

The Cultural Heritage Department of the National Research Council of Italy. Research and Innovation for Cultural Heritage

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Abstract

The Department of Cultural Heritage (*DPC - Dipartimento Patrimonio Culturale*) is the scientific coordination body to which the National Research Council of Italy (*CNR - Consiglio Nazionale delle Ricerche*) has assigned the statutory task of defining policies to co-ordinate the research activities of the CNR's Institutes and develop relationships with public and private, national and international players in the field of Cultural Heritage.

The goal is to improve governance of the cultural heritage and landscape in order to increase the economic, social and cultural output through the management of national and international projects and the exploitation of its research results. In the Italian national context, the CNR's mission in the field of Cultural Heritage is strictly integrated with the Universities (tasks of high level research and formation), which depend from the same Ministry (*MIUR - Ministero dell'Istruzione, dell'Università e della Ricerca* - Ministry of Education, University and Research), the Archaeological and Architectonic Superintendences and Regional Directions for Cultural Heritage, which depend from the *MiBAC (Ministero per i Beni e le Attività Culturali* - Ministry of Cultural Heritage; tasks of preservation and management of ancient evidence) and other Institutions of the same Ministry, such as *ICCD (Istituto Centrale per il Catalogo e la Documentazione* - Central Institute for the Catalogue and Documentation) and *ICR (Istituto Centrale del Restauro* - Central Institute for Restoration), both particularly focused on the mobile Cultural Heritage.

The established and operative assets of knowledge, skills and technologies of CNR-DPC sit in three strategic lines that represent different aspects of its policy: i) methodologies and technologies for the monitoring and preventive maintenance of cultural heritage; ii) holistic strategy for the integrated management and multi-user use of cultural heritage of a territory; iii) process for the enhancement and sustainable development of natural and anthropogenic cultural landscapes.

A distinctive feature of the DPC-CNR is the integration of the different human and scientific knowledge of the five Institutes that it coordinates; in general, these Institutes develop research in the sectors of Knowledge, Conservation, Diagnostic and Promotion of the Cultural Heritage, developing case studies in Italy and in the Mediterranean Basin. Two of these Institutes are more specialized in human, historical and archaeological studies: the Institute for the Study on Aegean and Near Eastern Civilizations (*ICEVO - Istituto di studi per le Civiltà dell'Egeo e del Vicino Oriente*) and the Institute for the Study on the Italic and Ancient Mediterranean Civilizations (*ISCIMA - Istituto di Studi sulle Civiltà Italiche e del Mediterraneo Antico*). Two other Institutes are more devoted to the development and testing of technologies to be applied to Cultural Heritage: the Institute for Technologies Applied to Cultural Heritage (*ITABC - Istituto per le Tecnologie Applicate ai Beni Culturali*) and the Institute for the Conservation and Valorization of Cultural Heritage (*ICVBC - Istituto per la Conservazione e la Valorizzazione dei Beni Culturali*). The fifth is the Institute for Archeological and Monumental Heritage (*IBAM - Istituto per i Beni Archeologici e Monumentali*) an interdisciplinary scientific structure with skills in the study, documentation, diagnosis, conservation, restoration and promotion of archaeological and monumental heritage. These skills are expressed in the multidisciplinary nature of its personnel, which includes experts in human, historical and

archaeological studies and in the technologies to be applied to Cultural Heritage. IBAM research focuses on numerous and important case studies in central and southern Italy, but also in Greece, Spain, Iraq, Peru, Bolivia and Turkey, where the Institute performed stratigraphical excavations, archaeological and topographical surveys, GIS and WebGIS, aerial and satellite high resolution remote sensing and geophysical prospecting applied to the study of the urban area and the surrounding territory; research also includes the study of mobile artefacts, including Roman and Byzantine ceramics (studies concerning manufacture and imports, and analyses on organic residue aimed at determining the contents).

