Von Neumann and Pliny

It would be a gross oversimplification to consider the fundamental relationship that exists between archaeology and computers without taking into account the fact that this relationship is based on profound reasons, wide-ranging affinities and attractions that involve the best part of the two worlds that confront one another, and not merely on the mechanical assumption of exterior contributions.

The history of the relationship begins in the 1960s and evolves through experimental initiatives and timid confrontations between an established science and a still mechanical instrument with artificial boundaries. That was the age of the introduction of mathematical and statistical techniques and the first data banks, but it was also a time of more extensive confrontation between the computer and the humanities.

The next decades witnessed radical changes in the technological horizon brought about by the numerous new generations of electronic systems and by the spread of the use of robots: the process continues, but undoubtedly this phenomenon has generated a qualitative leap that has led to unexpected and advanced innovations.

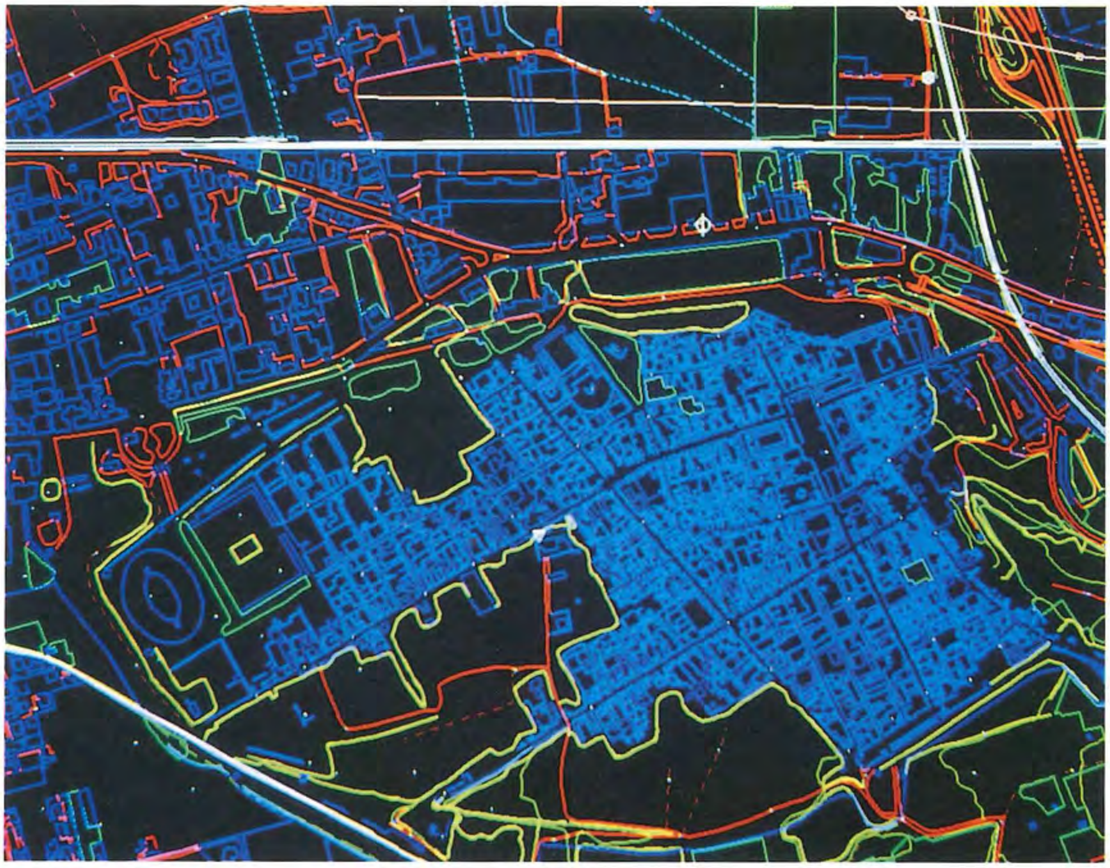
The technological horizon has changed, but more to the point, the horizon of thought processes has changed. Today we speak not of the relationship between archaeology and computers – an emotional, creative and innovative relationship – but between archaeology and information science, a methodological and systematic interdisciplinary relationship that draws vital energy from information and the comprehension of information. The information science that replaces the computer in this dialogue with the researcher proposed a well-thought-out range of methodologies, from mathematical models to territorial information systems which act as multipliers of knowledge; a significant exchange of experiences between different disciplines, innovations that anticipate privileged results.

Able to contain, arrange and transform a variety of cultural material, computer science is the vehicle best suited to our culture. Above all, it contributes toward a more comprehensive approach to knowledge and encourages the user to explore other disciplines and fields of learning.

Uncertainty and complexity are considered the only common elements of our pluralist and relativistic society. Instead of separation and confusion between archaeology and technology, one might imagine a metaphorical field and a range of options aimed at fueling a completely new creative activity. Computer science destroys the barriers that separate all dichotomies and leads toward knowledge – and the representation of knowledge – that celebrates new forms of communication and interaction, as well as the ubiquity and opening of new paths of the mind.

