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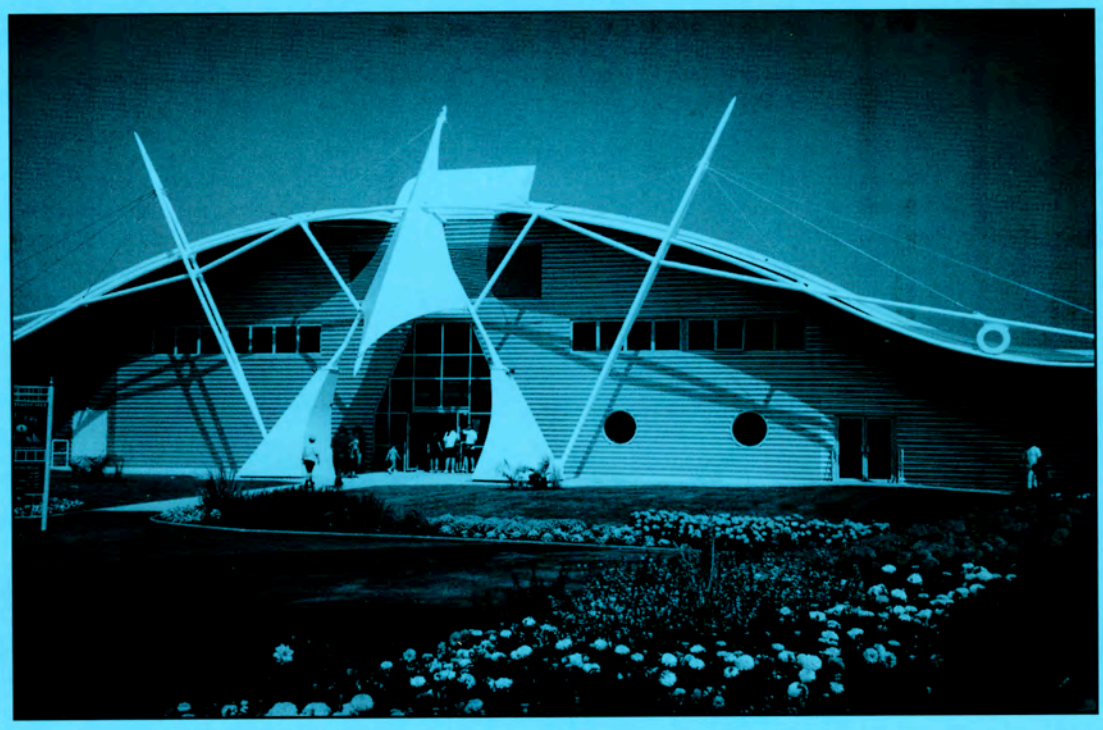

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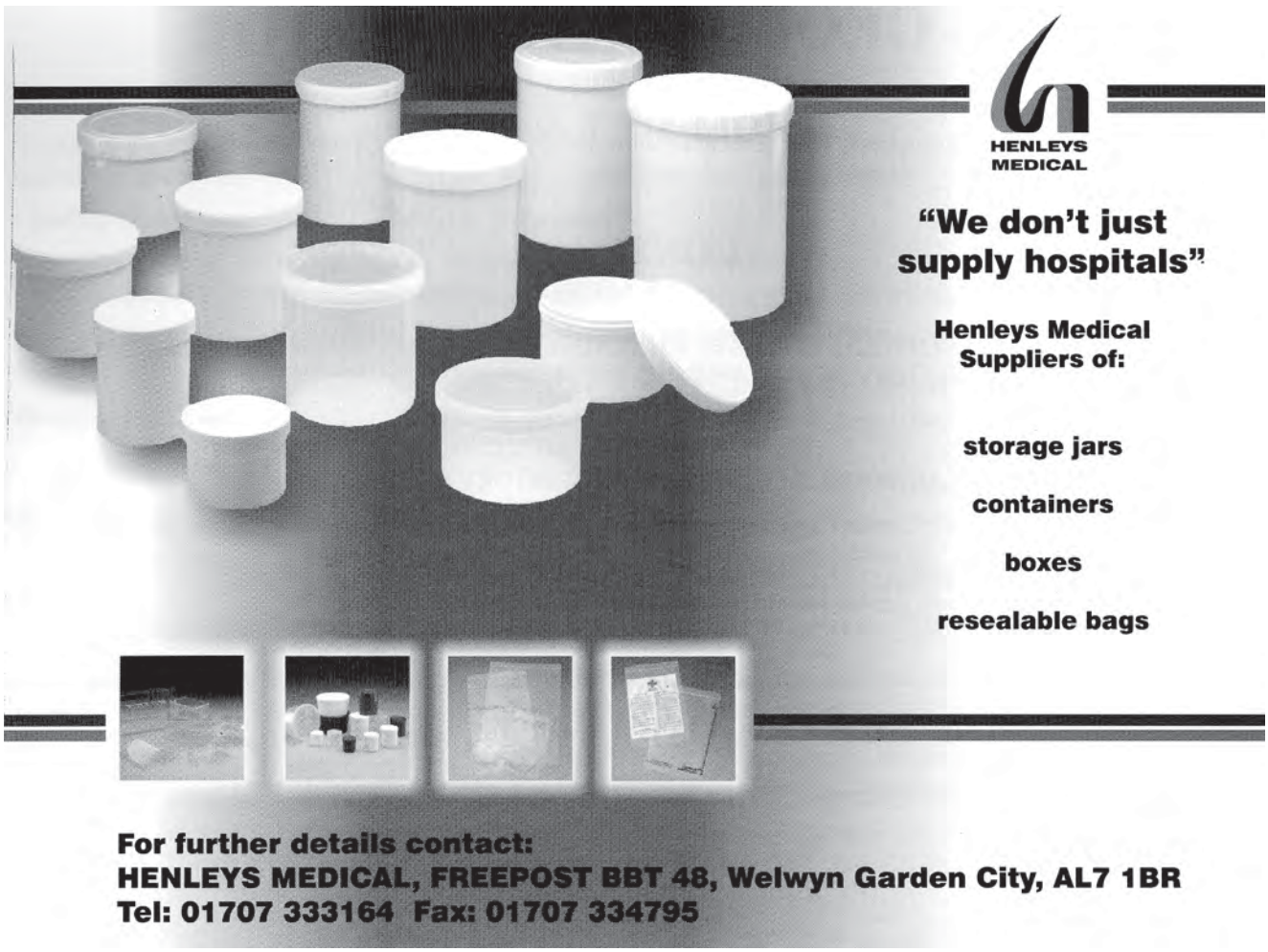

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3rd March 2000
Julie Rhodes

THE COMMERCIAL TRADE: ETHICS VERSUS SCIENCE FOREWORD

by John Nudds

The papers published here in this volume of *The Geological Curator* form a thematic set on the commercial trade in fossils and were originally presented at a one-day GCG Conference held on 23rd May 2001 at The University of Manchester. The idea for such a conference initially stemmed from discussions between staff at The Manchester Museum over the rights and wrongs of a museum acquiring unique and scientifically important palaeontological specimens, when it could not always be proved that those specimens left their country of origin entirely legally. Which was more important – the ethics or the science?

The appearance of the "Ethics Column" in the *Museums Journal* provided a further impetus, and when Steve McLean asked me if I would help to organise a GCG conference on this theme, I grasped the opportunity, first to explore the views of the geological curatorial community, and second, hopefully, to draw up some guidelines or recommendations for curators faced with such a dilemma.

The May 23rd Conference was very well attended with around 60 participants in total, representing all sides of the argument, including museum curators, research scientists, the Museums Association, and many commercial dealers and professional collectors from the UK and USA. Discussion was heated (!), but surprisingly there seemed to many observers to be a remarkable consensus between scientists, dealers and a majority of curators, in favour of a free trade with few restrictions. The Museums Association, however, took a very different view, defending the high moral and ethical ground.

But was the attendance at the conference really representative of the UK geological community and of the grass-roots GCG membership ? There have been claims that it was not and that only those with radical views spoke out, many of whom were not members of the GCG.

To attempt to answer this question, and to gain a real consensus, it was decided by GCG Committee to publish these Proceedings and distribute them quickly to all GCG members and to invite comment. A GCG Working Group has been formed which will consider all responses to these Proceedings and, based on the views expressed, will then offer advice to the UK Government Advisory Panel on Illicit Trade.

So please respond! Do you follow faithfully the *Codes of Ethics* published by the Museums' Association, or do you embrace the radical concept of "Rescue Purchase" as suggested elsewhere in this volume? What is the answer to the "Rosetta Stone Dilemma" as discussed on page 194 and 207?

If you have views on these issues it is vital that we hear from you. Please send your comments to the GCG Chairman, Tom Sharpe, Department of Geology, National Museums and Galleries of Wales, Cathays Park, Cardiff, CF10 3NP; e-mail tom.sharpe@kelston.globalnet.co.uk.

The Geological Curators' Group wishes to acknowledge the financial support of English Nature, the Geological Society and JNCC in the organisation of the conference and the publication of these Proceedings.

John Nudds Manchester, September 2001

ETHICS, SCIENCE AND THE TRADE: LET'S GET TOGETHER!

by John Nudds

Nudds, J.R. 2001. Ethics, science and the trade: let's get together. *The Geological Curator* 7(6): 191-198.

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Introduction

For most of my career, until very recently, I have been a bit of a purist when it came to the commercial fossil trade - not exactly against it, but all the same, a bit uneasy about it. My attitude underwent a total sea change, however, in 1999 when I first attended the Tucson Gem and Mineral Show. What I saw here and the people that I met, totally transformed my view of the fossil trade and my attitude towards it. The Tucson "Main Show", takes place over 4 days, Thursday to Sunday, at a huge Convention Centre in downtown Tucson, where the top mineral and gem dealers, and some fossil dealers, trade the very best specimens at the very top prices, mostly to rich, private collectors or jewellers. This is not the place to spend your money - there are no bargains to be had here.

Several years ago, the dealers, it seems, decided that prior to the Main Show they would also trade amongst themselves, in their hotel rooms, mostly on a wholesale basis. So evolved the "Satellite Show", officially the Arizona Mineral and Fossil Show, which is now bigger and far more extensive than the "Main Show", taking over numerous hotels and marquees throughout Tucson for more than 2 weeks. Three main hotels are involved. For fossil dealers, the Ramada Inn is the place to be. For 2 weeks over 100 dealers in this hotel alone, turn their hotel bedrooms into fossil shops and adorn the lawns with marquees.

In terms of just sheer numbers, you will see more exquisite, top-range, museum-quality specimens in the Ramada Inn than we have in our galleries here at Manchester and more than you will see in most museums in the UK. This year alone there was a 5 metre ichthyosaur from China, wonderfully prepared by Terry Manning and Chris Moore. There was a complete *Protoceratops* from Mongolia, a juvenile ankylosaur from Mongolia, White Sea Ediacara from Russia, spiny trilobites from Morocco, as big as dinner plates, iridescent ammonites from Alberta, and dinosaur eggs of all shapes and sizes in their hundreds, literally.

But more impressive you will see fossils which you've never seen before and which you have never imagined. Before I went to Tucson, I thought I knew pretty well what to expect from the fossil record. I'd been a professional geologist for 25 years, I'd been to most museums in the UK and to many in Europe and always seen the same assemblages, which we learned at University - the shelly faunas of the Cambrian, trilobites and graptolites of the Lower Palaeozoic, Devonian fish, Lower Carboniferous corals, Upper Carboniferous plants, mammal-like reptiles of the Permian, ammonites of the Jurassic for example. But in Tucson in 1999 I saw new wonders - the bizarre Chengjiang fossils from southern China - the Lower Cambrian equivalent of the BC Burgess Shale - priapulids, enigmatic arthropods, anomalocarids, medusoids, soft-bodied brachiopods etc. You won't see these in many European museums. There are Lower Cretaceous birds from Liaoning Province, only discovered in 1994, the same site that later turned up the feathered dinosaurs. You will see enormous, elongated dinosaur eggs, laid by tarbasaurs, the Chinese cousins of *T. rex*, huge palm fronds from the Wyoming Green River Eocene Shales. And at this year's show - Argentinian dinosaur eggshell, with fragments of embryonic dinosaur skin preserved on the inside.

There are many others. Every year new finds turn up. And it appears that we've been missing out. Our collections are no longer representative. But it's more worrying than that because these new finds don't stay on the market forever. David Green tells me that with new mineral finds, they will appear on the market, be around for a year or two, and then disappear - mostly into the hands of private collectors, and if you don't get in on the act straight away, the chance has gone - you'll rarely see that find on sale again - and if you do, it'll be at a very inflated price. Its the same with fossils. How long will the Chinese birds be available? Maybe we've seen the last of them already as a new law was passed in Liaoning Province on 1st March of this year preventing their removal. According to my Chinese sources, specimens exported before March 1st 2001 are legal, but how many European museums managed to acquire specimens of these birds? And will the Argentinian egg with embryonic skin ever appear again at Tucson?

In 1999 I was travelling back from Japan to China with a Canadian coral colleague, Paul Copper, of Laurentia University, one of the world's leading specialists in ancient reefs. He knew that I was heading for Guilin in southern China and had been there himself. He told me of the "International Tourist Commodity Market" which specialised in fossils and minerals, and of the wonders he had seen there - he particularly enthused over the conglomerations of *Stringocephalus*, the Devonian brachiopod, joined in huge, sculptured colonies like mussel banks and wished he could have bought one. "Its up to you guys to get hold of these things", he implored me - by "you guys" meaning "museums". "If you don't grab them now, you'll never see them again".

So what's the problem. Let's get out there and buy. But museums are not doing this. When David Green and I first went to Tucson in 1999 we were toasted at the Black Hills Institute 25th Anniversary party as being the first European academics to attend the show. I don't suppose that's entirely accurately by any means, but the point was made. Virtually all the clientele were dealers or private collectors. A few North American museums are usually present, but that's about it. So its easy to see what's happening. All these rare goodies are disappearing into the hands of private collectors and not getting into public museums. One dealer told me at that party in 1999, "we have the best collectors, the best preparators and are becoming the best educators. We look to the future, to new fossils to discover. You, in your dusty museums, with your drawers of dusty specimens look only to the past". Its true. We love making databases and history files and doing "collections research", but many of us are in danger of dealing with a dead collection.

So why are we not out there in numbers buying at the trade shows? Its not simply a question of money. We are facing resistance from two distinct camps.

Ethics

The first objection to the fossil trade is an ***ethical*** one and comes from the museologists. Their ethics are presented in the *Codes of Ethics* produced by the Ethics Committee of the UK Museums Association [MA] (Museums Association 1999). There is much in this Code which is admirable, although mostly common sense, but Articles A.5, A.6 and 2.6 all state that, "museums should not accept...any object that has been ... exported from its country of origin ... in violation of that country's laws". *The Code of Ethics* also suggests that museums should be bound by the spirit of the 1970 UNESCO Convention on the "means of... preventing the illicit import ... of cultural property" (UNESCO 1970). The UK is not at the moment signed up to the UNESCO agreement, but the Museums Association *Code of Ethics* endorses it and would have us bound by it just the same. In addition, to tighten the grip, the UK Museum Registration Scheme, which requires museums to be registered in order to qualify for many government grants, also now requires that statements regarding illicitly removed material be incorporated into the acquisition policy of every registered museum in the UK. This requirement is based on the MA Code of Ethics.

There are two quite different reasons why specimens might leave their country of origin illegally, and in both cases the museologists have muddled the fossil trade with the trade in antiquities which has resulted in serious misconceptions and misunderstandings.

Firstly, it seems that the international trade in antiquities deals largely with material which has been illicitly collected from its country of origin. This includes looting of temples, grave robbing, tomb-raiding etc. The looters, to cover their tracts, will falsify the provenance, and so there exists among museologists a perceived relationship between doubtfully provenanced specimens and the illicit trade. And so, through their various publications (Museums Association 1999; Brodie *et al*. 2000) the MA museologists are, quite rightly, hoping to stop the trade in such illicit antiquities as a means of stopping the original looting. This is fine for antiquities.

But, please don't tar the fossil trade with the same brush. In the fossil trade such looting or stealing of fossils is pretty rare. Of course we all know of some well-known examples where pillage of important sites, sometimes protected sites, has gone on by unscrupulous commercial collectors, but I really believe that this kind of looting is very rare in relation to the vast majority of fossils on sale at trade shows which have been legitimately collected. I also think that such looting of fossils, when it does occur, is more often done by private individuals for their own collections - one rarely sees such specimens offered for sale. So, MA please take note - looted material is not a major constituent of the fossil trade in the way that is for antiquities.

But, if we are honest we do know that many of the fossils seen at trade shows such as Tucson, even if *collected* legitimately, *have* left their country of origin illicitly, not through illicit collecting, but quite simply by the country in question imposing an export ban on fossils. Brazil, for example, bans export of all natural science material, both fossil and extant, and yet numerous, beautiful Santana/Crato fish and insects etc are regularly to be seen in Tucson (see Martill, this volume).

My own area of interest is China - and for two years I have been researching Chinese law governing export of fossils. Invertebrates seem to be OK for export, but certainly a 1983 Chinese law prohibits export of "fossil vertebrates and humanbeings of scientific value". In typical Beijing fashion the word "value" leaves this law ambiguous and open to interpretation, but certainly many valuable Chinese vertebrate fossils are to be seen at Tucson.

