Perseus

An Interactive Curriculum
on
Classical Greek Civilization

Perseus

An Interactive Curriculum on Ancient Greek Civilization

A Proposal to the Annenberg/CPB Project

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University of Maryland

τί δ' ἄλλο γε (τὸ φιλοσοφεῖν) ἢ κατὰ τὸ τοῦ Σόλωνος;
Σόλων γάρ που εἶπε· γηράσκω δ' ἀεὶ πολλὰ
διδασκόμενος, καὶ ἐμοὶ δοκεῖ οὕτως ἀεὶ χρῆναι ἕν γέ τι
μανθάνειν τὸν μέλλοντα φιλοσοφήσειν.

What else is philosophy other than that remark of Solon? For
Solon said: "I grow old but I am always learning many things."
And so it seems to me that anyone who would be a philosopher
must be always learning something new.

Solon, quoted by Socrates
(Solon *fr.* 18 West)

Abstract

Traditionally, students of the humanities have encountered barriers in their learning. The primary sources of their studies are often physically inaccessible and difficult to assimilate. In **Perseus**, therefore, we have begun to use the technology of interactive computing and the dense storage capacity of optical disk to create a vast, highly cross-referenced database of textual and visual information, and to experiment with ways to let the user explore this information. **Perseus** promotes active learning and, we believe, has already begun to alter the three-way relationship between teacher, student, and source material.

Subject: The classical Greek world.

Contents: On-line graphic, pictorial, and textual information with tools, including:

- Translations of major Greek texts with notes and introductions for general students and texts in Greek for specialized students.

- Color images and line drawings of monuments, archaeological objects, and art with accompanying description and bibliography.

- An atlas that will include color Landsat satellite images and topographic maps. Accompanying material will include a database of toponyms, descriptions of the major routes, and key ancient sources that describe the geographic settings and landscape.

- Site plans that will illustrate the major archaeological monuments along with key topographic references in ancient sources.

- Secondary material elucidating key facets of Greek civilization.

- Tools that will enable individual users to navigate through **Perseus** and to create their own applications on top of **Perseus**.

- Examples demonstrating how **Perseus** is used in the classroom, with accompanying paper material.

Hardware Base: At present, the Apple Macintosh is our system of choice, but other systems like the IBM PS/2 series will also be considered over the next four years.

Audiences: Perseus is aimed at both the instructor and the learner.

- Courses in Western civilization and Greek culture in institutions of higher learning in the United States. **Perseus** would also benefit instructors from outside classics who teach in large ancient culture and civilization courses

- Courses in classics, archaeology, art, history, linguistics, and architecture. **Perseus** will provide a broad base of material for the beginning but serious student of ancient culture.

- Courses in political science, philosophy, law, etc., that include the study of Greek institutions and culture as secondary material. **Perseus** will have materials that will supplement and expand the scope of courses outside departments of classics, art history, and archaeology.

- Undergraduate and graduate programs in classics. In small schools that cannot afford to maintain a full-time classicist, a nonspecialist could take advantage of **Perseus** as an aid when teaching classical subjects.

- Non-traditional learners who are interested in ancient Greek civilization, and who want to investigate it at their own pace.

Principal Investigators represent specialists in many fields:

- Classical literature, ancient history, Greek religion, and Greek art and archaeology, most of whom also have significant experience in diverse aspects of computing, including humanities computing.

vi

The Annenberg/CPB Project Full Proposal Demonstration Fact Sheet

Demonstration/Materials Project

Perseus
An Interactive Curriculum on Ancient Greek Civilization

PROJECT DIRECTOR: Gregory Crane

Department of the Classics
319 Boylston Hall
Harvard University
Cambridge, MA 02138
(617) 495-9025; 495-4027 (dept. office)

CHIEF EXECUTIVE OFFICER: Brad Clompus (see accompanying letter for signature)

DATE SUBMITTED: May 24, 1988

SUBJECT AREA: Humanities
ACADEMIC LEVEL: Secondary School through Graduate School

Time Frame: January 1989-December 1992	
Amount Requested from Annenberg/CPB	$1,960,158
Institutional Cost Sharing	$1,239,383
Amount from Apple Computer	$191,000
Total Amount	$3,390,541

GOAL OF PROJECT: To develop a core of texts and images about classical Greece with which courses in art, archaeology, literature andhistory can be taught. It will be stored on optical disks, and will be accessible on standard microcomputers.

WORK COMPLETED TO DATE: Since July, 1987 we have begun data entry, created sample course materials which were used in classes at Harvard and at Bowdoin College, and begun to prototype the database.

Road Map of the Chapters

Chapter I. Project Summary: the general goals of Perseus.

Chapter II. Significance of the Project: primarily explores its impact on the students, teachers and scholars who use it, both in classics and beyond, but also discusses the role of classics as a field and the importance of the project's size.

Chapter III. Context: places Perseus in its historical perspective, providing background on the importance of computing in classics, and the development of the project over the last three years.

Chapter IV. Tasks and Methods: has subsections devoted to the individual parts of the database, and concludes with a timetable for the project.

Chapter V. Evaluation: what we plan to evaluate and how.

Chapter VI. Delivery/Distribution: methods for distributing Perseus and the decisions that led to their adoption.

Chapter VII. Personnel and Facilities: the key members of the project, the advisory committees, and facilities where Perseus is being developed.

Chapter VIII. Rights: who owns the rights to Perseus, and how do we acquire rights to materials that we collect.

Chapter IX. Revenue Sharing: how any royalties would be divided.

Chapter X. Detailed Budget and Cash Flow Projections: a description of how much money is requested and how it will be spent; monthly estimate of the cash flow for the duration of the project.

Chapter XI. Vitae of the Principal Investigators

Appendix. The material in the Appendix is in a separate, accompanying volume.

Sample Materials. The printed Sample Materials are in a separate volume.

Contents

I. Project Summary

In **Perseus**, Phase I, we are developing a core of texts and images about the classical Greek world with which courses in art, archaeology, literature, and history can be taught. We have been exploring techniques and strategies for assembling many different types of information on optical disk and for using this data in teaching and research. We did much prototyping, and we began to experiment with actual classroom applications. In the fall of 1989 we will release the results of Phase I. **Perseus 1.0** will include a Greek-English lexicon and morphological parser, an atlas, complex texts of several authors, a core of one hundred to 150 key objects of Greek art, a general overview of Greek civilization, and various pedagogically oriented applications.[1] It will be disseminated on compact disk. If the compact disk cannot store all the images that we collect, we will also produce a videodisc.

In Phase II, we propose to build upon our initial work, creating three subsequent releases, **Perseus 2.0, 3.0,** and **4.0,** scheduled for the fall of 1990, 1991, and 1992 respectively. We plan to focus our attention on literature, history, and art. We will also incorporate a sizeable amount of material on Greek philosophy, including the major works of Plato and Aristotle.[2] An exhaustive treatment of ancient philosophy, however, will be a major effort by itself, and may form a third phase of **Perseus.**

Releases of **Perseus** will be cumulative. Each release will include (1) the material from the previous release; (2) new material that has been added to the database; (3) additions and alterations to, as well as comments on, material from previous releases. At the conclusion of Phase II, **Perseus 4.0** will contain between forty and one hundred megabytes of textual information (approximately forty to one hundred volumes of text, or between five and ten per cent of the surviving literary material) and several thousand images.

Instructors and students working with **Perseus** will have ready access to more different categories of information than they have ever had before. Source texts, reference articles, maps, pictures, plans—diverse categories of information—will be available for the instructor to assign or the student to peruse. This material will be delivered in a hypermedia database system that allows learners to make their own links and annotations.[3] Finally, sample teaching materials on Greek civilization will lead the user—both student and teacher— through these databases, introducing the powerful new resources at their disposal. The instructor will be able to assign passages from the complete works of Sophocles, pictures from a data base of Greek vases, architectural plans from various sites. Students, confronted with an assertion, will be able to probe into the reasons for this assertion: if the evidence is a passage in Thucydides, they will be able to call up a translation of the passage; if the evidence is topographical, they will be able to call up a map; if Greek vases give the primary evidence for a myth, the vases will be only a few keystrokes away.

Perseus is a broad-based effort. Professors from Harvard University, Boston University, Bowdoin College, Pomona College, the University of Chicago, and the University

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[1] The general overview is being funded by a grant from Apple Computer, Inc. A brief description is in the "Encyclopedia, Overview and Atlas," section of Chapter IV, and a detailed outline is included as "Overview of Greek Civilization," in the Appendix. The grant proposal to Apple Computer for funding is also in the Appendix . For a precise outline of the contents of **Perseus 1.0,** see "Building Perseus," in Chapter IV.

[2] For an estimate of what authors we currently plan to include, see "Texts," in Chapter IV. The "selection" of Plato and Aristotle is substantial (approximately seventeen Loeb Library volumes, or about seventeen megabytes of data).

