Numismatics and Computers

In an age such as ours, when technology rules supreme, the computer has become a symbol of efficiency and up-to-date awareness even to those who, by tradition, mentality and style of management, are still far from the managerial and scientific vanguard of which the computer is both expression and instrument.

At least in Italy, cultural assets belong to this category. However, although many proclaim the need to adopt advanced technologies as a speedy solution of problems relating to conservation, management and research, others still voice strong doubts and opposition to their widespread and standard use.

The reasons for this lukewarm response are numerous and not all negative. Certainly at the heart of the matter, political bodies and the scientific and administrative agencies charged with the management of cultural assets instinctively defend their established methods and infrastructures, even notoriously inefficient ones, against these new objectives or to modify the mentality and professional training of the directors of certain services, as well as the infrastructures, personnel, qualifications, recruitment and training of the staff, not to mention the purchase, maintenance and modernization of the necessary equipment. However, these manager-beneficiaries are diffident, at times not unjustly, toward technologies that, coming from fields which require speed and complex calculations, seem less useful in humanistic fields of study, in which the scarcity, vagueness and unreliability of the data do not permit mathematical calculations guaranteeing clearly defined and consistently reliable results.

This situation is all the more pronounced in the world of antiquities, where documentation is generally fragmentary and is often interpreted in so many controversial ways that the use of a computer seems ineffective to say the least. For this reason, it is more than necessary to define clearly the objectives, nature and characteristics of the material to be examined as well as the possibilities and limits of the research tools available, to avoid premature enthusiasm as well as preconceived rejection.

As an example of the real problems of circumscribed yet operationally verifiable situations, we will examine only the numismatic sector here, with special attention to current activities in Pompeii.

Coins could be an important testing ground for the practical use of the computer, as the large amount of material available warrants the use of technologies whose raison d'être lies in the need to elaborate a large number and substantial variety of data.

It is on this point – number and variety of data – that the first specific considerations should be made.

It is well known – though not often thought about – that numerous are the ways and circumstances in which the many kinds of objects that make up the material documentation of antiquities have reached us: the literary texts, for example (except papyri, which were preserved only in exceptional conditions, mainly in Egypt or, in Italy, at Herculaneum), have been handed down to us thanks to the labors of the amanuenses of medieval monasteries. The preservation of these texts is, in fact, the result of choices dictated by various interests that favored some and excluded others, for reasons often easy to comprehend. Instead, ceramics and other objects of personal use (jewelry, necklaces, arms, utensils, etc.) came mainly from tombs

Giorgio Sommer, «Panorama di Pompei», 1870 ca.
Stampa all'albumina da lastra al collodio umido.
Albumen print from a collodion glass negative.
mm 180 x 240. Firenze, Museo di Storia della Fotografia Fratelli Alinari.

and are linked to funeral rites and customs; terracotta figurines were found in large numbers in the votive depositories of temples or sanctuaries as well as in tombs, and are therefore related to religious or sacred rites. Only in the case of cities destroyed and no longer inhabited – a typical case is Pompeii and the other cities buried after the eruption of Vesuvius in A.D. 79 – is it possible to find objects, possibly including coins, virtually as they were when they ceased to be used. But these are not the contexts from which most coins reach us. Nearly all the coins in public or private collections (and the latter are usually private collections that have ended up in museums or other public institutions) come, instead, from hiding-places, that is, various forms of concealment (such as sanctuary treasures, military coffers, private hoards) that different, but always dramatic, circumstances (wars, invasions, revolutions) have prevented the owners or possessors from recovering, thereby ensuring their preservation down to the present day.

The frequency of these tragic events over the ages and in various countries explains the number, quantity and wealth of the monetary hiding-places discovered up to now (and many continue to be found today). This is easily understandable as these forms of hoarding were used in order to avoid the dangers of theft, robbery and pillage, and the coins so kept are generally of considerable intrinsic value – mostly in precious metals (gold, silver) and of large denominations – while small-denomination coins in base metal (bronze, copper, etc.) are almost never found in this way. However, the coins of our collections do not come only from these hiding-places.

Many coins are found during normal excavations or, less frequently, scattered on the ground in archaeological sites. These coins are normally those of lesser importance, made of base metal and of little value, mislaid without regret or thrown away when out of circulation. These are not precious or spectacular coins, since their state of preservation is poor and their intrinsic value low; they are not the most sought after by collectors, quoted at public auctions or in sales catalogues. Their interest and importance lies in the location, context and circumstance of their retrieval.

