QUANTITATIVE METHODS IN ITALIAN ARCHAEOLOGY:
A REVIEW

In memory of Amilcare Bietti

The use of quantitative graphs (chronological diagrams, block diagrams and cumulative diagrams) began, in Italian archaeology, between the end of Fifties and the beginnings of the Sixties.

An astonishing forerunner (Fig. 1) is an article written by Salvatore Puglisi in 1955 about the microliths found in the Early Neolithic levels of Coppa Nevigata, where he builds a correlation diagram between a number of microlithic points and shells of *Cardium* in each level, in order to test the hypothesis that the points were used to open the shells (Puglisi 1955).

A more systematic influence was exerted some years later by the two dominating schools of European Prehistory of that period: the German and the French one. In 1959 Renato Peroni published his monograph on Subappennine culture that contained the first seriation matrix (*tabella di associazione*) ever made by using a method elaborated by German archaeologists (Peroni 1959). In 1964 he was followed by his friend Carlo De Simone, who applied the matrix to the chronology of Messapian inscriptions (De Simone 1964).

Following the publication of a seminal article by Georges Laplace in 1957 on his own "method" (Laplace 1957), some Italian Palaeolithic scholars began to use the quantitative methods elaborated by the French school. Strangely enough, the first example of application of the cumulative diagram is contained in a study published by Franco Biancofiore (Fig. 2) on the excavations in the Apulian Bronze age site of La Croce, near Altamura (Biancofiore 1960). In the two soundings made in the site, each class of pottery is quantified with this method.

Biancofiore, who lived and worked most of his life in Apulia, in the second half of the Fifties was in Rome. Here he became close friend of Puglisi and member of the Italian Institute of Human Palaeontology, dominated by Palaeolithic scholars, two possible sources of influences for the use of quantitative methods.

