



Perez Alvaro, E. (2013) 'Experiments on Particle Physics Using Underwater Cultural Heritage: The Dilemma'

Rosetta **13.5**: 40-46.

<http://www.rosetta.bham.ac.uk/Colloquium2013/perezalvaro.pdf>

Experiments on Particle Physics Using Underwater Cultural Heritage: The Dilemma

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Abstract

One of the most important laboratories for the observation of rare events used 120 archaeological lead bricks from a 2000-year-old shipwreck for research into particle physics because of its low radioactivity. The dilemma is whether there is any justification for using underwater cultural heritage for the purpose of modern scientific research. The definition and attribution of values to archaeological and cultural material have changed throughout history. Although all values are valid, individuals and organisations emphasise some more than others.

Introduction

Shipwrecks evidence exceptional levels of preservation. Underwater artefacts stop decomposing from the moment of equilibrium as a result of the wet environment. All of these materials are well preserved because, unlike most dry-land sites, wreck-sites are protected against humans and bacteria by the ocean sludge that covers them. Maritime archaeologists have often found materials that would have decomposed a long time ago on land: wool, wood, leather or canvas. When the materials are removed from this equilibrium within the wet environment, if not done carefully and with adequate resources, diligence, or a scientific report, priceless evidence of human activity is destroyed. In this regard, this valuable archaeological material has faced two different outcomes: (a) it was either plundered by divers or (b) it was protected and mostly recovered by the authorities of the countries to which the waters in which it was found belong.

However, Ananthaswamy posits different findings on the use of shipwrecks; in this case, they are a source for experiments on dark matter:

The CDMS team - *Cryogenic Dark Matter Search* - had to find old lead [...] An Italian colleague mentioned that he had been using lead taken from two-thousand-year-old Roman ships that had sunk off the Italian coast. The CDMS team located a company that was selling lead salvaged from a ship that had sunk off the coast of France in the eighteenth century. Unaware that they were doing anything illegal, the researchers bought the lead. The company, however, got in trouble with French customs for selling archaeological material. Illegal or not, the lead worked.¹

On 14th May 2011 a 2000-year-old shipwreck's cargo was used as a source for experiments in particle physics. Italy's new neutrino detector, CUORE (Cryogenic Underground Observatory for Rare Events), at the Italian National Institute of Nuclear Physics, received from the National Archaeological Museum of Cagliari in Sardinia 120 archaeological lead bricks from a ship, which was built more than 2,000 years ago and recovered from the sea 20 years ago on the coast of Sardinia. This 'Roman lead' - mainly found in the anchors of sunken ships - was used because of its low radioactivity: for, being underwater for 2,000 years, the very low original radioactivity was reduced approximately 100,000 times.

The use of these objects as stock for experimentation had never been an issue before, but now it is beginning to be deemed ethically questionable. The fact that underwater heritage was legally - or not - excavated and recovered by a museum or a company and afterwards sold or transferred for its complete destruction in scientific experiment for 'the benefit of humankind',² introduces a whole new legal aspect to the treatment and protection of this heritage. In addition, if the use of this material becomes popular, and it is bought illegally from a company, as Ananthaswamy states, the issue is a major concern.³ We are facing a legal vacuum inside international law and archaeological ethics in reference to the use of underwater cultural heritage for legal purposes, which should now be redefined.

¹ Ananthaswamy 2010.

² A value set in the UNCLOS 1982: article 149; see below: page 5.

³ Ananthaswamy 2010.

Scientific argument

Research on dark matter detection aims to underpin our understanding of some of the most fundamental properties of the universe. It has been demonstrated experimentally that ordinary matter, i.e. elements of the periodic table, constitutes only 17% of the total matter in the universe whilst the remainder is attributed to dark matter. The understanding of the origin of the remaining 83% of the matter present in the universe remains an open question in the field of Cosmology. For these experiments, shielding against radiation is essential and laboratories are established underground as a first measure against cosmic ray radiation. More particularly, Gran Sasso is located 1.4km below the surface. However, additional shielding is necessary. Lead is an excellent shield against external events since it has the highest atomic number of all stable elements. However, freshly mined lead is polluted by naturally radioactive elements. By chemical means all of these elements can be greatly reduced below the sensitivity of the detectors, but not enough for experiments like the ones performed at Gran Sasso.