Clearly, for both the precious coins hoarded in hiding-places as well as the humble coins discovered by chance or during excavations, it is the circumstances and context of the discovery that gives a coin a historical and documentary value that often exceeds the intrinsic value of the "piece" considered separately.

Unfortunately, appreciation of this extra value is a recent achievement in the field of historical, archaeological and numismatic studies. Until the last century – and in many cases still today in the world of antique dealers and private collectors – coins were bought, collected and, in the case of public collections, catalogued and exhibited exclusively for their value as single specimens, the data concerning their origin and context being neglected and then forgotten, even when these data were well known or researched. In fact, the most important public collections were created in order to reconstruct and exemplify the structure and productive development of the various mints, and this is the criterion generally adopted by the numismatic collections of museums, as well as by public and private collections all over the world.

All the following data are essential and must be kept: the structure and diachronic organization of each mint; the chronological parallelism of issues in different areas; the provenience, circumstances of discovery of all coins either as individuals or groups.

The difficulties of acquiring all the information necessary to meet these and the other requirements, without favoring or neglecting any one in particular, and the need to arrange and articulate these requirements according to the approaches and incentives of research in a field such as numismatics, in which the material to be studied is still extremely scattered and not easily accessible, makes the use of a computer extremely useful and effective.

This is where the real problems begin: problems concerning the comparability or compatibility of language, of relationships, of the accessibility and confidentiality of the information.

This is not the first time problems have been discussed; on various occasions, meetings have been held and methods or forms of comparability, or at least of coordination, of criteria and initiatives in this sector have been attempted or predicted.

In Italy, an important international meeting was held in Milan in 1984. Organized by the city under the supervision of the civil numismatic and archaeological collections, it was sponsored by the Lombardy Region and the Ministry of Cultural Assets which saw to the speedy publication of the *Atti* in the *Bollettino di Numismatica*, supplement to no.1 (1984).

What computers have to offer is improved and faster memorization and calculation, i.e., data processing; it is evident that they can be used in cataloguing and research.

Naturally the two functions are interrelated as all research must begin with the acquisition of data provided by catalogues. However, a utopian dream – but one contained in many and various catalogue models – remains that of being able to create, as early as the cataloguing stage, a data bank that would be universally exploitable for the specific research of interested scholars.

In fact, all data that are not mere "inventory" indications of the basic identifying characteristics of an object are the expression of interpretation on the part of the cataloguer and therefore, to a certain extent, subjective and requiring verification. Furthermore, as the data are the expression of an interpretive and therefore intellectual process, they should be protected and safeguarded just like any other "creative work" and appraised in a scientific and administrative context.

To give an example from ancient numismatics, the simple identification of a type, such as "head of Athena" instead of "helmeted female head," or the indication of a date (when not acceptable with absolute certainty) is so vague as to be useless in large-scale elaborations.

If this information is to be immediately and freely usable, without confirmation or examination, afterthoughts or influence, it must be kept to a minimum; in other words, only the identifying characteristics of the coin: type, legend, weight, die position, mint and issuing authority, provenience and nature of context. Also needed are the inventory and catalogue number and its position in the collection (this last could, however, remain unpublished for security reasons).

A model of this type of cataloguing could be the *Sylloge Nummorum Graecorum*, long ago adopted internationally and now almost traditional in this successful series of catalogues used all over the world.

But for the system to be effective, the descriptive data, or to use computer language, the alphanumerical data, must be supported by an image bank.

Until a short while ago, the difficulty lay in trying to obtain, easily and at a reasonable price, good usable pictures of the coins described. This severely hampered the use of computers for both scientific and administrative cataloguing.

Recently however, in the specific field of numismatics, a reasonably priced system using 800 K optical disks as supports for image storing has been successfully adopted. In addition to a central processing unit, the "brain" of the computer, this system includes a disk management unit, a printer to reproduce the chosen image on cards, and a monitor. The resulting image has the added advantage of allowing screen manipulation and partial enlargements, transposition from positive to negative and last, by using "pictorial" software, the superimposition of sections of different images in order to verify correspondence; this last is particulary useful in numismatic research (up to now it was achieved by adapting a "comparative macroscope" originally intented for forensic ballistic tests), in order to establish the identity of coinages and determine the relative chronology of each one through the verified succession of chains or "sequences" of issues.

