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Armour, nails, rust, slag and chemistry : a review of ten years of innovative interdisciplinary research on heritagemetals and some perspectives

From the very beginning of its use, iron has been a key material in ancient societies.This material is particularly interesting because it concerns all levels of society. Indeed,it is used to make tools for agriculture, materials for construction, but also weapons such as armor or swords, which require highly skilled craftsmen. For this reason, studying its modes of manufacture, use and trade is of primary importance for different historical and anthropological disciplines (history of technology, economic history, material culture, war history, etc.). It is also crucial to preserve and protect the tangible evidence that are the archaeological objects made of iron and steel. Moreover, studying the degradation processes of these metals over centuries is also very useful for studies aimed at predicting the behaviour of materials intended to be used over the very long term by our contemporary societies. In fact, for decades, studies on ancient metals have been fundamentally interdisciplinary and have brought together historians, archaeologists and anthropologists as well as chemists, metallurgists and geologists. However, in recent years, crucial methodological developments have taken place, having used advanced analytical chemistry techniques that now allow us to renew questions about dating, about the study of the evolution of metallurgical processes, the circulation and trade of these materials, but also to advance our knowledge of degradation processes. The effectiveness of these approaches has been due, on the one hand, to the evolution of analytical techniques but also and above all to the fact that their development has taken place in appropriate environments, making it possible to integrate the questions of each of the disciplines involved. This will be illustrated by giving some key examples. In addition, some elements for discussion on the new perspectives of interdisciplinary research on the subject will be proposed, including the collection of massive data combined with a fine and multi-scale analysis of materials, but also the creation of appropriate databases and the use of articial intelligence.

Philippe Dillmann is "Directeur de Recherche" at the French CNRS, doctor and engineer in materials science. He is director of the "Laboratoire Archéomatériaux et Prévision de l'Altération" (CNRS and CEA), deputy director of the UMR3685 and UMR5060 of the CNRS. He conducts researches in archaeological science and archaeometry. His research deals with the understanding of manufacturing and trade routes of metallic artifacts in ancient societies and, on long term corrosion and conservation. He funded the Working Party 21 of the European Federation of Corrosion, dedicated to the study of Cultural Heritage Metals. His research programs and results were regularly awarded (GMPCA price, Société Française de Métallurgie et Matériaux, CASTRO prize, Société Française de l'Energie Nucléaire prize for the CIMETAL program, involving archaeological analogues for long term corrosion prediction).