Professor Jon Adams Teatime Lecture

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I spent a lot of my life on various excavations around the world including some of the shipwreck excavations you might have heard of including *Mary Rose* and as you will have discovered this morning shipwrecks are part of what maritime archaeology encompasses, but they're also (you probably learnt from the guys this morning who you met) that it involves a lot of other stuff too.

Right. Let's just refresh our memories. Did they give you any definitions about what maritime archaeology is this morning? Okay. I'll offer you one. "The study of the remains of part human activities on the seas, interconnected waterways and adjacent locales." If you ask somebody in the street what they thought maritime archaeology entailed and what it was all about and what maritime archaeologists did, what do you think would be the first things that people might suggest? [Off screen – Shipwrecks]. Shipwrecks. OK, that's predictable. Almost the first thing that people would say. What else? What might be associated with shipwrecks? Go on, say the dirty word – treasure! Which? [Off-screen – pirates!] Pirates, yes, that's another one. Pirates, shipwrecks, treasure. I'll show you an image that encapsulates just these things in a bit, but in fact as I've already intimated maritime archaeology encompasses a lot more than ships. Although, as you will discover this afternoon, I am a little bit fond of shipwrecks myself and that's where I actually spend a lot of my time researching. I hurl myself in the water at any opportunity but, if I throw up this diagram I'll try and indicate what I mean about Maritime Archaeology, which is more than just what is in the water, more than just one type of structural site, which is the shipwreck.

We've all heard of shipwreck sites, iconic sites like *Vasa* and *Mary Rose*, but there's an awful lot to it. Ships are built on shore, built by people who spend most of their lives on shore. Ships are responses to political, economic and military strategies that encompass land and sea, so everything is interconnected. Just look at this map of Europe this sort of diagrammatic map of Europe and what it's showing is rivers. It doesn't even show, by a long stretch, all the

navigable waterways and bits of streams and rivers that have been navigated by people in boats over the last several thousand years. But you can see how the continental mass is incised and riddled with water. And if we actually look at human activity, if we zone human activity, maritime archaeology is not just interested in what happens on the water, or even on the waterfront, it's interested in what happens in the whole of the coastal zone and in the rivers and lakes hence the definition of 'interconnecting waterways and adjacent locales'. We're not even just interested in the rivers and lakes. We're interested in everything that's in between.

So, in Homer's *Odyssey* there's a nice little bit where Odysseus, on his way home to his island home of Ithaca, has a dream. He meets the ghost of the seer Tiresias. Tiresias warns him that he will kill all the people who are suitors for his wife and to make atonement for that murder he has got to put an oar over his shoulder and walk inland, far away from the sea, until nobody knows what he's carrying over his shoulder. Now, if we think about people who wouldn't know what an oar or a paddle is in this country, you can't get far away enough from the sea for that. So, essentially we'd say (the maritime archaeology crew at Southampton would say) that actually the whole of the archaeology for the British Isles, for instance, is heavily maritime in many aspects. I'm slightly biased.

So, let's go back to our shipwrecks and treasure and pirates… Is this maritime archaeology? Well, yes and no. In fact, there are quite a few things right with this picture, and in fact in some ways it is actually not indicating the full potential, the full grandeur, of what we can find underwater. Perhaps we could argue with the artist's juxtaposition of plants, which wouldn't grow in tropical seas and the amount of shipwreck structure in this picture, which shows above the sea bed, but that's only because those things are in the wrong place. In other ways, it is actually quite true to what we can find in certain places in certain parts of the world and from certain periods. But let's just revert to "it's not all about what's in the water and it's not all about shipwrecks".

Going back to that diagram where we saw the coastal zone, the hinterland, the landscape, cut and incised with rivers and lakes etc all part of the same communication and transport system. Can you see through the trees here? What can you see? What do you think it is? There's a great big pile of rocks. Do you know what that big pile of rocks might be, carefully

placed there? [Off-screen - It's a grave]. It's a grave from the Bronze Age probably set up about three thousand years ago and now it's in this very atmospheric place in Sweden. You walk up to it through the trees and in fact it's one of several monuments on this island… There! I've given the game away… it's on an island. And, in fact, because of sea-level change, because the land has risen after the last Ice Age, the sea relative to this point on this island is now twenty metres lower than it would have been the Bronze Age. So, we're looking at a very different environment now.