In 1961, an "official" introduction of quantitative methods is the article published by Alberto Broglio, from Ferrara University, characterized by a brilliant and complete exposition of the two main methods of classification of the Palaeolithic industries: the typological lists by Bordes and, above all, the typomethrical indexes by Laplace (Broglio 1961), from then onwards the favourite one of many Italian scholars, as testified, the following year, by
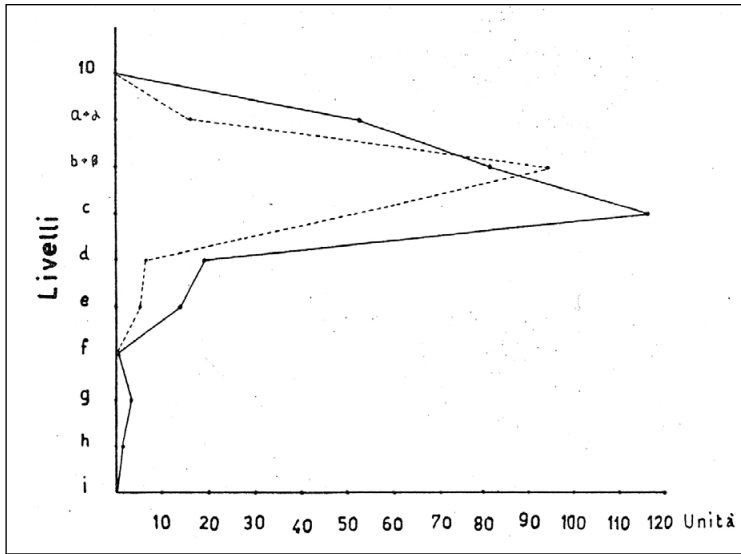
Fig. 1 – Coppa Nevigata. Correlation between *cardium* shells and microliths (PUGLISI 1955).
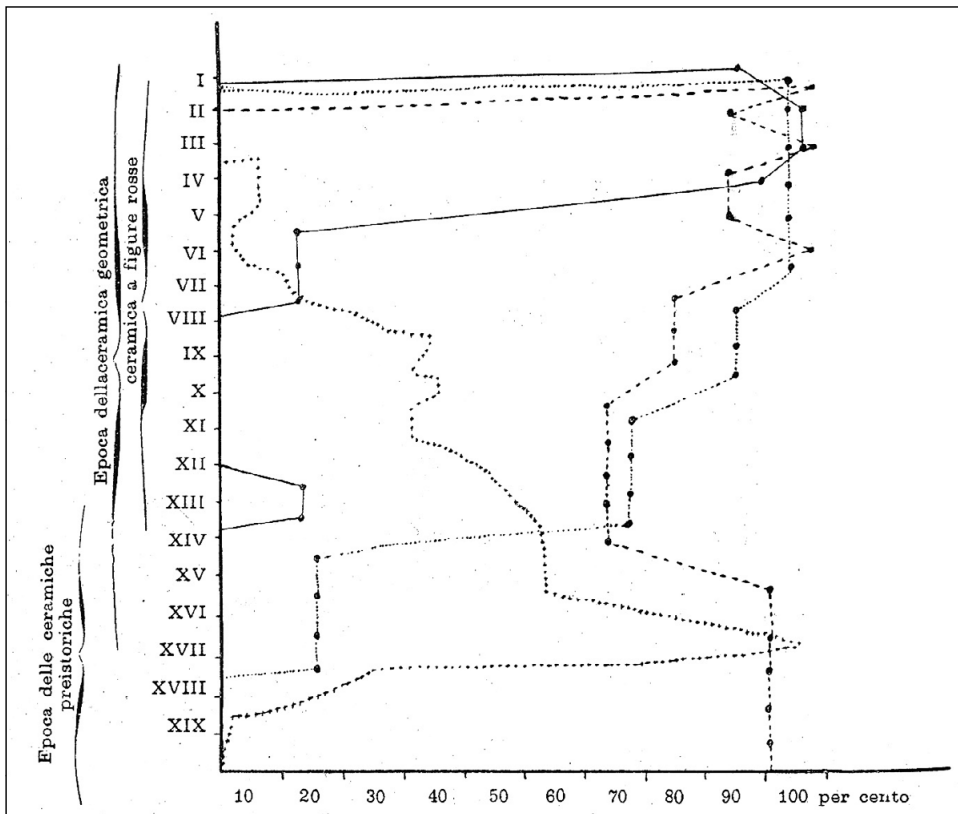

Fig. 2 – Quantitative graph of pottery from Altamura sounding A (BIANCOFIORE 1960).

a long article by Arturo Palma di Cesnola. It is interesting to quote here his introduction:

«L'eco risvegliata in Italia da questi nuovi metodi d'indagine si fa già sentire, specie tra le file dei più giovani studiosi, ed ha trovato un interprete appassionato nel Dott. A. Broglio, il quale ha chiaramente esemplificato i diversi criteri statistici usati in Francia in un suo recente lavoro. A questa nuova "mentalità" improntata al rigore ed alla esattezza della matematica, dalla quale non può andare disgiunto nell'indagine lo spirito moderno, sente di aderire con entusiasmo anche lo scrivente, seppure con le riserve che impone la novità del metodo e pur tenendo presenti i rischi cui l'uso indiscriminato e unilaterale di esso potrebbe portare» (Palma di Cesnola 1962, 2).

Another example of the "appeal" of quantitative methods can be found in an article by Giuliano Cremonesi (together with Dante Cannarella) in which the quantitative variations between the archaeozoological remains of differing economic activities is compared with the proportions of differing types of flint (Fig. 3; Cannarella, Cremonesi 1967).

In general, we can agree with the concluding remarks of an article by Massimo Tarantini:

«Questi giovani studiosi fanno parte di una nuova generazione, la prima ad essersi formata, da un punto di vista universitario, dopo la guerra, dopo il Fascismo; forse è anche la prima generazione ad essersi formata senza il riferimento di Benedetto Croce … non mi sembra così azzardato suggerire che l'attenzione per i criteri di descrizione e classificazione delle industrie litiche sia l'espressione di quella più ampia esigenza di introdurre una dimensione oggettiva nell'analisi e, in generale, di quella "seduzione" delle scienze propria di tutti gli anni '50 e trasversale ai vari orientamenti culturali e politici, dal cattolicesimo al marxismo» (Tarantini 2005, 35).