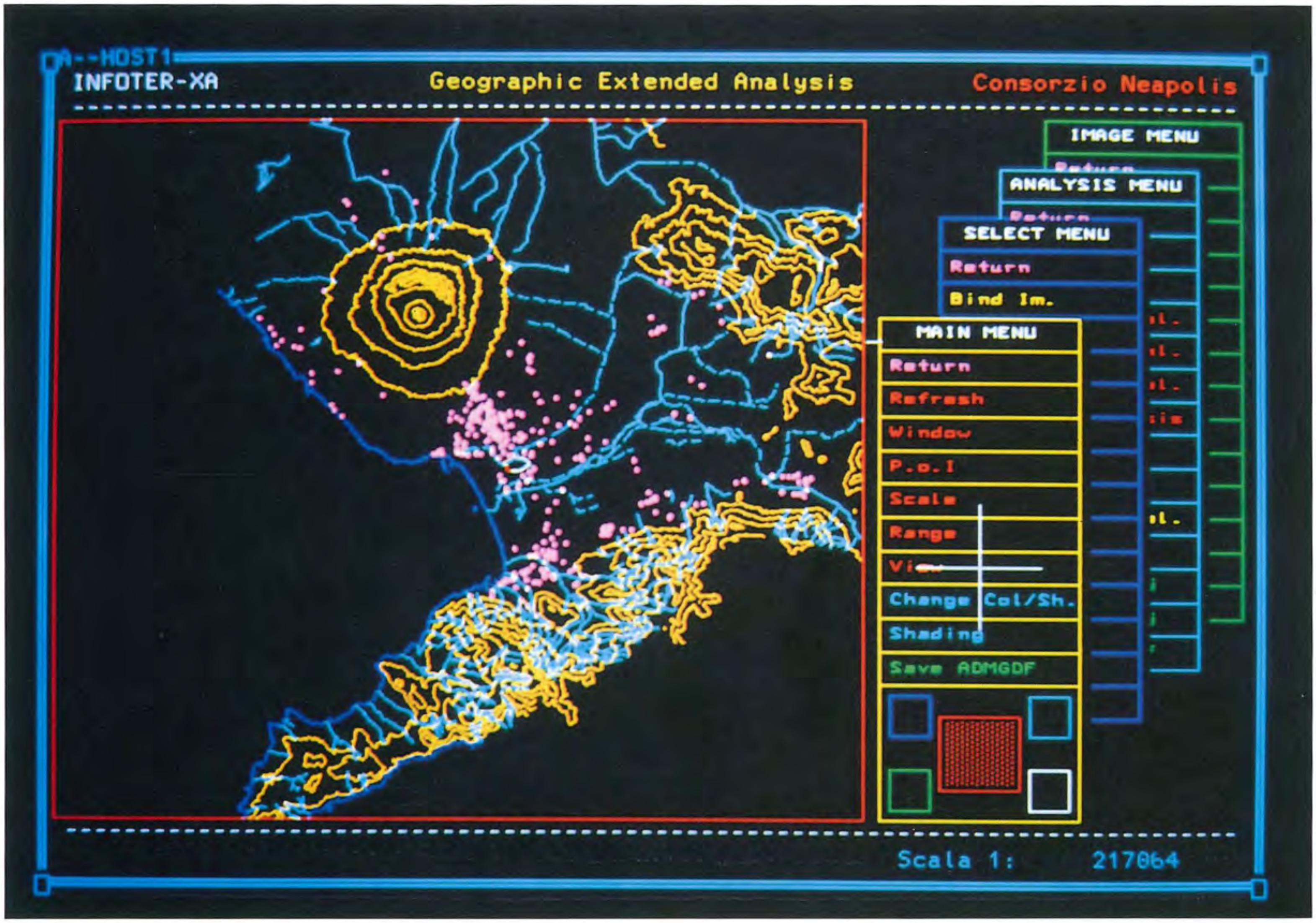
The flow of images, texts and charts, rich in different forms and complex contents, is not based on interest in technology alone, but leads to relationships which can exist only in electronic space.