[3] We are optimistic that Apple Computer will continue extending the capabilities of *HyperCard,* but *HyperCard 1.2* will already provide adequate access to the **Perseus** database. **Perseus 1.0** will be available as a series of *HyperCard* Stacks. We are not committed to a delivery system for any subsequent release. For more on the delivery system, see "Delivery Systems and Media" in Chapter VI.

of Virginia are already contributing their work. Others have expressed interest, and a growing variety of perspectives has begun to reshape and refine the direction of the project. Perseus authors and members of our Advisory Committees represent large research universities, small liberal arts colleges and community colleges. Our work has taken place in traditional four-year colleges, but we have begun to reach out beyond our initial audience. We are committed to making Perseus useful in as many different academic environments as possible.

Ultimately, Perseus can become an ongoing concern and can retain its vitality long after support from Annenberg/CPB has ceased. We are already encouraging others to add new Perseus themes and materials based on their own interests and expertise. We have therefore modelled Perseus after traditional publications. Our central staff are editors whose primary interests lie in the humanities. As Perseus expands to contain an increasingly large amount of information, it will attract more attention and further contributions from many quarters. Once the data has been collected, optical disks cost no more to produce than printed books. Perseus 5.0 and subsequent editions can be produced within the same economic framework as any conventional printed journal. The precedent would be profound: an electronic database would suddenly fill the same role as, and even substitute for, traditional means of publication.

A working model of electronic publication will exert influence far beyond the realm of classical studies. On a political level, we will help legitimize electronic publication within the more conservative areas of academia. On a technical level, we will establish standards and an editorial process to support disparate authors contributing to a single, massive publication. We will provide a blueprint which others can initially and subsequently improve.

We have designed Perseus from the outset so that as many people as possible can obtain it. This has at least two consequences for the design of the database. First, Perseus itself must be made available at modest cost. We are committed to delivering a product that a student could afford to purchase for a single course: approximately forty dollars (at current prices) for the core data and software. Second, we plan to make as much information as possible useful on the smallest possible systems. Working extensively with the Macintosh and *HyperCard*, we have made the first subsets of Perseus available on a Macintosh Plus for preliminary testing. Given current technology, we would offer supplementary material on videodisc for users who want access to information in this medium. Our ultimate goal is to build a version of Perseus that fits on a single compact disk. The Perseus 4.0, released at the conclusion of Phase II, will consist of four basic parts:

- Basic Materials: Texts, maps, dictionary, history, images, encyclopedia entries, and various reference materials. This will probably consist of between forty and one hundred megabytes of data, and several thousand images ranging from color pictures to line drawings.

- Software: Although we are not a software development project, we will nevertheless provide some customized software aimed at our subject. For example, we are currently integrating *Morpheus*, a morphological analysis system for Greek, into Perseus.[4]

- Themes: Some topics will be pursued to a considerable depth. These will be called *Themes* and will be created by Perseus *Authors*. They are analogous to secondary literature and will be separate from the basic materials.

- Sample Applications: Many people will use Perseus to develop applications for a wide variety of learners with very different backgrounds. We will include as many such applications as possible. Whereas basic materials and Themes will be designed as generally as possible, sample applications can be targeted at very specific groups.[5]

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[4]For more on *Morpheus*, see "Morpheus and the Greek-English Lexicon," in Chapter IV.

[5] See the discussions on "A Toolkit for the Instructor," under "Perseus and the Instructor," in Chapter II.

II. Significance of the Project

A large project such as **Perseus** has many different sides. This chapter addresses four major aspects of the **Perseus** Project. First, it discusses how **Perseus** can affect the interconnected processes of learning, instruction and research, stimulating the way in which all these phases of intellectual activity reinforce one another. Second, it outlines some of the reasons why classics, with its interdisciplinary subject matter, its importance in Western civilization, and its connections to various academic departments, is a suitable domain in which to build **Perseus**. Third, **Perseus** will derive its importance not only from the material that it incorporates but from the obstacles that it will have to confront. The third section summarizes some of these problems. Finally, **Perseus** is an enormous undertaking. The fourth section briefly explains how we came to design a project of this magnitude. Large as **Perseus** may be, it is an economical way in which to achieve the overall project goals.

Perseus and Education

The Student

The Goal: Fostering Skills, Exploration, and Motivation

The freshman at a community college clearly has many needs and expectations that differ from those of the graduate student in a specialized seminar. We are attempting to develop a single environment flexible enough to serve such disparate groups. Our conversations with instructors at a variety of institutions have convinced us that all learners face many of the same general problems.[1] In working on **Perseus**, we have focused on two general and complementary poles within the process of learning.

First, learners need to be able to use the material before them in an analytical way. Faced with a passage by Plato, they must be able to abstract from that passage the main points of the argument. Students viewing the drawings on a Greek vase must learn to differentiate elements common to all painters from those that identify the personal creativity of a particular artist, and they must learn to recognize how materials and form constrain an artist's style. They must be able to place historical events in their chronological sequence or to analyze the form of a Greek verb. Nor is is this strictly a pedagogical issue: the assimilation of new and different kinds of information is equally important to a freshman at a community college and a professor at a research university.

In our first year of work we have been able to address the problem of basic skills. We have developed exercises that help the learner focus on important aspects of a text, as well as pedagogical tools that help learners familiarize themselves with the gods and heroes that populate Greek poetry. We have used animation to illustrate the progress of a battle and the techniques of architectural drawing. We have employed maps as an introduction to prose

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[1] Gregory Crane and Christopher Biffle (a member of the Educational Advisory Committee) were surprised to find that much of their work with *HyperCard* had proceeded in entirely parallel directions, even though Crane teaches at Harvard and Biffle at San Bernadino Valley Community College. They were particularly struck when Biffle explained a tutorial he had created for helping his students understand Plato's dialogue, the *Euthyphro*. Biffle had collected sample questions, background material, and detailed commentary to help elucidate difficult passages, but he expressed concern that a professor at a research university might look down upon all such attention to close reading. The focus of Biffle's work, however, made a strong impression on Crane: the problems with which Biffle was wrestling in his freshman class were precisely those with which Crane had struggled in a graduate seminar at Harvard. Though their audiences were quite different, both were attacking the same intellectual problems.

history. Always we have sought to make the information clear, and thereby to make the learner think more deeply about this information.[2]

Second, **Perseus** is building an environment in which many different kinds of knowledge are accessible and in which the learner can travel farther, more efficiently, and with greater pleasure. Our students have already in some cases been able to build more complex intellectual models than otherwise would have been possible.[3] We have begun to see that this kind of environment can enhance creative, individualized, and active learning. We intend to expand the **Perseus** database so that learners can pursue more leads and encounter fewer dead-ends—limited data has been the major source for complaints in our experiences so far. Ideally, with **Perseus** learners should be able to immerse themselves in the culture of ancient Greece almost as deeply as if they were studying French language and civilization in Paris.

Our two poles thus form parts of a powerful, self-generating cycle. Once learners have acquired certain basic skills and background, they can pursue challenging and complex problems. At the same time, by pursuing problems they also hone their skills and internalize more background knowledge about the subject. This in turn opens up more possible avenues of investigation, and makes the process of inquiry increasingly more rewarding and worthwhile.
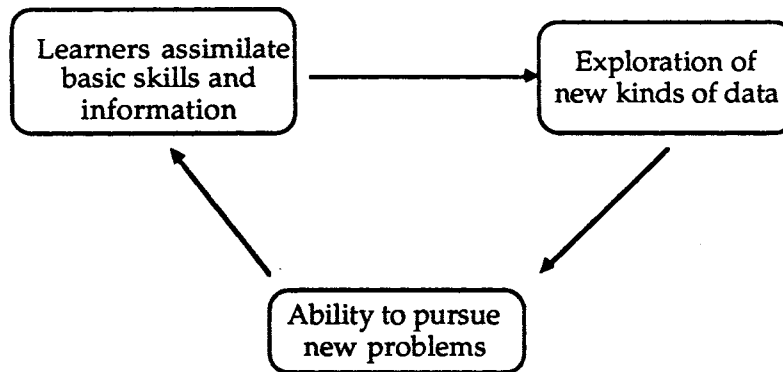
Figure 2.1. Learning is a self-perpetuating cycle that "lives by what it feeds on." The more learners know, the more questions they can pursue and the more satisfying this activity becomes. The more they enjoy learning and the easier it is for them to pursue new problems, the more different kinds of information they can encounter. These in turn generate new problems which further widen the learners' range.

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[2] For a general discussion of this issue, see Gregory Crane, "Redefining the Book: Some Preliminary Problems," *Academic Computing*, 2(1988):5, included in the Appendix, (hereafter cited as "Redefining the Book").