An increasing interest in computers, the gigantic mainframes that worked with punched cards, is present in some pioneer works of the Seventies.

A first, unknown example is the seriation matrix of the Halstatt necropolis performed by Renato Peroni in 1971. The book was dedicated to his brother Paolo, a mathematician who helped him to grasp with the complexity of this archaeological context (Peroni 1971). As a matter of fact, even though the seriation matrix of the Halstatt necropolis published in the book was "handmade", all the intermediate calculations were conducted through an algorithm based on the Lagrange multipliers method, with a program named CRONOS, using the FORTRAN language (Fig. 4)[1].

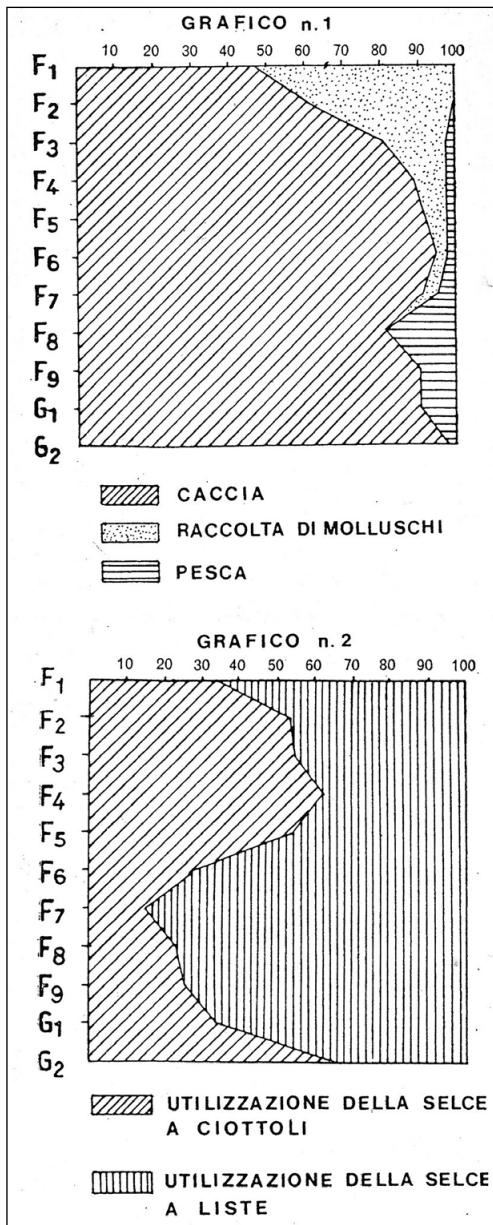[1] Thanks to the kindness of Paolo Peroni I could see some of the original calculations.

Fig. 3 – Quantitative graph of archaeozoological finds (graph 1) and of types of flint (graph 2) utilized in the levels of the Grotta Azzurra excavation (Triest Karst) (CANNARELLA, CREMONESI 1967).

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  M X X X X         *       X         *                 *                 *
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  Y                 *             X   * X   X       X   * X X     X X X   X * X   X
  W                 *       X             X   X   * X X     X X * X   X
  C                 *         X       X   X X X * X X   X X X X   *             X
  A                 *             X   X       X * X X X X X X X * X
  N                 * X             X     X X   X * X   X         X X X X X X X X
  4                 *             *                 X * X   X         X X X X X X X X X
  3                 *             *                 * X X X X * X X     X
  1                 *             *           X   * X * X     X X
  2                 *             *                 * X * X   X X X
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Fig. 4 – Computer-generated seriation (courtesy Paolo Peroni).

A more serious attempt to classify ceramic fragments using a descriptive code, on the model of the first attempts by Jean-Claude GARDIN (1967), was made in the early Seventies by Giampiero Guerreschi, a curious figure of amateur archaeologist (assistant of Professor Fusco who taught at Milan University). He was a chemist well acquainted with scientific methods and a close friend of an engineer, Gigi Pezzoli, who introduced him in the world of mainframes.