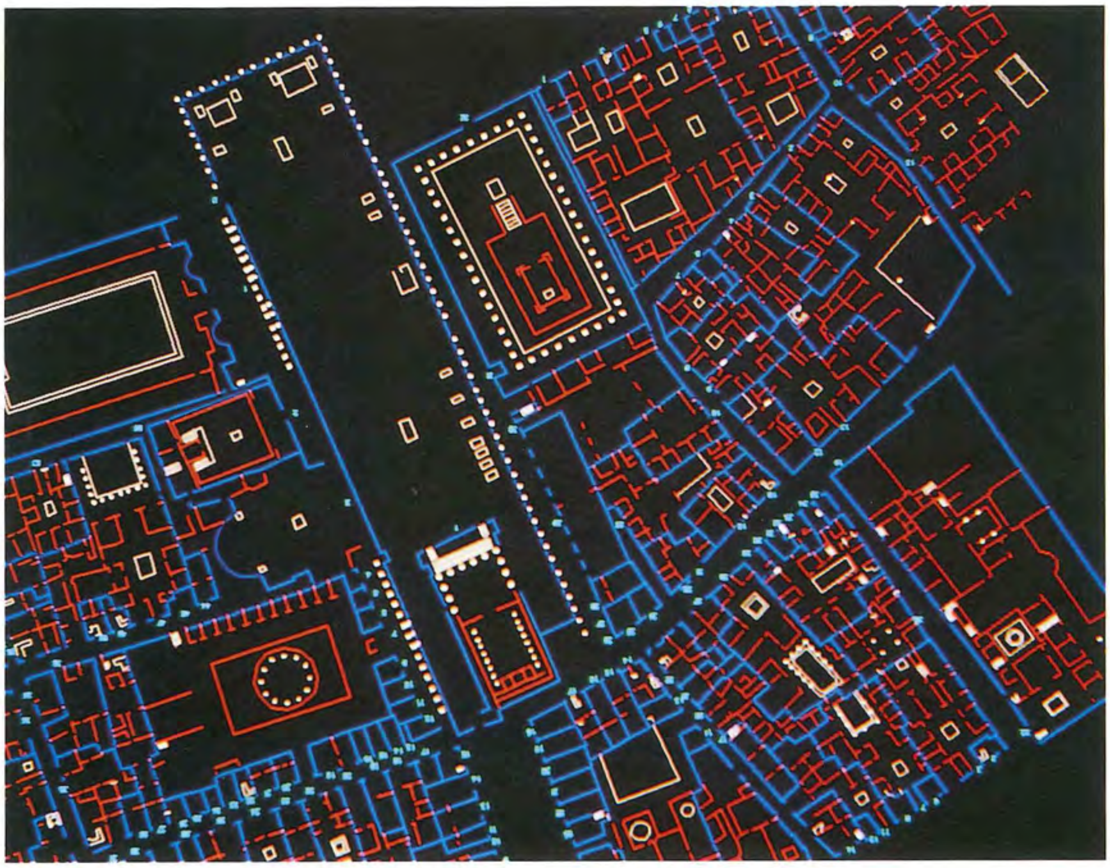
Furthermore, the definition of a topic as a process replaces that of a topic as the object of traditional mechanics. Instead of discovering a concrete object, we discover a process that defines it, by involving the observer and binding him to the object observed through the method



Cartografia numerica dell'area archeologica di Pompei.
Numerical mapping of the archaeological zone of Pompeii.

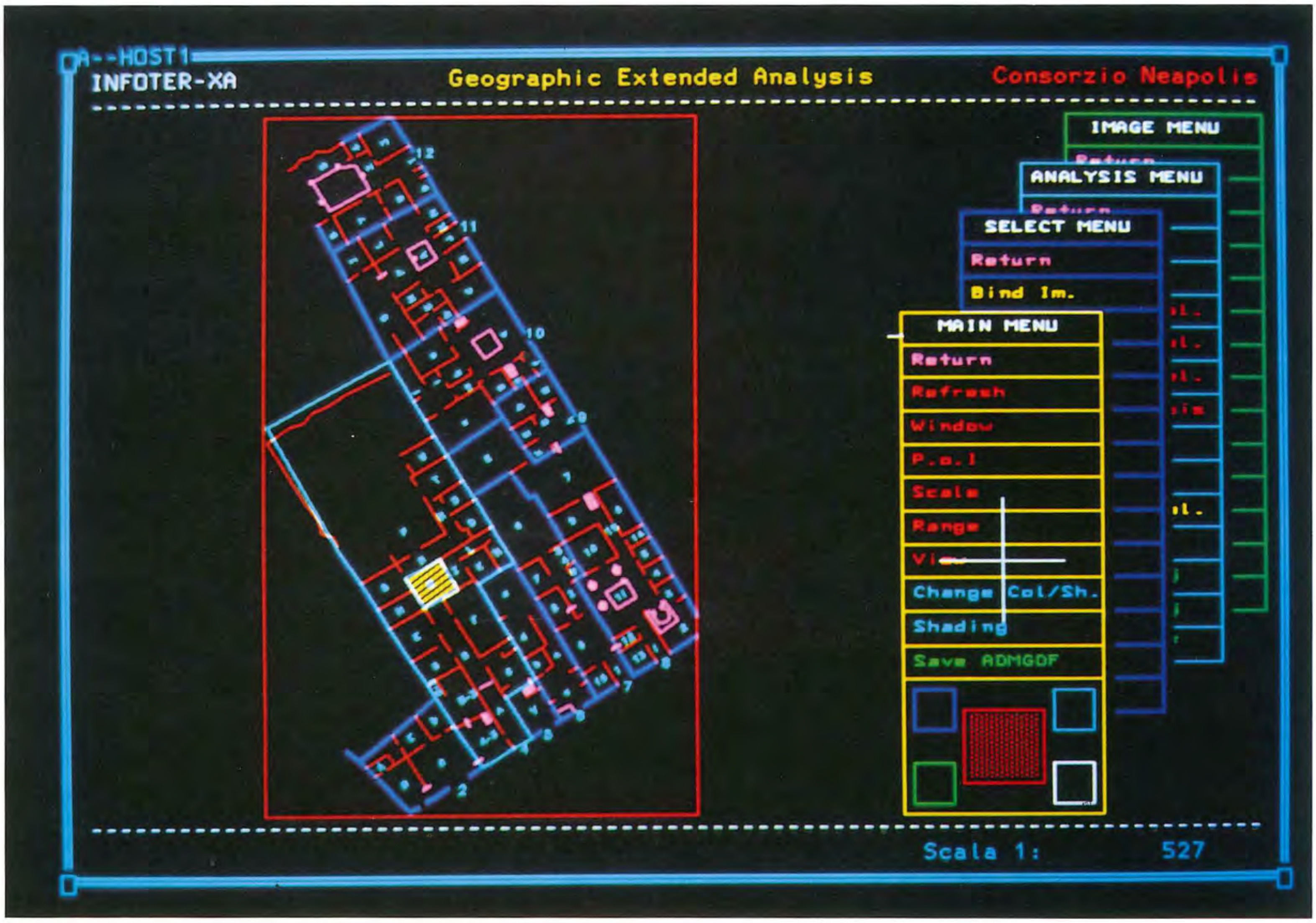
Elaborazione numerica delle emergenze archeologiche dell'area vesuviana.
Numerical processing of archaeological emergencies in the area around Vesuvius.