It's a very atmospheric and almost a romantic place, but it's on an island and so we have to think about people in the Bronze Age going out and burying their dead on an island many kilometres from the mainland, which is where their farmsteads would have been. But of course they were exploiting the water. They were moving around in boats and we can see this from the pictures of those boats that they've left behind in profusion in southern Scandinavia. We cannot number the number of carvings on the rocks of Norway, Sweden and Denmark and Finland. There are literally hundreds of thousands of them and they're being discovered at quite a fast rate even today. But of all the things those rock carvings depict: people, huntsmen, fish, whales, animals, wild bear, sun discs etc. All of those motifs are quite common, but the one that is most common of all - maybe 40% of all the rock carvings in Scandinavia - are the boats. So this tells us something about the importance of boats to the people who lived in that place and at that time. And if we think that they were using these boats to go back out to these islands and bury their dead in special places, we can see how maritime archaeology is not just interested in the boats that people sailed in - they are fascinating in their own right - but we're interested in the whole of the social approach to life-and-death: agriculture, seafaring, communication and the expression of identity in the prehistory, where we have no documents to help us.

And in fact those islands where the burials are now covered in trees, this is perhaps what they would have looked more like three thousand years ago, with a much higher sea level, no tree cover. And we can imagine those great big cairns of stones would have been visible for miles. And another aspect of monumentality out at sea in the prehistoric periods all over the world, in fact, is that when people set up monuments on the coasts of course people can see them for a long way. So they become markers of all sorts of different cultural aspects other

than just saying this is where a very important person was buried. They perhaps form quite useful navigation aids, for instance.

But, what about the stuff in the water? I'm going to turn back to the water because we do find lots of stuff in the water, which helps us to answer archaeological questions perhaps more efficiently and more thoroughly than much of the data we find on land sites - and we'll see why that is in a minute. Now archaeology was a little bit slow on the uptake. When I was a student - which is a very long time ago, I have to admit - when I was a student, archaeology conventionally didn't really approve of the idea of doing archaeology underwater. It was a bit sort of lunatic fringe. You know, why would you go into a place like this to try and find archaeological remains. Even if it was there, wouldn't it be destroyed? Wouldn't it be spread all over the place in a meaningless random scatter of stuff? Okay it might be interesting to pick up a piece of bronze statue from the Mediterranean and put it in a museum, but surely it had an art history value? What about archaeology?

Well, the destructive power of the sea in many ways is elusory, when it comes to the preservation of cultural remains, as we shall see. Of course, even if we do get in the water sometimes it's not particularly comfortable. Diving in these waters is a little bit chilly, for instance, and sometimes even if you go underwater, you can't see your hand in front of your face. So, again why would you bother, ran the conventional view of archaeology in the 1970s and 1980s. You know, why bother doing archaeology underwater when we've got so much stuff on land. Now in fact all of those three pictures I've just shown are archaeological sites. This is a wave that's just rolled over the wreck of the Dutch East Indiaman sunk in 1749 off the south coast of Sussex. The ice picture is from the Baltic, where I spend a lot of my time and we dive in the winter because that's the time we get the clearest water, the best pictures and the best video. And this was not such a good day on the *Mary Rose* site. But we work around these conditions. It's not like this all the time. Hastings Beach is not being thrashed by rolling waves 2 metres high all the time; the *Mary Rose* site had visibility of several metres for most of the summer and Sweden, well if you want to dive in icy waters just use a dry suit or, even better, a hot water suit. So, we've learnt our way around all these environmental problems and we've learned to develop methodologies and techniques that allow us to exploit the archaeological remains of these environments very, very efficiently. And we can exploit the advantages of investigating sites under water.

Now we could at our simplest work rather like a land archaeologist simply being underwater and using a hand or trowel as you might have seen on various excavations, or perhaps some of you have even participated in excavations. But sometimes the environment, the sediment we're working through, means that we have to use slightly more involved methods to do what archaeologists do on land. Now, if we think about… Has anybody done any archaeological excavation? Has nobody? Nobody? Right. OK. You'll see… *Time Team*? Have you seen *Time Team*? A few of you have seen *Time Team*… Okay. So Phil Harding's there in his hat in the trench, and he's saying, "Ooarr, Tony…" and all that sort of stuff and he's trowelling away and he's trowelling away. What he's doing he's actually doing is dismantling the sedimentary deposits in which various artefacts and archival materials have become assimilated over time. And what happens then is when Phil's scraped away a certain amount of soil, he'll transfer that soil into a bucket, into a wheelbarrow, and take it away to a spoil heap and there it may be sieved, just to make sure that he hasn't missed anything. But there's two things going on. There's the actual excavation where you're dismantling that physical catalogue of the past and then there's the removal of spoil. Underwater, we can do the whole thing seamlessly.