Keywords:

The **National Research Council** (CNR - *Consiglio Nazionale delle Ricerche*) was founded in 1923 and it is the largest public research organisation in Italy that performs multidisciplinary research. The mission is to conduct, promote, spread, transfer and improve research activities in the different branches of knowledge in order to support the scientific, technological, economic and social development of the Country. The CNR has 8,200 employees, of whom 52% are researchers. Its structure is formed by 11 Departments located in Rome and 108 Institutes located throughout Italy. The Departments manage, plan and coordinate the research of the affiliated Institutes; the latter propose programmes and perform the research activities coordinated by the Departments.

The **Department of Cultural Heritage** (www.dpc.cnr.it; director Prof. M. Mautone) was founded in 2006 and coordinates the work of 700 researchers, which represents 5% of its total research activities. The Department manages five affiliated Institutes that are specialised in historical and archeological studies such as ICEVO (*Istituto di studi per le Civiltà dell'Egeo e del Vicino Oriente* - Institute for the study on Aegean and Near Eastern Civilizations) and ISCIMA (*Istituto di Studi sulle Civiltà Italiche e del Mediterraneo Antico* - Institute for the Study on the Italic and Ancient Mediterranean Civilizations) and in interdisciplinary methodologies and technologies applied to cultural heritage such as ICVBC (*Istituto per la Conservazione e la Valorizzazione dei Beni Culturali* - Institute for the Conservation and Valorization of Cultural Heritage), ITABC (*Istituto per le Tecnologie Applicate ai Beni Culturali* - Institute for Technologies Applied to Cultural Heritage), and IBAM (*Istituto per i Beni Archeologici e Monumentali* - Institute for the Archeological and Monumental Heritage). In addition to these five Institutes, twenty-five research teams, belonging to other Departments of the CNR, collaborate with the activities of the Department of Cultural Heritage. This Department concentrates its activities on an innovative multidisciplinary network that establishes fruitful co-operations and synergies between human and engineering sciences. In fact, its mission is to promote integrated governance of the research applied to cultural heritage with the aim to improve conservation interventions and optimize cultural heritage and landscape in the framework of national and international co-operations and to encourage socio-economic growth through training and technological transfer.

The integrated management promoted by the Department of Cultural Heritage draws its strength in benefiting from the multi-disciplinary scientific apparatus of the research institutes that allows the Department to cover the different fields of actions of the cultural chain, to wit: i) historical-artistic and archaeological knowledge; ii) knowledge of the constituent materials by means of diagnostic analyses that help not only to understand the conservation state of the objects but also to acquire more information about the manufacturing techniques and the technological developments achieved by the ancient civilization of which the artwork being studied is proof.

The knowledge and diagnostic studies are followed by research aimed at improving the interventions for preventive conservation, conservation, restoration and monitoring. The end actions are the valorization to improve the tourist offer and to spread knowledge. For each of these steps, Department researchers develop new methodologies, materials and technologies. In addition, such an integrated approach aims at combining know-how and expertise so that each moment of study or action is linked to the previous step and enhanced. The established and operative assets of knowledge, skills and technologies of the Department are set in three strategic research lines that aim to develop: i) methodologies and

technologies for the monitoring and preventive maintenance of cultural heritage; ii) holistic strategy for the integrated management and multi-user use of cultural heritage of a territory; iii) process for the enhancement and sustainable development of natural and anthropogenic cultural landscapes.

Another strength of the Cultural Heritage Department is the creation and development of relations with other public and private, national and international, players. In fact, in the Italian national context CNR's mission in the field of Cultural Heritage is strictly integrated with the Universities (tasks of high level research and formation), which depend from the same Ministry (MIUR - *Ministero dell'Istruzione, dell'Università e della Ricerca* - Ministry of Education, University and Research), the Archaeological and Architectonic Superintendences and the Regional Directions for Cultural Heritage, which depend from the MiBAC (*Ministero per i Beni e le Attività Culturali* - Ministry of Cultural Heritage; tasks of preservation and management of ancient evidence) and other Institutions of the same Ministry, such as ICCD (*Istituto Centrale per il Catalogo e la Documentazione* - Central Institute for the Catalogue and Documentation) and ICR (*Istituto Centrale del Restauro* - Central Institute for the Restoration), both particularly focused on the movable Cultural Heritage. This network also involves local government (contribution to the correct planning in urban and territorial contexts) international organisations, with whom the Cultural Heritage Department co-operates within the European research projects, and private companies with the aim to support the promotion of research results and technology transfer activities.