Elaborazione numerica della mappa archeologica del Foro di Pompei.
Numerical processing of the archaeological map of the Forum of Pompeii.

Mappa della casa del Centenario: sono evidenziati i riferimenti topografici per la catalogazione archeologica.
Map of the House of the Centenary: topographical references for archaeological cataloguing are high lighted.



of observation. This dynamic process replaces the idea of a separate object that remains foreign to us.

Computer logic somehow excludes external reality and places man face-to-face with his own mental processes, even if this electronic flow provides us with the priceless advantage of inmeasurable speed. In such a situation there is no mental picture – reality – to be transmitted, only a final image – or rather, the concretization of the final calculation. As this encounter between traditional culture and new technological instruments becomes all the more urgent and inevitable, the conclusion is almost foregone: it is an up-to-date system that fits our needs; every type of image it contains – at least in a literal sense – is transformable into this electronic language.

Problems concerning image, text, surface, structure or context are examined in the framework of the novel hypotheses on time, space and memory advanced by these new telematic instruments. Mergers, fusions and interactions of means of communication and learning coexist with new relationships of content, original material and ideas.

The "knowledge machine" thus created will consist in this new way of considering culture. The network of interacting centers that spring from the various fields of knowledge into which our culture is still divided will be similar to an enormous geodesic dome in which each center is linked to many others. Between centers of equal caliber the structure will be horizontal – independent interdependence (catalogue system, hypertext, numeric cartography). Horizons will widen; information for the individual will involve the latter in a more active role; synthetic images will create completely new objects. The resulting system will be characterized by a series of multiple realities, which will add new dimensions to each individual cognitive reality.

The journey into the past will consist in finding oneself before an object that comes from the past and appears to be a symbol of a knowledge that must be reorganized.

THE PROJECT

Begun in March 1987, in the framework of the Ministerial Program financed by Law n. 41, dated February 28, 1986, the Neapolis Consortium was jointly founded by FIAT Engineering and IBM Italy, aimed at enhancing the environmental and artistic heritage of the Vesuvius area. The computer component of this enterprise is contained in an articulated project for a sophisticated information system regarding the region's historical and environmental heritage.

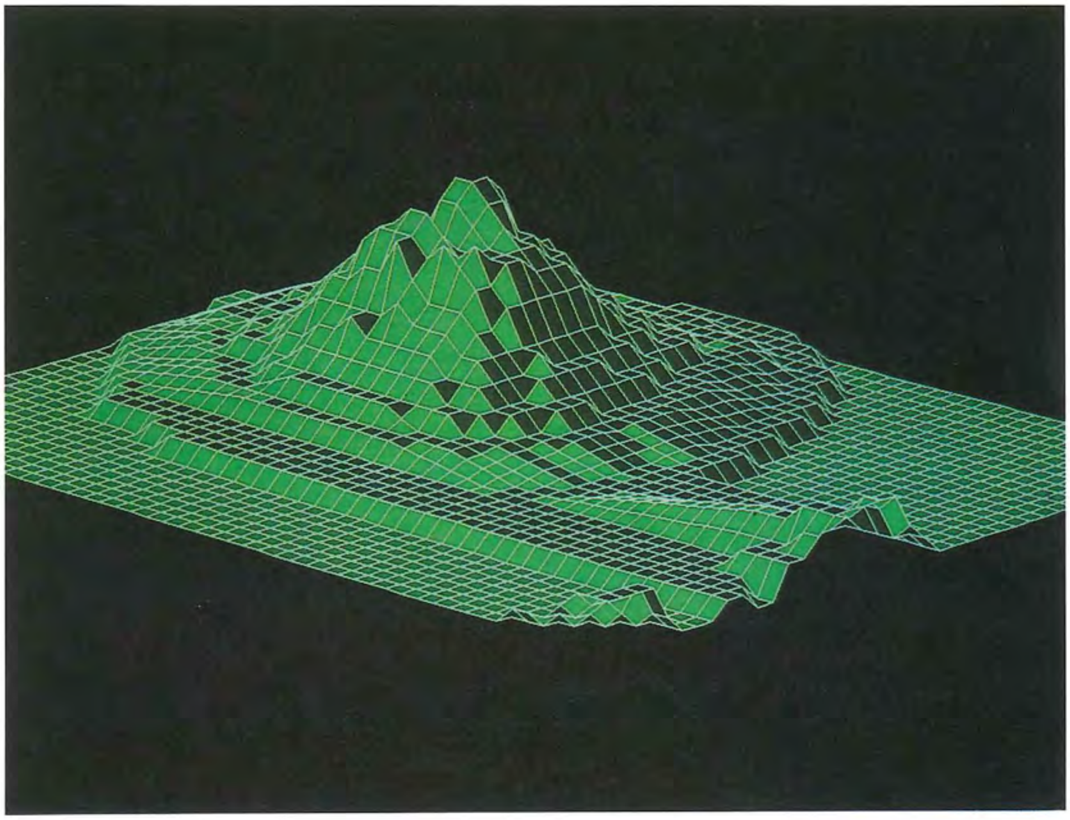
The need for a sufficiently accurate description of reality, the awareness of the difficulties inherent in appraising the conditions of this area, the complexity of the traces left by mankin and the multiple geographical and historical aspects of the territory are all elements that inspired the genesis and analysis of this project: but, if the essence of the system is to be identified by one single principle, then it would be "knowledge". Knowledge to understand an articulated and complex yet coherent and exceptional phenomenology; knowledge to intervene and promote effective conservation programs and, above all, new knowledge that springs from the combined action of several evolutionary dynamics.