So here is the business of the excavator on the *Mary Rose* site, actually in this case excavating with a paintbrush, because what is actually being excavated here is a sea chest - about this long, this high, made of wood this thick - and although it looks perfectly preserved (and indeed you can see this very chest if you go to the *Mary Rose* museum) if you had slipped and put your thing through it, or put the trowel through it, the wood would have had the consistency that wasn't much more robust than wet blotting paper. So the preservation is there, but in terms of stability it's a little bit elusory. So we have to work out ways of excavating this with sufficient control so that we don't break anything, miss anything and we can recover it to the surface and conserve it and record it and display it. So we can actually see what's going on here diagrammatically, if we put a drawing around the photograph, you can see the excavator is in fact a diver with no fins. Fins are inconvenient in this situation, so we don't wear fins. We have the feet on a grid, which gives us stability and we and the tools that we're using are neutrally buoyant, so that means we're not floundering around in the trench and putting our knees and elbows into that sensitive archaeological material that might be damaged if we did. And what the diver is holding in his left hand is an airlift – essentially an underwater vacuum cleaner and it works by piping air down from the surface

from a compressor into the bottom of the tube and as the air goes up the tube it expands and accelerates and it creates a suction at the bottom end and that draws up all the spoil that on land you'd have to put into a bucket, and into the wheelbarrow, and off to the spoil heap in the rain and everything like that. It's much easier underwater. And this is the technique; these are the devices that were used to excavate the *Mary Rose* over an 11-year period between 1971 and 1982 when the ship was recovered.

In slightly warmer and clearer waters, this is excavating the wreck of the *Sea Venture*, which was lost off the reefs of Bermuda in 1609 and this was a ship that left Plymouth in June 1609 bound for Jamestown, the first English settlement in North America. But it got separated from the rest of the fleet in a hurricane and for four days battled to stay afloat by chucking stuff overboard and they reorganised the whole of the ship's company to three shifts, bailed and pumped for their lives for nearly four days, and when all was lost, they'd given up hope, the Admiral Sir George Somers spied land, in the nick of time. So the captain tried to bring the ship as close to shore as possible, but they couldn't get over the reefs, so the ship grounded three quarters of a mile out. But it jammed so solidly in the reef and the weather by now, mercifully, was abating and so all 150 people on *Sea Venture* managed to get off onto the island and they found that its name at the time, the Isle of Devils, was rather a misnomer because they found that Bermuda was actually rather a nice place and indeed the permanent habitation of Bermuda starts from the time the wreck of the *Sea Venture* occurs on the reefs of Bermuda.

And in 1610 most of the people from Bermuda built two smaller vessels and continued to make their way to Jamestown and the were greeted as though they had returned from the dead - in fact they have - and the personal accounts of two of the people on board *Sea Venture* that were in that horrific storm - it in fact it was hurricane - make their way back to England, where those letters, those discourses on the adventure are passed around the backers of the company, the financiers of the company. Merchant adventurers in the Virginia Company of London. One of those men is Henry Risley, who was the Earl of Southampton and he was also the patron of one playwright, William Shakespeare, and the very next year Shakespeare writes the play *The Tempest*. The Tempest Wreck.

So we now have excavation, technology and methodology to excavate anything we find with sufficient control so that effectively there is no barrier to us excavating anything we find. So we could sensitively excavate skeletal material such as this archer from the *Mary Rose* and indeed these objects from the *Mary Rose,* many of them underwater, incredibly fragile but well preserved in the sense that they still maintain their form and they carry all the information. So we have a nit comb with organic material still in the teeth of the combs, that thing is a pocket sundial, rosary, a whistle, a thimble, jewellery, gold coins, the leather cover of a book, clothes, lots of organic materials, foodstuffs. So we have in a shipwreck like this, the whole environmental package of life at sea in the Tudor period. Many of these materials don't survive on land sites and it's the waterlogged deposits, it's the water and more particularly the sediments that covers things underwater and cuts out the light and the oxygen, which is the most fantastic preservative. This is why sites like the *Mary Rose* are like they are. That's why we are drawn to them as archaeologists because they're treasure troves, to use a dirty word again, but they're treasure troves of information. They're sources of information that we can't really get anywhere else, and so that's the lure of maritime archaeology.