This shows how the cataloguing of data and images with a computer many be used in sophisticated and complex research, even with basic, "objective" information; it also satisfies internal accounting, conservation and administrative requirements.

However, in order for this information, albeit simple, to cross the "internal" administrative circuit and become common knowledge, universally employed in scientific research (or, if one so chooses, for exploitation and utilization at various levels), data banks conceived with similar criteria of homogeneity or at least functional compatibility are needed. This is the most difficult goal. In order to dispose of the information acquired, a rigid discipline must be imposed; the information must be managed according to the requirements of the technical equipment used. For this reason, international coordination is needed for both the catalogue-entry model, and the language, compilation methods of individual headings and identification of various fields if coherent, comparative and complete answers are later to be obtained from the information gathered and memorized from many sources.

Once this mentality has been established and similar types of data banks set up, the exchange and common use of this information through a computer, i.e., the transmission of data over a distance, will be possible. The most coveted goals and most desirable results will be: acquisition of data located in far-away places; comparisons; verifying theories, almost instantly; avoiding long delays, difficulties and the squandering of energy and resources.

The formation of comparable data banks (even if limited only to the identifying characteristics of coins) and the free circulation of information do, however, represent only the preliminary base of every kind of research. The procedures necessary to gear the computer to fully fledged study programs are much more complex. In this field, the possibility of using data already elaborated separately in the various conservation and cataloguing centers appears very limited, if not outright impossible. Instead, each researcher or research group should elaborate a specific and well-prepared program with the aid of a computer expert. Having identified and determined, with the help of the computer network, the material necessary for the proposed study, a systematic, precise and well-designed data cataloguing and storage should then be initiated. With the assistance of the computer, these data will be elaborated according to the guidelines and objectives indicated by the specific program. As this is an established field of research, it should be suitably protected and safeguarded.

It might be useful to remember that, adequately arranged, the results of this research, above all the tabulations, catalogues, images and graphics, could also be used in publications thereby avoiding at least some typographical work and related costs in time and money.

If we want to move from general considerations and theoretical approaches to the evaluation of tangible achievements in the field of numismatics, we must realize that in research, the computer has been used satisfactorily in many ways, while in cataloguing, all over the world uniform criteria for the free circulation of information are still very far away. The attempts made up to now on various occasions – the 1984 meeting in Milan and its *Atti* – have served only to improve knowledge of the various models of catalogue entries, classification methods and criteria, programs and language. But not even within each country have common models and criteria been adopted.

One example: in Italy in 1986, an ambitious project called "cultural deposits", appropriately financed with government funds but entrusted to the management of a group of private companies, began the massive task of cataloguing monuments and documents of every kind in the vast and varied area of the public and private sectors of so-called cultural assets.

Among these were included coins from collections, excavations and sporadic finds. The results of this undertaking are not yet known, nor does anyone know when and if these data will be made public. It does not seem, however, that here, as elsewhere, uniform methods, criteria or programs are being applied. For this reason, it appears somewhat improbable that the information resulting from this study, often very detailed and elaborated with the aid of sophisticated technology, and elevated costs, may be integrated either with the information already acquired or with the information being gathered by the official organs of the state (superintendencies, ministries, etc.) which operate concurrently, even if in this case we are speaking only of cataloguing.

A concerted effort must be made, and it is hoped that the central bureau of the Ministry will finally promote this operation, at least in Italy, while waiting for the 1992 unification of Europe to lead to a broader and more efficient unity of methods and objectives. The opportunity to do this could be the law, now being debated in Parliament, that would allocate a large sum to the systematic and massive cataloguing of public, or publicly controlled, cultural assets.

In the meantime, it would be profitable to use methods already tested in more limited, but culturally similar, environments. A significant test in this field could be Pompeii.

One of the projects of the "cultural deposits" program has systematically catalogued the information contained in the excavation journals of Pompeii from 1960 to the present day by using the well-known and widely used database program d Base III. The volume of gathered and classified information on coins could be compared with the thousands of coins found at Pompeii and kept mainly in the Museo Archeologico Nazionale in Naples, in order to carry out, with the help of similar computer systems, a study aimed at reconstructing their provenience and contribute with definite, carefully researched and suitably elaborated data, to the most accurate reconstruction possible of the life and economic activities of Pompeii during the last years of its existence.

The equipment and infrastructures that the consortium working in Pompeii has brought to the task and the professionalism it has created by training a group of young scholars to use modern technologies in historical and archaeological research guarantee the success of the enterprise.