The first article by GUERRESCHI (1971-1972) is a theoretical paper on the descriptive code for the pre- and protohistoric pottery (Fig. 5), while the second one (GUERRESCHI 1976-1977) deals with the application of this approach to the study of thousands of sherds from the Neolithic dwelling site Isolino Virginia. This article is particularly appealing for the "appendix" by Pezzoli, where it is very interesting to note the presence, together with histo-
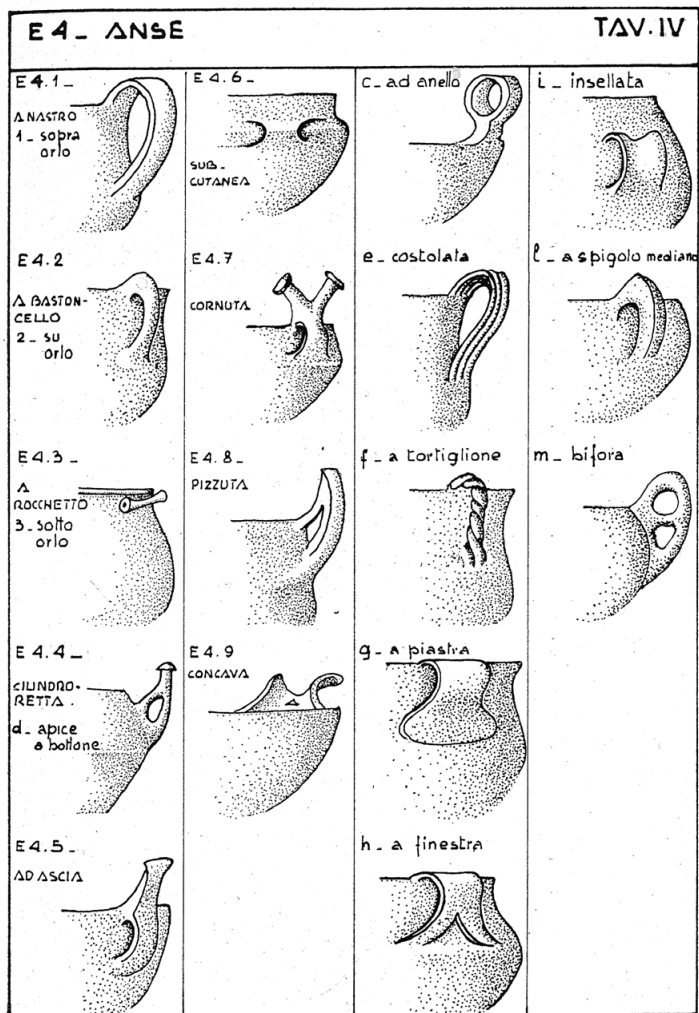
Fig. 5 – Example of protohistoric pottery descriptive code (Guerreschi 1971-1972).

grams "generated" by the mainframe, of a true processual model of the relationships between archaeology and computers (Fig. 6; Pezzoli 1976-1977).