These partnerships with public and private players have several objectives: i) to make operative the knowledge and expertise of the Department; ii) to reinforce the humanistic, scientific and technical bases for conservation and valorization of Cultural Heritage; iii) to create added value for society increasing the level of knowledge and developing training processes; iv) to create economic value, promoting activities linked to survey, diagnosis, conservation and communication; v) to improve the results and reduce the cost of interventions; vi) to encourage sustainable tourism; vii) to contribute to the competitiveness of small and medium businesses and industry through technological transfer.

The main research projects are addressed both to immovable and movable Cultural Heritage and concern the various aspects considered strategic by the Department: i) historical knowledge of the cultural heritage; ii) archaeometric studies of artworks made of different materials; iii) development of methodologies and technologies for diagnosis and conservation; iv) research for the development of new materials for conservation; v) development and improvement of ICT tools to increase knowledge, valorization and use of the heritage. For each one of these topics, research groups are able to achieve excellence, acknowledged and appreciated both at national and international levels.

Achieving these goals would not be possible without the activities of the five affiliated Institutes of the Department.

The Institute for the Study on Aegean and Near Eastern Civilizations (**ICEVO** - *Istituto di studi per le Civiltà dell'Egeo e del Vicino Oriente*, www.icevo.cnr.it; director M.-C. Tremouille), founded in 1968, is the first Institute to be established at the CNR in the field of historical sciences. ICEVO is specialized in philology, history and archaeology of the Aegean and Near East area in the Pre-Classical Age. It is a multidisciplinary institute in which history, philology, archeology and linguistics studies contribute to reconstruct the history of pre-classical Mediterranean. The Institute's core is the library, the result of more than thirty years of activities. It is an exclusive point of reference in the archaeological sector at national level. It contains a bibliographic heritage on the Aegean, Anatolian and Near East studies of 15,000 volumes (including books and periodicals), heritage that is difficult and only partially available in other Italian libraries. In addition, the ICEVO also publishes some journals: *Incunabula Graeca* (IG), *Biblioteca di Antichità Cipriote* (BC), *Documenta Asiana* (DA), *Corpus der hurritischen Sprachdenkmäler* (ChS) e *Studi Micenei ed Egeo-Anatolici* (SMEA).

With respect to Aegean studies, the ICEVO promotes and conducts systematic surveys on the archaeological documentation to contribute to the reconstruction of relations and trade during the second millennium BC between East

and West, particularly between the Aegean area and Cyprus and the Italian territories. With regard to the study of the civilizations of Anatolia and the Near East regions in Pre-Classical Age, research is based on the integration of written documents with archaeological, iconographic and philological data; the development of Sinlequinnini software is very important, designed for on-line edition of epigraphic sources and to management of databases primarily concerned with cuneiform texts.

The Institute for the Study on the Italic and Ancient Mediterranean Civilizations (**ISCIMA** - *Istituto di Studi sulle Civiltà Italiche e del Mediterraneo Antico*, soi.cnr.it/iscima/; director P. Santoro) was established in 2001 after the merger of two pre-existing Institutes (the *Istituto per l'Archeologia Etrusco-Italica* and the *Istituto per la Civiltà Fenicia e Punica "Sabatino Moscati"*). Both these Institutes have a long tradition of scientific researchers in the archaeological, historical, philological, linguistic and epigraphic fields in Italy and the Mediterranean basin. The ISCIMA inherited the research lines of the two former institutes and has launched new surveys thanks to innovative projects.