Of course once we've dug it we have to… excavation is partly a destructive process, and so we can only justifiably do that if we do two things: first of all, we've got to record what we find in various ways; secondly, we've got to publish it which would include museum displays as well. Otherwise, we've done an even better job of destruction than most treasure hunters. So that's the difference. So, sometimes we use the humble tape measure underwater, it's still reliable, still quite quick and easy, and we process those measurements with various software programs, which allow us to do clever things with three-dimensional survey.

Sometimes we can use sound as a tape measure instead, and in fact acoustics is a whole-industry in underwater technology, much of which is central to the way we do archaeology now, from whole process of finding sites to the way we record them, right the way through to publication and museum display. And the way it works is that we know the speed at which sound travels through the water. Say we say it's 500 metres a second, and so if I initiate a pulse of sound and I record the time that I have released that sound, and the time it takes to get to a receiver, I can actually convert that time to a distance. And so that that simple relationship is the basis of a lot of acoustic systems that we use. One of the simplest ones,

for instance, is literally an acoustic gun, which we used to measure distances, which would be slightly more than is convenient to swim backwards and forwards with the tape measure. So when we might use a tape measure very efficiently and achieve surprisingly accurate results - two or three millimetres or so within the confines of the bit of shipwreck structure, or within a trench - if you're wanting to measure twenty or thirty or forty metres, something like this is much more much quicker and much more convenient. So, the surveyor fires the gun, the pulse goes out and is received by a transponder, so it is receiving sound and it then goes, 'Ah - that's me' and it fires a pulse sound back and we can convert that to a distance. And, in fact, we can even take that distance several times and do a best fit, a sort of an average or a mean, of all those individual measurements to narrow the accuracy.

We use photography and video a lot underwater - increasingly now that digital technology has made taking photographs underwater so much easier, but how do we find stuff in the first place? And I've shown that that is another picture from Bermuda, and it is very nice to work underwater in Bermuda, but sometimes the water is more like that. And so how do we find stuff in water like this? How do we find stuff when it's several miles offshore? How do we find stuff in water that is moving a little bit too fast, current wise for safe diving? Et cetera et cetera. Well, I've mentioned acoustics and this is where acoustics come into their own, in terms of prospection - going out and seeing whether we can find either a specific site that we might want to find, or whether we're simply doing area survey so that we can actually assess the archaeological potential or the resource in a particular area of sea, lake or river bed.

And one of the systems we use now is essentially what we call multi-beam bathymetry. So a multi-beam essentially is a sonar, or it's rather 500 sonars, all mounted on the bottom of the ship, all firing an individual pencil beam of sound, so imagine the ship going along the seabed with this fan-shaped array of signals propagating from the single-source several times a second down to the seabed. What happens to that sound when it reaches the seabed, it hits the seabed and bounces back, and so the transceiver on the boat receives the echo and again does this time-distance calculation and effectively if you know where the ship is in three-dimensional space, you know exactly where that sound source is, when it's firing all those pings of sound. Not only where it is in XYZ, but in fact its attitude, its tilt, its pitch and its yawl - if you can control for all those criteria, all those parameters, you could then organise all those reflections from the seabed into what is effectively a topographic map of the seabed.

And it all happens so fast that the ship can be steaming along at up to 10 knots and in real time mapping the seabed. So we can do many, many square kilometres of seabed a day - tens of kilometres a day.

Now, if you want to narrow in on specific sites that we find, we can then move in and use an array of other systems to actually look at them in high resolution or in slightly different ways again using sound. This one works in a similar way to the multi-beam, but instead of lots of pencil beams, it has two fan-shaped arrays that hit the seabed, and this time they also reflect and give a reflection of the seabed, but in a sense they're telling us about the nature of the seabed, so whereas multi-beam gives us the geometry or the topography of the seabed, side-scan (which is what this is called because the beams are propagated either side of the tow-fish) that match the sea floor in terms of quality, so it's rather like a map. So on an aerial photograph we could see fields, we could see trees, we could see quarries, we could see sea shore etc, side scan gives us the marine equivalent to that, so that it shows us the mud flats, the sands, the gravels, the rock outcrops etc. So, geologists use this a lot. But it's brilliant!

In fact, both multi-beam and side scan are brilliant for finding anything that sticks up through the muds of the seabed, because anything that sticks up - especially if it's hard like wood, or rock or metal - will reflect the sound even more strongly than surrounding sediments and it'll stick out like a sore thumb. So it's a fantastic prospection tool. We can use these pieces of equipment from small boats or ships like this.