Morocco presents a similar situation. A Tucson dealer specialising in Moroccan fossils (Palaeofacts of Fallbrook, California) told me earlier this year, "Morocco is constantly changing its laws, depending on the current Minister in charge. One time only polished material could be exported, crinoids etc. were banned. Now crinoids are OK, trilobites are OK, but Eocene skulls for some reason are suddenly banned. They're out of their minds".

So if we abide by the MA *Code of Ethics* we are prevented from acquiring for our collections any material from these countries and many others. What do we do? We stand idly by and watch these new finds disappear into private collections and our dusty museums still look to the past. We deny access to all of this new material and knowledge to our public. Is this what we are about? Besterman (this volume, p. 200) may reject the title of the GCG seminar ("Ethics versus Science"), but he misses the point; the strict application of the MA *Code of Ethics* is clearly preventing research on much available material.

If we examine the countries which enforce such a ban on export of natural science material it is often the developing countries and often those with oppressive regimes which do so. The developed, enlightened countries usually have a freer attitude to the movement of scientific objects and knowledge. Are we right therefore to support such oppressive regimes and to respect their ban of free movement of scientific material and knowledge, as the MA *Code of Ethics* would seem to insist ?

I think not, and here is the second misconception of the museologists. The MA *Code of Ethics* is fine if applied to *cultural* heritage, i.e. to arts and fine arts, to archaeology and ethnology, to antiquities. Every country has the right to retain its cultural heritage and to resist its export, because culture pertains to that country. China has every right to keep its terracotta soldiers at Xian. But geological heritage, and the information that goes with it, knows no national boundaries. Besterman (this volume, p. 203) argues that because scientific theory is fashioned by humans, it is a part of culture, but that is not the argument. The point is that fossils are not part of the developed culture of the country in which they happen to have been preserved; there is nothing distinctively "German" about *Archaeopteryx*, anymore than there is anything "English" about the "Dudley Bug". The evolution of life did not take cognizance of today's political boundaries.

The MA *Code of Ethics* was, of course, written, mainly, by cultural heritage curators; the majority of the active membership of the Museums Association is made of arts and cultural heritage curators and not of scientists, certainly not of palaeontologists. They have written a Code for their own subject area, which is good, but which is not always applicable to our own. I believe that the MA *Code of Ethics*, insofar as it deals with international trade, is preaching the wrong ethic to palaeontology.

More sensible, and more workable for us, would be a more flexible attitude towards the commercial trade in fossils, whereby every case is treated on its own merits, rather than by a strict regime of rules, standards and regulations. In this regard I introduce here the concept of "Rescue Purchase", whereby a palaeontologist, on recognizing a new or unique specimen for sale, be allowed to use professional judgement to purchase that specimen, even though it may have left its country of origin illegally. I am not suggesting that you purchase such a specimen *within* that country of origin, however tempting, for to then

export it would be smuggling, an illegal act, and would put you at risk. But if you recognize such a specimen at a trade show, at Tuscon or Munich, for example, when it has already left its country of origin, by whatever means, you should be allowed to purchase it and to place in a public institution where it can be researched and published. Not to do so is only to condem that specimen to obscurity and to lose it for science.

This is, I suppose, analogous to the argument of "last resort", which is discussed by Brodie *et al*. 2000 (see also Besterman, this volume, p.207, for discussion of the "Rosetta Stone Dilemma"). Besterman (*ibid*.) rejects the idea on two counts; the first that there is no point in a palaeontologist importing such a unique fossil into the UK since publication of that specimen in a reputable journal requires that it be deposited in an appropriate institution, and that no reputable museum will accept such an ethically contaminated specimen. Maybe not in the UK, but we can safely deposit such a specimen in many museums in Europe that are not handcuffed by the MA or by UNESCO. (Palaeontology, after all, knows no international boundaries !) Besterman (this volume) and Brodie *et al*. (2000) also reject the "Rosetta Stone" argument on the grounds that the "number of Rosetta Stones can be counted on … the fingers of one hand". Not so – in Tucson this year I was shown, by a Chinese dealer, a little fossil bird which had a clear and distinct bony, reptilian tail. This was no forgery or composite, for with the specimen was provided an x-ray showing unambiguously that the skeleton had not been tampered with. The price was $11,000 and it had probably been smuggled out of China. To purchase it would have been bad ethics, but to publish it would not be bad science – here, perhaps, was the "missing link" that *Archaeoraptor* was not.

Of course it is not always the developing countries that enforce such bans. British Columbia, for example, bans all collection of fossils from the Burgess Shale by anyone other than the ROM, who currently have a 10 year permission, granted by the National Park Authorities, to collect. Fossils are common at the Burgess Quarry - as you walk up the last few metres of the Packhorse Trail to the Walcott Quarry you tread on perfect trilobites, sponges, molluscs etc. But you face severe penalties, like the impounding of your vehicle and a $30,000 dollar fine, if you are tempted to slip a fossil into your rucksack and are caught by the Park Rangers. When the ROM's 10-years are up there will be no more collecting at Burgess allowed by the Park for 50 years.

Alberta is even more strict - all fossils (as "historical objects") belong to the Crown! And so, in the badlands, where dinosaurs are very common, much goes uncollected and decays as summer temperatures of 30˚ are followed by winters of minus 30˚. I think this is a scandal - as Peter Larson has said, "fossils can only be conserved if they are collected".

The museologists will also warn us that many of these oppressive countries have been known to hand out pretty severe penalties to anyone caught smuggling fossils. Peasant farmers in China are becoming experts in collecting fossils and know what sells well. They can make far more from quarrying their land than they can from farming it, but it risks prison sentences, or worse, if caught. The museologists would argue that by buying from this trade, we only serve to exacerbate this situation. Of course we deplore such atrocities by these oppressive regimes, but because museum buyers form such a tiny percentage of the trade (see Larwood, this volume, p. 223), our actions *in the real world* have no effect whatever on this situation. If we refrain from buying purely on these grounds, we are burying our heads in the sand - the trade from these countries will carry on regardless of our high moral stand – all that we succeed in doing is denying such material to our museums, to our public and to science.

And there are further dangers. At the moment, we can ignore the MA *Code of Ethics* and at least remain within the law. Any material which reaches Tucson, for example, however it got there, we can buy and bring into the UK with no import restrictions. We can, if we chose, go against the MA *Code of Ethics* and the UNESCO agreement and acquire such material for our museums. And I know some curators and directors in the British Isles who are quite relaxed about doing this. I quote Phil Doughty, commenting on Ulster Museum's purchase of Kazakhstan dinosaur remains, "... we had some suspicions, but if we bought the material, at least it would be in a public collection". This is "Rescue Purchase" in action.

However, on the 14th March 2001, an announcement from Westminster committed the Government both to signing the 1970 UNESCO Convention and to introducing legislation that would *make it illegal to import into the UK any material which has left its country of origin in violation of that country's laws* (DCMS 2001 p.3; see also Davies, this volume). In the case of the UNESCO agreement, the definition of cultural property does includes "objects of palaeontological interest" (UNESCO 1970, Article 1a)". At the moment, thank goodness, there are no plans to include palaeontological material in the new criminal offence (M. Davies pers. comm 2001), and presently it only applies to material valued at more than £39,600 ! But we must strive to resist any future

inclusion of fossils in the criminal offence, and to argue the case to the powers that be for a more relaxed and flexible attitude from museums towards the fossil trade so that scientifically significant material can be legally acquired by the scientific community and made accessible to all.

Science

I think that most research palaeontologists, in the UK would agree with my sentiments and agree that all fossil material for research must be accessible to us, from whatever country it was collected. Not many researchers worry about such ethical niceties - our main concern is to get hold of the material and do the research. These same research scientists are, however, not always happy with the material being collected by the commercial trade.

And so the second objection to the fossil trade that the dealers often meet is a ***scientific*** one. There is an arrogant feeling amongst some researchers that only they, the professional research palaeontologists, should have the right to collect fossils. It is a view with which I can sympathise. I have been an academic and worked in universities for all of my life as a research palaeontologist. There are various issues.

The first objection is that the commercial collectors are removing the primary database - i.e. the specimens themselves. In my own discipline of fossil corals, and in the field of invertebrates in general, there is little problem - most invertebrate groups are common enough as fossils to supply the scientists, commercial collectors, amateur collectors and anyone else. And, moreover, trade in invertebrates and the prices which they command, makes them less attractive. This is why, in the UK, the majority of research palaeontologists (the typical members of the Palaeontological Association for example) are quite untouched by the commercial trade, because the vast majority of them work on invertebrate fossils.

Of course, it is usually in the field of vertebrate palaeontology that we come across the scientific objections to commercial collectors and dealers. Here specimens are larger, more recognisable by non-specialist buyers, and command big prices. But they are also much rarer and sometimes very rare. How many complete skeletons of *T. rex* have ever been found? (See Larson, this volume).

The scientific objection is much more prevalent in North America than it is in the UK. I quote Robert Hunt (University of Nebraska), "I become saddened by what I see in many commercial shows, particularly the shows in Tucson and in Denver. You do see vertebrate fossils that are scientifically significant, fossils that will only be found in a century, on display to the highest bidder. Many times those fossils, when they're sold at the meetings, are never seen again and we all know that there's a tremendous loss of information". Mark Goodwin (University of California) says, "I just bristle at the thought of our fossil heritage being available for sale to the highest bidder".

Of course there are far more dinosaur workers in North America than we have on these shores, and, moreover, the numbers of dinosaurs for the commercial dealers to collect is far greater. The Montana badlands are just as rich as neighbouring Alberta in dinosaur fossils, and the relaxed collecting rules of the United States (if its on private land, anything goes) means that the State is easy picking for the commercial collectors. But some scientists have objected. Jack Horner has not always been at ease with what he saw as competition on "his patch", but as Rene Vandervelde of Canada Fossils points out (pers. comm. 2000), "there are enough dinosaurs in Montana for Jack and for Canada Fossils to collect for a hundred years".

And Vandervelde's words surely point to a simple solution to the scientists' objection. If we, the scientists, would only talk to the collectors, we can surely come up with an agreement, whereby the commercial collectors are allowed free reign to collect and to trade any common material - there are, after all, hundreds of skeletons of ceratopians and hadrosaurs in the badlands of Montana - whilst any rare, new or unique material is offered first to a scientific institution at a reasonable price. Many responsible collectors do this already, I know, and many museums have such arrangements with their local collectors. Canada Fossils, for example, have found 2 new dinosaurs, a new ammonite, 3 new fish, a new squid etc. All type specimens are in museums and have been described by scientists. Perhaps palaeontologists should stop moaning, and start raising money to buy these fossils from the private sector.

This is surely a better solution than simply attempting to ban private collecting which is what the Society of Vertebrate Paleontology in the US would like to do. The SVP would like to see laws passed that help to deflate the fossil demand by making it illegal to export vertebrate fossils from the US, and that reinforce the sanctity of public lands against commercial fossil exploration. But this, in my view, would pose the most serious threat to the science of palaeontology as it would encourage in the US a fossil blackmarket where illegal traders will attempt to cover their tracks. I quote Robert Hunt again, "If fossils are collected illegally, if data is not accurate,

if specimens are reported to come from Wyoming, but in fact they really come from Montana, then ... we can't trust that data. And once we can't trust the data, we can't trust the science that comes from that data". In other words we would put palaeontology in exactly the same situation that the antiquities trade is presently in.

A second objection commonly heard from the scientists is that the commercial collectors are also removing the *secondary database* - that is the associated scientific knowledge and information that goes with the actual specimen. That they will take the skull and leave the post-cranial behind, for example. Or more commonly, take the skeleton and leave the associated information - the taphonomy, the stratigraphy, the diagenesis, the palynology etc. I quote Jack Horner, "The kinds of data that we're now collecting...includes not just the dinosaurs, but everything else. And if people just go in and take the pretty stuff out, that ruins what we're trying to do. You can have commercial collectors that are very scrupulous, that are collecting data at their own sites, they're keeping good records, they do the preparation, they mount specimens, they sell them somewhere to a museum, and its all accessible. There's nothing wrong with that. But if I'm out collecting and someone comes out and digs up a dinosaur that I've got half out of the ground, well that's irritating."

Many commercial collectors are responsible collectors, and I can point to the *Tenontosaurus*, bought by this museum two years ago from Barry James of Pennsylvania, via Glenn Rockers of PaleoSearch in Kansas. The purchase included gastroliths and cycad seeds, recovered from the stomach, and two tiny *Deinonychus* teeth embedded in the neck vertebrae. Perhaps some scientists would not have spotted these? I would go even further in the case of the Black Hills Institute of Geological Research - Peter and Neal Larson are perhaps the biggest professional dealers in the US, but they are also scientists in their own right and have many publications to their name. Again this is only a question of education. If the scientists would only talk to the collectors we can tell them what we want collected - and often they are far better equipped than us to do the job.

The third objection from the scientists relates to some of the *practices* that the commercial collectors and dealers use. These range from the innocent to the fraudulent and the Tucson Show is often described as "buyer beware". At the bottom of the scale is simple *repair* of a specimen - gluing together broken parts - nothing wrong with this, of course, we do it in our museums and have whole departments of conservators to help us.

But from repair we go on to *restoration*, a slightly more sensitive practice. Examples might be the adding to the tip of a broken dinosaur claw to make it appear complete, or in mineralogy it might be the polishing of a damaged mineral face. Our specimen of *Confuciusornis* has part of the skull and breast bone restored, expertly by Terry Manning. I think it is accepted in the museum profession that restoration is perfectly acceptable as long as the restorers tell us what they have done and that there is no intent to fraud. Beware, however, that some restoration might destroy scientific information -the tip of the dinosaur claw may have been broken during combat.

From restoration it is a small step to deliberate *forgery*. Some fossils at Tucson are highly restored. Parts are added from other fossils or even carved from matrix to make them look more complete. The Moroccans are very good at it. Many of the spiny trilobites from Morocco are carved or at least have carved additions. A notice on display at Tucson in 1999 warned buyers that 80% of Moroccan fossils were forgeries. But again it is a question of what is the intent. At Munich last year, Mandy Edwards and I were examining under a handlens some spiny Moroccan trilobites. The Moroccan dealer recognised that we were palaeontologists and admitted quite openly that while the pygidium was genuine, the spines had been carved, and the whole thing had then been coloured for effect. He said that if we wanted real specimens he would show them to us. Of course they were much more expensive, but he openly explained that his carved specimens were done for the general public who simply want something that looks good and have no interest in how real it is. It was refreshing to see such an honest attitude and I guess, therefore, his intent was not fraudulent.

Other examples include composite specimens - for example, using the pygidium and cephalon of different specimens or even different species (!); sticking a small ammonite into the protoconch of a large ammonites (again often a different species) to complete the spiral; in mineralogy, sticking crystals onto matrix; colour enhancement in minerals using oils; colour bleaching in minerals to give transparent crystals, as with the Chinese red quartz. These practices are only fraudulent if there is an intent to deceive, and if we, the scientists, disapprove of certain practices, again we only have to talk to the dealers to tell them what we want and what we don't want. At the moment the dealers are selling largely to a non-scientific public, who are often totally unconcerned

about the scientific accuracy of their purchases, and much more interested in how good it looks on their mantlepiece. The dealers will prepare their specimens according to the market.

Of course I do not deny that there are dealers who *do* intend to deceive and who deliberately sell forged fossils. Listen to these words e-mailed to me by Tim Rowe, Regents Professor at The University of Texas, "In addition to illegally exported specimens, I would warn anyone planning to purchase specimens that fossil forgeries abound, and that they can be difficult to detect. I visited the Tucson Show last year and saw countless examples of cosmetic alteration aimed at inflating the specimen's commercial value. Some specimens bearing high price tags were entirely carved or fabricated from synthetic materials, and the craftsmanship was sufficiently skilled to fool some professional museum staff".

From forgery, which has a deliberate intent to deceive, its only a small step to *reproduction*, which has perfectly good intentions. In the UK we are all used to Stuart Baldwin's fossil reproductions, used for decades now in many university departments for teaching, and in the US the Black Hill Institute makes superb research-quality casts of teeth, claws, skulls and whole dinosaur skeletons for sale to museums and universities. I don't think anyone would object to any of these practices.

Next we must look at the practice of *preparation*. I have never quite established why the trade uses the term "preparator", whilst the museums use the term "conservator". Perhaps the former does suggest doing a bit more than just conserving what nature has preserved. Perhaps the professional preparator is more prepared to enhance a specimen to make it look a little bit *better* than it really is? Perhaps the preparators should be wary of *over-preparation* to the extent that the specimen almost becomes an objects of art-decor? Again its a question of intent. Art-decor is fine in itself if that's what it is intended as. Many examples are regularly on sale at Tucson of exotic carvings from rock, especially from fossiliferous rock.

The final practice that scientists often object to in the trade is the choice of *materials* used in preparation. Our *Tenontosaurus*, superbly excavated and mounted was, nevertheless, done using a super cyanoacrylate glue, and the lower jaw glued to the steel armature is giving me difficulties now that I want to cast the jaw. But Barry James, who prepared our dinosaur, was amazed when I questioned this practice. To him, the only consideration was to use the *best* glue, the one with the strongest bond. That we, as scientists, might want to reverse the process never entered his thoughts. I don't blame Barry for this attitude - or any of the professional preparators for this. I blame us, the scientists and the conservators - who never talk to the preparators and have never explained the reasons why all conservation should be reversible. Many professional conservators think its appalling what the professional preparators do - but why don't they talk to the preparators and tell them?