The computer may be used in yet another way, not less important for being mentioned last. This time, its users are not the administrators and guardians of this heritage, researchers or scholars, but a larger and more varied public: school children, enthusiasts and amateurs who approach the world of the past with curiosity and interest, people who deserve to be correctly informed.

The computer is particularly suited to this function as it permits active utilization with versatile programs aimed at various groups of users, and systems of direct interrogation through touch-screen videos or other, not strictly standardized, forms and methods of utilization.

The various sections of the image archives may be used for the same purpose in exhibitions and appropriately supplemented by descriptive and interpretive data and possible elaborations. This too may be implemented by using suitable simulation and layout programs, thereby saving time and money.

However, perhaps the most useful aspect of the computer in traditionally humanistic disciplines is that of imposing a certain methodology, precision of language and careful scrutiny of all the stages of the research program. In other words, computer science, born from mathematics, permits the retrieval, even if in an instrumental manner, of the unity between scientific culture and humanistic science, culture, once part of classical education and which the modern world has imprudently lost. At present, to recover and reactivate this unity in an organic and balanced way would be mutually advantageous.

ATTILIO STAZIO

Papyrology and Computers

In 1970, thanks to international collaboration, the Officina dei Papiri Ercolanesi began to use modern technology. The gift, from Eric G. Turner, of a binocular microscope led to the reorganization of the instruments used in the transcription, decipherment and drawing of our papyri. Other donations of microscopes followed, and then came another use of modern technology, photography of the papyri. After intital timid, homespun experiments, a team led by Knut Kleve, in Oslo, in collaboration with the Centro Internationale per lo Studio dei Papiri Ercolanesi began experimentation with the use of the computer in 1980. Thus were laid the foundations of papyrological computer science.

In 1980, at the sixteenth International Congress of Papyrologists, in New York, Kleve outlined the two programs that are at the basis of his research: "lacunology" and "letterology". Although he began with the Herculanean papyri, his results can be applied to papyri of every other type and provenience.

Lacunology consists of restoration, by means of computer, of a lacuna with the aid of the letters legible before and after it. The first requirement is a central computer, which could be that of a university, linked to a number of terminals with monitor or printer or both. The rather lengthy and laborious preliminary phase is represented by transmission of the data, Greek or Latin as the case may be, to the central computer. A base-file consisting of texts with various similarities to the one being worked on is stored in the memory. For example, if we are studying the text of a papyrus of Philodemus from Herculaneum, we should use a base-file made of texts of all the other works of Philodemus, obviously according to the most modern and reliable editions; but since Philodemus rails against the other philosophies of the ancient world, sometimes quoting the thoughts of his adversaries, it is appropriate to put into memory other philosophical texts as well: from the Pre-Socratics to Plato, from Aristotle to the Stoics, and so on. Moreover, since he also frequently cites poetry, for style or polemic reasons, the file should also contain the broadest possible selection of ancient poetic texts. Naturally the works of other Epicurean philosophers, even if preserved in fragmentary state, should not be omitted.

Until a few years ago, the inputting of these data was an extremely slow job. Now, however, with the appearance of so-called optical scanners, it is much more rapid and sure. No longer is fallible human typing on the keyboard a sort of middleman between the text and the computer, with all the risks that implies – typographical errors or misreadings; it is the machine that reads and transfers directly and without errors the text of the printed page to the central memory.

The computer thus programmed can be used in three basic ways:

1. If we read in the papyrus some letters before and after a certain lacuna (e.g., ε[...]ν), we can order the machine to list a series of progressions of letters, taken from the same text or from another, that might fit that lacuna (e.g., ἐ̱πιμν̱ησϑησόμεϑα, ὀφε̱ῖλον̱ etc.).

2. If we read a group of letters between two lacunae (e.g.,]ονε[), we ask the computer for examples of the same progressions (e.g., πλεῖστο̱ν ἔ̱χουσιν, μόνο̱ν ε̱ἰς etc.).

3. Given a sequence of single letters (e.g., μ[..]π[..]ι), it is possible to seek examples

of such successions to help us restore the words (eg. μ̲ὲν π̲ερί̲, συμ̲πίπ̲τει̲ etc.). The succession can be of single letters, combinations of letters (e.g., αβ..γδ...εζ,) or single letters plus combinations (e.g., α...β...γδ etc.).