The paradigm "of the knowledge of wide-ranging cultural assets as the creative basis for the conservation and exploitation of the works themselves" illustrates the methodologies of «knowledge representation» within the context of the project: methodologies which must be applied to the entire cognitive process, during both the identification and documentation stages and the later stages of analysis.

If, on the one hand, it is true that for certain disciplines the memory method is well established (files, catalogues, etc.), what are the rules governing the analysis of this information? Which critical strategy is chosen when the multiplicity of the phenomena is compared with the scale of the area? And again, what are the rules of research in a multidisciplinary domain capable of reestablishing the general and synthetic perception of reality?

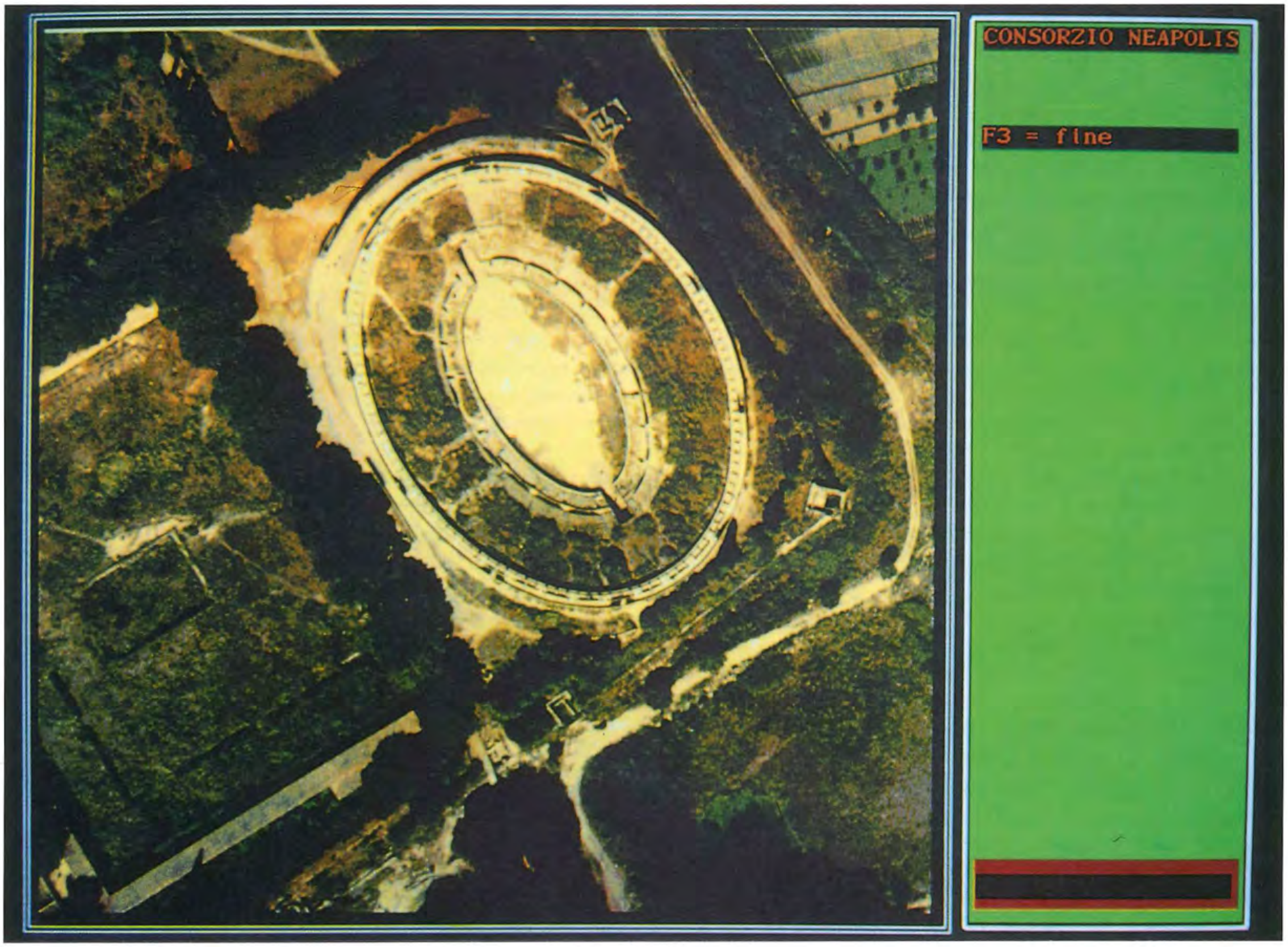
These are the topics that guided the engineering of the project's information system, providing a methodological and instrumental solidity to the matrix which grouped each disciplinary aspect.