How many conservators in the UK are aware of "PaleoBond" range of products? Sold and promoted widely at Tucson as, "developed and field tested by paleontologists for paleontologists", and used universally in North America by professional preparators and collectors as the wonder-product for fossil collection and restoration - the range includes adhesives in various viscosities from the penetrant stabilizer at 2 cps through a variety of glues (40-1500cps), to "Jurassic gel", at 80,000 cps, a vaseline-like gel used to bridge cracks and gaps. There is also a non-CPC activator which instantly hardens all the adhesives. I've used it in the field and it is wonderful stuff for instantly repairing damage to bones *during* collection, but the adhesives are are cyanoacrylates, in other words, super-glues.

UK conservators will probably hold up their hands in horror, but also in the PaleoBond range is a debonder, a water-carried solvent that supposedly removes the adhesive. However, Lorraine Cornish of the NHM tells me that she tested this product some years ago and the solvent is only partly successful. Once the glue has been on for some months it becomes resistant to solvent attack and advised against using it on specimens. Also, does it have any long-term effect on the specimen? Perhaps it is all right for field use if it is immediately removed when back in the laboratory - but this is a classic case where we can help each other and learn from each other.

Conclusion

In conclusion, to the museologists I would say, please don't impose cultural heritage ethics on the commercial trade in fossils, which unlike antiquities are most usually collected perfectly legitimately and are therefore only ever "illicit" when they may have come out of an unenlightened country which has placed an unreasonable ban on their export. Remember also that fossils do not relate culturally to the country in which they were preserved (in the way that a Japanese ivory or Peruvian pottery, for example, does). We have our own ethics which dictate that scientific knowledge should be freely accessible by all.

And to my fellow scientists I would say, talk to the dealers, talk to the collectors and preparators, form a relationship with them, tell them your concerns, tell them about over-preparation, tell them which glues etc. not to use, tell them what *you* want to collect and how you want it collected, and make agreements with them whereby they will give you first offer on anything new or special, and they will go out there and collect for you. We have much to learn from each other. We, the scientists may arrogantly think that we have a lot to teach the trade, but equally the trade has an awful lot to teach us, because often we have been left far behind.

And finally, we must decide where the Geological Curators' Group stands in all of this - how do we as geological curators fit between the museologists and the scientists? That must be the outcome of this conference. No doubt there will be curators that have come from both camps, but let's make a start - let's get together!

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FRONTIERS TO SCIENCE: FREE TRADE AND MUSEUM ETHICS

by Tristram P. Besterman

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There is nothing inherently wrong about museums purchasing specimens from commercial dealers who act honestly and in good faith. Indeed, a significant amount of the taxonomically important material in the UK's great public collections has been acquired in this way. Doing business with the trade does, however, carry risks, and there are many ways in which the unwary curator can be ripped off by an unscrupulous dealer. Apart from fakes and forgeries, the most pernicious and damaging aspect of the trade is in illicit material. Museums should respect the laws of countries which seek to protect fossils as part of their cultural patrimony. This ethic is enshrined in international convention and in the ethical codes that apply to UK museums both at an individual and institutional level, through the UK's Registration scheme. The UK is about to become signatory to the 1970 UNESCO Convention, which outlaws the international illicit trade in cultural property, and will create a new law to criminalise such activity. This paper argues the case for accepting UNESCO's inclusion of fossils in the definition of cultural property. The more relaxed ethic of some academic palaeontologists compared with the ethical standards of mainstream geological curators in the UK should be addressed by drafting a protocol, whose standards should be developed in consultation between curators, academics, and reputable representatives of the trade and third world countries from which most illicitly traded fossils originate.

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Introduction

This paper was prepared for a seminar which resulted from a number of conversations with colleagues concerning the standards that should be applied when an institution like The Manchester Museum becomes involved with those who trade in fossils. It soon became apparent that perspectives differed. If, as we concluded, these positions represent a polarity of opinion in the wider scientific and museum communities, it seemed sensible to arrange a seminar at which the issues could be openly debated.

At the outset, I would like to put down some markers on my own position. The first is that there is nothing ethically wrong with a museum buying from the trade *per se*. The purchase of specimens from commercial suppliers has a long and reasonably honourable tradition, and our national collections would be much the poorer had a healthy relationship between museums and commercial collectors and dealers not existed. The entrepreneurial activities of the great nineteenth century fossilist, Mary Anning, are well documented (Torrens 1995). Anning collected the fine specimen of *Plesiosaurus macrocephalus* in 1830, from whom William Willoughby purchased it a year later for 200 guineas. The species was named by William Buckland in 1836 and described in 1840 by Richard Owen (Owen 1840). This is an example of a species new to science that entered the scientific literature whilst in private hands, and which, happily, ended up in a public collection at the Natural History Museum. However, Milner (1997) has warned of other specimens in private hands that were published by Owen which cannot now be traced. The dilemma of including material in private hands was faced by Conybeare and De la Beche when they published on ichthyosaurs and plesiosaurs a decade or so before Owen (Taylor and Crowther 1997, p.19). The debate about publishing material in private collections today has been well rehearsed in the pages of the Palaeontological Association's *Newsletter* during 1996 and 1997, with opinions surprisingly polarised on the issue. The trade may be a part of the problem but does not seem to the author to be the cause of it.

We may lament it, but the existence of a free market in legally acquired palaeontological material is

arguably not of itself an ethical issue, provided that normal standards of scientific methodology and documentation have been followed in excavating and developing the specimen. John Nudds ascertained that this was the case and ensured that the acquisition met The Manchester Museum's institutional standards (Manchester Museum 1997) when he negotiated the purchase of *Tenontosaurus* for the Museum's new Fossils Gallery in 1999. The qualifier, 'arguably', is used because it is undeniably the case that the legitimate trade in fossils does both create and nourish a commercial market in which most museums lack the resources to compete. As Shelton (1997, p.151) pointed out, "Generally, once fossils are caught up in the market loop, they are unlikely to be acquired by any but the largest museums. Most US museums cannot compete in the financial arena with commercial dealers". The advent of selling on the internet (Figure 2) is further fuelling the commercial trade in fossils, both expanding and feeding an increasingly insatiable market. Reconciling the benefits of palaeontological entrepreneurship of the Anning variety, which produces important new discoveries on the one hand, with the loss to science of important material that disappears into private collections on the other, is clearly a challenge to the palaeontological community. Sometimes the 'loss' is only temporary, when, as with Anning's plesiosaur, the specimen eventually makes its way into a public collection.

So, in one sense, I reject the title of the seminar, implying as it does, that the commercial trade inevitably pits ethics against science. It doesn't need to, any more than ethics are compromised when an art gallery buys a fully provenanced painting at auction.

Buyer beware

So let me put down a further marker, that of *caveat emptor*, (buyer beware). No one should be in any doubt about the divergent purposes of a trader who deals in fossils to make a profit, and a curator/ scientist who acquires fossils for learning. This is a point that is made clearly in the GCG *Guidelines for the Curation of Geological Materials* (Brunton *et al*. 1985, pp. A10 and A12). Further practical guidance is set out in "*Buying in the market: a checklist for museums*", published by the Museums Association (MA 2000). If this distinction in purpose is merely stating the obvious, it is not done as a value judgment. For after all, the dealer, scientist and curator are all making a living out of fossils: they simply do so by different means. There are good and bad curators and scientists, just as there are good and bad dealers. One purpose of this paper is to distinguish that which is good from that which is bad in the ethical standards that should be applied in practice by the science curator.

As the *caveat emptor* dictum reminds us, the market place in fossils is just like any other market place: it has many traps for the unwary. The curator/scientist should be cautious about their relationship with the trade even when not closing on a deal. Traders can gain significantly from an association with a reputable museum, and so curators should be on their guard to ensure that the reputation of their own institution is not compromised by association with a trader whose standards have more in common with a back street second-hand car dealer than a reputable high street trader. A dealer in fake Moroccan trilobites may well recognise the expertise of a professional from a reputable institution, and offer them the real thing (at a price). That same dealer can then trade on that association as he cons the next poor sap into buying phoney fossils. Even when associating with traders who stick by the rules, and who seem to be offering great benefits to the museum, just remember that there's no such thing as a free lunch!

Bad ethics produces bad science

So the ethical issues really kick in when dodgy goods are on sale. Dodgy goods come through dodgy traders and from collectors who are either ignorant of the law, or who deliberately flout it. Any curator or scientist who is prepared to deal with such people and such material is acting unethically. And my contention is that **bad science equates with bad ethics**. Good science can only be founded on sound ethical practice at every step from specimen origination, research and curation to interpretation and publication. The history of palaeontology is littered with disasters where this simple principle has been either stupidly forgotten (by gullible curators and scientists) and deliberately abused (by rapacious con-men). From Piltdown Man, so-called '*Eoanthropus dawsoni*' (a composite fake created early in the last century from an orangutan jaw-bone and human skull fragments supposedly from the Pleistocene gravels of Sussex) to the slightly less spectacular, but much hyped '*Archaeoraptor liaoningensis*' trumpeted by *The National Geographic Magazine* early this century as a 125 million year old feathered theropod dinosaur. The latter was, of course, nothing of the kind: this so-called 'missing link' was also a composite fossil faked up from at least three different species onto a single slab from Liaoning in China.

Kevin Padian at the University of California at Berkeley published an essay on this whole sorry episode on the Internet (Padian 2000). He has some instructive insights, which are worth quoting:

> "Why," he asks, "are specimens altered by Chinese villagers in the first place …? The answer is that there's a huge international market in the sale of vertebrate fossils. '*Archaeoraptor*' is such a specimen. It was apparently illegally smuggled from China; any so-called export papers, even if signed by local authorities, are regarded as invalid (fossil dealers tell me that they are easy to arrange)" (Padian 2000, p. 3).

One small, albeit rather belated, glimmer of ethical good practice illumines this otherwise woeful tale. Padian continues:

> "Our Chinese colleagues are extremely upset about the loss of these fossils from China through commercial sale. In April 2000, Storrs Olson, curator of fossil birds at the Smithsonian's Natural History Museum, refused to allow the '*Archaeoraptor*' specimen in the door for a press conference, until an agreement had been reached to return the specimen to China. Happily, it has now been returned." (Padian 2000, p. 3).

Had the over-enthusiastic purchaser on behalf of the Dinosaur Museum in Utah applied such a rigorous ethic at the Tucson Gem and Mineral Show, and had *The National Geographic Magazine* also refused to have anything to do with an illicitly smuggled specimen, let alone hype it before the normal peer review processes expected of a serious scientific journal had been applied, none of this embarrassing fiasco would have occurred.

There can be no better example of the Bad Ethics equals Bad Science principle.

So how do we distinguish good from bad ethical practice? Where are these standards codified and how are they implemented and enforced? At this stage, let me define a few terms.

The illicit trade and public museums: some definitions

First, what do we mean by the **illicit trade**? For the purposes of this paper, I shall paraphrase the term as it is used in the Report of the Ministerial Advisory Panel on Illicit Trade (Palmer 2000) published by England's Department of Culture, Media and Sport in December 2000:

> "The illicit trade involves those who import, deal in or are in possession of any cultural object that was stolen, illegally excavated or removed from a site contrary to local law or exported from its country of origin contrary to that country's national laws."

The issue of whether a fossil can or should be included in the notion of a 'cultural object' is a matter to which I will return later. I also think it important to define what I mean by a '**public museum**'. Any museum in the UK that has a formal, publicly accountable constitution, a long term purpose and is 'Registered' with Resource (the UK's Council for Museums, Archives and Libraries) is one that safeguards and makes accessible collections held in trust in the public domain. As far as palaeontological collections are concerned, in this definition one can include national trustee museums such as the Natural History Museum and the national museums in Edinburgh, Cardiff and Belfast; many university museums such as those in Cambridge, Birmingham, Manchester and Oxford; and the many local authority museums throughout the UK. I do not include research collections that are held in university academic departments administered outside such formal structures. They may be the focus of important research whilst their academic progenitor is in post. But with one or two notable exceptions, such collections are notoriously vulnerable to the whim of individuals and their departments, and rarely have institutionally robust procedures and policies to safeguard specimens and make them accessible to the wider scientific community in the longer term.

No museum and no collection exists in isolation. Museums, natural history collections and dare I say, even science itself, are social constructs to enable us to describe and comprehend the observable world. It follows that they exist to serve society. It is also axiomatic that such constructs, be they in the arts, humanities or the sciences, provide an insight into the creative workings of the human mind as well as the world around us. The social context of a museum may be local, regional, national or international. No matter. Museum ethics codify the principles that underpin an implicit social contract that permits curators to act as the guardians of society's interest. The ethical standards put into practice by a curator in Hove may impact on a child in Brighton, an academic in California or a farmer in Liaoning. So, let us examine some of these codified standards, starting at the international level.

Internationally agreed standards for museums

The International Council of Museums expects its members to abide by and uphold its *Code of Professional Ethics* (ICOM 1986). On the illicit trade it is unequivocal:

> "The illicit trade in objects… encourages the destruction of… sites… and contravenes the spirit

of national and international patrimony. Museums should recognise the relationship between the market place and the… destructive taking of an object for the commercial market and must recognise that it is highly unethical for a museum to support in any way, whether directly or indirectly, that illicit market.

"A museum should not acquire whether by purchase, gift, bequest or exchange, any object unless the governing body and responsible officer are satisfied that the museum can acquire a valid title to the specimen or object in question and that in particular it has not been acquired in, or exported from, its country of origin… in violation of that country's laws.

"So far as biological and geological material is concerned, a museum should not acquire by any direct or indirect means any specimen that has been collected, sold or otherwise transferred in contravention of any national or…natural history conservation law or treaty of the museum's own country or any other country…" (ICOM 1986, para 3.2).

The ICOM *Code* also addresses the ethics of field collecting:

"Museums should assume a position of leadership in the effort to halt the continuing degradation of the world's natural history… resources…

"…All planning for…field collecting must be preceded by… consultation with both the proper authorities and any interested museums or academic institutions in the country or area of the proposed study sufficient to ascertain if the proposed activity is both legal and justifiable on… scientific grounds. Any field programme must be executed in such a way that all participants act legally and responsibly in acquiring specimens and data, and that they discourage by all practical means unethical, illegal and destructive practices." (ICOM 1986 para 3.3).

Also at international level, there is the UNESCO *Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property* adopted at its General Conference in Paris in 1970. The year is significant, because it is now taken as a datum line on the status and treatment of illicit material. The Convention defines 'cultural property' as any property…

"…specifically designated by a State as being of importance for archaeology,… history,… art or science and which belongs to the following categories:

"a) Rare collections and specimens of fauna, flora, minerals and anatomy and objects of palaeontological interest;" (UNESCO 1970, Article 1 (a)).

The convention describes the impact of the illicit trade on the country of origin:

"The States Parties to this Convention recognise that the illicit import, export and transfer of ownership of cultural property is one of the main causes of the impoverishment of the cultural heritage of the countries of origin of such property and that international co-operation constitutes one of the most efficient means of protecting each country's property against all the dangers resulting therefrom." (UNESCO 1970, Article 2 para 1).

So how are these international principles and somewhat aspirational standards reflected in the legal framework of the UK?

Currently, the 1970 UNESCO Convention has no statutory status in the UK, although its essential provisions are applied by Registered museums in the UK (see the definition of a 'public museum' above and the section below 'A first world museum ethic: the USA and UK'). However, on the 14 March 2001, the Arts Minister, Alan Howarth, announced in Westminster that this situation was about to change. He publicly committed the UK Government to signing the 1970 UNESCO Convention and to introducing legislation that would make it "*a criminal offence dishonestly to import, deal in or be in possession of any cultural object, knowing or believing that the object was stolen, (or) illegally excavated…*" (DCMS 2001 p.3).

These two important developments, which will have a profound impact on cleaning up a disreputable trade in the UK, resulted from the recommendations of the Ministerial Advisory Panel on Illicit Trade (Palmer 2000). This Panel, under the energetic chairmanship of Professor Norman Palmer, a specialist in commercial law at University College London, was in turn established as a direct result of the publication earlier in 2000 of the hard-hitting report *Stealing History: the Illicit Trade in Cultural Material*, (Brodie *et al*. 2000). This report was commissioned jointly by the UK Museums Association and ICOM-UK.

Fossils as cultural property?

The primary preoccupation of these recent reports and initiatives to stem the hugely remunerative flow of illicit material through the UK is undoubtedly art and antiquities. Where, then, does this leave fossils? Is palaeontological material, as the product of 'natural

processes,' in a different ethical category from artefacts as the product of human creativity, as some would claim? Certainly this has been argued by Clements (see Taylor and Harte 1988, p.39), who stated in discussion that "I object strongly to the nationalistic notion of *British* fossils; they are part of a global heritage…". This is a view echoed by Martin (1999, p. 114), "…fossils are probably not 'cultural', and if they are ever anyone's property, once in the public domain they, and the information they carry, belong to the international scientific community, in trust for everyone". Taylor (1999, p. 126), however, suggests that this view reflects a particularly academic perspective. He rejects the academic position, stating that "…I remain unconvinced about the merits of having research collections of Scottish material scattered all over the world as historical markers for the research interests of now-departed researchers. The same aims can be achieved by keeping the specimens in the collections of Scottish museums". This echoes the argument made forcefully by Rolfe (see Taylor and Harte 1988, pp39-40), who, in discussion, noted that the best material should never be removed from its source area, since it would be best appreciated there by locals and visitors.

