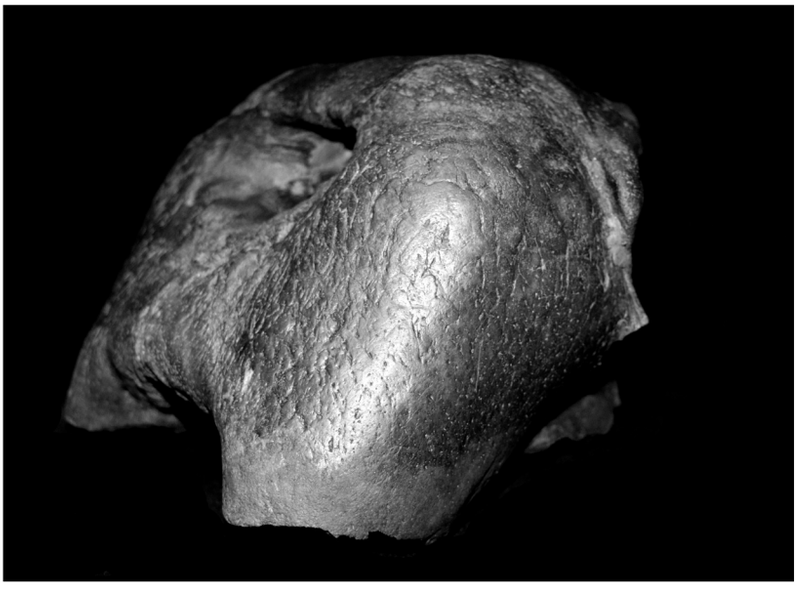

Figure 1. The walrus skull. See also https://skfb.ly/6xUHs for a three dimensional model on sketchfab.

Museums Trust and Scarborough Collections, which belong to Scarborough Borough Council and are in the care of SMT will be referred to as 'the Museum'.

The find

The skull (Figure 1) of a walrus (*Odobenus rosmarus*) was discovered *in situ* in glacial strata in early March 2018 by a member of the public who contacted Scarborough Museums Trust for further information. The finder also took photos of the strata and location, and the site was visited on 28th March 2018 by a member of the Collections Team and a local geologist who located the excavation site. No further bone was present and a sample of the bed was taken. The bed appeared to be a poorly sorted gravel that was above a grey fine clay with few inclusions that lay directly above the Kimmeridge Clay.

The gravel contained a large amount of chalk as well as (Kimmeridge?) shale and several belemnite fragments. The bed had clearly been subjected to further glaciation and was significantly distorted in many places. The skull had apparently been disarticulated from the rest of the skeleton and formed a bulging lens in the bed, presumably due to the dense nature of the front of the skull (the hind portion of the skull had been crushed and was in several pieces).

The significance of the find being *in situ* was confirmed by Klaas Post (pers. comm. 2018) of the Natuurhistorisch Museum Rotterdam, as other Pleistocene walrus remains are mainly *ex situ* material dredged from the southern North Sea. The following was his reply to our initial enquiry (all sic):

> "Fantastic fossil and unique find! Clearly a beautiful and fairly complete skull of walrus (*Odobenus rosmarus*) with almost complete dentition (left and right I3 and PC 1,2 and 3), only the canines are missing. The most interesting point is of course that this skull was found *in situ*. None of our Dutch skulls are found *in situ* and are 14C dated between 30-50 Ka BP; however marine conditions might not have been present during this period. Recent publications conclude 14C contamination of the data and presume that walrus was present in North Sea between 60-80/90 Ka. This controversy is not (yet) solved. Any situ find with a good stratigraphic picture would greatly enhance our knowledge on the whereabouts of the North Sea walrus and is definitely worth a publication!"

The dating of the Pleistocene deposits of Speeton and Reighton (particularly the Speeton Shell Bed) has been much discussed since they were first recorded in the 19th century (Phillips 1875) with early speculation by Lamplugh (1879, 1881). A stratigraphic approach was taken in the mid-20th century (Catt and Penny 1966 and references cited therein; Edwards 1981,1987), and more recent studies using oxygen isotope studies (Wilson 1991; Bowen *et al.* 1991) and palaeomagnetic and mineral magnetic techniques (Thistlewood and Whyte 1993) have all failed to reach a satisfactory conclusion. What can be said though is that it must date to an interglacial period much earlier than the implied dates given by testing of *ex situ* material, and could either be Oxygen Isotope Stage 5e or 7.