[3] Both Morrell and Smith felt that this was true in their initial tests of **Perseus** material. Morrell, for example, was astounded at how confidently and in what detail his students discussed Greek tragedies after they had completed the project on "Critical Reading" (described in section 5.2 of his paper, "Teaching with HyperCard," in the Appendix). He told other members of the project that he had never seen undergraduates so well informed. Neel Smith found that the archaeological exercises enabled his students to control far more information and made their work generally more sophisticated. The *Visualizing Aristophanes* Project was particularly striking: it allowed students to think about *different kinds* of problems than they could ever have addressed in such a course with pen and paper. At least one of the undergraduates seems to have produced a publishable contribution. These impressions are difficult to quantify but are nevertheless extremely important, as many instructors place great faith in such anecdotal evidence.

Once any learner enters into this cycle of intellectual activity, he inevitably realizes that learning is not just important for his personal advancement but that learning is fun.[4] If we as instructors can instill this driving fascination in our students, we will have accomplished our most beneficial goal.

The Means: a Rich Learning Environment Through Hypertext/Hypermedia

Our conversations with colleagues who are working with other hypertext systems[5] have long suggested that a rich collection of information, stored in a hypertext/hypermedia form, could provide an environment in which students could rapidly pursue a wider variety of ideas than otherwise would be possible. Our experience in the first year of the project has tended to support our initial impressions. Even a simple hypermedia system such as *HyperCard* has allowed us to convey our material more quickly and more effectively. The first technique had attracted us from the beginning:

> • *Connecting data in a more fluid way.* This is the driving idea behind **Perseus.** If a learner sees the name "Pericles," he should be able to call up a description of "Pericles" by pointing to that name. Likewise, a student, confronted with an unfamiliar geographical name, should be able to jump to a map illustrating that name. If a student sees a reference such as "Sophocles *Antig.* 338," he should be able to open a window that is centered around line 338 of Sophocles' play.[6]

When we actually began to work, we found that we had not fully appreciated the pedagogical importance of at least two other components:

> • *More interactive graphics.* We can use much more graphic material to convey information in a more natural way: e.g., instead of one printed map on which many events are superimposed, we can present a string of maps which show the events of period one after another in their chronological sequence.[7]

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[4] Students at both Harvard and Bowdoin College who worked with Morrell and Smith using early **Perseus** materials noted that the computer made their work much more fun (see Morrell, "Teaching with *HyperCard*," p. 65; and Smith, "Teaching with *HyperCard* at Bowdoin College," p. 77, in the Appendix). Only time will tell how the students react when the novelty of the technology wears off. We believe that the computer itself played only a minor role in this: the students enjoyed themselves more not because they were using a computer but because the computer allowed them to learn more material and in a more natural, interesting manner.

[5] For a survey of those hypertext designers with whom we maintain contacts, see "Perseus and Other Experiments in Interactive Learning," in Chapter III. Three in particular have experience with making large amounts of material available through a hypertext/hypermedia system. George Landow of Brown has taught several courses on English literature with *Intermedia* and has collected a substantial database of texts and images with many thousands of links. Tim Oren helped develop the *Knowledgeset* retrieval software for the Grolier Encyclopedia. As an optical media specialist at Apple Computer he designed and managed the *Apple Learning Disc.* He also played a particularly large role in designing Grolier Encyclopedia's contribution on American history. Gary Marchionini began his career as a teacher and has studied how learners interact with Ben Schneiderman's *Hyperties* system.

[6] The *Persian Wars* stack illustrates how the learner can start with a series of maps, move to textual descriptions of the events on those maps, jump directly into primary source material, and then return to the main sequence of maps. Neel Smith's *Archaeological Catalog and Related Materials* in the Sample Materials allow students to jump to bibliography, maps, or other relevant images. See also section 4.4 ("Chronology, Historical Atlas and Bibliography Stacks") in Morrell, "Teaching with *HyperCard*," p. 55, in the Appendix.

[7] See the *Persian Wars* stack in the Sample Materials. See also the "Gods and Heroes" exercise described in Morrell, "Teaching with *HyperCard*," p. 58 (with figs. 5.1.a. and 5.21.b.): students learned about Greek mythology by filling in relatively simple forms and diagrams, but these forms and diagrams themselves visually reinforced the family ties between the various Greek gods and heroes. Neel Smith's *Visualizing Aristophanes* stack forced students to visualize the stage action of a Greek comedy—a critical

- *Other media*: Simple animation or sound can often communicate much more than an oblique textual description.[8] Sound can convey something of the flavor of Greek lyric poetry even to those who do not know the language.[9]

We expected that our initial preconceptions would change. We were prepared to find that we had overestimated the impact that a hypertext/hypermedia system would have on learning. We found instead that we had underestimated the flexibility and power that even a relatively simple system such as *HyperCard* offers.

The Sample Materials give some illustrations of how we have been using more graphics and other media. Chapter IV, *Tasks and Methods* describes at greater length the kinds of material that we will collect and bind together during the course of Perseus, Phase II.

The Instructor

Now that we have described in general terms how **Perseus** can affect learners, we will provide an overview of its impact on instructors. Teachers vary in expertise, in background, and in their interests, but as users of **Perseus** they can be described in three groups:

- Instructors in various disciplines who want to integrate material about the classical Greek world into their learning, instruction, or research. Courses in Western civilization, literature, history, art, and philosophy all have sections that cover this material. (Note that classics is itself an interdisciplinary field and that many classicists would find **Perseus** useful in just this way: the archaeologist could use **Perseus** to study literature, while the literary critic would enjoy the accessibility of artistic and archaeological data.)

- Specialists in literature, history, art, philosophy or some other aspect of Greek civilization.

- Instructors and researchers in all fields of study who would learn to design hypermedia databases for their own disciplines from the successes (and weaknesses) of **Perseus** .

Instructors, like students, have many different needs and expectations. Specialists in classical Greek civilization need detailed and sophisticated information (e.g., measured drawings, an *apparatus criticus*[10] for texts, Landsat images of Greece). Although we expect that most of those who use **Perseus** will not be classicists, we aim to meet the intellectual standards of those who know most about the classical Greek world.

Once we have established a powerful model for representing information about classical Greece, we can provide useful paradigms for others. We have expended a considerable amount of effort on very technical aspects of our field (e.g., the *apparatus criticus*, making *Morpheus* cope with Greek dialectical forms, and museum catalogue entries), but such tightly focused work has implications far beyond its immediate audience. Historians may never use *Morpheus* itself, but they can see in *Morpheus* how a discipline-specific tool fits into a more general framework. Our general vision of **Perseus** as a wide-ranging, hypermedia

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critical dimension of the play that literary classes tend to overlook (see Neel Smith's description of this stack in "Teaching with *HyperCard* at Bowdoin College," in the Appendix).

[8] The *Persian Wars* stack in the Sample Materials contains an animated version of the battle of Salamis; Neel Smith used animation to create a tutorial illustrating technical aspects of architectural drawing.

[9] We have done preliminary work integrating sound to illustrate the sound of Greek. At Bowdoin next fall, Neel Smith will use sound to help teach introductory classical Greek; at Harvard next spring, Gregory Crane will record sequences of Greek lyric for his translation class in the Core Curriculum.

[10] An *apparatus criticus* is a list of the variant readings associated with a text. For a description of the *apparatus criticus* and of a scholarly text in general, see "Texts," of Chapter IV, *Tasks and Methods*.

database may attract the attention of many; the small details will validate **Perseus** and make it a genuinely powerful model.

The goal is to create a resource not exclusively for classicists or non-classicists but rather to satisfy the specialists and to engage the overworked political scientists struggling with Plato and instructors in Western civilization courses so that they devote more time to teaching and less time to collecting and organizing material.

A single compact disk can contain information for several audiences, and this technology presents us with an unprecedented opportunity to lower the barriers that lock many out of our field. The overall structure of **Perseus** must support the enormous tensions between the novice and the expert, between the specialist in one field and the specialist in another, and between the general and specific. We have made progress in developing tools that can serve a variety of needs, and we have much work still in mind to do.[11]

A Toolkit for the Instructor[12]

Using *Perseus* to expand or create course material. During the past year, systems such as a Macintosh SE with *HyperCard* or *Guide* have vastly expanded the number of instructors who create their own interactive instructional materials. In the humanities, however, flexible authoring tools and inexpensive computers are not enough. Instructors need data and lots of it: even if they only want to discuss a single text, they need to identify people, locate places on maps, and illustrate things with pictures. **Perseus** will allow instructors to integrate such material much more easily into their normal teaching.

Perseus as a clearing-house for course material. In "Summary," teaching applications were mentioned as part of the material that **Perseus** would include. Most of the instructors with whom we spoke during Phase I argued strongly that they did not want prepackaged "courses." Humanists in general and classicists in particular tend to rely more on source material than on textbooks. They have their own ideas about the classical Greek world and would prefer to have direct access to source materials so they can personally tailor their own teaching approach. We will therefore devote most of our resources to assembling general-purpose data rather than teaching materials aimed at specific courses.