In 1971, two additional papers were published that show an unprecedented interest in "non prehistoric" archaeology: one by Luana Poppi, showing percentages of diverse ceramic productions in Marzabotto archaic settlement, validated with a chi-squared test analysis (also in this case the
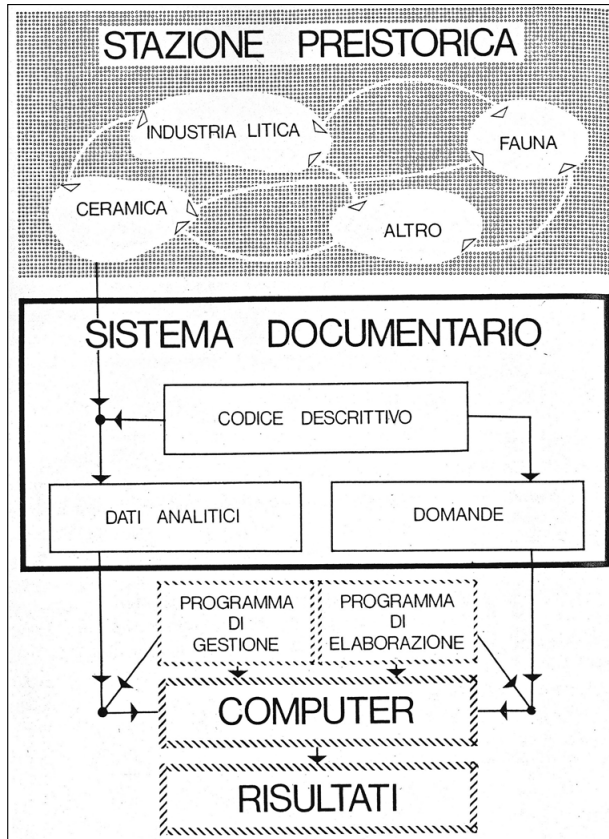
Fig. 6 – Model of interaction between archaeology and computers
(Pezzoli 1976-1977).

first example in the Italian literature: Poppi 1971), and a numismatic study
by Nicola Parise, showing histograms of Ugarit coins (Parise 1971). These
pioneer works were followed after few years by Carlo Tronchetti contribution
on the commercial networks of Etruscan cities, with block diagrams of the
Attic ware imports (Tronchetti 1973); by some works on quantification of
the production of different types of *amphorae* in Republican and Imperial
Rome (Panella 1973; Carandini, Settis 1979); and by the first example of
statistics applied to medieval objects, the bricks of a glass industry, studied
in 1975 by Tiziano Mannoni and published in «Archeologia Medievale»
(Fossati, Mannoni 1975); in the same number of the Journal appeared a
brief paper by an historian, Oscar Izcovitch, on archaeology and computers
(Izcovitch 1975).

Fig. 7 – Correlation matrix of Southern Italy Eneolithic sites (Cazzella 1972).

Among the new methods applied to archaeological data we must re-
member the correlation matrix (a first application in Robinson 1951), used
by Alberto Cazzella (1972) in a paper on the Eneolithic period in South
Italy and Sicily (Fig. 7) and the first "richness curve" (a first application in
Randsborg 1974) of the Shahr-i Sokhta necropolis (Fig. 8) published by
Maurizio Tosi team in 1977 (Tosi 1977).

The first and surely most brilliant scholar who dedicated most of his
activity to mathematical methods and computers applied to archaeology is,
from the mid-Seventies onwards, Amilcare Bietti.