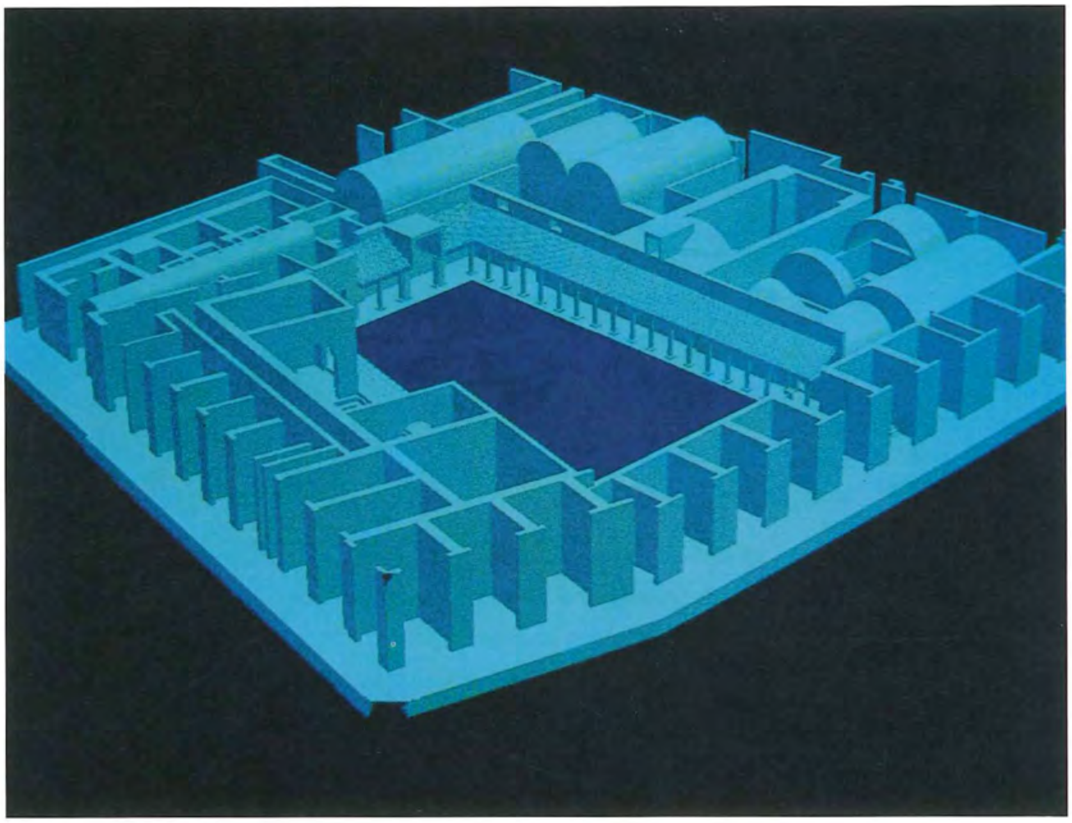
As far as the implementation of the project was concerned, the information on the cultural heritage of Pompeii was taken as the starting point for a detailed analysis that included the scientific cataloguing of frescoes and mosaics, the reconstruction of the excavation context and the retrieval of existing historical documentation – journals of the excavations and icono-



Modello tridimensionale del cono del Vesuvio.
Three-dimensional model of the cone of Vesuvius.