Within their definition of cultural material, agreed internationally, both ICOM and UNESCO include fossils, as explained above (ICOM 1986, UNESCO 1970). If the detail underlying the recommendations of Norman Palmer's Panel is accepted, then the application of the law to enforcing the UNESCO Convention in the UK will be with reference to a definition of 'cultural object' that corresponds with that set out in a European Union Directive, which includes "*Collections of historical, palaeontological, ethnographic or numismatic interest*" valued at "*£39,600*". (Palmer 2000 Annex E)

This somewhat bizarre rag bag of apparently unconnected cultural *collections* with a price on their head contrasts with archaeology, on the same list, at no. 1, which deals with individual objects irrespective of any consideration of financial value, as products of both sites and collections.

Such a distinction between an excavated archaeological object and a fossil I believe to be spurious and invidious, and does science a disservice. Both a fossil and a pottery shard provide verifiable, material evidence, in which context is a vitally important and integral part of our understanding of the past.

Science, culture and national patrimony

Science has always been, and will always be, a manifestation of cultural activity. The pursuit of systematic, verifiable explanations of natural phenomena is a product of the human mind whose methodologies have evolved over time and space. To argue that the preoccupations of science stand somehow independent of other forms of cultural activity is to admit of a false premise. From the study of the universe to the interaction of subatomic particles, and from the palaeoecology of the Burgess Shale to the mapping of the human genome, the raw material of science does have an existence independent of human intervention. But the mathematical models and scientific paradigms with which we seek to further our understanding of such phenomena are human constructs. Quantum theory and cladistics may be the stuff of science, but they are no more than the intellectual tools fashioned by humans to prise open the secrets of the universe. There is no logical justification, then, for suggesting that 'science' somehow stands apart from and above what defines us as cultural beings. This is not just an issue of professional ethics: it is also one of personal morality. By what authority, then, can any scientist worthy the name, claim that he has the right to act above the law or to disregard the normative ethical values of society?

There is then the claim that fossils, as natural specimens, transcend notions of national patrimony. As Padian says in his essay, "*…in the end nobody owns it; everyone owns it*" (Padian 2000, p. 10). Even when refracted through the scientist's lens, this notion seems merely a variation of the nineteenth century "*property is theft*" polemic of Pierre-Joseph Proudhon (Kelley and Smith 1994, p.13). It's curious how it's usually someone else's property that we seem happiest to question. Again, there is more that unites palaeontology with the world of art and antiquities than divides it on this point. The Tate Gallery may own the keys to the door of the gallery in which Rodin's '*The Kiss*' is housed, but the work is regarded by the art world as part of an international patrimony. When the Taliban blew up two ancient statues of the Buddha in Afghanistan in March, it was the subject of an international outcry and triggered the intervention of the Secretary General of the United Nations. The concept of international patrimony co-existing with the notion of national ownership is well established in cultural domains other than the scientific. The claim by palaeontologists that fossils (even the most iconic, like *Archaeopteryx*) are somehow different, just doesn't stand up to scrutiny.

The scientist who espouses the notion of a kind of pan-global palaeontology that recognises no national claims or borders is in practice working against not only international treaties, but also against egalitarian principles. For, most of the illicit trade in fossils and artefacts is from poor third world countries to the

affluent first world. *Stealing History* is forthright on the point:

> "...it is a one-way trade. Cultural objects are illicitly moved from south to north, from east to west, from third and fourth worlds to the first, and from poor to rich. There is no countervailing flow." (Brodie *et al*. 2000, p.12).

A third world perspective: Brazil

I am surprised that it was considered appropriate to convene this conference without a speaker from any of the third world countries which are being stripped of their palaeontological heritage through the illicit trade. I believe this to be a serious omission, for it would be salutary for us to hear their voice. Of the many countries that suffer large-scale and continuing palaeontological plunder, perhaps the two which are most prominent are China and Brazil. Knowing that David Martill was to give the perspective of a non-Brazilian scientist on the Brazilian fossil trade, I felt a moral obligation to attempt to represent the views of some Brazilian palaeontologists in this debate. The issues revolve around the buoyant market in fossils stolen from the Santana and Crato formations of the Araripe Basin in north-east Brazil, and then illegally exported to be traded in North America and Europe.

These limestones, of early Cretaceous age, yield an extensive and important vertebrate and invertebrate fauna, superbly preserved. The vertebrate specimens, particularly of fish, are attractive to dealers as so-called 'décor fossils'.

Let us start by considering the protection afforded under Brazilian law to these fossils and to fossiliferous sites. Article 1 of a law passed in 1942, and still in force, states that all fossiliferous deposits are the property of the State. It is illegal for anyone to extract fossils without the prior permission of the National Department of Mineral Production, with the exception of Brazilian museums and universities. According to Dr Alexander Kellner, a palaeontologist in the national museum in Rio de Janeiro, "since the Department has not issued any collecting permits for fossils, all the fossils that are available for sale, both within and outside Brazil have a *de facto* illegal status." (pers. comm.).

Kellner has told me that there is also a regulation passed by the Brazilian Scientific Council in the mid-nineties, which requires that:

- all scientific fieldwork undertaken in Brazil by a non-Brazilian scientist must be conducted in partnership with a Brazilian scientist who has recognised scientific credentials in the relevant field of study;
- the appropriate documentation must be completed and submitted to the Scientific Council for prior approval; and
- all holotypes and taxonomically significant specimens must remain in Brazil and be deposited in an accredited institution.

This is the regulatory framework in Brazil. Any scientist or museum from another state that chooses to undertake research in Brazil or wishes to acquire fossil material from Brazil has, as explained above, an ethical obligation, under international treaty, to comply with the expression of a state's legitimate intent to protect and retain control over its natural patrimony. The Brazilian authorities do occasionally intercept and confiscate illegal shipments, but such is the scale of the problem, that they do not have the resources to police these rules effectively.

So, yes, admittedly it may be possible to buy a Brazilian fossil fish from a market stall in Rio, or from a dealer in Tucson, but if a scientist knows that it is stolen property, and taking it out of the country is illegal, how then can that be justified? Let us say that the palaeontologist's expert eye picks out a specimen with a hitherto undescribed characteristic, which s/he reckons may be of great significance to science. The palaeontologist buys it, on those grounds, rather than let it fall into the hands of a private collector, or into the backpack of a tourist who won't recognise its scientific value. Our intrepid scientist bears it back in triumph to England, where, after careful study s/he attempts to publish a description. Ah, but here's the rub: a condition of publication in any reputable scientific journal is that all described and figured material must be registered and deposited in an appropriate, permanent institution, with the staff and facilities capable of ensuring their conservation and future reference in perpetuity: i.e. a public museum. This fulfils a basic tenet of science, that published research must be verifiable. The editorial policy of the science journals of first choice is quite unequivocal on this point (e.g. *Journal of Vertebrate Palaeontology* 1996). And what reputable museum will accept such illicit material into its collections? If the International Codes of Botanical and Zoological Nomenclature are properly applied by the editors of science journals and the ethical standards related to acquisition properly applied by museums, the palaeontologist who tries to cut ethical corners for the so-called good of science will find that s/he has a problem on his or her hands. For that much prized but illicit specimen can only be published and

brought into the public domain by following one of two routes. Either it must first be repatriated to an appropriate institution in the country from which it was illegally removed, or, if it has been intercepted, it may be deposited by HM Customs and Excise in a UK museum, when the source cannot be unambiguously identified.

Before leaving Brazil, it is instructive to listen to the personal views of two eminent Brazilian palaeontologists:

Alexander Kellner (pers. comm.):

> "The region where the Santana Beds outcrop is very poor. The local people who exploit these resources are not regarded here as thieves. These people make very little money, even with the fossil trade. The profits go to the middle man. There is a German fossil dealer in Nova Olinda, a small town in the State of Ceara, who was recently discovered by the police to have a stock of over 2,000 specimens. He pays less than 10 cents (US) for one fossil insect, which may be sold on for as much as US$1,000 to both private collectors and to museums.
>
> "There is always a loss of scientific data with illicit fossils. Precise details of stratigraphy and location are lost.
>
> "Scientists in other parts of the world should be aware that there is a palaeontological community in Brazil, which is actively studying fossils. Scientists elsewhere should be aware that the illicit fossil from Brazil that is on their table could belong to the same taxon that is being currently studied by Brazilian scientists.
>
> "Furthermore, palaeontologists in Brazil oppose the illegal export of fossils because it diminishes the chance for us to prepare good palaeontological exhibits for the people of Brazil. Because we have the disadvantage of working in a nation with severe economic difficulties does not give scientists from richer nations the right to use their superior spending power to remove fossils from Brazil and thereby hinder the development of palaeontology in this country."

This is echoed by Ismar Carvalho (pers. comm):

> "It is very common for foreign scientists from museums and universities in the US, Japan and Europe, to buy directly from the poor workers of the Santana do Cariri and Crato counties. This is a problem of complete loss of intellectual integrity. The researchers who buy these fossils do not know the provenance or the geological context of the material. They destroy the opportunities for developing sustainable economic growth based on eco-tourism. And perhaps worst of all, they encourage the destruction of the thin layer of soil in this area and contribute to the pollution of small rivers in this semi-arid environment.
>
> "Despite the presence of many Brazilian universities researching in this region, and an important local museum (Museo de Palaeontologia de Santan do Cariri), the respect that we receive seems to be typical of that shown by the First World to the Third World. Our perception is that they think we deserve nothing, and that our cultural heritage should be controlled by those who have the money to provide the most rapid access to information."

The picture is clearly a complex one, and depicts a story that has other sides to it. The bulk of fossil fishes that are illegally sold by the local "fishermen" (as they are colloquially known in Brazil) no doubt belong to a very small number of well-documented species, so what is the significance of their loss to palaeontology? If Brazil were to be relaxed about them, how do they filter the catch to ensure the big ones don't get away? Where would that leave the principle of cultural patrimony which they have a right to defend? Some of Brazil's palaeontologically sensitive sites are worked for the construction industry, so our first world ideas of site protection are difficult to apply in a country with great economic problems.

The views of the Brazilian scientists, quoted above, provide an instructive comparison with those presented elsewhere in these proceedings by David Martill, who has extensive personal experience of collecting such material in the field in Brazil. I find unacceptable and indefensible the argument advanced by some during the debate on 23rd May 2001, that the endemic corruption alleged in a Third World country of origin justifies the suspension of the standards of behaviour expected of a scientist in the First World. The remedies don't seem to be too difficult to identify: the establishment of appropriately negotiated research partnerships between, say UK and Brazilian scientists could draw upon the resources of the comparatively affluent UK to publish Brazilian fossils to the benefit of both the international scientific community and Brazilian science and culture. This should be done in ways that comply with national laws and regulations and with international treaty obligations.

Similar principles apply in China. The main difference there is that, in contrast to the rather more relaxed attitude of the authorities in Brazil to the nefarious activities of local people, in China, the retribution of

the State visited on local people can be swift and terrible. In February last year, three men were executed for stealing 15 Tang Dynasty murals from a museum in Liquan, Shaanxi province (Doole 2000, p 8). That same month, in Liaoning, the very region that is producing so many new Lower Cretaceous beasts, four suspects were reportedly arrested trying to sell antiquities (Doole 2000, p 8). How can a museum curator or scientist in the west square the temptation to purchase an illicitly traded Liaoning fossil with their conscience, knowing that they are conniving in a deadly trade at the other end of which is a local who was paid a pittance to put his freedom or his very life in jeopardy?

A first world museum ethic: the USA and UK

So how do national codes of practice for museums in the USA and UK measure up to the kind of standards that I advocate? Both are consistent with the ICOM Code and the 1970 UNESCO Convention.

In the USA, the American Association of Museums (AAM), through ethical standards published successively in 1978 and 1991, outlaws the illicit trade, which it equates with the destruction of sites.

> "Illicit trade in objects encourages the destruction of sites, the violation of national exportation laws and contravention of the spirit of patrimony. Museums must acknowledge the relationship between the market place and the initial and often destructive taking of an object for the commercial market. They must not support that illicit market.
>
> "The distinctive character of museum ethics derives from the ownership, care and use of objects, specimens and living collections representing the world's natural and cultural common wealth. This stewardship carries with it the presumption of rightful ownership…Thus the museum ensures that:
>
> • acquisition, disposal and loan activities are conducted in a manner that respects the protection and preservation of natural and cultural resources and discourages illicit trade in such materials" (AAM 1991, p.12).

In the UK, the Museums Association (MA), defines and articulates ethical standards for museums in Britain through its published *Codes of Ethics* (MA 1999) and *Ethical Guidelines* (MA 1996). These similarly prohibit museums from accepting on loan, acquiring, exhibiting or even researching, an illicit item. Museums are also expected to abide by the principles of the 1970 UNESCO Convention, as well as the 1995 UNIDROIT Convention, which is primarily concerned with issues of restitution.

The MA's current *Code of Conduct for People who Work in Museums*, adopted in 1996, is explicit on the subject of illicitly obtained objects:

> "Museums should not accept on loan, acquire, exhibit or assist the current possessor of, any object that has been acquired in, or exported from its country of origin…in violation of that country's laws." (MA 1999, p. 7).

The Code goes on to exhort museums to take account of the principles of the 1970 UNESCO Convention, as well as the 1995 UNIDROIT Convention, which is primarily concerned with issues of restitution.

The MA Ethics Committee is currently merging the hitherto separate institutional and individual Codes into a new and fundamentally re-considered *Code of Museum Ethics*. This places the social purpose of the museum at the heart of its philosophy. The new Code, which will be published early in 2002, articulates 10 key principles, two of which are particularly relevant to this discussion.

> "Society can expect museums to:
>
> 5. ACQUIRE ITEMS HONESTLY AND RESPONSIBLY
>
> Museums develop collections using long-term plans that are socially responsive. They reject items with dubious provenance. Museums…adhere to acquisition policies…These address issues of context and legitimacy of acquisitions, due diligence…Items are acquired on the basis that they will be retained in the public domain.
>
> All those who work for or govern museums should ensure that they:
>
> • Exercise due diligence when considering an acquisition…Refrain from acquiring any item if there is any suspicion that the current owner is not legitimately able to transfer title or to lend.
>
> • country of origin…in violation of that country's laws or any national or international treaties.
>
> • Comply not only with treaties which have been ratified by the UK Government…but also uphold the principles of the …1970 UNESCO and 1995 UNIDROIT treaties…
>
> • Refuse to acquire, display or research unprovenanced items that may have been looted, unless there is reliable documentation to show that they were exported from their country of origin before 1970." (MA 2002, Section 5).

"Society can expect museums to:

8. SUPPORT THE PROTECTION OF NATURAL AND HUMAN ENVIRONMENTS

Collections in museums represent the rich diversity of the world's natural and human environments…They contribute to sustainable economic activity and benefit local and wider communities.

All those who work for or govern museums should ensure that they:

• Value and protect natural…environments. Prevent abuse of places of scientific…importance. Uphold appropriate national and international conventions and treaties on protection of natural…environments, whether or not they have been ratified in the UK." (MA 2002, Section 8).

These principles are further embedded in the professional standards expected of UK museums through the national Registration scheme. This scheme defines the minimum standards with which a museum must comply in order to qualify for inclusion on the national Register of approved museums. The scheme and criteria were drawn up and previously administered by the UK Government's advisory body on museums, the Museums and Galleries Commission (MGC), which was abolished in April 2000, when its successor, 'Resource' (the Council for Museums, Archives and Libraries), came into being. Resource now administers the national Registration scheme. All reputable museums in the public domain in the UK are on the Register, a precondition for receipt of government and other major grants, including funding from the National Lottery. Amongst the conditions for gaining full registered status is the requirement that the museum must have a formally approved Acquisition and Disposal Policy, which must include the following provisions *verbatim*:

"a) The museum will not acquire, whether by purchase, gift, bequest or exchange, any object or specimen unless the governing body or responsible officer is satisfied that the museum can acquire valid title to the item in question, and that in particular it has not been acquired in, or exported from, its country of origin (or any intermediate country in which it may have been legally owned) in violation of that country's laws.

"b) So far as biological and geological material is concerned, the museum will not acquire by direct or indirect means any specimen that has been collected, sold or otherwise transferred in contravention of any national or international wildlife protection or natural history conservation law, or treaty of the United Kingdom or any other country, except with the express consent of an appropriate outside authority." (MGC 1995, p.13, Manchester Museum 1997, pp. 12 and 14).

In summary, the conduct of museums in the UK is subject not only to the laws that prevail in England, Scotland, Wales and Northern Ireland. They are also bound by the administrative conditions of the regulatory systems under which they operate, and they elect to abide by the standards of professional ethics which have been developed by the museums profession over the last 25 years. Under these circumstances, there is no point in importing a fossil into the UK if it has been stolen and/or illegally exported from its country of origin, since its scientific value cannot be realised if no reputable museum will accept a specimen that is contaminated ethically and legally through its means of appropriation. Palaeontologists who are aware of such issues are entitled to seek to change the law and to campaign to change the ethical and other administrative protocols by which UK museums operate, wrong though I believe they would be to attempt to do so. In the meantime, however, they have no right to breach the law or flout such regulatory standards.