Nevertheless, when experimenting with a new medium, instructors do want to see how their colleagues at other institutions have used the material. Tools for specific courses developed under **Perseus** such as Kenneth Morrell's *Identification Tutorial* and Neel Smith's *Visualizing Aristophanes* have already attracted the attention of other teachers. Applications from a variety of different academic settings will therefore be part of each **Perseus** release. Instructors and learners can then either adapt what they find, model their own work after other applications, or use the applications unchanged.

Perseus as a support system for instructors outside of Classics. Many instructors teach aspects of classical Greek civilization, in which they do not specialize; some are not even classicists. A student from one college informed us, for example, that he had read Plato's *Republic* in courses on political science, philosophy, and even English during his first two years at college. An instructor whose graduate work focused on Elizabethan drama may need to teach Aeschylus, or the professor who wrote her dissertation on early Chinese history may want to include the Peloponnesian War in one of her courses.

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[11] For example, Frederick Hemans has begun work on an electronic atlas of Greece with toponyms; Neel Smith has created *Visualizing Aristophanes*, an application that lets the students learn about the staging of a Greek comedy; and Greg Crane will create a tool to facilitate metrical analysis.

[12] We seek, insofar as possible, to adapt **Perseus** to the needs and goals of those who are actually teaching. The report on "Using **Perseus** in a Variety of Educational Settings," included in the Appendix, summarizes some of what we had learned as of fall 1987. Our understanding of what instructors want is still evolving and will continue to shape the form that **Perseus** assumes.

Using the **Perseus** database, these instructors can more efficiently familiarize themselves with topics such as Greek tragedy or the Peloponnesian War. Results from our educational survey show that many instructors in this position were eager to use **Perseus**. They felt not only that they could gain from using **Perseus** but that it would also allow them to use the materials more innovatively with their students. In fact, each of us involved in the project has several subjects which we would like to integrate better into our teaching. We hope that **Perseus** will inspire similar efforts in many other disciplines.

Perseus **and the Researcher**

Many of our colleagues have found that if they can link their research and instruction, they can do better at both. **Perseus** therefore seeks to offer an environment that serves research as well as instruction. Many of the elements in *Tasks and Methods* of Chapter IV will interest the professional scholar as well as the student: **Perseus** provides a more flexible environment than print for many kinds of scholarly information. However, some time will elapse before specialists as a whole accept this. The following section outlines how researchers have begun to view **Perseus**.

Disseminating Knowledge: Perseus and the Specialist. Most of the scholars to whom we have described **Perseus** have quickly seen its potential for teaching. Its significance for the advanced learners such as graduate students and faculty was less clear to them. More than once they pointed out that no matter how much material is included in **Perseus**, it still will not entirely liberate the specialist from the modern research library.

An assistant professor of classics from a major Southern university wrote Professor Crane regarding his article in the February, 1988 issue of *Academic Computing*:[13]

> "I saw your article in 'Academic Computing.' Good job of writing to several audiences—the laymen academics, the hacks, and the classicists. Overall, I'd say you made a good case for the **Perseus** project, though I am still unconvinced about its utility for real classicists."

The following paragraph, however, makes this suggestion:

> "You may or may not remember that I mentioned something to you that you thought might be useful for the P. project. That is, a sourcebook for [Subject X]. This would be a very large project, so even though I have not begun it, I am thinking about the groundwork. Professor Y and I would do it as collaborators—it is too big for one person. The question is, would you like to try to incorporate either the entire sourcebook or some of it into **Perseus**? I know that we would in any event want to publish it as a book. But that would not prevent us from incorporating it in P. at the same time. Tell me what you think, and what you suggest we should think about if we want to offer it to you for P."

Even though this young classicist views **Perseus** as primarily a pedagogical resource, he discusses whether it is a suitable vehicle for his next major scholarly work—a book that may determine whether or not he gets tenure. The printed version of his source book (which will probably be published as a scholarly monograph with a limited publication run) will cost at least twenty-five dollars, and more likely two to four times that amount. Many experts will have already attached CD players to their Macintoshes in order to use the *Thesaurus Linguae Graecae* (**TLG**) and the *Packard Humanities Institute* (**PHI**) databases.[14] The forty dollar **Perseus** CD will not have to contain very many such sourcebooks before it becomes a bargain for this group of classicists.

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[13] See "Redefining the Book," in the Appendix.

[14] The pioneering TLG disk, which contains more than 300 megabytes of Greek text, is discussed in more detail in Chapter III, *Context*. The same chapter also includes a description of the **Perseus** plan to write software that will allow anyone with a Macintosh and a CD player to search the TLG. PHI stands for the *Packard Humanities Institute*. The PHI disk contains the first installment of a database that will ultimately encompass all of Latin literature.

Others have had a similar reaction: after expressing skepticism about whether they would find **Perseus** useful in research, they explain how they would like to use **Perseus** to help them do their own work. Ready-made templates such as *HyperCard* stacks for museum catalogues or critical editions immediately appeal to them. Other **Perseus** resources such as the atlas of Greece with its collection of Landsat images have never been available before, and open up new windows into the classical Greek world for even the most learned scholar. Even simply putting a Greek-English dictionary on-line is an advance: many will use **Perseus** as a new kind of Greek thesaurus, searching the English definitions of the on-line Greek dictionary for those entries that contain terms such as "justice" or "shameful." Neel Smith's *HyperCard* Stack for *Visualizing Aristophanes* was designed for a class, but allows the classicist to explore much more easily an elusive, but critical dimension of Greek drama. Once again, even a few such things can make the forty dollar **Perseus** CD a relatively inexpensive standard research tool.

Perseus and the Adjacent Expert. Specialists in fields other than classics should find **Perseus** useful not only when they wish to incorporate material into their teaching[15] but into their research as well. By making basic information about the various aspects of Greek civilization easier to use, **Perseus** hopes that this material will play a larger role in research outside of classics. Thus, Neel Smith's *Vase Catalogue* lets nonspecialists use more artistic evidence and thus integrate iconography more effectively into their work, while students who are not philologists can use *Morpheus* and the Greek-English lexicon to read Greek text more efficiently. By reducing the barriers between specialized topics, we can help people view individual problems in more complete and powerful ways.

Several members of the Project see themselves as "adjacent experts" and find **Perseus** exciting in part because it will allow them to expand their own horizons within classics. Professor Crane, for example, specializes in Greek literature. He has always wished to know more about Greek art and archaeology. He finds that tools such as Neel Smith's *Vase Catalogue* or *Drawing Tutorial* have already made new kinds of expertise far more accessible to him.

Classics as the Subject for *Perseus*

Classical Greek civilization provides some of the basic concepts of the Western Judaeo-Christian culture in which students live. Most colleges and universities expect students to take courses in Western civilization and literature, and much of that material is based on or derives from a culture that was conversant with the classical tradition. It is difficult to understand the achievements of the Renaissance without a knowledge of classical mythology and Plato. Likewise, a knowledge of Plato and Greek political history is necessary to understand the French and American Revolutionary Wars. Painting, sculpture, and architecture during our era have returned over and over again to classical styles and motifs. Many of our most appealing values (democracy, the belief in freedom and the rights of the individual) spring from Greek origins.A knowledge of classical Greece forms part of a person's cultural literacy.[16]

Classical Greek civilization does not, however, depend upon requirements in Western civilization for its appeal. Harvard has no courses in Western civilization: under the old General Education program and now under the Core Curriculum, classics holds no privileged position. Those who teach here must compete for students in a generally free market.

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[15] See "**Perseus** as a support system for Instructors outside of Classics," above.

[16] The Western culture program at Stanford University has recently become a subject of lively debate. Some members of the Stanford community felt that this program, with its emphasis on the work of white males from the upper reaches of society, was not entirely appropriate for our evolving pluralistic society. Nevertheless, when the issue was reviewed by the faculty senate, there was "no dissent from requiring freshmen to study ancient and medieval culture" (see "Western culture faculty proposes compromise on shared themes, texts," in *The Stanford University Campus Report*, March 23, 1988, p. 13). Almost all members of the debate agreed on the importance of ancient civilization.

Nevertheless, Greek civilization and literature have always drawn a very large following. Professor Nagy's course on *The Hero in Hellenic Civilization* is one of the most popular courses at Harvard, with enrollments ranging from four to five hundred students. Professor Martin's *Periclean Athens* drew between two and three hundred students and, when it was last taught, had the highest ratings of any course in the Core Curriculum.