Notes on the legal and ethical issues

The finder's early actions were in line with what we would expect of a responsible amateur enthusiast interested in fossil hunting for the sake of scientific endeavour rather than financial or personal gain. He had expressed his intention of bringing the specimen to us for further investigation at a mutually convenient time and consequently, asked for advice on how best to store the skull in the meantime to prevent any deterioration. When he brought the specimen to our office several days later he agreed to leave it with us so that we could further investigate the skull and provide an informed identification. He was also keen to leave it in our care so that the specimen could dry out slowly in our environmentally controlled stores. An entry form was duly completed to record the object's entry into the Museum's care but only the 'Reason for

Entry' section was signed by the finder as the depositor.

When asked for further details about where he had found the specimen, the finder revealed that he had spotted the skull protruding from the cliff face between Speeton and Reighton during a casual walk along the beach and had inspected the area more closely. He had, therefore, excavated the skull from *in situ* and taken it out of context. Consequently, we asked if he could show us exactly where the skull had been found so that we could ascertain the precise location of the find, visit the site, and conduct additional investigations. Furthermore, as the specimen had been removed from the cliff face and not found lose on the beach the situation became far more complicated; legal ownership of the specimen was now in question. Even if the finder had offered to donate the skull during that first meeting we would have been unable to accept the acquisition until contact had been made with the landowner and permission to transfer ownership had been confirmed.

After we had conducted our initial research and liaised with colleagues on the Continent to determine the potential the walrus skull held as a find of particular scientific significance, that information was communicated to the finder in line with his desire to learn more about what he had found. We also explained that our colleagues were keen to conduct further scientific testing.

The discovery of the skull also coincided with plans we were formulating for a forthcoming two-year exhibition at The Rotunda Museum, *Ancient Seas of the Yorkshire Coast* (opened on 21st July 2018), which was due to include a section in the narrative about the Pleistocene. This was conveyed to the finder and although, as he stated in his emails, he was happy for the Museum to display the specimen and for the scientific testing to be undertaken he wanted to retain ownership; he had been in touch with several auction houses about selling the skull. The finder was under the false impression that he had automatically become the legal owner of the specimen on its discovery and removal. Subsequently, an offer of purchase was made to the Museum, which was declined. It was explained to the finder that due to the skull being excavated from the cliff face on a SSSI (Natural England, 1986) it was against the law to sell the fossil and that the specimen was not legally his to sell.

According to the Joint Nature Conservation Committee guidelines (JNCC, 1997) "*fossils of prime scientific importance should be placed in a suitable repository, normally a museum with adequate curatorial and storage facilities*" and "*permission to enter private land and collect fossils must always be gained*" with "*a clear agreement*" being made "*over the future ownership of any fossils collected*". Nevertheless, this guidance is not widely known by the average person scouting our countryside and coastline for fossils and the finder refused to accept the legal position we found ourselves in despite being directed to the JNCC's Position Statement. So, how do we as a sector better convey best practice? How do we tackle the difficulty of the public removing items from SSSI sites that may also be vulnerable to natural erosion, such as coastal areas, where those fossils may have been lost in the next high tide?

Advice was sought from Natural England who stated the activity of the finder did not warrant their consent and could not, therefore, be pursued but did agree that permission should have been sought from the landowner as the find would legally be their property. They suggested we conduct a land registry search to learn who the landowner might be. A land registry search was duly undertaken by our solicitors, the landowner established and contacted and their permission sought for the fossil to be donated to the Museum. After an investigation by their legal team the landowner was satisfied that they were indeed the legal owner of the specimen and agreed to transfer ownership to the Museum. The 'Additional Agreement' section of the object entry form was signed by the landowner, as was a Transfer of Title form, to complete the official transfer.

The advice of the Museums Association Ethics Committee was also requested via the officer responsible for the MA's Code of Ethics. He agreed that the procedures we had followed so far were in line with the Code of Ethics and JNCC's guidance. He also stated that we had been right to approach the landowner and withhold the return of the fossil to the finder until the landowner's position on the matter had been clarified. However, he also conceded that "the legal and ethical guidance doesn't clarify matters much" and that our case was a complex one (Museums Association, 2018). Consequently, the matter will be raised for discussion at the next Ethics Committee meeting scheduled for September 2018.