Some concluding thoughts

There can be no doubt about the ethical position of the governing bodies and professional staff in UK public museums when faced with the illicit trade in fossils. They want no part in it. Legally they may soon not have much choice, though the position of palaeontology in the proposed new legislation is admittedly ambiguous. Long experience of professional ethics in practice as well as in theory, teaches that there are often difficult judgements to be made when making ethical choices. To help us make informed decisions, we need a clearly articulated set of over-arching principles to navigate by. That is what the national and supra-national codes and conventions provide. If their interpretation and application to some areas of current scientific practice requires clearer definition and discussion, then this debate is timely and welcome. Differences of perspective and opinion on standards of openness, honesty and integrity are issues that must be addressed by palaeontologists in partnership with the museums community.

As this paper tries to demonstrate, there is no moral or scientific justification for a scientist or curator to ride roughshod over the national laws of individual states. However, there is the argument of 'last resort', which is explored by Brodie *et al*. 2000. For archaeology, the 'Rosetta Stone Dilemma', poses the

question of the choice faced by a curator who is offered (by a shady dealer) a tablet with no provenance, on which is inscribed two texts, one in a known language, the other in a language that has always baffled scholars. It is the unique key to understanding an ancient civilisation. Does he refuse to have anything to do with it and thereby pass up the scholarly opportunity of a lifetime, or does he suspend ethical principle and give in to his scholarly instincts? *Stealing History* warns us to be cautious about the Rosetta Stone argument: "The number of Rosetta Stones can be counted on one finger, and the number of equivalent items on the fingers of one hand." (Brodie *et al*. 2000, pp. 46 - 47.) Manus Brinkman, the Secretary General of ICOM, is even more scathing and condemns the notion of a 'museum of last resort.' Can it really be argued that every fossil with a hitherto undescribed characteristic is the palaeontological equivalent of the Rosetta Stone?

It seems to me that one of the most useful and lasting benefits that could flow from this debate is for research palaeontologists and museum curators to work together with representatives of the prime science journals to develop '*Guidelines for Due Diligence in Palaeontology*'. This *must* be done in consultation with colleagues overseas. These *Guidelines* would articulate the issues and standards expected in the conduct of field work, the acquisition of fossils from all sources including the trade, loans of fossils between research institutions, their research, publication and long-term disposition. The purpose of the guidelines would be to balance the interests of science internationally with the interests of individual nation states as enshrined in international treaty, and to harmonise the practices of palaeontologists working both within and outwith the museum sector.

To those who say, but we already have published rules and agreed standards, both in museums and in the science journals, I would suggest the fact that we need this debate is symptomatic of a discipline that is far from united on the issues. Practices differ as widely as the values of its practitioners. What we must agree, therefore, is an ethical foundation on which to build the quality of science that will stand the test of time.

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THE TRADE IN BRAZILIAN FOSSILS: ONE PALAEONTOLOGIST'S PERSPECTIVE

by David Martill

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

The Santana and Crato formations of the Araripe Basin are a prolific source of exceptionally well preserved mid Cretaceous fossils. Fossils are collected from the Crato Formation as a byproduct of quarrying activity, but those from the Santana Formation are mined commerically. The commerical trade in Brazilian fossils is illegal, but the trade flourishes. Despite occasional attempts to stamp out the trade, widespread corruption allows its continuity. A legitimate case can be made for the legalisation of the fossil trade that would be of benefit to the international scientific community and to the local commuinties where the fossils are found.

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An almost unbelievable tale

In 1990, Dr (but then plain old Mr) Phil Wilby and I were working in Brazil on the soft-tissue bearing fossil fishes of the famous Santana Formation in the Chapada do Araripe, north eastern Brazil. Dr Paulo Brito of Rio de Janeiro had specifically asked us to look out for 'baby' fishes. These were of interest to him for his ontogenetic studies on the aspidorhynchid fish *Vinctifer*. Phil and I quickly discovered that small, or juvenile fishes were rather rare in the Santana nodules, and that there appeared to be a lower limit to the size of fish that could initiate concretion development. Thus we only found baby fishes when they occurred in mass mortality assemblages of hundreds, or even thousands of individuals, or where a small fish lay next to larger fish that did initiate concretion formation. We collected several exciting concretions in which a large fish had two or three smaller ones by its side, though sadly we found no young specimens of *Vinctifer* smaller than 200 mm.

Back then Wilby and I were based at the Open University and we prepared our samples for shipment to the Milton Keynes campus. The most scientifically important specimens were carried in our rucksacks and we prayed that the airlines would not be too hard on us. TAP and VARIG were great and only British Airways ever charged for excess baggage (just one of the reasons why I try to avoid travelling with the world's most pompous airline). Where we had both halves of a concretion we carried one half and shipped the other.

Shipped specimens had to pass through customs in Rio. Our authorisation documents issued by the DNPM in Fortaleza were in order, and the boxes were left for shipment. One box arrived without problem, but the other failed to arrive. When Brazilian customs officers are in doubt about fossils the specimens are sent to the DNPM palaeontological office, which just happens to be based in Rio, rather than Brasilia. Apparently there were some problems with one of our boxes and it was despatched to the DNPM's palaeontological office for inspection. We never saw that box again.

Time moves on

In 1994 I took up a position at the University of Portsmouth continuing my researches on Brazilian fossils. Portsmouth had a small collection of Brazilian fishes in a display cabinet, while lecturer Mike Chaplain had a rather nice specimen on his desk as a conversational piece. It was particularly noteworthy as it contained a fine fish with three small fishes in a distinctively shaped concretion. Mike explained that a student who had bought the fossil at a market while holidaying in Rio had given it to him. I explained to Mike the importance of 'baby' fishes and he loaned me the specimen for a period.

Serendipity rules OK

Sometime later Dr Wilby visited Portsmouth to present his findings on Solnhofen fossils at a Palaeontological

Association research seminar on fossil Lagerstätten. On entering my office he noted the concretion with the baby fishes and simply commented, "Oh, so the second box finally arrived". I explained that this specimen was nothing to do with the missing box, and that the specimen was not mine, but a gift from a student. But Wilby was adamant, and indeed, the concretion is the counterpart to the specimen he brought back to the UK and used in his Ph.D. thesis. So how did the specimen get from our box to a market stall in Rio?

This is just one of many enigmas, and curious little cameos to unfurl during my years of work in Brazil. Trivial though it is, it serves to demonstrate that corruption operates at all levels and not just at the presidential levels that Latin American countries have become synonymous with. Such petty corruption, remarkably, and certainly without design, has unintentionally resulted in one of the most important advances in our knowledge of Cretaceous vertebrate palaeontology and palaeoentomology since palaeontology began. The fossil flora and fauna of the Chapada do Araripe offers the best opportunity to investigate a Mesozoic ecosystem. No other deposit offers the diversity of palaeoflora and fauna and quality of preservation in such abundance. And all of this rides on the back of one of the largest and longest surviving fossil smuggling operations in existence.

More preamble

By now, most palaeontologists should be aware that a thriving, but illegal trade in Brazilian fossils exists, especially those from the now famous Crato and Santana formations of the north eastern states of Ceará, Piaui and Pernambuco (Farrar 1999). The fossils come mainly from the western end of the Chapada do Araripe, and are collected around Jardim, Porteiras, Sao Philipe and Santana do Cariri. Here I present a view; my own, of the commercial trade in fossils from the Araripe and Val do Cariri regions. These views have developed over the last fifteen years during months of fieldwork in the Chapada, where I have worked with Brazilian scientists and government officers. I have met illegal fossil diggers, visited safe houses where the fossils are stored, talked with the middlemen, and looked down the barrels of their guns. I have incurred the wrath of some who have tried to link me with the fossil trade. I have met with British and German dealers to see the scale of the operation at the European end, and I have met with European museum curators who have bought Brazilian fossils in the full knowledge that they were illegally exported. I have also visited the area with investigative journalists from national newspapers. I was told many intriguing stories of high-level corruption and the connivance of academics, but unfortunately few people were willing to stand up and be counted. To protect the anonymity of the diggers, dealers, smugglers and those selling fossils on the international market I have avoided using names wherever possible. Some examples are relocated for similar reasons.

My views on the trade are often discordant with those of other palaeontologists, and attempts have been made to link my name in the Brazilian press with European fossil dealers for which arrest warrants have been issued in Brazil. To those people I take this opportunity to raise two fingers in the time-honoured salute attributable to historic archers opposing the French, rather than that attributed to Sir Winston Churchill.

The region, its geology and its fossils

The Chapada do Araripe is an elevated plateau of red sandstones and conglomerates underlain by a varied sequence of clays, sands, limestones and evaporites of Mesozoic age (Martill 1993). The plateau is approximately 150 km east to west and about 50 km north to south and extends across the southern border of Ceará and Pernambuco, and also encroaches on a sparsely populated part of Piaui. The region thus comes under the jurisdiction of three state authorities. However, for the purposes of geological research and exploitation, it comes under the auspices of one organisation, the Departmento Nacional Produçao de Mineral (DNPM). The main office for the north east of Brazil is located in Fortaleza, but a small office and museum is situated in Crato, at the foot of the Chapada and close to the action. The staff here are responsible for monitoring mining and other resource-related activities in the region, including the exploitation of the fossil beds of the Santana and Crato formations, and they have the full authority of Brazilian law, being able to make arrests. These agents may carry arms. On a tour of the region with one DNPM officer we entered property armed merely with a Government ID badge. But when visiting the fossil digging regions the agent accompanying me always wore his revolver.

Two geological formations in the Chapada are highly fossiliferous and represent fossil conservation Lagerstätten. Indeed, fossils are so abundant in the nodules of the Santana Formation, that this deposit also constitutes a concentration Lagerstätten (Martill 1999). The fossil assemblages are diverse and include vertebrates and invertebrates in an excellent state of preservation, usually fully articulated, three dimensional, and often with soft tissue preservation

and stomach contents (Maisey 1990, Martill 1988, 1991).

The Santana Formation is particularly well-known for its diverse fish fauna (some 23 species) (Brito et al. 1998, Brito and Martill 1999), but it also yields pterosaurs (*circa* 10 species in seven genera - *Tapejara*, *Tupuxuara*, *Cearadactylus*, *Brasileodactylus*, *Tropeognathus*, *Coloborhynchus*, *Santanadactylus*) (Kellner and Tomida 2000), turtles (2-3 genera), crocodiles (2 genera) and dinosaurs (*Irritator*, *Santanaraptor* and at least two unnamed taxa) (Frey and Martill 1995, Martill et al. 1996, Kellner 1999). All occur in early diagenetic carbonate concretions in the Romualdo Member (Martill 1988), a deposit that crops out discontinuously around the Chapada for approximately 300 km.

The slightly older Crato Formation yields an equally abundant and diverse fauna in the Nova Olinda Member limestones that are exploited commercially for building and ornamental stone between the small towns of Santana do Cariri and Nova Olinda, and for cement manufacture at Barbalha (Martill and Frey 1998). The fossil assemblage here includes a diverse flora, often of complete plants (including roots, stems, leaves, fruiting bodies), an insect fauna (Grimaldi 1990), other terrestrial arthropods (Wilson and Martill 2001), fishes (Davis and Martill 1999), pterosaurs (Frey and Martill 1994, Martill and Frey 1998, 2000), lizards, turtles and amphibians. Isolated feathers also occur (Martill and Filgueira 1994). Although slightly flattened, the Crato Formation fossils are nevertheless exceptionally well preserved and may even show evidence of soft tissue preservation. Pterosaurs provide among the most spectacular examples of this: remarkable fossils of tapejarids preserving their soft tissue head crests have been found (Martill and Frey 1998, Campos and Kellner 1997). A fossil bird, preserved with its feathers intact, is also known (Martill pers. obs.) but is presently of unknown whereabouts. It is thought to be in a private Japanese collection, after several European museums felt unable to buy it.

Fossils from the Santana Formation nodule beds (Romualdo Member) can easily be found in field brash, in stream sections where they may dominate the boulders of the river bed, and in natural exposures where deeply incised valleys penetrate the Chapada. The fossiliferous nodules have been known since pioneering naturalists visited the region in the early 1800s (e.g. Spix and Martius 1828-31), though they were first considered scientifically by Agassiz (1841) after specimens were shipped back to England by Scottish botanist G. Gardner (Gardner 1841). Local Brazilian farmers now excavate mines on the outcrop of the nodule beds to obtain fossils for the commercial markets, and in some places these mines may reach depths of ten metres, and be laterally extensive. Fossils from the Crato Formation limestones on the other hand are obtained mainly as a by-product of the ornamental stone industry. Hundreds of small quarries have been opened as family businesses to sell stone to local cutting yards. These operations are labour intensive, with every slab of rock excavated being examined, and thus hundreds of fossils are discovered each day. New insect taxa are being discovered so frequently that palaeoentomologists are struggling to keep pace with the descriptive effort required to put them on record.

It is apparently illegal to collect vertebrate fossils in Brazil without permission of the DNPM, and it is illegal to export them without authorisation. The law is still unclear, but it is most likely that if you have bought a Brazilian fossil from a European or North American fossil dealer, it has been obtained illegally. It is not possible at present to obtain a licence for the export of fossils unless they are for scientific research.

No Brazilian organisation has published an account of how a licence might be obtained to collect fossils in Brazil for scientific research, while letters of mine to the DNPM palaeontological office in Rio remain unanswered. It is thus unclear as to which authority should be approached to obtain a licence for the collection and removal of Brazilian fossils. For my own research, which began in the field in 1988, I visited the Fortaleza offices of the DNPM and was given authorisation, while the Crato office produced the necessary documentation. At no time did I ever have to show my authorisation on leaving Brazil, though I was stopped and searched on several occasions. The presence of fossils in my baggage did not appear to be of importance to the customs officers.

Brazilian fossils offered for sale in the shops and fossil trade fairs of Europe, Japan and North America have usually been collected by very poor people, usually displaced farm labourers, who dig fossils or dig ornamental stone and accidentally find fossils as a means of supplementing a meagre income. They are often organised into gangs by middlemen who 'employ' the diggers and then sell the fossils on to European dealers who visit the region or to Brazilian dealers based in Sao Paulo.

Several safe houses exist in the small towns around the Chapada where freshly dug fossils are stored prior to export. These are good places to search for rare or unusual pieces, and a visit to one of these houses may save a fossil from possible destruction.

Those fossils considered to be of little scientific value (decisions are made sometimes on the basis of size, and many new insects and spiders slip through the net) and therefore considered to be of little monetary value, are treated badly. In the case of fossils from the Crato Formation, these are usually in very bad condition by the time they end up on the market stalls. From these safe houses the fossils are either sent to the dealers in Sao Paulo, or sent to one of the ports for shipment overseas. Many fossils go out packed in liquor boxes, while others go in trucks and are covered with coconuts. It is great fun to travel on the backs of such trucks, and to watch the drivers pass bribes of local produce to the police at the state border checkpoints.

So why all the effort? At outcrop, a complete, fully articulated fish in a nodule can be bought from a fossil digger for less than five dollars. A large *Cladocyclus* (up to 1 m long) can sometimes be bought for as little as $40. From middlemen based in the towns of Santana do Cariri or Porteiras prices are higher. Indeed, the asking price may be higher than the price on a market stall in Rio de Janeiro, as the middlemen believe that, being European, you are filthy rich and can afford inflated prices. Prices of the same fossils in the European fossil shops vary considerably. By way of some examples, I have been offered coelacanths for as little as $5 from the fossil diggers, but seen them on sale for $3,000-4,000 in Europe. I was offered a pterosaur lower jaw for $20, though all the teeth had been prepared off, and a partial pterosaur wing for $100. A nodule with some bones was offered to me for $100. The bones represented a new species of dinosaur. I was offered a turtle for $1,000 by one of the local middlemen, and saw the very same specimen, after preparation, in a German fossil shop for $10,000 (enhanced value in preparation). Complete pterosaurs sell for much more. Some are selling for $100,000 or more.

Many of the fossils that are collected for commercial purposes are of common species and are of little scientific value on their own. Indeed, fossils are so abundant that the common species such as the fishes *Dastilbe*, *Tharrhias* and *Rhacolepis* could be viewed as a commercial resource to be used for earning foreign currency, or for educational supply (*Dastilbe* is so common that every school on Earth could have one - perhaps two or three).

Active collecting of the common fossils reveals the rarer as well as the scientifically more interesting specimens (I do not equate rarity with scientific importance). In the past rare species were thrown in with the common species, and astute palaeontologists could often obtain exciting new specimens simply by looking at the fossil stalls of the Ipanema Thursday hippie market in Rio de Janeiro. What a great way to do field work. Presumably some specimens would have become less exciting as the effects of a spliff wore off!

This was in the 1970s and early 1980s and predated the big renaissance in palaeontology. The market is more sophisticated now, and rare and exceptionally high quality specimens are extracted by the middlemen of the Chapada who are well able to recognise important material.

Ethics

Should palaeontologists be buying such fossils? Do palaeontologists have an ethical question to answer? The digging of fossils by the inhabitants of the Val do Cariri represents an opportunity to earn a living. The fossil diggers work hard under hot and sometimes dangerous conditions. They might be being exploited by the middlemen, but the alternative is no work, no money and therefore real deprivation. The middlemen of Santana do Cariri do not appear to be getting fat. I have been visiting the area for nearly 15 years and all of the middlemen I have come into contact with still seem as poor as they ever were. Most are taxi drivers as well as fossil dealers, and their taxis are not upmarket BMWs. But the dealers in Sao Paulo are getting rich, and so are the European, Japanese and American dealers. Fossils are getting out of Brazil by the truckload, presumably because of corruption. There are some fifteen small towns and villages where fossil digging is undertaken. Some gangs of diggers move from one location to another, and if the police in one state begin a crack down, the diggers simply cross the border.