Like Guerreschi, he came from the "hard" sciences, being – until the
mid-Seventies – a physicist. This is the only similarity between the two men:
Amilcare in few years was to become one of the most important scholars in
Palaeolithic studies, and a worldwide renowned expert in mathematics and
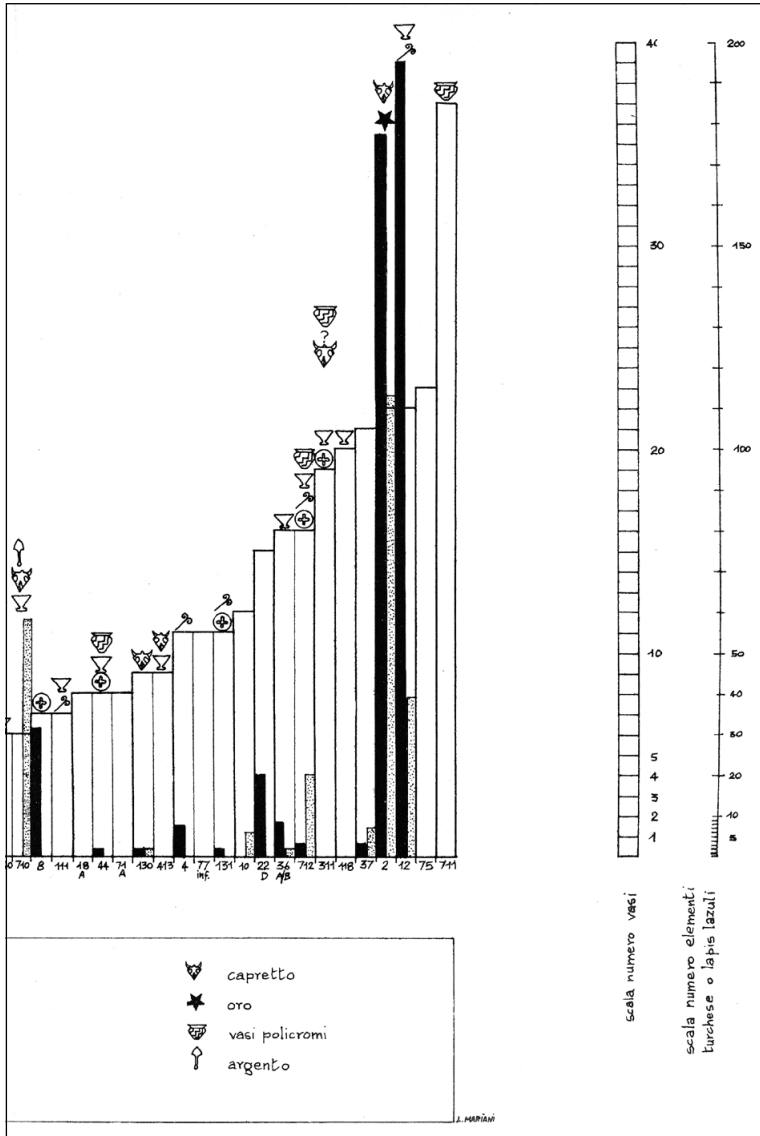statistics (for the first examples of cluster analysis, see Fig. 9) applied to ar-

Fig. 8 – Shahr-i Sokhta graveyard richness curve (Tosi 1977).

chaeology (he was also President of the Mathematical Data Commission of the IUPPS), beginning a brilliant academic career in 1980 (Bietti 1974-1975; Bietti, Cazzella 1976-1977; Bietti *et al.* 1978).
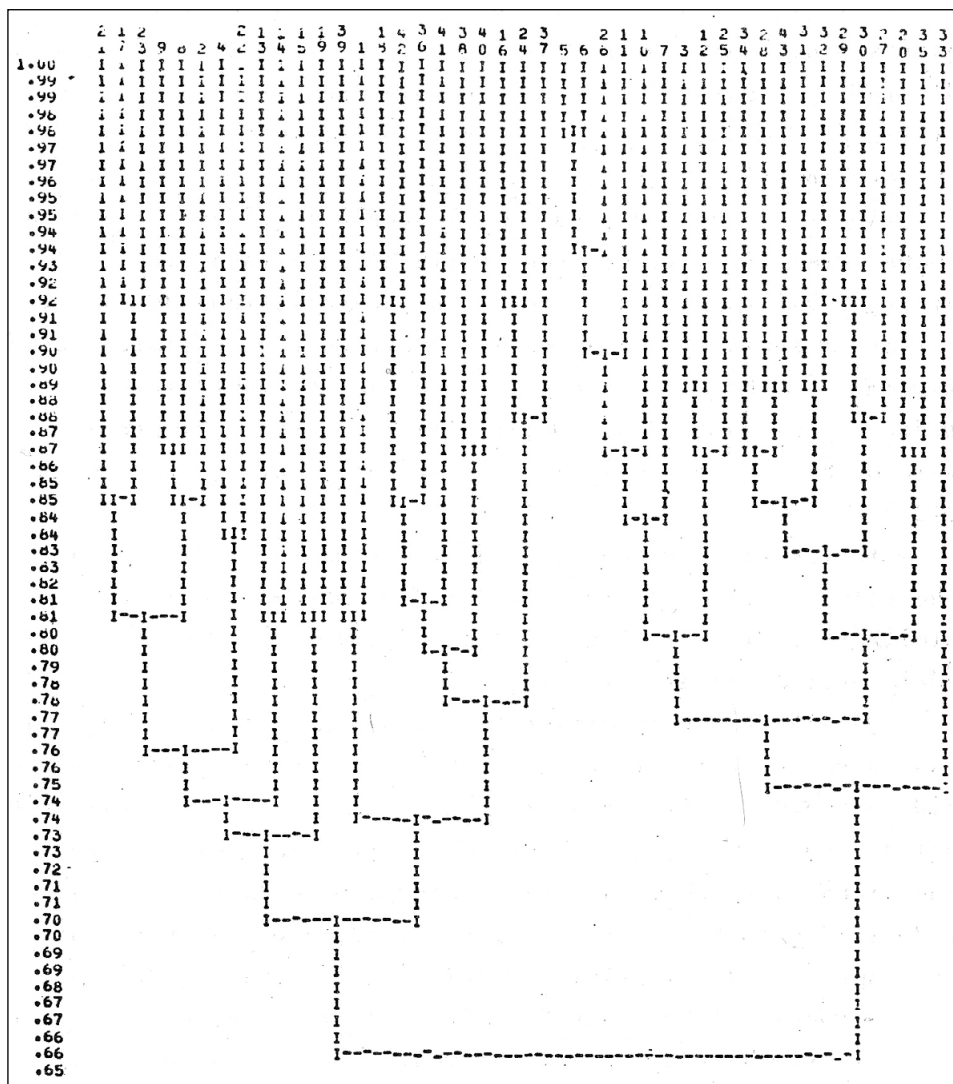
Fig. 9 – Italian Upper Palaeolithic sites cluster analysis (Bietti *et al.* 1978).