Conclusions and call for further discussion

Despite following all of the industry, legal and ethical procedures currently available, keeping the finder informed of the process and offering him the opportunity, several times, to be listed publicly as the finder, we have still encountered a great deal of neg-

ative publicity about how the specimen has been acquired. How do we protect museums and their staff who followed all legal and ethical procedures from a public backlash when faced with the displeasure of finders who cannot legally retain their discoveries? We have found to our cost that social media can be used as a particularly effective tool against museums by a disgruntled finder and their friends who refuse to accept that the Museum has followed all of the correct procedures. However, we have also found that there has been nobody willing to protect us from such an onslaught. Which body will act as an advocate for museums and protect their reputations as places of public trust and centres of preservation and research? Surely, clearer guidelines for the removal of geological and palaeontological material, together with clarity on legal ownership, disseminated more effectively to the wider public will go some way to diminishing the problem.

The whole process of ensuring we were following the correct legal and ethical procedures, aside from the usual object entry procedures, was extremely difficult as we had not encountered such a problem before and it seemed nobody from whom we sought advice could provide a clear answer. Consequently, we believe that the possibility of a regulatory body and the implementation of a recording system for geological and palaeontological specimens found by members of the public, taking inspiration from the British Museum's Portable Antiquities Scheme for archaeological finds, should be raised for discussion within the museum sector. The clear guidelines laid down for such a system, with dedicated regional officers tasked with better educating amateur enthusiasts and encouraging best practice, proper agreements with landowners, correct recording of find sites and contacting Finds Liaison Officers on the discovery of finds *in situ*, together with a database for recording finds would hopefully alleviate many of the issues we faced.

Acknowledgements

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References

POST, Klaas. klaaspost@fishcon.nl. "Fossil Walrus". 25th March 2018.

CATT, J. A. and PENNY, L. F. 1966. The Pleistocene of Holderness, East Yorkshire. *Proceedings of the Yorkshire Geological Society* **35**, 375-420.

BOWEN.D. Q., SYKES.G. A. and WILSON, S.J. 1991. Discussion of "The correlation of the Speeton Shell Bed, Filey Bay, Yorkshire, to an oxygen isotope stage". *Proceedings of the Yorkshire Geological Society* **48**, 463-465.

EDWARDS, C. A. 1981. The tills of Filey Bay. Pp. 108-117 *in* NEALE, J. and FLENLEY, J. (editors) *The Quaternary in Britain*. Pergamon Press, Oxford.

EDWARDS, C. A. 1987. The Quaternary deposits of Filey Bay. Pp. 15-21 *in* ELLIS, S. (editor) *East Yorkshire*. Quaternary Research Association Field Guide. Hull.

JOINT NATURE CONSERVATION COMMITTEE. 1997. Conserving Our Fossil Heritage. [ONLINE] Available at: http://jncc.defra.gov.uk/page-4206. [Accessed 10 August 2018].

LAMPLUGH, G. W. 1879. On the divisions of the Glacial Beds in Filey Bay. *Proceedings of the Yorkshire Geological Society* **7**, 167-177.

LAMPLUGH, G. W. 1881. On a shell-bed at the base of the drift at Speeton near Filey, on the Yorkshire coast. *Geological Magazine* **8**, 174-180.

MUSEUMS ASSOCIATION. "Advice Concerning Potential Stolen Item". 4th July 2018.

MUSEUMS ASSOCIATION. 2015. Ethics. [ONLINE] Available at: https://www.museumsassociation.org/ethics/code-of-ethics. [Accessed 10 August 2018].

NATURAL ENGLAND. 1986. Designated Sites View. [ONLINE] Available at: https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1002289. [Accessed 10 August 2018].

PHILLIPS, J. 1875. *Illustrations of the geology of Yorkshire.* Part 1, The Yorkshire coast. London.

THISTLEWOOD, L and WHYTE, M.A. 1993. A palaeomagnetic and mineral magnetic study of the Speeton Shell Bed, North Yorkshire. *Proceedings of the Yorkshire Geological Society* **49** (4), 325-334.

WILSON, S. 1991. The correlation of the Speeton Shell Bed, Filey Bay, Yorkshire, to an oxygen isotope stage. *Proceedings of the Yorkshire Geological Society* **48**, 223-226.

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