The ISCIMA research activities range from Italy to the countries of the Mediterranean and Middle East area and focus on: i) the multidisciplinary study of the Phoenician and Punic to the Etruscan and Italic cultures, including the history of studies on both topics; ii) safeguarding archaeological heritage, also through the promotion of archaeological parks; iii) the study of the Near Eastern roots of the Phoenician-Punic civilization; iv) the study of the cultural role of pre-Roman Italy between Mediterranean area and Europe; v) computer-aided analysis of archaeological and linguistic data. The ISCIMA publishes some international journals including *Studi Fenici* and *Archeologia e Calcolatori*. In particular, the latter publication since 2005 has participated in the Open Archives Initiative and represents one of the most important tools for digital repositories focusing on the main theoretical and methodological aspects of Informatics applied to archaeology.

With regard to the study of the Etruscan-Italic area, some excavations and survey campaigns were performed in Northern Latium, in particular in several Etruscan cities as Castel d'Asso, Norchia, Tarquinia and Cerveteri. At the present time the ISCIMA's researchers in Cerveteri in cooperation with the *Soprintendenza per i Beni Archeologici dell'Etruria Meridionale* are working on a project to implement a multimedia path thanks to which tourists can move about and visit the most important buildings in the Etruscan city. The institution of this natural archaeological park with the contribution of the multimedia technologies is an example of the issue surrounding the need to safeguard and valorize the archaeological heritage and the natural landscape.

Concerning studies on the Phoenician and Punic civilization, research ranges from archaeology to art, from history to philology, from religion to economy, from epigraphy to numismatics. At the present time the Institute is concentrating its archaeological researches mainly in Sardinia, Tunisia, Sicily, Malta, Tunisia, Algeria and Lebanon.

Founded in 2001, the Institute for the Conservation and Valorization of Cultural Heritage (**ICVBC** - *Istituto per la Conservazione e la Valorizzazione dei Beni Culturali*, www.icvbc.cnr.it; director P. Tiano) is the result of the merger of three CNR Study Centres for Works of Art, which had previously been established in 1971. The ICVBC research activities focus on the study of scientific (chemical, physical and biological) and technological aspects of the conservation of Cultural Heritage. To achieve its mission, the ICVBC staff is multidisciplinary and consists of chemists, biologists, geologists, physicists, engineers and architects. Moreover, the Institute avails itself of specialized equipment, to enable advanced research and scientific diagnosis in the study of artistic, architectonic and archaeological artefacts (above all, in stone materials and mural painting) and their state of conservation.

The ICVBC scientific activities are aimed at developing advanced research in the field of scientific methodologies applied to the conservation and promotion of the cultural heritage: i) characterization of constituent materials of artworks and identification of alteration and deterioration; ii) experimentation of new technologies and materials for the conservation of cultural heritage; iii) development of innovative criteria for planning and conducting conservation treatment; iv)

development of innovative projects for the promotion of Cultural Heritage. Often research activities are carried out in the framework of national and international research projects such as CHARISMA - Cultural Heritage Advanced Research Infrastructures: Synergy for a Multidisciplinary Approach to Conservation/Restoration. Additional activities include training personnel and PhD graduates. In particular ICVBC was partner of the consortium of the EPISCON (European PhD in Science for Conservation), a project which closed in 2010 and was funded by the European Community's Marie Curie programme to promote synergy between the cultural heritage field and natural sciences and engineering.

The Institute for Technologies Applied to Cultural Heritage (**ITABC** - *Istituto per le Tecnologie Applicate ai Beni Culturali*, www.itabc.cnr.it; director S. Garraffo) was founded in 1978 and is located in Rome. The main goals of the Institute are: i) advancement in GIS (Geographic Information System) research and in statistical methods applied to cultural heritage. More specifically, it concerns the reconstruction and contextualization of the archaeological landscape using GIS instruments, remote sensing, virtual reality and multimedia; ii) the characterization of archaeological sites and historical artefacts using geological and high resolution geophysical methodology; iii) the cataloguing, analysis and study of ancient coins and monetary treasures; iv) the study and analysis of historical and artistic handicraft objects, with particular regard to metallic objects; v) the analysis, documentation, evaluation, recovery, conservation and exploitation of historical buildings through multidisciplinary research; vi) the dating of archaeological and geological discoveries using ¹⁴C and amino acid racemisation methods.