The student of ancient Greece must reconstruct an entire world. One cannot properly study Greek literature, Greek history, Greek art, or any other subset of the Greek world in isolation. All aspects of a civilization are intertwined, and our understanding of one aspect will determine our interpretation of another. Literary conventions help determine the meaning of historical texts; history affects the interpretation of art; art sheds light upon religious practices that in turn help shape literary conventions.
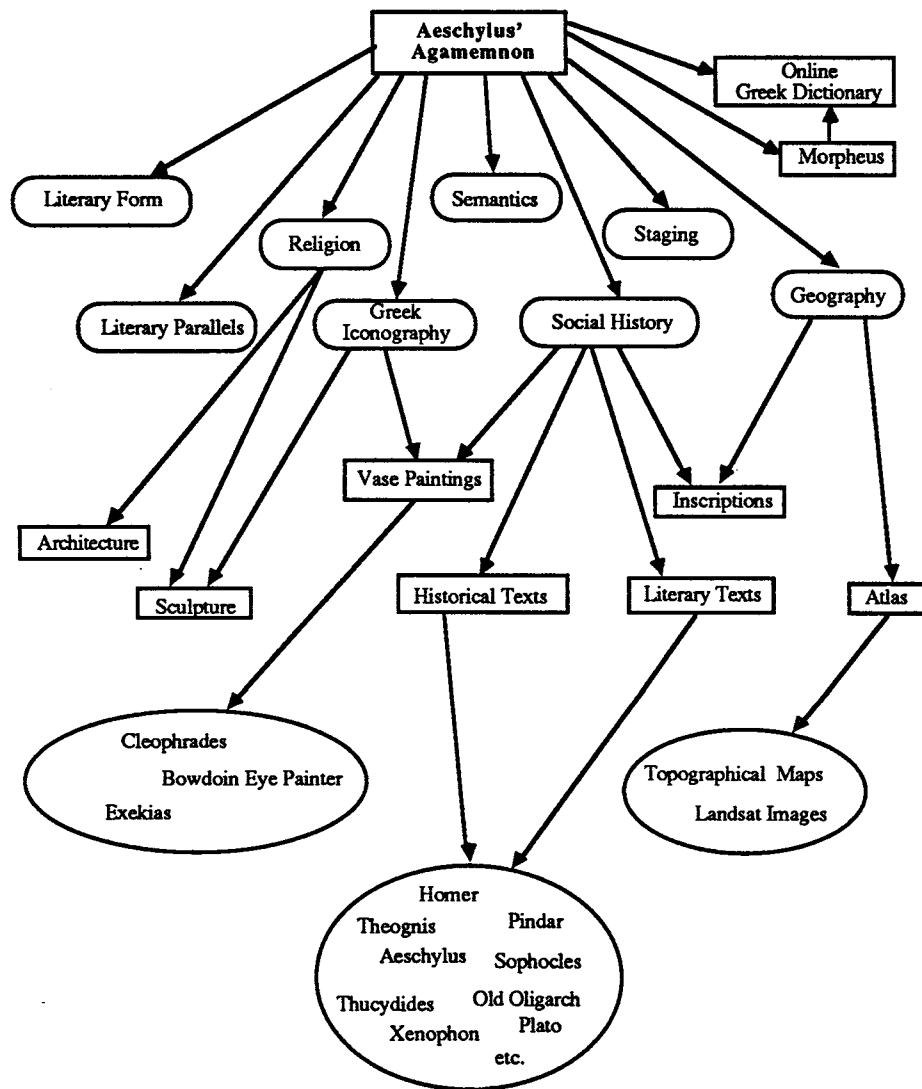
Figure 2.2. This illustrates the many factors that affect our understanding of even a single text, such as the *Agamemnon* of Aeschylus. Four general levels of complexity confront the reader. At the top stands the *Agamemnon*, which provides the focus for the reader. The categories immediately below represent some of the intellectual disciplines that influence how we read the text. The third level describes categories of

information and corresponds roughly to the types of material within **Perseus**. The
fourth and final level in this hierarchy shows samples of the primary material.

A student of the ancient world must consequently lavish generous amounts of time
simply tracking down different pieces and types of information. To study the myths of
Heracles in literary sources, for example, one must consult representations of myths about
Heracles on Greek vases, but tracking down relevant vase paintings is a tremendous
undertaking. Even professional scholars faced with limits in time must on occasion cut
intellectual corners. The art historian may not be able to devote enough time to literary
evidence, while the literary expert will not always do justice to the artistic record. Such
logistical problems exert a profound impact upon our field: if these problems hinder
professionals, they can cripple students.

Figure 2.2 (p. 13) maps a broad intellectual space. Each of the areas in the second level
is a specialty in itself. The types of information in the third level are also broad: tens of
thousands of Greek vases, for example, reside in the museums of Europe and America, and
hundreds of megabytes of Greek text have survived from antiquity.

The diagram shows some of the paths that lie before a person faced with a Greek text.
Dense storage media and emerging hypertext systems are excellent tools to help us smooth
these paths. We are now in a position to greatly extend the intellectual distance that our
students can travel as they crisscross the intellectual map. No learner could hope to travel
nearly as far using only conventional printed information.

Covering intellectual distance is a generic problem that we share with a wide range of
disciplines. Students of Mesopotamia or Medieval England must create their own vision of a
long vanished, fundamentally foreign world. Even our own forebearers, the seventeenth-
century inhabitants of Massachusetts or the men who, two centuries later, led their states out of
the Union are not as close to us as we may think. For most people, Paraguay and the Punjab will
remain as foreign as fifth-century Athens. Resources such as **Perseus** offer the best remedy for
this dislocation.

Classics is already a technologically advanced branch within the Humanities.
Classicists at this point are more prepared to integrate technological tools than many of their
colleagues in other branches of the humanities. The existence of the TLG[17] has stimulated
vigorous interest throughout our field. A number of major departments have expended
considerable time and money making this database available; virtually all those who study
Greek civilization recognize the importance of the **TLG**, and the marriage of classics to high
technology has become a major issue in the field.

**The principal investigators are all classicists and archaeologists with extensive
computer experience.** Commercial programs that could create and organize a Perseus do not
exist at present. Some research projects like *Athena* and *Intermedia* are addressing the
problems raised by the computer needs of the humanities, but their approach is from the
computer science point of view. We are in the unique position of being experts in our own fields
and also having expertise in several aspects of computing. We can thus make intelligent
decisions about the feasibility of the computer side of the project, and innovative choices about
what the computer can do for us.

Significant Problems to Consider in Creating *Perseus*

We intend to collect a corpus of between forty and one hundred megabytes of textual
data and several thousand images ranging from digitized color pictures to line drawings. But
data collection itself is not the most difficult task that lies before us. Organizing and

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[17] See chapter III, *Context*, for a description of the TLG and and its influence on the classics.

developing a heterogeneous database such as **Perseus** forces us to confront many other general problems.

Each of these problems is complex, and several will be discussed at greater length in the Chapter IV, *Tasks and Methods*. Some are open questions that can never be resolved. But in some respects such problems are as important as the final results that we will produce in **Perseus**, Phase II. We will not only have a hypermedia database that our colleagues in classics and in other disciplines can use and observe, but our experiences in building this database will help others develop analogous resources in other fields. These problems include:

• How do we keep our data as independent as possible from any particular delivery system? We do not want to build a *HyperCard* database or an *Intermedia* database. We wish to build a database of material that we can distribute in *HyperCard* or *Intermedia* or in any other hypertext system that appears and proves suitable for **Perseus**.[18]

• How do we create a structure that will adequately describe and access the range of information that we want to put into **Perseus**? In order to make **Perseus** more than just a collection of unrelated data we must structure not only the individual groups within the database but also the relationships between the objects. This is what will make **Perseus** different from other CD ROM products like *Microsoft Bookshelf*.[19]

• How do we make the data accessible to the novice? Making data available does not necessarily make it accessible. Any undergraduate at a major university can use the same library facilities as his professor, but few do, and those who try often quickly lose heart.[20]

• How do we make the data acceptable to the expert? A database of information that is entirely geared for the undergraduate will have little appeal for many professors and graduate students. But unless we can catch the interest of those conducting their own research and publishing their results, **Perseus** will have far less of an impact on education than it otherwise could.[21]

• How can we bridge the gaps between disciplines? Even within a field such as classics, there are vast differences among practitioners. Archaeologists, historians and literary critics, for example, often have little contact with one another, but **Perseus** must view the classical Greek world as a whole. Literary critics, for example, must remember that not only their immediate colleagues or students in a course on literature but also specialists in archaeology and history must be able to use their contributions to **Perseus**.[22]

• How can **Perseus** become an organic entity that continues to develop after the initial work has been done? We would like to publish new versions of Perseus on a regular basis. We want to design **Perseus** so that it can evolve into a mixture of database and journal. We intend to have contributors submit alterations or new material for review by an editorial

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[18] This was a major topic of discussion at the November, 1987 meeting of the **Perseus** Technical Advisory Committee. The minutes are included in the Appendix. See also Elli Mylonas, "Document and Hypertext Structures for **Perseus**," in the Appendix.