In fact, there was one other I want to mention to you. This one here is another really important system, because whereas the first two that I mentioned – the multi-beam for mapping the topography and side scan for the quality of the seabed - the sub bottom profiler sends lower frequency sound actually into the seabed, so whereas with the higher-frequency stuff like side scan the sound hits the seabed most of it's reflected back up straight away. The sub bottom profiler puts the sound into the seabed, so if you've ever been to live music and you've stood by the base speakers, you can feel the speaker, you can feel the floor move, and that's because it's low frequency sound. The high-frequency stuff is the stuff that hurts your ears. Now the sub bottom profiler is really useful to us, because while we are interested in mapping the topography and the nature, the character of the sea's surface we also as archaeologists interested in what's underneath, perhaps completely invisible, not visible on

the surface at all, and what the low frequency sound does is it travels into the seabed and every time it meets a change in material so gravel, sand, silt, clay, wood from something cultural, every time the sound passes from one material to another part of the sound is reflected from that interface. So essentially, it's refraction, and so we end up with a slice through the seabed, a vertical profile (hence the term sub bottom profiler) of what is going on below the seabed. And we can mount all these things on fairly small boats or even submersibles or indeed ships like this to cover more areas out at sea.

A lot of the stuff that I do is in this place: the Baltic. The Baltic is a fantastic place because of its particular qualities with respect to those shipwrecks that I'm interested in.

Those of you who have seen *Mary Rose* will know (or even seen pictures of it in a book know) that in fact the *Mary Rose* survives as one half of the ship. It's almost, when you look at it now, it's almost like one of those Victorian dolls' houses, where you open out the front wall and you see the floors of the house in cross-section. Well, *Mary Rose* looks like that. And that's because when she sunk, she sunk deeply into the seabed sediments of the Solent and the stuff that was in the seabed is what you see today.

Everything above the seabed in the water column was eroded away by various agencies - many of those agencies biological. And on the right of the screen, you see a piece of wood that has been eaten by the critters that did for the upper half of the *Mary Rose*. In fact, there are two agencies, which are the two organisms, which cause us most trouble. One is a little crustacean, called limnoria and the other is actually a mollusc - it's known as a ship worm, but it's really a mollusc and that's Teredo, *Teredo navalis* and Teredo is what has made these honeycomb tunnels through this piece of wood and essentially infestation from these organisms means that any wood exposed in the sea is essentially gone in a relatively short space of time.

But in the Baltic, see that it's only connected to the oceans of the world through the North Sea through relatively small channels here. And the budget of rainwater from its catchment around the Baltic means that, in fact, it's more freshwater than seawater. So, in fact, there is water flowing out of the Baltic - that means its salinity is much, much lower than any other sea in the world and that means that these critters don't live. Teredo and limnoria can't

survive in the Baltic, and that means that when a ship sinks in the Baltic it's going to be there for a very long time.

The first time we had a dramatic example of the sort of preservation that the Baltic could offer was the salvage of the warship *Vasa* in 1961. This is the ship just showing above the water when they have lifted it from the bottom by 12 strong wires, and this is that ship having been underwater 333 years being floated back into a dock on its own keel. They raised it from the seabed after more than three centuries, pumped it out and floated it back into the dock. We couldn't do that with *Mary Rose* - she wasn't quite so complete.

And that's what *Vasa* looks like now in a museum in Stockholm. It's rather like walking into an enormous cathedral – it's a huge museum. And to a certain extent this ship is a monument to a time when Sweden was a very different country to the one we know today. At this time (in the early 17th century) Sweden was one the bullyboys of Europe. It had the most professional mercenary army and they were right at the centre of European power politics. But *Vasa,* although it was thought to be a unique case and just, you know, just a quirk preservation we knew from what other wrecks were like in the Baltic that there might well be others almost as well preserved.

And as we have now only in the last few years started to move into the deeper waters with the systems that I showed you (the multi-beam, the side scan and sub bottom profilers), we've now started to find wrecks that are completely changing the nature of our maritime assemblage in the Baltic, if you like. Here is a side scan sonar trace discovered by this ship, this one here. It was searching, in fact, for a lost seaplane and in the process it discovered all sorts of things including this.