In my opinion, the most important contribution of Amilcare was in teaching and promoting the application of quantitative methods to Italian archaeology.

After a first conference held in 1978, in 1980 Amilcare gave three lectures at the Accademia dei Lincei which were published in the same year in a green booklet that is still today an unrivalled handbook in this field (Bietti

1980). In the following years and until his premature death, in 2006, he led many courses on Mathematical and Statistical Methods applied to Archaeology and on Archaeometry.

In the Eighties, Italian archaeology lived a sort of processual "hangover", specially between 1982 and 1988, although it is possible to recognize some "forerunner" articles, like a paper by Lucia Sarti published in 1980, a first example of the nearest neighbour analysis used to test the reliability of the distribution of sherds collected in the Bronze Age site of Dicomano (SARTI 1980) or the review article by Paul Arthur and Andreina Ricci on the systems of pottery sherds quantification (ARTHUR, RICCI 1981). At the same time, we must remember the first conferences on computer and archaeology held in Lecce, Roma and Siena.

In the wide literature of the period, I can only remember some main trends (for the bibliographical references see GUIDI 1994, 1996):

– computer-generated diagram on the locational analysis of Bronze Age north-eastern settlements, produced by Leonardi, De Guio, Balista and Ruta Serafini;
– some of the following works by Armando De Guio, probably the most innovative Italian scholar in the field of theoretical modelling;
– the first simulation model on pre- and protohistorical population of coastal Latium (the present Author together with Angle, Gianni and Zarattini);
– the cluster analysis, "richness curves" and block diagrams of the Iron Age Latial necropolis of Caracupa, performed by Micaela Angle and Adolfo Gianni or of the Iron Age graves of Torre Galli, in Calabria, performed by Marco Pacciarelli.

In 1987 the monograph *Archeologia e Calcolatori*, by Paola Moscati, was published (MOSCATI 1987); three years later the first number of the homonymous Journal was edited by Moscati, involving many of the main foreign scholars, like Djindjian and Orton, and creating the most important "forum" on the matter.

From that period onwards, the use of quantitative methods became a sort of routine in the daily archaeological practice in our country, even though, unfortunately, only few of the researchers involved in this history were given an academic position and no chairs of "quantitative archaeology" were created in Italian universities.

To conclude, I shall not deal with the last developments in the discipline, but I would like to underlie the history of GIS applications in Italian archaeology.