A dealer confided in me that her fossils are shipped out of a port in the north, whereas another had his fossil fishes smuggled into the UK in barrels of amethyst. Clearly Brazil leaks like a sieve. No doubt the customs officials in Brazil are overworked as they are anywhere else in the world, and quite probably they wonder what all the fuss is about. After all, it's just a bunch of dead fish. The DNPM office at Crato has a room stacked to the ceiling with fossil fish sequestered by federal agents from dealers and market stalls in Fortaleza. There is no room for any more confiscated fossils, and no one has done anything with those that have been sequestered anyway.

Should museums buy these fossils?

Yes, of course. The trade in tourist fodder fossils has been going on for decades, and long before scientists got on the Brazilian bonanza bandwagon. The

osteological studies of Patterson (1977) and Forey (1977), and the early studies of Martill (1988) were in part dependent on fossils bought by tourists and donated to museums. (The first specimens I worked on were traded by swapping belemnites from the Oxford Clay; fifty belemnites = one fish.) If palaeontologists do not buy the scientifically important fossils then one of two things happens. The fossil may end up in the collection of a member of the general public who doesn't recognise the scientific worth of a specimen and puts it on his TV as an ornament. Then when he dies it gets thrown into the skip along with the rest of the material that he collected over his life. The second thing that might happen is that an arch rival may buy the specimen, and beat you to palaeontological fame and glory. But if palaeontological fame and glory is your motive, then make sure not to follow in the footsteps of Stephan Czerkas who landed severe egg on his face when he purchased an allegedly illegally exported composite dinosaur from China (Simons 2000).

If we refuse to buy specimens simply because they have been collected illegally, or exported illegally, then the trade will either dry up completely as the profit margins narrow, or the price will go up as such fossils become rarer. Of course, you may find that your government has signed up to one of the treaties that make the purchase of such exports illegal at the point of sale. Then the decision has been made for you. You cannot buy the fossil without bringing your institution into disrepute. You must kiss it goodbye and see a scientifically important piece disappear, perhaps forever.

At its simplest, if the tourist market for Brazilian fossils disappears then the exciting discoveries will not be made. There will be no fossils for any palaeontologists, Brazilian or European.

Every new Santana pterosaur or dinosaur discovered in Brazil has been an accidental consequence of a poor Brazilian farmer trying to earn some extra cash by selling a fossil fish or digging stone. Science was just plain lucky that the farmer dug out a nodule with a pterosaur rather than a fish, or that the fossil was saved from the saw of the stone yard.

What about contextual information?

Locality or horizon data is rarely recorded with the specimens when collected by the Brazilian commercial fossil diggers. Even when advertised as coming from Santana do Cariri, a fossil can be from as far afield as Araripina, a distance of nearly 100 km. Although something of an imprecise black art, it is possible to 'guess' the locality of a concretion by certain aspects of its texture, colour and by the preservational style of enclosed fossils. But is contextual information so important? For those specimens used for anatomical and biomechanical studies (the Santana Formation nodule pterosaurs are 3D and when extracted from the concretion, can be reconstructed as complete skeletons) it is of little importance to know that the specimen came from Santana do Cariri, Jardim or Araripina. For systematic studies, cladistic analysis does not require the input of stratigraphic or locality data to resolve questions of relationship. Of course, contextual information is of importance when trying to reconstruct ancient ecosystems and variations in faunal diversity both temporally and spatially. But in such studies by far the most important signals come from the common taxa which field palaeontologists can go and collect themselves. Rare or unique specimens add little to such studies.

A main concern is that the fossil diggers simply collect concretions. Those parts of the fossil that extend beyond the margins of the concretion go uncollected. Indeed, they are destroyed during collection. Although such bones would be crushed flat, they are nevertheless important. The fossil diggers certainly do not collect in a scientific manner. But this problem could be addressed. Another important concern is that of preparation. Once a concretion has been collected it is carried to a safe house and prepared (I have seen some prepared in the field), usually very crudely. Some concretions are split perfectly into part and counterpart, but the fossil preparator will still add some chisel marks so that it looks as though he has put some work into the job. This nasty habit does tend to remove fins from some wonderful specimens. At least one European dealer has tried to rectify this by buying the nodules before preparation, and has even gone to the expense of training some of the farmers as preparators to avoid such 'vandalism'. This system works to the advantage of the fossil digger, while the dealer runs the risk of buying her fossils blind.

Will an embargo by museums prevent the plunder of the Chapada fossil sites?

Probably not. There is a thriving tourist fodder fossil trade, and it would be churlish to try to persuade Joe Public of the World not to buy a fossil at a souvenir stall in Rio de Janeiro. Brazilian fossils are even sold in Morocco on roadside stalls in the Atlas Mountains (Martill pers. obs. 2000). If museums in Europe, America and Japan stop buying the spectacular specimens, then the material will simply go into private collections.

There are some cases whereby collections of Brazilian fossils in museums have become impressively substantial. The huge collection of Brazilian fossils in the American Museum of Natural History, New York has been dual accessioned with the DNPM in Rio. How did the AMNH acquire such a large and spectacular collection? By gift from benefactors who had been to Brazil? Was the museum to say no to the offer of such gifts? Hardly.

Brazilian fossils should be studied by Brazilian scientists.

Brazilian fossils should be studied by Brazilian scientists. This is the clarion call of at least some palaeontologists as reported in recent Brazilian newspaper articles. Such calls could be considered as nothing more than sentimental claptrap, or, more menacingly, as expressions of xenophobia. Either way, it is a call that has no place in modern science, and will, in the long term, alienate Brazilian palaeontologists. Fossils should be studied by those most motivated to study them, and hopefully, by the best brains available regardless of nationality. Brazilian palaeontologists have been happy to receive funding through international organisations, and should be happy to see Brazilian fossils studied by the international community at large.

One argument used by advocates of Brazilian fossils for Brazilian palaeontologists is that the high prices paid by rich institutions in North America, Europe and Japan prevents Brazilian scientists from working on Brazilian fossils, and prevents Brazilian institutions from obtaining them for their own collections. Yep, I guess that's right. I can't argue with that. Life can be such a shit can't it. But hang on. IS this the reality? I see Brazilian scientists travelling all over the world working on fossils from Brazil and other countries. After all, Brazil is not a third world country; it's a first world country for a significant elite and growing middle class. It's just the poor sods at the bottom who miss out, but then they do in the USA and the UK as well.

Brazilian scientists regularly visit Paris and the NHM while palaeontologists from the Natural History Museum of Rio de Janeiro were in Toulouse at the Pterosaur Symposium in 2001 and went on to visit Germany to view the Karlsruhe collection. Brazilian palaeontologists also visit Japan and certainly work on fossils from other countries. Palaeontologists from the DNPM visit New York while postdoctoral palaeontologists are researching at Bristol University and I have a Brazilian Ph.D. student studying here in Portsmouth. (He currently has loans of specimens from the UK, USA, Sweden and Germany.) Methinks Brazilian palaeontologists are as international as are North American and European palaeontologists. So, does the illegal export of fossils from Brazil prevent Brazilian institutions from obtaining excellent quality specimens? Well, of course it must, for those fossils that get out. But recently the DNPM has acquired some very nice specimens. The skull of the pterosaur *Tapejara* with soft tissue head crest (Campos and Kellner 1997) and the theropod dinosaurs *Santanaraptor* and *Angaturama* (Kellner 1999), for example, are all new acquisitions. I doubt that any of these was actually discovered and collected by a palaeontologist. Every time the federal authorities intercept an illegal tranche of fossils they must surely put the good ones in the national collections. Unless of course, such fossils find their way back on to the international market (see above). This might not be the ideal way to obtain material, but it must be the cheapest. It certainly would be more expensive to stage a palaeontological excavation and run the risk of not finding anything. Let the illegal guys dig the fossils, then confiscate a few for your own museums.

Some of my reasoning may seem fatuous, over simplistic, and verging on the naïve, but I am not that naïve. I know that some of the dealers are bad guys. When big money is involved some people get nasty, very nasty. At least one Brazilian palaeontologist that I know of has received life-threatening calls and Phil Wilby and I have been at the end of their guns. I know that corruption operates at so many levels that this trade isn't going to get stopped. However, the trade could end up in the control of just one or two men, and this might not be a good thing. If scientists refuse to buy fossils for self-righteous reasons they will be cutting off their noses to spite their faces. After all, body stealing for budding surgeons and anatomists in the 19th century was a very necessary route to the advancement of medical knowledge. Let's start supporting the commercial dealers. We should lobby governments to get the international trade liberalised, legitimised and legalised wherever possible. Even the Chinese are unable to suppress the trade, and just look at their penalties. Hanging people for collecting fossils is not the palaeontology I want to be involved with. Neither is the American way of persecuting dinosaur collectors such as Peter Larson by the FBI.

I make the following observations and pleas for change.

1. Brazilian fossil diggers are not criminals. They are poor people trying to earn a living under difficult circumstances. Most are very friendly,

kind hearted souls, and they have always treated me generously. Buying fossils provides a market that keeps these people fed when crops fail.

2. The middlemen are Brazilians, and not big bad North American, European or Japanese dealers. Most of these guys would prefer that the trade was legalised so that they could legitimise their businesses. But being on the wrong side of the law brings them into contact with other marginals, and exposes them to blackmail and bribery by corrupt officials.
3. Some fossils in the Chapada do Araripe are so common that it would be difficult to conceive of a reason to want to protect them as any sort of object of natural/cultural heritage.
4. In Brazil rare and valuable fossils only come out of the ground as a consequence of digging for common 'tourist fodder' fossils or as a consequence of stone mining. Licensed commercial dealers could increase this output.
5. Organised palaeontological excavations would not obtain as many of the rarer fossils as the commercial collecting does. Organised palaeontological excavations, however, are to be welcomed.
6. The Chapada do Araripe represents such a large resource of fossiliferous nodule beds and plattenkalk limestones that areas could be sanctioned for conservation while other areas could be opened up for commercial exploitation.
7. Museums and other organisations from overseas could be invited to operate scientific excavations. Licences could be offered for sale. This would earn the DNPM revenue that could be utilised to support studentships and travel for Brazilian palaeontologists.
8. Licences could be granted to commercial dealers.
9. Commercial dealers could be invited to train Brazilian fossil diggers as preparators as a condition of their licence. Such activity would be a boost to the economies of several small Brazilian towns currently suffering employment difficulties. Other conditions of licence could be applied, such as the surrender of some types of fossil, or a given number of fossils per year. Penalties for failure could be invoked.
10. Museums with important collections of Brazilian fossils might like to adopt a dual accessioning system that allows Brazilian palaeontologists to tap into a resource that has 'leaked' from their country.
11. A successful ban on commercial fossil collecting in the Chapada do Araripe will result in no fossils of any importance reaching the scientific community, Brazilian or otherwise, unless the Brazilian Government is prepared to put significant funding into palaeontological research excavations (it surely can think of better things to spend its money on). In a global climate of privatisation Brazil should look to commercial fossil dealers to develop the Chapada do Araripe fossil grounds for both scientific and commercial gain. It does not make economic sense for government money to be spent on halting the trade in fossils to then have to spend more money funding palaeontologists to excavate the fossils that would have come out of the ground for free.
12. A commercial system could be self-policing. Licence holders would be quick to suppress any non-licensed fossil collecting activity.
13. At least one stone operator in Nova Olinda destroys all the fossils that his men encounter to avoid the possibility of any trouble with the authorities. So, that's what happens when you legislate to protect fossils. C'est la vie.

Acknowledgements

Since my first visit to the Chapada do Araripe in 1988 I have been greeted with kindness from most of the people I have met there. Even those that held me to gunpoint were friendly when they realised I was not there to arrest them. When I have walked across miles of drought stricken caatinga and agreste I have had my rucksack filled with fresh avocados and mangoes, and have been offered water (often of a muddy brown colour). Some of the people who have brought fossils to me have been to prison for practising their trade. At least one palaeontologist has died as a result of a killer bee attack and many have acquired strange and colourful diseases. I have been lucky so far, having escaped with little more than giardia and mild dysentry. During my down days the people of Nova Olinda have fed me and taken care of me. In Crato the officers of the DNPM have allowed me office space and arranged transport and permission to visit important localities. Staff at the Regional University of the Val do Cariri (URCA) have helped me to obtain maps and send emails. Many of the middlemen who pass fossils to the rich western dealers and the dealers of Sao Paulo, have let me have fossils at remarkably cheap prices, even when rich German dealers have been in town. Many of the stone workers have given me fossils for nothing. To all of these people I say thank you.

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FOSSILS FOR SALE: IS IT GOOD FOR SCIENCE?

by Neal L. Larson

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Introduction

People love to collect everything from rocks and flowers to antiques and art. It is the nature of people to be amazed by things in the world and to want to own a part of it. For everything that people collect there is, and always has been, someone selling those things to make a living.

Fossils have interested humans since history began. Fossils have been found all over the world, from the British Isles to the deserts of Egypt, from the mountains of India to the Great Plains of North America and everywhere in between. Fossils have been collected, traded, sold, and even revered as magical, medicinal, and spiritual. In some places they have even been used in place of money. Fossils are regarded by some to hold the key to the future, and by others to be merely evidence of the past.

History

One of the earliest, and best-known fossil dealers was a lady from Lyme Regis named Mary Anning. Mary was the daughter of Richard Anning, a fossil dealer who sold fossils to visitors to the area. From the late 1700s through the early 1800s she and her family made a living collecting and selling numerous marine fossil finds from the southern coast of England. Her clients were dukes and barons who thought it fashionable to collect fossils. She collected and sold the first identified skeleton of an ichthyosaur to The British Museum of Natural History for £23. They not only purchased that specimen, but many other reptile and cephalopod fossils she later collected. Because of her discoveries many new specimens were introduced to science, and as a result many scientific papers were written regarding them. It is also said that from her remarkable business came the well-known tongue-twister, "She sells sea shells by the sea shore". The practice of selling fossils was clearly acceptable and common knowledge two hundred years ago.

From the 1870s through the 1890s two well-known American palaeontologists, Professor Edward Drinker Cope and Dr Othniel Charles Marsh, made fossil collecting in the American west a serious business. Both men paid collectors to find fossils for them, and each had large field crews out earnestly collecting and actively competing against each other. Sometimes things got out of hand, and if they could not collect all of the fossils from a site, they would destroy what was left so that the other would not be able to collect them. The bribery and stealing was so bad that the collectors felt they had to carry guns to protect themselves from their competitors. Apparently paying fossil hunters to find and collect fossil specimens worked; the two men found and named more fossils than any other palaeontologist before or since.

From 1867 until the 1960s the Sternberg family collected and sold fossils to museums around the world for a price. The father, Charles H. Sternberg, collected for Professor Cope in the 1870s and in the 1880s for Cope's adversary, Dr O.C. Marsh. Charles also taught John Bell Hatcher, one of the great American palaeontologists how to collect fossils. Hatcher collected extensively and sold his finds to institutions such as Yale Museum, the Smithsonian Institute and the Carnegie Museum. Charles passed his passion on to his sons and they joined the family business collecting vertebrate fossils. The family's expeditions led them to Kansas, Wyoming, Montana

and Canada, where they collected fish, reptiles, mammals and dinosaurs for various museums throughout the world. The *Edmontosaurus* mummies at the American Museum of Natural History in New York, and at Senckenberg Museum in Frankfurt, are some of the more famous fossil specimens that were collected and sold by the Sternbergs.

In 1912 the family moved to Canada where they collected dinosaurs along the Red Deer River for the Canadian National Museum in Ottawa. They worked for the Geological Survey of Canada, University of Alberta, University of Toronto, the Provincial Museum of Edmonton, and dozens of other institutions providing fossils and expertise in preparation. Parts of these collections also later became the nucleus for the Royal Tyrrell Museum of Palaeontology in Drumheller, Alberta, Canada. By 1916 Charles and his son, Levi, worked primarily for the British Museum of Natural History, collecting fossils of dinosaurs from the badlands of Alberta. Son Charles M. decided to continue working for the Canadian institutions, and his son, George, went out on his own collecting in the American west and in Patagonia for the Field Museum. Later in life George went back to Kansas where the family had begun and helped establish the Sternberg Museum in Fort Hayes, Kansas. This particular family of professional palaeontologists was responsible for providing thousands of rare, previously unknown, and well-prepared fossils to most of the museums throughout Europe and North America for more than 100 years. Without their drive to find new fossils, their knowledge as geologists, and their abilities as collectors and preparators, the palaeontological and scientific world may not have advanced to the stage that it is today.

The late Jurassic lithographic limestone in southern Germany, north of Munich, has been mined for centuries for use as building stone, slate, tiles and lithographic plates. The miners noticed that there were fossils in the rock and sold them separately as fossil specimens. These fossils soon became popular with some of the locals and as early as 1781 it was noted that the prices of these fossils were subject to inflation. Pieces consistently brought ever higher prices as collectors kept adding to their collections. Many of these collections were sold or donated to form the nuclei for many museums throughout Europe. In 1861 the first link between birds and dinosaurs, *Archaeopteryx*, was found in the lithographic limestone at Solnhofen. This extremely important specimen was sold to the British Museum for an enormous sum of £700. Since that time fossils have remained popular and the public has been quite aware of them.