[19] For a discussion of this problem, see "Navigation , and Authoring in **Perseus**" in Chapter IV.

[20] This is one of our most general concerns and shapes much of the discussion in *Tasks and Methods* (see especially "Types of Information in **Perseus**"). Crane, "Redefining the Book," (included in the Appendix) provides a general overview of this principle.

[21] For details, see *Tasks and Methods*.

[22] This problem is less technical than political but is nevertheless serious. The structure of modern higher education in America and especially in Western Europe divides disciplines. Not only the **Perseus** Project but the proposal itself is an unusual collaboration between people from different parts of classical studies. Simply creating something as diverse as the **Perseus** database will demonstrate the importance of such collaboration.

board. Successful contributions can then be included in the subsequent edition of the database. We would thereby promote a new medium of academic publication.[23]

The Size of the Project

This is the third full proposal that we have submitted to Annenberg/CPB. Each has had roughly the same goals (to collect a critical mass of information about the classical Greek world) and the same general budget (between 1.7 and 1.9 million dollars).

In January and February of 1988, when we began to decide what to put into the current proposal, none of us in the project wanted to outline another massive proposal. A large (but much smaller) effort aimed at teaching and at collecting data for a few selected courses presented a safer and more manageable paradigm. A small central staff (perhaps one full-time and one half-time person), money for faculty release time (between one and two full time equivalents), substantial but limited amounts of data entry (perhaps five or ten megabytes of documents and several hundred images per year) would allow us to do extremely exciting work. Overall, such an effort could cost between $200,000 and $250,000 per year, and a three- or four-year project could be supported for between $800,000 and $1,000,000.

In the end, however, we designed a project that was twice as large as this. **Perseus** Phase II, as it is outlined in this proposal, is far more complex than the project we imagined in January and February. We could, of course, continue developing **Perseus** at the same or at a somewhat more accelerated pace than we have adopted in Phase I, and we could produce excellent results. But as soon as we began thinking about how we would use **Perseus**, we realized that we needed the large database.

To do our best work, we simply needed more. We need more plays, more histories, more vase paintings, maps, inscriptions and other kinds of data. We need more types of expertise and more perspectives to shape the data. We need more instructors from different backgrounds to help make **Perseus** serve the widest possible range of learners. We need extensive evaluation so that we can identify what is and is not effective during the course of the project. We need an environment that has a certain scope and depth.

We realize that **Perseus**, as we perceived it, has its own existence. No matter what we felt or planned, the project defined itself, by its own internal logic, its general parameters, and its size. To study Aeschylus we need authors such as Pindar and Herodotus, pictures illustrating mythology or stage production, and countless other data. We need everything at once.[24]

Simple quantity of information is important for those who use **Perseus**. It can have a liberating effect and can help keep **Perseus** from serving excessively narrow points of view.[25] Quantity is important for many students who do not live near college libraries: a compact disk full of texts and images can allow such a learner to pursue problems that would otherwise be

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[23] On this, see the "Project Summary." Note also the interest expressed in the letter from Brian Murphy of Harvard University Press that is included in the Appendix.

[24] Recall figure 2.2 above. Much of *Tasks and Methods* describes the materials that we feel should be in **Perseus**.

[25] Part of the debate at Stanford University (see note 16 above) focused on whether the authors traditionally taught in the Western culture program represented a narrow point of view. Note, for example, the remarks of Paul Robinson, director of the Western culture program: "we are eager to replace a canonized and seemingly unalterable 'core list' with a process aimed to create a 'common intellectual experience.' The great virtue of this compromise, as I see it, is that the regular faculty actually teaching ... will take charge of the process by which the common intellectual content of the courses is to be achieved" (see "Western culture faculty proposes compromise on shared themes, texts," in *The Stanford University Campus Report*, March 23, 1988, p. 1). A rich and varied environment such as **Perseus** would allow those in charge of a Western culture program to draw from a far wider variety of sources, and to have greater control over the themes and texts that they choose to emphasize.

intractable.[26] And quantity is one of the things for which students and instructors have most enthusiastically sought from us. At Bowdoin, Neel Smith's students found the limited amount of information at their disposal enormously frustrating: no matter how carefully he tried to focus their computer-based projects, they wanted to wander through a wide collection of materials. In a letter to Gregory Crane, one member of our Educational Advisory Committee put his attitude very succinctly: "you make **Perseus** as big and rich and ample as you can and then just let me get my hands on it!"[27]

A large **Perseus** will also be of greater interest to those who wish design hypertext/hypermedia databases on other subjects. The only way to learn how to organize large quantities of heterogeneous data is to do so: many problems do not come to light when working with smaller quantities. A single, large project such as **Perseus** will encounter much that even two projects half the size of **Perseus** will not. Both the process of building **Perseus** and the various releases of the **Perseus** database will be laboratories in which people can study the effect of a large hypermedia on learning.[28]

Though more conventional research would involve less risk and would probably advance our careers more rapidly, in **Perseus** we have the chance to create and then experience something that by its size and diversity is, as far as we can tell, unique within the humanities. **Perseus** could be one of the first landfalls in a "New World" of intellectual discovery.

Finally, **Perseus** would be a cost-effective investment for Annenberg/CPB. Classics is relatively compact; much of its data is in the public domain; it encompasses many disciplines and can thus affect many departments within a university. Large and expensive as **Perseus** may be, it offers an economical passage to a vast collection of problems and possibilities.

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[26] See the discussion of delivery systems in *Delivery/Distribution*, where we point out the importance of delivering all of the essential **Perseus** material on a single medium. Technology that is aimed at the consumer market (such as CD-I or DVI) is of great importance to the project because it will ultimately allow the non-traditional learner to have access to **Perseus** at home.

[27] For the diversity of classics as a subject, see "Classics as the Subject for **Perseus**," figure 2.3 in this chapter, and "Types of Information in **Perseus**" in Chapter IV. For outlines of important source material, see the relevant sections of *Tasks and Methods*.

[28] Several members of our Technical Advisory Committee have repeatedly informed us that this was what attracted them to **Perseus**. They all have theories about how hypermedia databases should be organized and designed, but all wanted to see what would happen when something very large was built. As one member of our Technical Advisory Committee, Tim Oren of Apple Computer, once not very comfortingly remarked: "**Perseus** will be the first over the wall and will draw the fire. After the rest of us see what happens to you, we will understand much better what problems arise when you build something like this."

III. Context

The Historical Context of *Perseus*

The *Thesaurus Linguae Graecae*

Classicists have long wanted to apply computer technology to the study of ancient Greece. The *Thesaurus Linguae Graecae* (TLG) was founded in 1973 at the University of California at Irvine. This project has almost completed its primary task of placing all classical and many postclassical Greek texts on-line. Currently, approximately three hundred megabytes of Greek text are available on compact disk; the final corpus of classical Greek texts will amount to roughly five hundred megabytes.

Gregory Crane's interest in developing a complex database about the classical Greek world grew out of work that he did on the TLG. Between 1982 and 1985 he developed a Unix based system that created inverted indices for the TLG and designed standard string-based full-text retrieval tools that could cope with the peculiarities of Greek. This system became widely used by classics departments in the United States and Europe.

During the 1985-86 school year, Crane collaborated with the Institute for Research and Information in Scholarship (IRIS) at Brown University. He ported his search programs to the IBM PC/RT and then adapted the software to work with the *Isocrates* environment.[1] Elli Mylonas also collaborated in this project, designing a user interface called *Isoc*, which allowed the classicist to use the Unix based utilities with only minimal Unix experience.

Many classicists now have access to the TLG (approximately 250 institutions and scholars now have licenses to TLG CD). **Perseus** represents a complementary effort. The two databases have different primary markets: where the TLG focuses upon research and the professional classicist, **Perseus** is interested in instruction and in the general learner. More importantly, however, **Perseus** and the TLG explore different areas. The TLG probes one dimension of texts exhaustively: it contains no variant readings, no dictionary entries, no commentary or introductory matter—just texts. But, with more than three hundred megabytes on the current TLG CD, its scope is vast. The **Perseus** Project hopes to share information with the TLG itself so that, whenever possible, it can avoid duplication of effort.[2]

Perseus Phase II will include less than ten per cent of the texts that the TLG will ultimately contain; however, it offers as many different kinds of information about the classical Greek world as possible. A classicist may use the TLG to search any Greek text from Homer to 600 A.D; **Perseus** allows the learner to study a much smaller time period (800 to 400 B.C.), but offers a more complete view of what it covers. **Perseus** draws its strength from the diversity and richness of the material that it contains.