Even if between 1995 and 1997 we find the first applications in different periods and regions (Magna Grecia, Tuscany and North-Eastern Italy), the forerunners were especially active in the field of Ancient Topography. As a mat-
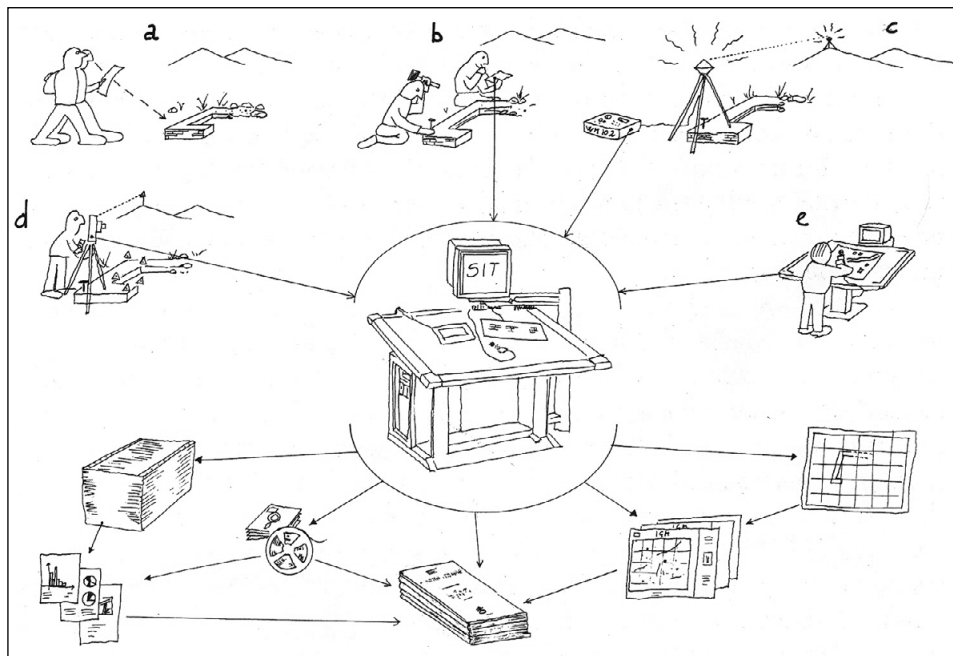
Fig. 10 – Model of a GIS (in Italian language SIT = Sistema Informativo Territoriale) applied to archaeology (Azzena 1997).

ter of fact, from the late Eighties Paolo Sommella worked on the digitization of *Forma Italiae* maps. We owe to Giovanni Azzena (Fig. 10) the first articles on the subject with a sort of popularization of GIS (in the Italian version SIT or Sistemi Informatici Territoriali) architecture (Sommella, Azzena, Tascio 1990; Azzena 1992, 1997)[2].

Finally, we must remember that the first GIS application to an archaeological excavation, the Montale terramara, was performed more than ten years ago (Candelato *et al.* 2002): a clear example of the high level reached by Italian archaeology also in this field.

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[2] For a first instructive review of GIS applications in Italian archaeology see the volume 9 of the journal «Archeologia e Calcolatori» (Moscati 1998).

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ABSTRACT

The use of quantitative graphs began, in Italian archaeology, between the end of the Fifties and the beginnings of the Sixties in the last century, thanks to the work of Renato Peroni (Bronze and Iron Age) and Alberto Broglio (Palaeolithic). In 1976-1977 Amilcare Bietti and Alberto Cazzella published the first important article on the subject in the journal «Dialoghi di Archeologia». The Eighties began with Amilcare Bietti publication of the first monograph on the use of mathematical and statistical methods in archaeology, that were to become very popular in many works inspired by processual archaeology. In 1987 the monograph *Archeologia e Calcolatori*, by Paola Moscati, was published; three years later the first issue of the homonymous Journal was edited. The last "chapter" of this history is the introduction of new methods (functional analysis of objects and GIS) between the end of the Nineties and the beginnings of Twenty-first century. From that period onwards, the use of quantitative methods became daily routine practice in archaeology in our country.