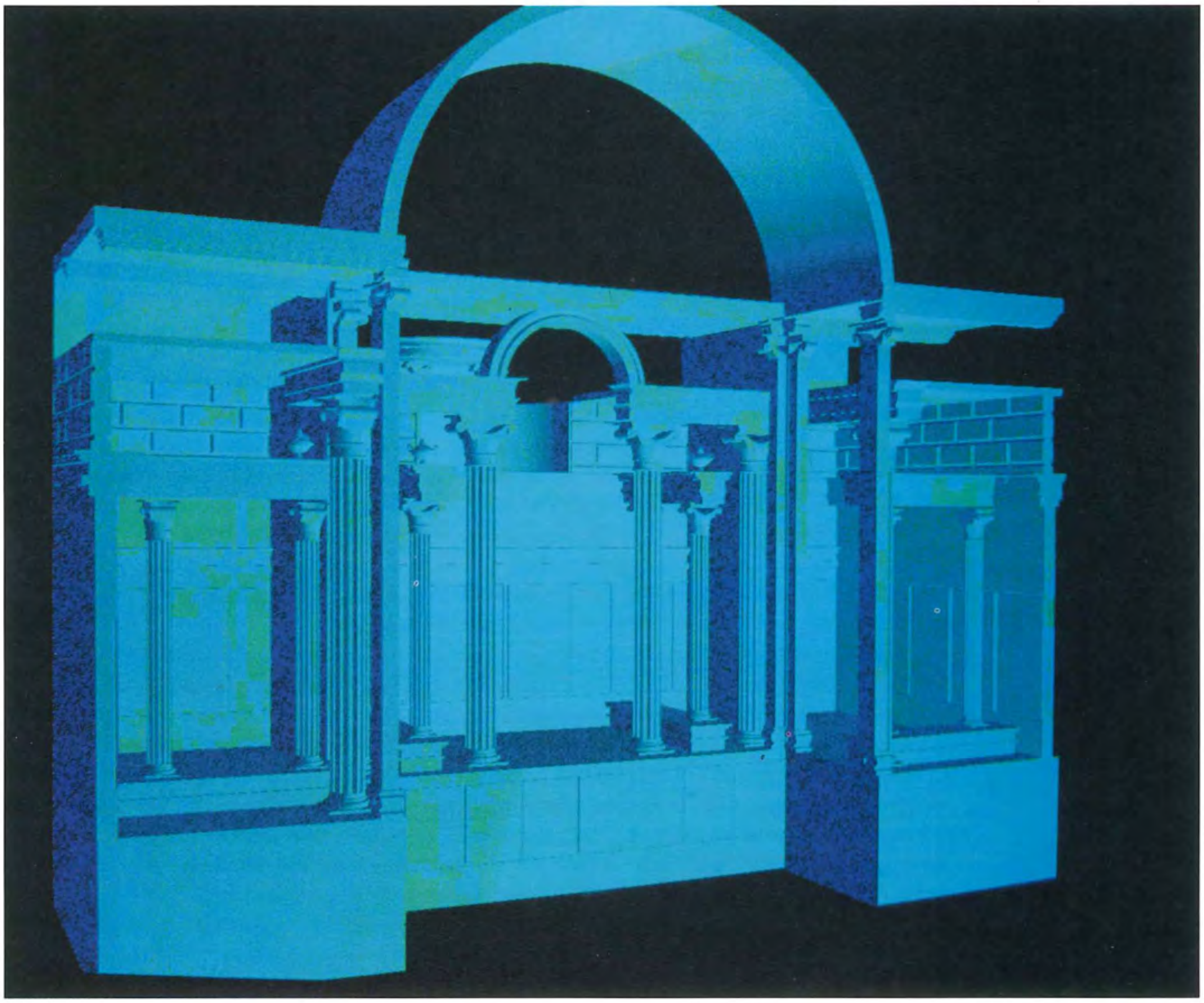
Elaborazione digitale della fotogrammetria aerea dell'Anfiteatro di Pompei.
Digital processing of aerial photogrammetry of the Amphitheater of Pompeii.





Modello tridimensionale del complesso delle Terme Stabiane a Pompei.
Three-dimensional model of the Stabian Baths, Pompeii.

Rappresentazione tridimensionale di un affresco di soggetto architettonico della Villa dei Misteri di Pompeii.
Three-dimensional simulation of a fresco with an architectonic subject, Villa of the Mysteries, Pompeii.



graphic sources – and the assessment of archaeological finds in the Vesuvius area, including the Sarno valley.

At this point it is worthwhile illustrating the objectives of the information system, stressing its global approach and the study of the various subsystems which ensure both its gradual execution and the subsequent integration of components produced separately.

The creation of a single, centralized data bank based on precise theoretical requirements:

a) Knowledge of the environmental and cultural heritage of the Vesuvius area – its territorial, cultural, economic and natural aspects – in relation to the architectural and archaeological discoveries.

This knowledge consisted in complete, comparative, extensive, in other words, "coherent," information – even if this is a vast and dissimilar domain – for example, all the texts, catalogue entries, cartographic information, images and tridimensional models.

b) A methodology with which to elaborate this knowledge, both in its disciplinary context as well as in the framework of possible new discoveries.

It may appear strange that computer science venture into a cognitive context by citing structures of knowledge.The facts are simpler and more pragmatic: the terms refer to objective information – codes, symbols, texts, generalized data and their semantics – and the relationships that arise from the innumerable "information-relationship" liaisons. And it is in this context that computer science, as an established yet emerging discipline, plays a role that exceeds the mere mechanical fact of storing information, and embodies the condition necessary for the fruition and construction of knowledge.

c) A rational model between the different disciplines which are at the root of knowledge, and which materialize the generalized matrix of the information acquired.