Fossils from the Posidon Shale of Holzmaden in Germany, were sold as early as 1668. By the 1890's Bernard Hauff, a miner and collector of these fossils, started marketing completely prepared slabs of these early Jurassic marine vertebrate and invertebrate fossils to museums and collectors worldwide. His preparation laboratory and gallery were stocked with reptiles, pterosaurs, fish, crinoids and ammonites for sale to the public. Most of the more unique fossils from this site were purchased by museums and universities for display and research. The fossils that Mr Hauff collected and prepared are still some of the most spectacular specimens from this locality that are exhibited in museums in the world.

Business, families and individuals are not the only ones that have sold fossils. Between 1900 and 1906 Barnum Brown, a paid collector for the American Museum of Natural History, collected three *Tyrannosaurus rex* skeletons for the museum. Two of the specimens, including the type specimen, were sold by the museum. The type specimen now resides at the Carnegie Museum of Natural in Pittsburgh, PA, and the other skeleton is at the Natural History Museum in London. The third, and most complete skeleton of *T. rex* was retained and is on display at the American Museum of Natural History in New York.

At the South Dakota School of Mines' Museum of Geology in Rapid City, South Dakota, Dr C.C. O'Hara and Dr James D. Bump built one of the finest palaeontological museums in the upper Midwest. They collected so much material that they needed a way to dispose of some of it. They opened a rock shop in Scenic and a gift shop at the Museum of Geology, where they sold many of the abundant, common vertebrate and invertebrate fossils which they collected. In this manner they were able to help finance their digs and expeditions so they could collect more specimens for research and display in the museum. This method enabled them to collect more material and find homes for it so it would not weather away or take up important museum storage space.

Ongoing

In a manner reminiscent of the early palaeontologists, today's professional palaeontologists, otherwise known as commercial or private collectors, are skilled in fossil collecting and preparation. They have created new methods to make fossil preparation faster, better and safer for the fossils. They have assisted manufacturers with the designing of new products for cleaning, gluing and preserving of fossils. Although many of these professional palaeontologists do not

have degrees, their love and dedication for the discovery of fossils is real. Because of the time spent in the field and laboratory, the knowledge and skill of these collectors may be more advanced than that of their academic counterparts. They also seem to have the drive and the determination of the old-time palaeontologists, like the Sternbergs and the Hauffs. These private palaeontologists work long and hard in the field and in the preparatory laboratory to provide magnificent prepared and unprepared fossils specimens for museums, universities and private collectors the world over. And, they do it at a fraction of the cost that a museum could do it for. They also make tens of thousands of specimens available for scientists to examine for research each year that would otherwise not be seen. Most of these research specimens are donated by the "commercial" palaeontologists to scientific institutions.

Allen Graffham of Geological Research in Ardmore, Oklahoma, has been providing fossil specimens for sale since 1956. His company has been one of the major suppliers of educational and museum specimens. He has donated thousands of specimens for scientific research and has been responsible for finding more than 100 new species of fossils. He also has a family and genus of crinoids and more than 20 other species of fossils named after him. Allen Graffham helped pioneer the mechanized preparation of crinoids and trilobites with some of the first commercial uses of the air brade (air abrasive) units and the use of an electric engraving tool.

Black Hills Institute of Geological Research has been providing quality prepared fossil specimens since 1974. We employ some of the finest preparators in the world. Preparators at the Institute have refined the art of fossil preparation through the use of pneumatic tools. We have also trained dozens of other fossil preparators who now work in the US, Canada, Europe and Asia. Our techniques were even adopted by the Field Museum for the preparation of "Sue", the *T. rex*. Specimens prepared by our staff are on display and used in research in most major museums throughout the world. Black Hills Institute continues to be innovative in the mounting, preparation, moulding, casting and collecting of fossils. Our staff are also responsible for the discovery of many new species, genera, and families of fossils, as well as the publication of scientific papers and books on palaeontology.

The sale of fossils to museums is common. Most major palaeontological museums acquire many of their specimens from the professional commercial palaeontologists. Some examples of sales to museums are as follows. The Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta, contracted with Black Hills Institute and others to provide most of the rest of the specimens for exhibition. The new North American Museum of Ancient Life, Lehi, Utah, obtained literally all of their exhibits from commercial entities like Western Paleo Laboratories, Black Hills Institute, Triebold Paleontology, Chase Studios and others. The Saurier Museum, Aathal, Switzerland, was created entirely by Siber & Siber, a for-profit mineral and fossil company. The North Carolina State Museum of Natural History, Raleigh, North Carolina, purchased their centrepiece, an *Acrocanthosaurus atokensis* skeleton, from Black Hills Institute and Geological Enterprises. The Field Museum, Chicago, Illinois, acquired their star attraction, "Sue" the *T. rex*, from Sotherby's, an auction house in new York. The National Science Museum in Tokyo, Japan, built a major new fossil exhibition in which all their specimens were purchased from businesses like Canada Fossils, Black Hills Institute, Leonhart and Partner, and Triebold Paleontology. The Children's Museum, Indianapolis, Indiana, is contracting to acquire completely prepared dinosaur specimens from Cliff and Sandy Linster, Black Hills Institute, Canada Fossils and others. Finally Manchester University Museum in the UK, purchased their gallery centre-piece, *Tenontosaurus tilletti* from PaleoSearch of Kansas.

These museums, and many more, acquire fossils for display and research from the many different professional palaeontologists. Often the specimens become the focal point and the major attractions of those museums. A case in point is the recent discovery from Liaoning, China. This fossil find includes dinosaurs, birds, insects and fish, most with soft parts preserved. This site includes the finest preserved dinosaurs with "feathers" and internal organs. These discoveries were fuelled by the capitalistic drive to make money. It was the farmers, trying to make a few extra dollars, who made these discoveries. As a result the new finds have changed everyone's ideas about the origins of birds. And we have learned a tremendous amount about one particular part of the Cretaceous.

The business of selling fossils is not limited to dinosaurs. The state of Wyoming has sold fossil leases in the rich Green River Formation of southwestern Wyoming for many years. From this site are the extremely abundant fossil fishes of the middle Eocene. The fauna not only has fossil fishes, but also abundant plants, mammals, reptiles and birds. This site is one of the richest fossil lake deposits in the world. The state retains possession of

the rare vertebrate fossils, but allows the lease-holder to sell the common fish fossils. In this manner thousands of rare fossils have been found and preserved for research and display.

Likewise, in Brazil, the discovery of pterosaurs and insects from the commercial fossil fish localities has given scientists a new look at these winged wonders. These specimens would probably have never been discovered if not for the entrepreneur trying to make a better living for his family. A majority of these rare important palaeontological finds are made by the farmers and villages who are trying to find specimens to sell in the market place to tourists, geologists and palaeontologists.

In Madagascar, Indonesia, Russia, Kazakhstan, Pakistan and elsewhere, new fossil discoveries are being made not by the academics, but by people trying to make a living. As a result, thousands of new discoveries are being made and palaeontologists are seeing more incredible fossils than ever before. Most of these fossils would probably lie undiscovered without the efforts of private enterprise. There are fewer than 1,500 academic palaeontologists employed in the entire world, and they cannot cover the millions of acres of landmass present on the Earth.

Conclusion

The science of palaeontology is a partnership of academic, amateur and commercial palaeontologists who need to rely on each other. Without scientists and amateurs, commercial collectors would have no one to sell their fossils to. And scientists rely on amateurs and professionals in the industry to make new and exciting discoveries, assist with fieldwork and lead the way for preparation in the laboratory. The professional commercial palaeontologist is also able to provide museum exhibits more economically than can be done by any other group.

The benefits of acquiring material from the professionals are many. Businesses collect many more specimens than the scientific community could ever hope to find. Purchasing fossils is often more economical for the scientist than for the scientist to collect the fossils. Often scientists are invited to help the commercial palaeontologist by assisting on the excavation. They are often allowed to keep what they need for research. The commercial collecting of fossils means that more fossils will be found, collected and saved from the ravages of weather. This also means that more fossils will become available for study and display. Having fossils for sale makes sense to all involved.

We all know that fossils that are not collected are destroyed by the elements of nature. Working together we can save more fossils and improve the recovery of contextual information. Together we can preserve our ability to collect and to transfer them without fear across political boundaries. Fossils are the life-blood of palaeontology. Without the amateurs and the commercial palaeontologists, it would truly be a dead science.

Recommendations

I give below some recommendations for museums who wish to work with the palaeontological professionals. Work with the people that love fossils and not with the people who only love money; your institution will usually spend less and the science will benefit more from this relationship. Work with the professionals that provide site and specimen information and who are interested in the science. Give credit where credit is due for the recovery of the specimen and the site. This will help to create a close bond between the researcher and the discoverer. Co-operation with the professional palaeontologists will open doors and make the museum's designers', researchers' and preparators' jobs much easier.

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COMMERCIAL FOSSIL TRADE: GOOD OR BAD FOR SITES OF SPECIAL SCIENTIFIC INTEREST?

by Jonathan G. Larwood

Larwood, J.G. 2001. Commercial fossil trade: good or bad for Sites of Special Scientific Interest? *The Geological Curator* 7(6): 223-226.

Key palaeontological sites throughout England are designated and protected as Sites of Special Scientific Interest. This provides legislative protection against damage whether from threatening development or inappropriate fossil collecting. English Nature has established guidelines, outlined in this paper, on the management of site based fossil resources that reinforce the need for a responsible and sustainable approach. As with all aspects of fossil collecting commercial trade can be both negative and positive. The impact of this trade on the site resource is discussed particularly in the light of recent experience and initiatives in Dorset, on the Somerset Coast, in Humberside and Yorkshire. On balance the positive impact of commercial trade outweighs the negative – though this has very much relied on the co-operative willingness of the collector, researcher and museum.

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Introduction

In England there are approximately 4,000 Sites of Special Scientific Interest (SSSIs) of which around 1,450 are either notified on geological grounds alone or include a notified geological interest as well as a biological interest. It is the responsibility of English Nature, as the government's statutory advisor on nature conservation, to designate and advise on the management of these SSSIs.

Between 1977 and 1990 the Geological Conservation Review (GCR) provided a systematic assessment of British geology (Ellis *et al*. 1996) and selected a comprehensive network of key geological sites. Over 3,000 sites were considered to be nationally important in understanding British geology and it is these GCR sites that have formed the basis for geological SSSIs throughout Britain. The GCR selection process identified key fossil vertebrate, invertebrate and plant localities, as well as key stratigraphical sites from the Precambrian to the present. In England 226 palaeontological GCR sites were identified together with over 1,000 stratigraphical GCR sites (Larwood and King 2001).

Palaeontology is therefore a core interest of the geological SSSI network. Achieving the correct management of the site-based fossil resource is crucial to maintaining this network.

Establishing best practice

Fossil collecting has often been viewed as a contentious activity, particularly where commercial trade is involved. The conservation of palaeontological sites has been much debated and two conferences *The use and conservation of palaeontological sites* (Crowther and Wimbledon 1988) and most recently, *A future for fossils* (Bassett *et al*. 2001)) brought together interested parties to discuss key issues around fossil collecting, including commercial trade. For sometime English Nature, and its predecessor the Nature Conservancy Council, has been engaged in establishing clear policy and practical guidelines on the management of fossil collecting.

In 1992, the leaflet *Fossil collecting and conservation* (English Nature 1992) was published and widely disseminated. This set out clearly why fossil collecting is important, what can be gained from fossil collecting and the principles of responsible fossil collecting. This leaflet, together with existing guidelines and advice (e.g. Geologists' Association's *Geological Fieldwork Code* and the Geological Curators' Group's *Thumbs-up* guide to collecting), provided the basis for English Nature's Position statement on fossil collecting (English Nature, 1996) (see also www.english-nature.org.uk) which was established after wide consultation within the geological community. The position statement, one of a series

produced by English Nature on all aspects of nature conservation, sets out clear policy and guidance on fossil collecting. Tailored to SSSIs it can be equally applied to any fossil locality.

Two principles are central to the position statement. Firstly, responsible fossil collecting is an important part of the conservation of sites with a fossil interest. Secondly, fossil collectors are treated equally (that is, without prejudice), whether amateur, research or commercially orientated; all collectors can make a contribution to palaeontology, but at the same time all can damage the site-based fossil resource.

It is, however, essential that all collectors act in a responsible and sustainable manner (Larwood and King 2001). In simple terms, collectors should adapt the scale of collecting to the available resource (whether extensive or finite in nature), should collect only from loose material and collect only representative specimens, make appropriate records, should, wherever necessary, establish permission to collect and clear agreement of ownership and, wherever possible, ensure that scientifically important specimens are acquired by museums or equivalent institutions.

Commercial fossil trade and its impact on SSSIs

The commercial market for fossils is well established and has been since the first fossils were found. Whether for simple exchange or sale, fossils have always had a commercial value largely based on their aesthetic appeal, rareity and their value to science. The fossil collections of most museums will contain substantial elements that have in some way been traded whether purchased from individuals, at auction or from commercial dealers.

Fossils today can command truly phenomenal prices, the sale of 'Sue', the *T. rex*, achieving $8.36 million at Bonham's in 1997. A recent review of U.S. natural history auctions (Forster 2001) showed that between 1996 and 1998 the New York based auctioneers Phillips held four major natural history auctions totaling sales of approximately $2.1 million of which almost $1 million was from the sale of fossils. As may be expected more than 50% of sold fossils originated from the USA with Germany, Morocco, China and Russia being the other most popular countries of origin. Fossils from the UK represented less than 0.5%. Virtually all the specimens were auctioned into private ownership.

The market demand for fossils is therefore great and the potential price-tag high but what effect does this commercial market have on the site-based fossil resource in England?

Negative

Collecting for commercial gain can result in site damage due to over collecting and targeted collecting with the removal of specific fossil-bearing units from fossil localities. It can also lead to the loss of scientifically important specimens from the available public domain - specimens going into private collections being effectively lost to science.

It is English Nature's responsibility (Weighell 2001), through use of it legislative powers under the Wildlife and Countryside Act, 1981 (and subsequent revisions), to promote good practice and to establish strong working relationships to reduce and prevent such damaging activity on SSSIs.

It is often difficult to distinguish site damage which is specifically for commercial gain or the result of the obsessive and unscrupulous collector. For example, it is likely that over collecting from inland Jurassic Inferior Oolite SSSIs in Dorset and Somerset is commercially driven, but this is difficult to prove. On the Isle of Wight there has been a long tradition of commercial collecting and in recent years the ownership of a number of fossils has been contested and the long-term fate of a number of scientifically important specimens remains uncertain. Actual damage to the site-based resource is difficult to demonstrate (the rapidly eroding coastline is effectively a continually renewed resource), but the removal of *Iguanodon* tracks and foot casts has depleted the educational resource at certain localities, though it is unclear once more whether this was for commercial gain.

More clear-cut has been the targeted collecting of the Lower Jurassic *Caloceras* Beds of Doniford Bay, part of the Somerset Blue Anchor to Lilstock Coast SSSI (Webber 2001). The attractive iridescent aragonitic shell preservation of *Caloceras* and *Psiloceras* ammonites from Doniford has lead to a commercial demand for these specimens. The resultant damage, mainly in the early to mid 1990s, has affected approximately 65% of the exposed *Caloceras* Beds. Notably, of the few UK specimens submitted to Phillips (Forster 2001), a pair of mother-of-pearl ammonites from the Lower Lias of Somerset, England, were successfully auctioned for $350 in 1997. Since the mid-1990s increased local awareness and vigilance, plus the co-operation of commercial collectors has successfully curtailed any large scale collecting from the SSSI.

Positive

Trade in fossils has always been important to the science of palaeontology. Most museum palaeontological collections have been established by purchase of specimens or collections, many from commercial dealers. Mary Anning, collecting from the Dorset Coast in the 19th century, sold many new and rare finds to museums and other collectors and communicated her discoveries to some of the leading geologists of her time. The trilobite *Calymene blumenbachii* (known as the "Dudley Bug") from the Wenlock limestones of the Wren's Nest National Nature Reserve in the West Midlands, was widely traded by quarrymen in the 18th and 19th centuries, with fine examples now being found in museums throughout the world.

It is clear that the purchase of specimens has always been actively pursued. Osborne's (1998) accounts of the discovery and fate of ten reptiles from Yorkshire in the 18th and 19th centuries demonstrates the museum desire to purchase prize specimens for their collections in what was already a global market. Does the trade in fossils and activities of the commercial collector still contribute to the furtherance of science?

Conesby Quarry SSSI, near Scunthorpe, Lincolnshire, exposes the Lower Jurassic (Sinemurian) Frodingham Ironstone. This yields a particularly well-preserved and diverse invertebrate (and occasional vertebrate) fauna. As well as being of high scientific value fine, chamositic, preservation gives a high aesthetic appeal to the ammonites from the Frodingham Ironstone which gives them a high commercial value.

At the end of its working life Conesby Quarry has now been infilled (sections have been retained for the SSSI). Prior to infill in 1990 agreement was reached between two commercial collectors, the land owners and the local North Lincolnshire Museum over the collection of specimens in advance of infill (Thompson 2001). This was essentially a commercial enterprise in which the professional collectors were able to sell specimens collected. At the suggestion of the collectors two provisos were agreed. Firstly, any rare specimens (selected by the museum) would be donated to the local museum and secondly, amateur collectors would be allowed to collect from the site without charge.

Approximately 100 specimens were donated to the museum including a previously unrecorded multi-armed starfish. Though specimens were not purchased by the museum the establishment of a commercial enterprise and the open co-operation of the collectors benefited both museum and science in a fashion that would not otherwise have been achieved.