Letteralogy is the use of graphics elaborated by computer to reconstruct letters partially preserved in the papyri, once a file-base has been stored in the computer's memory by means of photography. Here too Kleve began with the Herculaneum papyri, but the method can be applied to papyrology in general, to palaeography and to epigraphy, in the sense that it represents a valid instrument for reconstructing any type of writing preserved in fragments. Kleve is convinced that it can be useful also to archaeologists studying ancient objects preserved in fragments.

Any text on papyrus, whether from Herculaneum or Egypt, contains residues of ink that cannot be identified as letters. When the text is edited, the problem is noted with dots, one for each of the missing letters. But even the tiniest traces of ink contain information that can be exploited by means of comparison with completely preserved letters in the same papyrus. We input both all the minimal traces of ink and the form of all the letters of the alphabet which the scribe has written (called the hand). This allows fairly easy comparison between fragments of letters and preserved letters, to try to establish to which letters the fragments belong.

The preliminary phase consists, therefore, in drawing the alphabet of the papyrus and all the residues. This can be done either directly from the papyrus of from photographs. Kleve prefers to work mostly with photographs because the originals are not always available (the ones he works on are in the Biblioteca Nazionale in Naples) and because they are so fragile. However, at least in the case of the Herculaneum papyri, before working with photographs, a caraful comparison with the original is needed to make sure that the letters or the traces of ink reproduced in the photograph belong to the same layer and are not the result of a superimposition of several layers. No matter how sophisticated the photograph may be, it is not always possible to identify the regular stratigraphy, and therefore the normal succession, of the Herculaneum texts. The fact that photographs lack depth and compress various elements into one plane can sometimes impede accurate reading.

Another inconvenience is the folds and crevices that often wrinkle the surface of the scroll, concealing letters or parts of letters from the lens. Under present conditions, the study of the Herculaneum papyri cannot do without autopsy of the original.

Kleve begins with color slides of the Herculaneum texts. Applyng the camera to the microscope and using a special infrared and ultraviolet film, he has tried to photograph possible traces of ink not visible to the naked eye, aiming at particular residues left by the ink itself on the surface of the papyrus; the results, however, have been nil. He prefers color to black and white because in color it is easier to distinguish the writing from other elements of the papyrus. He uses a reflex camera (Nikon FG 55 mm, Vivitar automatic extension tube AT - 3/A1 36 mm and 20 mm, with a Hoya NDx4 filter) equipped with ring flash (Hama 6101). The ring flash gives a uniform light to the entire surface photographed, while a common flash tends to illuminate certain parts of the photograph excessively. However, a reflex camera cannot reproduce all the residues of ink: in some cases it is necessary to photograph with a camera applied to the microscope and using artificial light, cold and shadowless. Kleve uses a Wild M8 zoom stereomicroscope, a Leica M4-P camera and an Intralux 5000 apparatus for optical fiber illumination.

According to Kleve, it is not yet possible, given the present state of our knowledge, to input the photographs of the fragments and the letters directly into the computer, because it cannot distinguish the ink from other marks on the papyrus. But he is convinced that with time computerized tecniques for photograph enhancement, similar to those applied in satellite photography, can allow direct storage in memory of photographic data. For now, it is still necessary to draw the fragments and letters reproduced in the slides. This can be done in two ways: with a special apparatus for microscope drawing or with a light table; in the latter case, the drawing is made against a back light.

Naturally in inputting the letters of the papyrus into the computer it is necessary to keep in mind the entire gamut of forms any given letter can take. For example, the fact that when the scribe nears the end of the column, he tends to compress his writing, for reasons of space, while, conversely, the first letter of the line is traced more generously and without concern for space. The idea that is at the basis of letteralogy is the same that E.G. Turner poses as the basis of the accurate study of a papyrus: the requirement that the papyrologist master the alphabet used in the papyrus book, reproducing himself the forms of the letter, making the pen trace exactly the same route that it must have followed in the hand of the ancient scribe.

At this point with a plotter or a cursor the drawings, previously outlined on millimetered graph paper, are executed on the screen of a computer and are memorized. With this operation the formation of the basefile can be said to be complete: from this moment it is possible to call up and compare on the screen any fragment and any letter. The procedure is facilitated by the fact that we can reduce or enlarge the images as we wish, rotate them over one another and superimpose them. Let's take an example. We have to reconstruct a fragmentary letter that could be part of a sigma or a kappa. We call up on the screen of our computer the graphic of these traces and all the forms of sigma and of kappa found in the same papyrus; the letter on which the residues appear superimposed more or less completely is probably the original.