The creation of a reference system of this knowledge which permits logical disciplinary analysis as well as – if it is possible to use the term – to "inspire" novel, multidisciplinary associations. The user can rely on the necessary characteristics of information reliability as well as having access to a creative world of research. The computer screen becomes a window open onto texts, codes, archaeological and technical maps, images of documents, frescoes and iconographic sources.

What does it mean to use the computer in the cataloguing of a heritage? Certain answers are banal, such as the illustration of activities or the substitution or repetition of the infrastructures (I no longer use a typewriter but a word processor); but what is not at all trite are the new ways of managing a work group, following progress reports, or the support systems that verify the congruence of the information – think of the documentation contained in the information system and the automatisms used to carry out semantic and interdisciplinary controls. This is the most meaningful point, especially when speaking of "scientific" cataloguing, as it contributes toward the standardization of the operations used to describe the heritage; it is the necessary repetition of the experiment that reenforces the theoretical base.

"The human mind operates by association. Selection by association, rather than indexing, may yet be mechanized. One cannot hope . . . . to equal the speed and flexibility with which the mind follows an associative trail, but it should be possible to beat the mind decisively in regard to the permanence and clarity of the items resurrected from storage" (V. Bush, "As We May Think," *Atlantic Monthly*, 176 1, July 1945, p. 101).

The key to the code of access to knowledge is therefore a system in which the information lies in a network of points – the geodesic vault – linked by branches (a scattered matrix coherently represents this structure, in which, for example, a point hosts a cartographic subsystem, or the subystem of the archaeological finds entries: numerous connections run between the points and establish a logical relationship between the information of each discipline. The user can travel along these routes and in each point receive information pertaining to the activated discipline. Furthermore, he is operating in a virtual system that ergonomically integrates different objects and remembers, at any given moment, the logical route followed. This is a far cry from the technological oracle that provides predictable answers in jargon; on the contrary, a sophisticated an innovative information system that operates as a multiplier of knowledge.

Another aspect of the concept of "knowledge multiplier" occurs when the system is no longer a mere organizer of computer knowledge, but a methodological operator that provides not only information and suggestions but proposes precise actions and research by reproducing, on a larger scale, the modus operandi of a specialist in the field. This is the case of the subsystem developed as a guide to the restoration of frescoes; historical and scientific knowledge is drawn from automatic cataloguing subystems (entries for the archaeological finds and for the iconographic documentation of that period) and represents the roots of another subsystem that identifies the characteristics of the physical factors that depict the fresco – chemical, physical and graphic statistics, classifies it according to its mural structure, plaster and pictorial representation as well as identifying its mechanical, physical, chemical and biological damages. This whole body of information drives another subsystem which elaborates the conservation criteria and provides a diagnosis for the first restoration of the fresco.

The possibility of varying the quality of the information, from a very specific disciplinary detail to the synthetic vision of a thematic diagram, comes directly from the general design of this particular system. The educational subsystems are firmly grafted onto this main system, selecting the scientific information from a concise educational and informative structure. In this context, the results of tridimensional numeric modelings, designed for a detailed study of archaeological emergencies, become part of the publicity programs with their strong communication potential.

At this point, one asks to what extent is the above-mentioned system an archaeological information system. The immediate answer is very much in the affirmative and is confirmed not only by the emotional and enthusiastic impressions of novices but by the reactions of people who use it to work and study, because it is important that the system be designed according to effective needs, that it be capable of satisfying current requirements and evolve with the increase in demand. However, it is true that the benefits of this system are not limited to archaeology: the importance of understanding and managing a cultural and environmental heritage are clear to all.

Technical notes

The information system operates from a central, average power IBM 3090-150E computer which simultaneously activates the various computer subsystems for multiple users, guaranteeing the necessary calculation power for access to the information and its integration. The data bases – files, cartographic and geometric data, black-and-white and color images – are centrally memorized in a space of approximately 50 GB and managed with relational instruments – SQL/DS – and specific programs for the treatment of the text. Several intelligent subsystems are linked to the central computer: IBM PS/2 workstations which carry out certain elaboration stages separately – for example, the elaboration of images synchronized with the centralized system – as well as terminals, graphic subsystems specialized in scientific and technical cartographic environments and subsystems for the acquisition and treatment of images.

The information is recorded in over 12,000 scientific catalogue entries of Archaeological Finds, coded according to the standards of the Central Institute for Cataloguing and Documentation, as well as according to project standards. These entries contain 8,700 digitalized color images for the documentation of assets and the historical and iconographic series. There are more than 22,000 catalogue entries of the excavation activities from 1862 to the present day with the iconographic support of 7,000 digital images of pages of the excavation journals, as well as approximately 600 entries of the Archaeological and Territorial census and basic technical and numerical cartography, produced either from the digitalization of archaeological maps or from plottings; a 1:500 and 1:1,000 scale for the archaeological map of Pompeii, a 1:5,000 scale for the Vesuvius territory extended to the Sarno valley and a 1:25,000 scale for the Vesuvius area, the Sarno valley and Sorrento peninsula, as well as maps dealing with morphology, road networks, area leases, usage, etc.

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