This is a shipwreck. It doesn't look much like much now, because what's happening, what you're seeing here, is the sound that has travelled from the shape, which is probably about here it's hit the wreck and bounced back, so the bright areas are the timbers of the ship's structure itself, the ship's hull. But if I show you what the shadow is, because this thing is standing up about the seabed and the sound's coming here, so the sound can't get behind the wreck, so it leaves an acoustic shadow on the seabed. This is what the shadow looks like. There you have… When we put the remote operated vehicle, the submersible, down to have a look at what we'd got, we saw this. And just to put that in context, you're looking at that

piece at the stern of the ship, in fact, you can't see it clearly on the screen, but even the carvings are still on the ship. So this is a merchant equivalent to the warship *Vasa*. And it's in 128 metres of water, and that gives you a clue as to why it's so well preserved, because there's very little oxygen down there. So not only do we not have Teredo, we don't have limnoria, we don't have much oxygen. So although all this material, the wreck of the ship is degrading slowly, it's very, very slow. Two of the masts of the ship are still standing. Going in a little bit on the stern, you can just see the rudder [pointing] (rudder here) and all the furniture is still in the captain's cabin. Further along, you can see the main hatch, the anchor still catted over the side of the deck, the windlass (that sort of rotary winch affair to draw the anchor up), all still there. Almost looks as though the crew have only just left it the day before. So this is the sort of staggering preservation that is coming up in Baltic.

The very next year - only a couple of years ago - the wreck of a warship that people have been searching for for years, decades, was found and this is the wreck of the warship *Mars* that sunk in 1564, so this is a Swedish equivalent to the *Mary Rose,* although *Mars* was twice the size of *Mary Rose*. It was the biggest and most powerful ship of its day and it sunk a German ship of a combined German-Danish fleet in a great battle in 1564 and it was so powerful that no single ship could have tackled it, so the Danes and the Germans rather cleverly said okay we can't defeat it ship-to-ship so we'll just close in on it with lots of ships, and we'll just board and fight it out hand-to-hand, and that's what happened. And with hundreds of soldiers fighting it out hand-to-hand, something caught the magazine alight, the ship blew up, and went down in a matter of minutes taking 800 people with it.

And this is the degraded bit of the ship. Here's one of the bronze guns lying on the seabed, and here's a couple more sticking out from the underside of the ship, but the stern of the ship is still largely intact. Here's the rudder. Here is the upper side of the hull, with the diver just looking through the gun port, and this is at 70m in the Baltic Sea, so I don't know whether any of you dive, but most scuba diving is done with compressed air, down to about 30 metres. This is more than twice as deep as that, so you have to use special kit with different gases to get over the physiological problems that would occur if you tried to breathe compressed air at this depth.

But archaeology is still possible and that's what's the surviving part of the hull structure at *Mars* looks like as a photo mosaic. So this is actually a digital mosaic of hundreds of individual underwater photographs taken in artificial light, so you wouldn't see any of this down there, if you were down there without light. It would be literally pitch black, but shine powerful lights and all of a sudden you can see for metres and metres. And so individual, about one metre square at a time, is photographed with a 50% overlap and it's all put into a into a program like Photoshop (it's not, it's called AGISOFT), so it's actually photogrammetric software, which essentially does the maths to work out how to stitch adjacent photographs together and if you have 50% overlap or more what the software does is identifies the common points in the two adjacent photographs and essentially combines them. Bit by bit you work out until you've got your whole site photographed.

However, it looks great, but in fact there are probably, well we know there are, inaccuracies with it, so, as well as the photography, we use acoustics again to try and provide a more reliable and accurate three-dimensional model onto which we will then drape the photographs. And this is another type of sonar. It's a sector scanning sonar. And what's going on in the black sort of curved bit there is the scanner is going to go up and down like that when the instrument is activated, deployed overboard, send down to the site, and then put up next to the wreck. And here's a single scan. That's the ship over there, this is the seabed, this isn't a hole in the seabed, this is simply where the scanner is standing, so it can't survey what's underneath it, but it can actually survey the sort of hemisphere above it, if you like, including a wreck.

Here's another one and what you're looking at is the stern of the warship *Mars*. You've got the rudder, or the sternpost here, a loading port just to the right of it, and then up above that, gun ports. And you'll probably be able to see it a little bit more clearly if I put alongside it a photograph of the same part of the ship taken from roughly the same view. And then, of course, what we can do is we can then start to put the acoustic digital model together with the photograph and we can stitch the acoustic scans together. And we'll end up taking literally hundreds of these scans that take about, maybe, 10-15 minutes each having to move the tripod each time. So, it's a bit of a long job, but the technology is moving this way – it's getting faster and faster all the time.