The computer can help the scholar in the reconstruction of partially preserved texts on papyrus in other ways. It can construct certain lists of words in alphabetical order and the reverse; lists of terms that recur often together; statistics of any type. The computer can also indicate the probability that certain letters or words have of filling a lacuna exactly. It is particularly invaluable when it allows the papyrologist to establish to what works even minimal scraps of text belong. We recall the case of William H. Willis of Duke University, which he recounted at the seventeenth International Papyrological Congress, held in Naples in 1983. He had long been studying the miserable remains of a hundred-odd papyrus fragments, never managing to identify the work to which they belonged: in the best of cases they present half words, and traditional lexicons are of no use at all. In the meantime Duke had acquired an Ibycus computer, particularly equipped for storage, reading, publication and research of Greek and Latin texts; later the University acquired magnetic tapes containing some ten million words from texts of the most important Greek authors, in a computer-readable form. The tapes were put at the disposition of the University of California at Irvine, which has for many years been working on a *Thesaurus Linguae Graecae* (now in collaboration with the Scuola Normale Superiore of Pisa). Willis transferred the contents of these tapes to a large-memory disk readable by the Ibycus system. Later, he keyboarded the few letters of one of those hundred mysterious fragments. In less than three minutes, the computer found the fragment in *The Adventures of Leucippe and Cleitophon* by Achilles Tatius; the other fragments were quickly located in the same work.

In 1989 the same procedure led Kleve to the highly important identification of the remains of the first, third, fourth and fifth books of Lucretius' *De rerum natura* in small pieces of papyrus from Herculaneum.

And so the computer has been among the papyrologist's tools for some years. Therefore, great projects have been announced. Willis works with a data bank including all the Greek and Latin documentary papyri and *ostraka* published: at the eighteenth International Papyrological Congress (Athens 1986) he announced that the Duke University team, directed by him, had memorized 143 volumes of documents, corresponding to about 40 percent of the material published as of that moment. For the documentary papyrologist, the Duke databank is of fundamental importance. It can scan all the passages similar to the one under study in a few minutes.

Another American scholar, Kathleen McNamee, of Wayne State University, has for years been working on creation of a date base of all those literary papyri that contain marginal or interlinear notes, glosses, abbreviations, and so forth: more than five hundred scrolls which had never been compared as a whole group.

A project for computerization of the "Bibliografia metodica" and the "Testi recentemente pubblicati" which have appeared regularly since 1920 in the journal *Aegyptus*, was announced in 1986 by the school of papyrology of the Catholic University of Milan.

In 1988, researchers at the Centro Internazionale per lo Studio dei Papiri Ercolanesi, in Naples, approached with great emotion the computer put into operation by the Archaeological Superintendency of Pompeii in collaboration with the Neapolis Consortium. A program was implemented to permit very sophisticated reading of photographs of papyri: among other things, it can enlarge the image, isolate single letters and highlight them chromatically against the background. The experiments were conducted on the splendid photographs of the Herculaneum papyri taken in 1971-72 by the Gabinetto Fotografico Nazionale, in Rome, with interesting results. But not even this can replace comparison with the originals. Computer methods

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could open up prospects of exceptional importance when applied to the papyri rather than to photographs.

At present all the equipment of the Superintendency and the Neapolis project has been trasferred to Boscoreale, near Pompeii, thus opening the possibility of having a terminal in the Officina dei Papiri Ercolanesi. However, if a terminal should not be available, the Herculaneum papyrologists can use the equipment at the headquarters of the Soprintendenza Archeologica. Computerized reading of photographs of the Herculaneum papyrus books and, it is hoped, in future direct reading of the originals themselves constitute one of the most important goals of the collaborative efforts of papyrology, archaeology and computer science. Those first experiments in the articulated reading of a text on papyrus remain unforgettable, and we trust that the further developement of such cooperation can give results of great significance in the decipherment of fragmentary texts.

We will not dwell on the papyrological, philological and antiquarian value of our research nor on its contribution to our knowledge of the history of thought and of the ancient civilizations, but it is clear that everything that can still derive from the reading of our texts will increase considerably with the full use of computer technology. But we should never forget that the computer remains a tool to help the scholar in making choices, for in no case can it replace his or her intelligence.

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