In more recent years wider co-operation in achieving good site-based conservation is now also being achieved. This is best represented on the Dorset coast which today remains the most collected area in Britain and has the highest number of local commercial collectors. Virtually the entire length of this rapidly eroding coast is designated as SSSI and, together with the East Devon Coast, is currently proposed as a potential World Heritage Site. In 1997 the West Dorset Fossil Collecting working group was established (all stakeholders including commercial collectors were involved) to look at the fate of scientifically important fossils, the ownership of fossils and the safety of digging within cliffs and landslides. From the working group sprang a voluntary *Code of Conduct* (Edmonds 2001) providing guidance on good practice (which carefully manages collecting practices) and, perhaps more importantly, a Fossil Recording Scheme in which collectors record fossils of key scientific importance with the understanding that British museums should be given the first opportunity to acquire specimens. Records are maintained by the Charmouth Heritage Coast Centre and can be viewed at www://members.aol.com/charhercen/page16html

The *Code* and Recording Scheme are based on a voluntary and positive approach which only works through the co-operation of those involved. The local collectors have been central to achieving this and have actively adopted the *Code* and participated in the Recording Scheme. The Recording Scheme is aimed at bringing collector, museum and researcher together to increase communication and adding to our knowledge and understanding of Dorset's fossil resources.

The Dorset example is now being followed on the Yorkshire Coast where, as part of the Dinosaur Coast Project, local collectors (including commercial) have been involved in establishing collecting guidance and the development of a second recording scheme.

Weighing it up

As ever, there are two sides to the coin. On one side, damage to geological SSSIs can result from collecting for commercial trade. On the other, commercial collectors can make a positive contribution to the conservation of geological SSSIs and the furtherance of scientific study.

In ten years English Nature has established clear guidelines on the management of site based fossil

resources promoting the principles of responsible (and sustainable) fossil collecting as an essential part of the conservation of geological SSSIs. Over this period the co-operative relationship with the commercial collector has strengthened and they have been closely involved in the establishment of, and participation in, collecting codes in key regions - Dorset and Yorkshire.

There is still a need for greater communication and co-operation between all groups involved in the conservation and use of fossil resources. Much has been done to establish good site based conservation of fossil resources raising awareness amongst all those involved in the management and use of SSSIs. There does, however, need to be a better link with the museum and researcher as an end beneficiary of successful site conservation.

Part of the success of the Dorset Recording Scheme will be the interest shown by museum and researcher in the specimens recorded by the collectors. More dialogue and interaction between these groups is required to identify more clearly the needs of each group. Acquisition by museum is also problematic as museums (certainly in the UK) are often unable to purchase specimens with a high market value. Ultimately this may undermine the success of the responsible collecting ethic as scientifically important specimens, as demonstrated by the Phillip's auctions, will largely end in private, inaccessible collections. But rather than an argument against commercial trade this is perhaps an area for museums to address in discussion and debate with the commercial collector. Is it feasible to have more co-operative ventures such as Conesby described above or could commercial collectors be paid for their expertise in terms of excavation and specimen preparation? There is no straight-forward answer but there is experience to build on. One of the next tasks of the West Dorset Fossil Working Group is to address these problems in relation to the recording Scheme and its long-term success.

English Nature's aim has been to discourage and prevent the negative (damage to the scientific interest of SSSIs) and encourage and promote the positive (enhancement of the scientific interest of SSSIs). Despite the fact that there will always be commercial collectors who ignore any guidance or legislative restriction, the existence of a commercial trade, on balance in England, is currently more positive than negative. Over the last ten years the recorded instances of site damage from collecting (for whatever reason) have declined as one hopes the willingness to adopt a more responsible approach has grown. The establishment of co-operative collecting codes and recording schemes provides a strong foundation on which to increase the mutual trust between all interested groups, achieve good conservation of fossil sites and increase our palaeontological knowledge.

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PHONEY STONES

by Maurice Davies

Davis, M. 2001. Phoney Stones. *The Geological Curator* 7(6): 229-230.

Museums staff should uphold the highest ethical standards and not research illicit specimens. To possess illicitly removed specimens may, in some cases, represent a criminal offence of handling stolen goods.

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Introduction

I was asked to speak at the seminar only at the last minute,as the last speaker, and to look briefly at the conclusions of the Ministerial Advisory Panel on Illicit Trade, on which I sit. As it turned out, most of the factual material I intended to present was covered by Tristram Besterman in his characteristically thorough paper (see Besterman, this volume), so I won't repeat the details of the conclusions of the advisory panel and other bodies here.

Ethical standards

During the seminar I was extremely alarmed by the arrogant and greedy attitudes of several other speakers - views apparently supported by some members of the audience. With this in mind, I rewrote the beginning and end of my talk at the last minute and that is what I think it will be most useful to present here.

It may be that the papers published here are more circumspect than the talks that were delivered at the seminar. If that is the case, the language of my response to them may seem a little excessive. But I, and at least a few other seminar participants, were outraged by what some speakers said.

As one friend said to me after one talk (in which the speaker said he had to break local laws on fossil collecting so that he had new material to research in order to further his career) at least Lord Elgin offered a 'public benefit' defence of his removal of the Parthenon Marbles. But, like a professional Italian tombarolo (grave robber), the speaker came across as having no concern for any benefit other than his own. The phrase that has stuck most vividly in my mind from his talk is, "why should I give a shit about ethics". I'll be interested to see if he expresses that sentiment in his written paper. It strikes me that even the sleaziest London antiquities dealer would no longer say something like that in public, and would be pretty careful about saying it in private.

According to my notes of the day, John Nudds expressed a similar view, although in the context of a far more thoughtful talk. Nudds stated, "not many researchers worry about such ethical niceties - our main concern is to get hold of the material and do the research". In his talk Nudds clearly and honestly presented the geologist's dilemma: in a nutshell, lots of previously unknown specimens are on sale on the open market and scientists see it as their job to research them. However, the specimens' origins are unclear and they may have been excavated or exported illegally. In my hastily rewritten talk I noted that I am not qualified to judge the ethics of university-based academic research, but I am clear about the museum ethics in this case. I argued that while it may be appropriate for some scientists to work on such material, it was not acceptable for museums, and museum staff, to get involved.

I said to delegates that if, in spite of today's tales of immorality, exploitation, fraud, violence and general criminality and deceit, any of you in museums are thinking of lowering your museum's ethical standards, or your personal ethics, then don't. I hazard that if the tales and attitudes we heard before lunch were attributed on record to a museum curator or director, then public pressure, not museum-sector pressure, would end their career in public service.

University-based academics (by which I meant those outside university museums) can perhaps continue to be so selfish, in the way that until recently our doctors retained our children's organs without proper consent.

However, museums do not exist to allow individual employees to further their own careers and research reputations come what may. They have a clear mandate to uphold the highest standards. In a largely secular society it is not wholly fanciful to say, as many do, that museums are the 21st century's churches and temples, and curators are the priesthood.

People still trust museums. Indeed, museums are some of the few remaining trusted public institutions. In return for this trust people expect museums and their staff to have high standards and show ethical and moral leadership. Breaking the public's trust will have a huge cost for museums. At an avaricious level, the right of museums to things such as lottery funding depend on public support. But most importantly, a failure to meet generally agreed ethical standards, let alone the law, will lead to a long-term decline in public support and a consequent long-term decline in museums as public institutions.

Criminal offence

At the end of the seminar there was considerable discussion about whether geological specimens are likely to be covered by the proposed new criminal offence of dishonestly importing, dealing or being in possession of any cultural object, knowing or believing that the object was stolen, illegally excavated, or removed from any monument or wreck contrary to local law. For technical reasons, it looks as if individual geological specimens will not be covered by this new law (although collections above a certain value will be).

However, it's worth making the point that much of the trade in illicit geological specimens is already a criminal offence in the UK and the USA. It is a complex area of law (and I am no lawyer), but as far as I understand it, if the specimen concerned originates from a country where illegal removal or export of a geological specimen is defined by that country's laws as theft, then it will sometimes be possible to secure a criminal conviction for theft in an English (or American) court. This will depend on the precise details of the illicit removal and the way in which the laws of the country of origin interact with the laws of the England (or America). There have been several criminal convictions along these lines in England and America for the illicit removal abroad of cultural property and there seems to me a strong possibility that a dealer in illicit geological material, or even a purchaser of such material, could be convicted of theft or handling stolen goods in an English or American court. To flirt with illicit geological material already brings some legal risks, as well as being ethically unacceptable.

GALLERY REVIEW

DINOSAUR ISLE PULLS 'EM IN!: DINOSAUR ISLE, SANDOWN, ISLE OF WIGHT, ENGLAND

by Tony Cross

Last August saw the opening of the new, improved, purpose-built Dinosaur Isle "attraction" in Sandown on the Isle of Wight. It replaces the 75 years old site on the restricted first floor of the small local library.

Tha change of name does not really bother me. If you are going to re-package an old museum, albeit with superb fossil collections, it is obviously a bit of a gamble for the Local Authority. I suppose it might even be regarded as evolution.

But what a transformation! A gleaming, silver-skinned building, the front of which hints at a pterosaur, contains essentially two galleries. One is tunnel-like, with traditional cased museum displays and information panels, taking the visitor back in time to the Cretaceous. The other, cavernous by comparison, with an adjacent 'goldfish bowl' preparation area, deals with the Wealden - the time of the dinosaurs on what is now the Isle of Wight. The fossils of these beasts are the jewels in the crown of this area, one of the classic areas of British geology.

It is difficult to get visitors to appreciate, and hopefully understand, geology let alone palaeontology or even palaeoecology! So how do you generate interest in a collection of small shells and bits of bone? The Isle of Wight Council (IWC) has obviously got the answer.

Firstly, arrange for the BBC to screen a block-buster series. Follow it up a little later with a televised "dig" on your coastline. A couple of months afterwards open a £2.7m attraction next in a seaside location at the height of the holiday season and charge commercial admission fees!

Cynical or not, how else might one explain twenty thousand visitors over ten days in a hot August against an enviable sailing programme in Cowes, the yachting capital of Britain?

The IWC deserves the success of the new venture as tourism is the lifeblood of this magnificent island moored off the Southcoast of England.

Mind you, as a local, I think I would be a bit miffed to swop a free museum for a paying attraction. Especially after having paid for it already through my Council Tax and after the Millennium Commission had given grant aid to the tune of £1.3m and

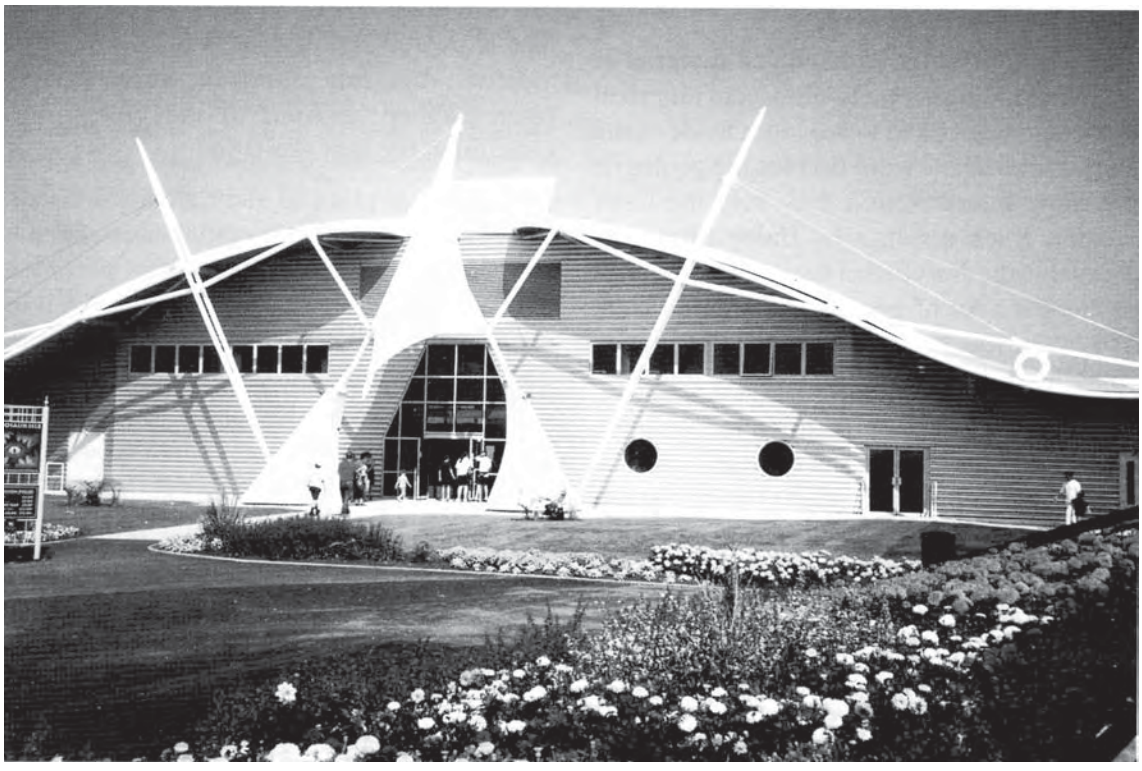

Figure 1. View of the Dinosaur Isle complex.

Figure 2. An *Iguanodon* considering lunch.

sponsorship had been given by local ferry operator, Wightlink!

I think it is one thing to charge tourists who do not contribute directly to IWC taxes, but islanders might well expect more than have to purchase season tickets at £12. No doubt attendance figures "out of season" will be the judge of that.

The building is different, the displayed material is generally good, although it is the dinosaurs that steal the show. I would have liked to see more made of the other material - the labels were fine for the geologist but a little more interpretation may help the more general visitor. Slick displays by Haley Sharpe of Leicester develop the storyline of local curator Martin Munt and there is a lot of good stuff. A guide book may well reduce the need to read the many text panels, so perhaps they can be replaced in time?

As a typical family group we explored the museum having first sought identifications of fossil material we had found. We appreciated the time the curator spent with us in a first-floor education room looking at our vertebrate finds. It was one of the quieter days he explained, but it still looked pretty busy to us.

Most of the 'interactives' are in the Wealden area and our children delighted in pressing buttons, feeling the contents of boxes and opening the lids of smells that the dinosaurs may have experienced! All of this, with life-size reconstructions of five local dinosaurs and with the cacophony of dinosaur-like noises that reminded me of a monkey house at feeding time. Pity the poor preparator working in the "goldfish bowl" lab in the same area!

The animated *Neovenator* was an obvious hit with visitors, but few children were waiting to be photographed in front of the glass-fronted case containing the real skeleton.

It was a great place to visit; we appreciated the air-conditioning too but why did this not extend into the sales area? After making their purchases (like everyone else seemed to be doing) and having an ice cream on the grass outside, our children were keen to go to the beach on the other side of the road. I went back in for another look – well, one visit was not enough.

The Museum of Isle of Wight Geology is dead. Long live 'Dinosaur Isle' and may it prosper in it's new guise as an "attraction".

Tony Cross, Curator, The Curtis Museum and Allen Gallery, Alton, Hants, U.K. 11th September 2001.

BOOK REVIEWS

Green, Owen R. 2001. ***A Manual of Practical Laboratory and Field Techniques in Palaeobiology*****. Kluwer Academic Publishers, 538pp. Hardback. ISBN 041258980X. Price: £85.00.**

This manual is aimed at those geo-scientists who are involved in the collection and preparation of palaeobiological specimens.

Apart from an 'Introduction' and 'References Appendix' it is basically divided into two sections, 'Field Techniques' (pp 20-61) and the significantly larger, 'Laboratory Techniques' (pp 64-449).

The 'Introduction' provides the reader with an outline of the practicalities involved in the collection of specimens in the field and the necessary procedures for bringing them into the laboratory. This section contains a number of useful flow diagrams and tables which will help the reader to structure and timetable these tasks.

Section II, 'Field Techniques' is divided into five chapters beginning with collecting methods for both macro and microfossils. The following chapters deal with the preservation of the specimens in the field and staining techniques for determining the carbonate mineralogy. The final chapter in this section covers the important subject of documentation as well as packing and transportation.

Section III, 'Laboratory Techniques' is divided into five parts, beginning with an introduction which included how to set up a laboratory facility. This covers everything from design to health and safety considerations. The various conservation and preparation methods used for unstable and recent material are also discussed here. 'Physical Procedures', 'Chemical Procedures' and 'Analytical Procedures' follow and make up the bulk of the publication. These are sub-divided further to cover a wide range of techniques familiar to most geo-scientists. Each method is supplemented by references so that the reader can make an informed choice and proceed with all the necessary information. The fifth and final part of this section is 'Exhibition of Fossil Material' which includes replication techniques and photography.

The 'References Appendix' is an important section which deals extensively with health and safety as well as suppliers, documentation and other technical information such as conversion data and formulae.

The division of this publication into a number of well-structured sections and sub-sections make it easy for reference. Although more diagrams would be useful, the procedures are simply presented with health and safety information suitably highlighted.

This manual has managed to fill a gap in the market, which has existed for several years. In the last few decades developments in palaeobiological field and laboratory techniques have generally been published as booklets or papers. Green has successfully brought these together here, to produce what will be valued by many as a standard reference on this subject.

Jill Kerr, Natural Science Conservator, Ulster Museum, Botanic Gardens, Belfast BT9 5AB, Northern Ireland. 19th December 2001.