Just to finish off with the one of the most recent wrecks discovered in the Baltic. If I had seen this photograph about ten years ago, I would have suspected it was fake. It looks rather like a Steven Spielberg film set, but it's not. It's real. The guns are still sticking out of the gun ports in this wreck. This is the wreck of the Swedish warship *Sword* that sunk in 1676 – another battle against the Danes - they were always hammer and tongs against each other. Good for archaeology, because we have a lot of wrecks on the seabed as a result of their struggles.

So those are all in the diving range, but now what about the places we can't go physically as divers? Those same technologies that we use to discover wrecks on the seabed or assess areas of archaeological potential, acoustics and various other technologies, magnetometry, et cetera, we can use those in very much deeper water, simply by sending them down on submersibles or vehicles such as remote operated vehicles. So, a remote operated vehicle is essentially a submersible, which is tethered to the surface by an umbilical, usually a fibre optic cable, through which we send data and retrieve data to control the vehicle, to drive it around and to receive the photographic or digital imagery coming from the seabed.

And this is a project we were involved in the Mediterranean a few years ago with Bob Ballard, the guy who discovered the *Titanic* amongst other things. And this is, although it's orange, it's actually an American Navy ship, but that's not the real, sort of, vessel of importance here. This is simply a support vessel for this. If you want to do archaeology in the Mediterranean, and you want to find things, use a nuclear submarine. This thing is the perfect search vehicle. It's festooned with all the lights and sonar you could ever require or at least it was. Alas, the Americans scrapped it. Unfortunately, it doesn't exist anymore. But, for a few years, it was a great archaeological tool and essentially it has the capability of submerging down to the seabed, staying down there for many days and essentially going up and down surveying the seafloor and recording what it finds. And then it could come back to its point of origin, and after 24 hours it will only be a few metres away from that original point of origin - that's how accurate its Doppler guided navigation system is. And so we used NR1 (as it was called) to find archaeology on the seabed and then we use one of these remote operated vehicles to send down and actually look at the sites so found. This is the sort of archaeology you do with a cup of coffee in one hand and a joystick in the other, so it's quite lazy from that point of view. But this is the sort of thing we're finding.

On the deep seabed of the Mediterranean, half a mile down, we find shipwrecks that have not been interfered with by people, so they haven't been salvaged. So we have a class of shipwreck, which provides data in perhaps slightly purer forms than wrecks in shallow waters where they've been dived on, or salvaged, or trawled or cut with anchors and stuff like that.

We also carried out some experiments in terms of how we could use robotic technology to excavate with and we also used - not in such deep waters, but in slightly shallower waters - another sort of underwater vehicle. This is the autonomous underwater vehicle. So instead of an ROV, which is tethered to the support vessel, an autonomous underwater vehicle is something that is programmed, so it's loaded up with the instrumentation you want to use, it's programmed to navigate a certain route underwater for a certain time. It does that and it then comes to the surface where you can go and pick it up, download the data and send it off for another 24 hours, or another week, or whatever.

We make them here in the Oceanography Centre. We have a fleet of autonomous underwater vehicles, known as auto sub, and these things are the longer duration ones are from about here to the wall and then there's a shorter type, which is designed to go more slowly through the water. But, again, they can carry any array of instrumentation, depending on what sort of underwater science we want to do. This is a slightly different form of AUV. This is designed to go very slowly, so whereas auto sub might go, sort of, this speed through the water this thing will literally go about 1-2 centimetres a second. So, like two microknots. And the reason we want to use something like this on an archaeological site is that it's carrying cameras as well as sonar and it will pass over the site very, very slowly, and take lots of overlapping photographs, the same photographs, that same pattern of photographs that we need to provide those photo mosaics. Something like this.

So, here's a wreck in 80 metres of water off the island of Chios, in the Aegean. It contains largely two forms of amphora. And it's one of the earliest examples of a ship carrying almost an industrial scale cargo. This is oil and wine being exported from where it's been grown and processed on the island, exported all over the Mediterranean world. And we can create a mosaic like that from individual photographs now in a matter of minutes. We could drape that photograph over the digital terrain model derived from the sonar systems. So, this is that same combination that we're using the Baltic on the shipwreck surveys.