The First *Perseus* Proposal: January 1986

Gregory Crane, Rus Gant, V. Judson Harward, Albert Henrichs, Thomas Martin, Gregory Nagy, and D. Neel Smith submitted the first full **Perseus** proposal to Annenberg/CPB in January, 1986. The initial collaborators on the project conceived of **Perseus** as a database broken down into four sets of "modules." A module was a set of files that would exist in an hierarchical arrangement. For secondary materials, each file would correspond roughly to a paragraph in an essay and convey a single major idea; and for primary materials, each file would contain a small portion of a text or an image.

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[1] See Paul Kahn, "Isocrates: Greek Literature on a CD ROM" in *CD ROM. The New Papyrus* (Redmond WA: Microsoft Press, 1986), pp. 577-584. A photocopy of this article is included in the Appendix.

[2] On this, see *Rights*, Chapter VIII.

The first two sets contained contextualizing materials. The first, the "literary" modules, would provide the user with introductions to five major fields of Greek literary development from Homer through the fourth century B.C. The second set of modules provided an outline of Greek history. Users would be free to move linearly through the entire set of files to cover a module or view individual files of interest. Users would be able to follow references to primary texts through a "Textual Reference Tool."

Two other modules would contain primary materials. The set of "text" modules would provide Greek texts and English translations of major literary works and other forms of documentation, e.g., inscriptions, papyri, and coins. The collaborators would, for a small number of key texts, provide a set of commentary files. The fourth set of "visual" modules would contain maps, drawings in two and three dimensions, and pictures of sites, monuments, and artifacts. The graphic images would focus on three major aspects of the ancient world: the topography from archaic Greece through the fourth century, geography, and vase paintings.

Finally, as a means of guiding the user through the database, a set of videotapes would contain lectures by Professors Nagy, Martin, and Henrichs. Professors outside of the Perseus collaborators would also provide similar taped lectures. In these tapes the lecturers would not only convey information about the materials in the database but would also show how the user could use the database.

To make it possible for the user to access and files in each of the modules, Perseus would include "browsing" tools. The Text Browser would enable the user to read primary and secondary texts, access primary materials from references in the secondary materials, view notes on the primary materials, and look up Greek terms in a dictionary. The Picture and Graphics Browser would provide access to the images, and a General Index Browser would allow the user to find information by searching primary and secondary materials for key terms.

Although reviewers found much that was appealing in the proposal, they also found much to criticize. The problems of converting a Unix-based, hierarchical file system into a flexible network of information would have required considerably more software development than the project could provide. The proposal was unrealistic in its goals for data entry. It also passed lightly over major technical problems associated with handling images, especially images in three dimensions, and with structuring elements in the database. The lackluster appearance of the IBM PC RT underscored a general disappointment in the progress of computer technology: the $3,000 to $5,000 "3 M" Workstation[3] had not materialized, and software that could manage a hypermedia database such as Perseus was far from being generally available.[4] Perseus was seen as an attractive idea, but the Annenberg/CPB Project felt that its time had not yet come.

The Director's Grant: June 1986

Annenberg/CPB felt, however, that the first Perseus proposal had raised some important issues and suggested a Director's grant so that the project could continue the work and prepare for a new proposal.

Gregory Crane, V. Judson Harward, Albert Henrichs, and Gregory Nagy submitted to Annenberg/CPB a proposal entitled, "Problems in Creating Large Multi-media Databases for the Humanities." During the summer of 1986 Gregory Crane and Judson Harward evaluated available software and hardware systems for a large database that would include both textual and graphic material.

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[3] The term "3 M" stands for one million bytes of internal memory, one million pixels on the display, and one million instructions per second of processing power.

[4] The most promising environment was, in fact, the *Intermedia* system developed at Brown's *Institute for Research in Information and Scholarship* and funded by the Annenberg/CPB Project. Problems with hardware and licensing, which could not be foreseen at the project's start, had delayed progress.

At that time "hypertext" systems were starting to become a viable environment for structuring a complex database. Project members had seen early versions of *Intermedia* that were in use at Brown. Crane had also received as part of an equipment grant from Xerox three 1108 workstations and the *NoteCards* hypertext environment. In his investigation of these and other potential software and hardware systems for textual materials, Crane concluded that a number of vendors were developing hypertext systems that would be suitable delivery vehicles for **Perseus**. He suggested that **Perseus** attempt to establish working relationships with companies so that the project could provide input into the design of these systems. The closer these ties could be, the more likely it seemed that products would provide the capabilities that the project needed.[5]

After studying the potential methods for archiving and accessing visual images, Harward concluded that the project should first define the intended audience more clearly and let the needs of that audience shape the design of the database. Secondly, because the design of the database would depend on the technology, **Perseus** should either employ a programming staff to provide the necessary tools, or find one or more "technology partners." On the basis of his conclusions, Harward suggested that the project first concentrate on the content in order to attract technology partners, and then experiment with potential systems as they evolved. Because the content of the visual images would depend on obtaining rights to collect images of artifacts in museum collections, **Perseus** should begin establishing ties with various museums and collecting images for experimentation.

In the third component of research done under the Director's grant, Kenneth Morrell and Christopher Smith worked on the creation of two hypertexts in *NoteCards*. Morrell worked with a prose text, Plato's *Gorgias*, and Smith edited a hypertext of a poetic text, Aristophanes' *Birds*. Preparing the hypertexts involved entering and formatting the English translations and preparing introductory material and commentary for readers of both the Greek and English texts. During the course of work on the hypertexts, Randall Trigg from Xerox PARC served as a consultant, and helped prepare software for the demonstration package that **Perseus** delivered in October. Through Morrell's and Smith's work an early outline of a three-step authoring process emerged: 1) data entry, verification of the text, and initial formatting; 2) authoring of commentary, preparation of related secondary material, and building explicit links; 3) editorial review and revision. The project also gathered preliminary information on the time required for the authoring process.

Perseus: the Exploratory Phase: September 1986

In September, 1986 **Perseus** submitted a revised and expanded proposal that outlined more specifically the content of the textual and visual database, the computing environment for developing the database and accompanying tools for the user, and the issues of distribution and rights. In December, Annenberg/CPB Project received authorization to fund an exploratory phase of **Perseus**. The project staff would begin sample data entry and image collection and create a prototype that would incorporate both the textual material and visual images. Related objectives for the first year also included studying possible applications for **Perseus** in the classroom, negotiating for rights with sources of textual and visual materials, and forming the technical and educational advisory boards.

During the exploratory phase, a number of developments in software and hardware led to the introduction of a delivery environment that fit the needs of **Perseus**.[6] Apple Computer, Inc. began shipping a line of Macintosh computers with sufficient computational power and

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[5] This principal turned out to be valid. As a beta test site for *HyperCard*, the project expressed the opinion that **Perseus** could not use the system without scrolling text fields. Sources at Apple informed the project that its comments were a major influence in the decision to include this feature.

[6] For more on *HyperCard*, see the discussion in this section below. For more on its problems and on the delivery system in general, see Chapter VII.

graphics capabilities to serve as a delivery environment. In addition to the advances in readily available hardware, Apple also introduced *HyperCard*, a software package that represented one of the first widely distributed hypermedia environments. Although *HyperCard* (at least in its initial releases) has many limitations, it does enable users to adapt features of hypermedia technology to virtually any need. **Perseus** established a working relationship with Apple in 1987 and served as a beta test site for *HyperCard*, supplying demonstration stacks for the introduction of *HyperCard* at the MacWorld Exposition last August.[7]

From its initial release in August, 1987, *HyperCard* has been a convenient authoring environment for video disks, and could answer many of the project's most basic needs for working with visual materials. **Perseus** was also an early test site for the Macintosh CD ROM drive that Apple introduced in March. **Perseus** provided a number of prototype stacks for the *Apple Learning Disc: A HyperCard Collection for Education* that Apple distributed with the introduction of their CD ROM drive.[8] With the appearance of *HyperCard 1.2* (which can support a read-only medium such as a compact disc), the first viable delivery system for **Perseus** had arrived.

Work on data entry has proceeded as planned. With regard to the textual elements of the database, **Perseus** has now entered 10 megabytes of information including the entire *Intermediate Greek-English Lexicon* (7.5 megabytes) and a variety of Greek literary works (approximately 3.5 megabytes). The project has also made a number of decisions concerning the visual component of the project. On the advice of the Technical Advisory Board, **Perseus** will transfer high-resolution images from both video tape and 35mm slides into a digital format and then deliver the images in resolutions that will match the display characteristics of the systems. As an interim step during the development of the visual materials, **Perseus** began collecting images in video and integrating images from a video disk with the textual materials.[9]

With respect to the structure and application of the database, the project has created the basic data structures that form the foundation of **Perseus**, and has prepared courseware for use in three courses during the 1987-88 school year. These courses tested computer-based educational materials that incorporated certain aspects of the overall design for **Perseus**.[10] The experience in using the courseware has provided the necessary background to develop a framework for a system of evaluation. The project has also surveyed potential users of **Perseus** and expanded the initial audience profile.