Recently, ancient Roman lead recovered from the bottom of the Mediterranean Sea has been studied in detail and demonstrates extremely low levels of intrinsic radioactive emissions. Moreover, its conservation underwater prevented the lead from being radioactively activated by cosmic rays, thus further improving its properties. In order to achieve similarly low radio emission levels, the best commercially available lead should be kept shielded underground for a period of over 300 years.

The shipwreck used in the CUORE experiment was loaded with more than 1000 ingots. Using only one shipwreck loaded with 33 tonnes of lead, the nine laboratories performing these experiments around the world can have enough Roman lead for 10 years. The discussion opens a new *ethical* perspective in favour of/against the use of Roman lead as an element used in scientific experiments.

Values attribution

As claims for their valuable attributes have broadened, historic shipwreck resources have become the subject of confrontations among different "users" or interest groups (archaeologists, historians, commercial salvagers, sport divers and companies exploiting the subsoil).

There is in existence an array of values which depends on cultural symbolism and social ideology involving the feelings of the individual and the community. All of the factors and complexities of the issues around the management of underwater cultural heritage reveal the relation between its management and the historical, sociological, cultural and traditional particularities of every individual and every community.

There are several threats to this underwater heritage, the most important being human interference, such as construction, illegal salvage and "treasure-hunters". However, human interference includes not only illegal uses but also legal applications, like laying submarine cables and pipelines or its use for scientific purposes. In this context we find those scientific experiments that require, without any other option, Roman lead that has been under water more than 2000 years in order to answer questions about the fundamental properties of the universe, which are considered essential for the development of humankind and, as a consequence, for 'the benefit of mankind'.⁴

The only legal instrument to specifically protect underwater cultural heritage is the *2001 UNESCO Convention*. The key conclusions of this convention are the priority of the preservation *in situ* and the rejection of commercial recovery of underwater cultural heritage. However, there is no reference anywhere to the use of shipwrecks for the purposes of experimentation - *new uses* of underwater cultural heritage. Although the convention's attribution of values is dynamic and relative, in its context it creates a hierarchy in which shipwrecks are more worthy of protection. Legislation needs to be based on the ethics of preservation and these ethics need to establish dominant values that, if it is not possible for them to co-exist with others, are the leading values that set up what is worth protecting and managing.

⁴ A value set in the UNCLOS 1982: article 149; see below: page 5.

The 1982 United Nations Convention on the Law of the Sea 1982 (UNCLOS hereafter) refers to underwater cultural heritage in only two articles: 149 and 303. In Article 149 it establishes a new goal for this type of heritage and introduces as a consequence a new value: its use for the benefit of humankind.

Article 149 - Archaeological and historical objects

All objects of an archaeological and historical nature found in the Area shall be preserved or disposed of for the benefit of mankind as a whole [...]

No definition of the term *mankind* is given in the text of the Convention. However, Boesten defined the term as 'taking into account intra- and intergenerational interests'.⁵ In a broader extent, the common heritage of mankind is an international principle, which establishes equal property interests for all people.⁶

In this definition we set up our approach: if the underwater heritage has to be preserved 'for the benefit of mankind', there is a need to define what sort of benefit. The use of underwater archaeological artefacts as a source for scientific purposes may be seen as 'for the benefit of humankind', since it is undertaken with the purpose of increasing mankind's knowledge of the universe. However, preservation of these underwater archaeological artefacts and sites for future generations may also be 'for the benefit of mankind'. Only the attribution of values to underwater cultural heritage in order to categorise its use, disposition and preservation will help to answer this question in the future.

Conclusions

The study of sunken vessels is essential to history because entire continents have been discovered, colonised, invaded and defended by sea. The salvage of this material should be done under the surveillance of an archaeological team.

On the other hand, not so far in the future, the development and operation of new sciences and technologies – make it likely that further investigation, development and use of the underwater cultural heritage for other purposes may occur. If

⁵ Boesten 2002: 43.

⁶ Tenenbaum 1990: 26.

boundaries are not well defined, a “first come, first served” approach may occur.

New uses of the oceans and their patrimony have recently been invoked by relevant international law of sea actors and their instruments. It is necessary to identify gaps and suggestions in order to analyse whether and to what extent the existing rules can be applied or modified to adequately deal with these new uses. Compromise does not equal defeat; sometimes, it is the only path to success. Guidelines are necessary ‘for the benefit of humankind’.

Bibliography

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