So, if we're thinking of the old question of whether archaeology is an art or a science, perhaps it's a bit of both. These days we can't do archaeology without science, and yet we're interested in the final analysis - in people. We're investigating these sites with all these whizzo pieces of kit, because we want to understand the sites and while we might be interested in the material remains of the past: the ships, the amphora, the coastal communities, the relationships between harbours, the hinterland, shipyards, all sorts of stuff. So, the material culture, the material remains of the past is our starting point. But, the reason we're looking at stuff, at things, is because, as Mortimer Wheeler said a long time ago, archaeology is actually about people, not things. The things are the way of getting at what the people were doing. So, let's have a look…

I'm going to finish off with one example a little bit closer to home. And here's another ship, which is useful to get at the politics of the past, in this case the medieval period. If you go along the M27 between Southampton and Portsmouth you'll pass over the Hamble River and if you look up to your left, as the river sweeps away around a bend, there lies the wreck of Henry V's great ship the *Grace Dieu*. He had it built in order to carry troops to France, but in fact by the time *Grace Dieu* was ready for the sea, he'd been over and he'd won the battle of Agincourt, so it was really not needed. But, it was the greatest ship ever built in medieval England. Indeed, it was so big that there was not another ship constructed in England that exceeded the *Grace Dieu* in size for another two hundred years, that's how big it was. With the help of *Time Team,* if we actually imagine what it would look like next to our diving vessel here, it was that size! So, perhaps not the size of a super carrier of today, but this was the super carrier of the medieval period. And to build a ship that size out of wood and iron nails, which is essentially what we're talking about, they had to adopt extraordinary sort of methods to join the timbers in a sufficiently strong way to make a viable seaworthy hull. They actually made the hull out of overlapping thicknesses of planking, up to six layers thick. And we can't yet work out how the sequence of timbers go together, so one of the reasons we're going to go back to the site next summer (which is the anniversary of the battle of Agincourt) is because we want to try and find out a little bit more about the wreck of the *Grace Dieu* and how the shipwrights at the medieval period did what they did.

Now you've just seen the bare mud. You say where's the ship? Well, it burned to the water line in 1439 and although that means all the upper stuff is gone, the ship was so big that is

below the water and indeed now lying in the mud is still an enormous piece of ship structure. It would still be as long as the remains of the *Mary Rose* in Portsmouth.

So, what are we doing? Well, we're going to go back to that old favourite, the sub bottom profiler, myself and my colleagues from the Oceanography Centre have used a variety of systems on this wreck and essentially what you're looking up in the top right hand corner is one single pass with one of these sub bottom profilers – so, what you're looking at is a slice through the riverbed, looking down from the surface. The top of the orange and yellow bit, that's the river bed and then looking down into the river bed all those bright orange and yellow bits, those are the things buried in the river sediments, which are reflecting the sound. So, as you can see they're literally bright reflectors acoustically and you can see the stuff off to the side but nothing underneath it - that means that the sound is not being able to get through whatever it is it in the mud. In fact, we can tell that the interface between what is in the mud, in the mud below it is sort-of boat shaped, and if we then take not one slice across the site, but loads and loads of slices, just like the slices of a loaf bread, we can actually reconstitute the shape of the buried hull of the *Grace Dieu*.

Now that's the old-fashioned way of doing it. The guys down at NOC weren't satisfied with this slightly tedious way of producing a three-dimensional model of what is buried. What we get is essentially a map of density of the amplitudes of the reflection. So, this is the strongest reflection and it gets weaker and weaker, and this is describing roughly the shape of Henry V's *Grace Dieu* lying in the mud. This is OK, but they came up with an even better instrument. Still a sub bottom profiler, but instead of sending down sound into the seabed and getting a slice, they send down sound into the seabed and capture the reflections in a mat of hydrophones. So essentially what we're doing is we're insonifying a great block of the sub mud settlements of the River Hamble, so we're now able to characterise the buried anomaly as a three-dimensional object rather than making it up out of slices and this is the result. And that is the acoustic reflection of the buried hull of Henry V's *Grace Dieu,* and if we just put it next to a sub bottom profile trace from 1967 we can see how far things have come in a relatively short space of time. This on the left is the sub bottom profiler trace that shows the *Mary Rose* lying in the bed of the Solent. This is how the *Mary Rose* was discovered with a sub bottom profiler.

Transcript

So I'll leave it there. We've nearly done the hour, and perhaps I'll have time for a bit of… a few questions, because there's a lot of maritime archaeology that I don't do as much as the ship wrecks, so, waterfront archaeology submerged prehistory, such as… you met Fraser Sturt this morning. He does all that sort of stuff, so there's a lot more to it. I've only really just given you a sort of bird's eye view, well a 'my eye' view of it, if you like. I would be pleased if you, before your next session - I think you got until half past before your next assessment - fire a few questions at me, if you want.