The ITABC promotes multidisciplinary research applied to the study of cultural heritage thanks to the presence of researchers from diverse disciplines such as archaeology, chemistry, physics, geology, engineering and computer science. An important research focus on movable cultural heritage is the study of the fabrication technologies of coins from the Misurata hoard belonging to the Archaeological Museum of Leptis Magna in Libya. The more famous research activity of the ITABC is the application of virtual reality to support communication and spread of knowledge in the sector of Cultural Heritage. Several are the products of excellence developed by the Virtual Heritage Laboratory of ITABC such as the virtual reconstruction of the Scrovegni Chapel, the virtual museum of Ancient Via Flaminia and the virtual experience amongst the characters of the painting of Giotto "Approval of the Franciscan Rule". Within the ITABC experience in the field of Virtual Heritage the "Italian Virtual Heritage School", will be organized, in June and July 2012 in cooperation with CINECA (the largest Italian computing consortium) and the University of Padua.

The Institute for Archaeological and Monumental Heritage (IBAM - *Istituto per i Beni Archeologici e Monumentali*, www.ibam.cnr.it; director D. Malfitana) was constituted in 2001 following the merger of three pre-existing Institutes (the *Istituto per la Conservazione delle Opere Monumentali*, the *Istituto Internazionale di Studi Federiciani* and the *Centro di Studi sull'Archeologia Greca*) and has its central offices in Lecce and branches in Catania, Potenza and Rome. The IBAM is an interdisciplinary scientific structure with skills in the study, documentation, diagnosis, conservation, recovery, promotion and valorisation of the archaeological and monumental heritage; specific activities also regard technological transfer and the high level of formation. These skills are expressed thanks to its multidisciplinary staff, which includes archaeologists, historians, architects, geologists, engineers, chemists, physicists and experts in information technology and in Roman law. The research activities include numerous and important case studies in Italy (especially central and south Italy and Sicily), Turkey, Greece, Spain, Iraq, Peru and Bolivia, etc.

The Institute has some laboratories with a considerable amount of specialized equipment, for advanced research in different fields. In Lecce: Laboratory of optical microscopy; Laboratory of electronic microscopy; Laboratory of x-ray diffraction; Laboratory of spectrophotometry IR-FT; Laboratory of ancient topography, archaeology and remote sensing; Laboratory of Information Technologies applied to Cultural Heritage; Laboratory of physical characterisation; Laboratory of chemical tests. In Potenza: Laboratory of in situ investigations for the built environment and cultural heritage; Laboratory of archaeology. In Catania: Laboratory of cartography; Laboratory of photogrammetry; Laboratory of photography applied to archaeology; Laboratory of non-destructive analysis - LANDIS (INFN).

Primary research activities of the Institute regard: i) multidisciplinary methodologies for the knowledge of ancient settlements and their territory, with studies of Ancient Topography and Landscape Archaeology, with production of digital archaeological maps also integrated in GIS; ii) integrated multidisciplinary approaches for the analysis of ancient manufactured products (from production to diffusion and to use); iii) methodologies aimed at the knowledge, the diagnosis and the intervention for the preservation, restoration and delivery of the archaeological and monumental heritage; iv) advanced techniques for non-destructive testing and geophysical prospecting for the identification and reconstruction of buried structures of archaeological interest; v) advanced techniques of virtual reality for the 3D reconstruction and the remote fruition of monuments and landscapes; vi) studies and applications of remote sensing from satellite data, LIDAR and archaeological interpretation of old and recent aerial photos; vii) study and cultural valorisation of the industrial activities not used in modern age; viii) examination of the seismic risk of a site, made by means of a technical-historical investigation of the damage effects generated by past earthquakes in southern Italy, with particular reference to Basilicata and Sicily; ix) methodologies and techniques of physics of the environment and the historical built heritage, with particular reference to bounded environments and to manufactured items of historical-artistic interest; x) geo-pedological applications in the laboratory and in the field for the reconstruction of the landscapes and of the climatic variations during historical ages; xi) diagnosis of the geomorphologic and anthropic risk factors for the preservation of historical and archaeological sites in southern Italy; xii) Integrated methodologies for investigations in the laboratory and in the field aimed at the preservation of architectural and archaeological patrimony.

With regard to the activities in the Mediterranean basin, outside of Italy, the IBAM (in particular, the Ancient Topography, Archaeology and Remote Sensing Laboratory) conducted its main research activities in Hierapolis of Phrygia (Turkey, Pamukkale, Denizli) since 2002 (F. D'Andria, G. Scardozzi, N. Spanò, *Atlante di Hierapolis di Frigia*, Istanbul 2008). The Institute operates inside the Italian Archaeological Mission, directed by Prof. Francesco D'Andria, with a PRIN 2008 project "Landscape Archaeology in Anatolia: multidisciplinary research activities in Hierapolis of Phrygia and in the Salbakos Region" (coordinator G. Scardozzi), in cooperation with other teams from Italy, France and Norway (University of Salento, Polytechnic of Turin, Catholic University of Milan, Sapienza University of Rome, Scuola Normale Superiore of Pisa, Messina University, Ca' Foscari University in Venice, University of Bordeaux and University of Oslo).

The Institute performs archaeological excavations and architectonic research in Hierapolis in the three main sacred areas: the Sanctuary of Apollo and the nearby so-called Sanctuary of the Springs, both of the Hellenistic and Roman periods, and the Sanctuary of St. Philip, built in the Early Byzantine age near the tomb of the Apostle. Archaeological and topographical systematic surveys were conducted in the city and surrounding territory, and are aimed at the creation of a digital archaeological map integrated in a GIS (G. Scardozzi, *Integrated methodologies and technologies for the reconstruction of the ancient topography of Hierapolis in Phrygia and its surrounding territory (Turkey)*, in Proceedings of the 5th International Congress "Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin, (22nd-25th November 2011, Istanbul), in print); field work was conducted using a robotic Total Station, a high precision differential GPS system and Tablet PC for the documentation, and was supported by low-altitude aerial photographs, taken from a tethered air balloon and by radio controlled cam copter and hexacopter. The use of multi-temporal high-resolution satellite images (both panchromatic and multispectral) taken by recent satellites for civil use and by US spy satellites during the 1960s is also very important: image processing is aimed both to enhance archaeological traces linked to burial remains and to produce ortho-maps.

In addition, given the presence in some areas of the city of colluvial and alluvial deposits and recent limestone formations that have covered and incorporated the ancient structures, research has been supported by geophysical surveys (Ground Penetrating Radar, Magnetometry and Electrical Resistivity Tomography). The archaeological research also took into account the hydro-geological and seismic features which characterized Hierapolis and are closely connected to the ancient monuments. Specifically, all the evidence regarding the seismic fault (fractures in the surface, collapsed structures, thermal springs) were documented. The research was also supported by the use of Digital Elevation Models

characterized by different geometric resolution, elaborated from cartographic data and through GPS surveys and remote sensing data. Moreover, the rich documentation collected during the archaeological research is the base for the 3D reconstruction of some monuments of Hierapolis, performed by the Laboratory of Information Technologies.

Finally, research includes also the study of movable artefacts, for example studies concerning the manufacture and the importation of Roman and Byzantine ceramics, or regarding particular finds such as the eulogies from the Thermal Building of St. Philip; lastly, archaeometric analyses were also conducted on the organic residue in the ceramics aimed at determining the original contents, and petrographic analyses on travertine and marble (performed by Laboratories of optical and electronic microscopy, and spectrophotometry IR-FT).

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