Perseus has created a considerable amount of interest among system and application designers, educators, and scholars. Members of the project have been invited to participate in a number of conferences including the International Conference on Databases in the Humanities and Social Sciences '87, MacWorld Exposition, Hypertext '87, the annual convention of the American Philological Association and the Archaeological Institute of America, CALICO '88, the Conference on Office Information Systems '88, and Ascent '88. As **Perseus** has drawn closer to becoming a viable means of distributing information on ancient Greece, a number of scholars have expressed interest in doing their normal work in such a way that it could appear both in the conventional printed form and in an electronic form as part of **Perseus**.

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[7] See the *Persian War* stack in the Sample Materials.

[8] A copy of the disk jacket is included in the Appendix.

[9] *HyperCard* stacks included in the Sample Materials contain bitmaps derived from *PostScript* images, as well as black-and-white examples of Landsat images. The Annenberg/CPB panel reviewing applications for the May submission date will see sample video and digital color images.

[10] See Morrell, "Teaching with *HyperCard*;" and Smith, "Teaching with *HyperCard* at Bowdoin College," in the Appendix.

Software to Search and Display the *TLG* CD on a Macintosh

Apple Computer has given **Perseus** a $15,000 grant to produce software that will search and display texts from the **TLG** CD on a Macintosh. This smaller project will begin this summer, with Elli Mylonas as project leader. A programmer has been hired to use whatever he can of Gregory Crane's original search and display programs for the VAX, and to write whatever new code is necessary to accommodate the Macintosh and the file formats of **TLG** CD. We plan to write this as *HyperCard* XCMDs (external commands) and XFCNs (external functions), so we can take advantage of the windowing and interface facilities of *HyperCard*. We expect at least to have simple searches running by the end of the summer, and to extend the system over the course of the winter. With minor modifications these programs will also be able to handle the **PHI** CDs.

Other Concurrent Projects on Classical Greece

The **TLG** has awakened classicists to the possibilities of an electronic medium. David Packard's *Ibycus SC* has allowed many departments and even many individual scholars to gain access to this vast database (the entire system costs approximately four thousand dollars, including a Compact Disk player). Many classicists who knew little or nothing about computers a year ago have now become experienced users with clear ideas of what they can accomplish and what they would ultimately like to do. Consequently, interest in the application of computer technology to Greek studies and classics in general has grown considerably. The following is a brief overview of the activity, both past and present.

The Packard Humanities Institute has provided funding for a number of projects relating to Greek studies. At present they are funding a project that will produce a morphological analysis of the New Testament. They also provided funding for half of the data entry costs for the *Intermediate Greek-English Lexicon* and will work on a project parallel to **Perseus** to prepare the work for wider distribution.[11] At UCLA, under the direction of Bernard Frischer, scholars have been working on the *Classicist's Workbench*, which provides scholars with access to lexical, encyclopedic, and bibliographic information as well as the **TLG** through network and telephone connections to a VAX minicomputer.[12] Data entry efforts have been concluded or are currently underway at Duke (the Duke Databank of Documentary Papyri, formerly under the direction of William Willis and now headed by John Oates), the University of Michigan (subliterary papyri, under the direction of Ludwig Koenen), Cornell (Attic inscriptions, under the direction of Kevin Clinton), Princeton Institute for Advanced Studies (inscriptions from Asia Minor, by Donald McCabe under the direction of Glen Bowersock), the University of North Carolina at Chapel Hill (Athenian inscriptions, under the direction of William West), the University of Minnesota (Linear B documents, under the direction of Holly Morris), the University of Ohio (inscriptions from the Peloponnesus, at the Center for Epigraphical Studies under the direction of Stephen Tracy). International projects include the Oxford Text Archive under the direction of Susan Hockey, a large text archive that the Centre de Traitement Électronique des Documents at the Catholic University of Louvain at Louvain-la-Neuve under the direction of Paul Tombeur, and "The Athenians," a prosopographical database at the University of Toronto under the direction of John Traill. In addition to those who are creating databases, a number of people are preparing texts,

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[11] The Packard Humanities Institute is funding the collection and entry of Latin texts that will eventually form a Latin database analogous to the **TLG**. A number of other projects are involved with Latin materials. Among them is the Istituto Linguistica Computazionale at Pisa under the direction of Antonio Zampolli. We are indebted to John Gleason of the Packard Humanities Institute for his help in preparing this summary.

[12] Bernard Frischer, the outgoing chairman of the Classics Department at UCLA, is a member of the **Perseus** Educational Advisory Committee.

translations, or general books for distribution in electronic forms. Several have expressed interest in seeing their material appear as part of **Perseus**.

Graphics has proven more challenging, and there is currently no equivalent to the TLG for visual images. However, the *Lexicon Iconographicum Mythologiae Classicae* represents an international project that seeks to collect information about all the major visual illustrations of Greek mythology. The LIMC does not intend to archive images, but rather provide means for scholars to locate and research illustrations of mythology through detailed descriptions. For example, by turning to the article on the Greek hero Ajax, a scholar can find a comprehensive list of representative illustrations of Ajax that appear in vase paintings, terracottas, statues, and other objects. Next year Jocelyn Penny Small, director of the American branch of LIMC, will finish the 7,000 catalogue cards for iconographical objects in American museums. **Perseus** has conferred with Small on several occasions and has initiated an exchange of data. The project considers her an extremely valuable resource in classical studies because of her considerable experience in dealing with problems of establishing a standard technical vocabulary and with practical issues of information retrieval.[13]

Perseus and Other Experiments in Interactive Learning

Optical disks allow **Perseus** to offer the vast quantities of necessary information, but storage alone does not provide access. **Perseus** seeks not only to serve many different audiences, but to include many different kinds of information. In order to manage the texts, drawings, color images, and other kinds of data, **Perseus** will use a hypermedia system

Although hypertext/hypermedia is not a new concept,[14] the hardware and software needed to support such systems are only now becoming accessible to the general public. This parallel development is promoting new and innovative uses of computers in education. The computer can store more data than traditional media at a lower cost. Computers can also be used to structure data so that it is more accessible and to provide tools that make the data easier to comprehend. Finally, software is appearing that makes it easier for the nonspecialist to customize his electronic environment and to adapt applications for his own use.

We have established a widening circle of contacts with others actively designing hypertext systems or creating hypertext/hypermedia databases. Our Technical Advisory Committee includes Frank Halasz and Randy Trigg, two of the major authors of Xerox *NoteCards*; Norm Meyrowitz, the designer of *Intermedia*; and Tim Oren of Apple Computer, who produced the *Apple Learning Disc* and has been a long time researcher in hypermedia applications. We have spoken extensively with Professor George Landow, who has for several years built English courses around *Intermedia* at Brown University, and with Jay Bolter, a classics professor at the University of North Carolina at Chapel Hill, who is one of the authors of *StorySpace*, a hypertext system for the Macintosh. We are anxious to expand our contacts further.[15]

We recently took one small step in increasing the dialogue between users and designers of hypertext/hypermedia systems. With special funding from the Annenberg/CPB Project, **Perseus** hosted a workshop at Harvard in March, 1988. Scholars who are currently working with a variety of hypertext/media systems came together to discuss how these systems have

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[13] On collaboration with LIMC, see Chapter VIII, *Rights*.

[14] The concept was first described by Vannevar Bush in 1945 ("As We May Think," *Atlantic Monthly* 176, 1). Ted Nelson was writing about it as early as 1965 ("A File Structure for the Complex, the Changing and the Indeterminate," *Association for Computing Machinery, Proceedings of the National Conference, 20th*, 1965).

[15] In the final weeks before this proposal was due, Robert Kozma, the director of the project on Learning, Teaching and Technology at the Natonal Center for Research to Improve Postsecondary Teaching and Learning, brought to our attention *Learning Tool*, a hypertext system for the Macintosh.

affected the assignments they give their students.[16] The discussion focused on four related effects of hypertext systems in the classroom:

- Hypertext can be used to extend students' grasp of information, and to help them control a wider body of knowledge than they otherwise could.

- Insofar as it allows learners to cover more ground, hypertext can enhance the development of multi-causal reasoning and can permit a multi-disciplinary approach to a subject.

- Hypertext blurs distinctions such as reader/author and student/teacher.

- Because it breaks down traditional distinction between teacher and student, hypertext can promote collaborative learning.

Perseus has submitted a proposal to conduct a panel at the EDUCOM convention this fall in Washington D.C. that will be based on the March workshop. The Project plans to distribute *HyperCard* Stacks that illustrating ways in which hypertext can influence instruction. As on on-going hypertext/hypermedia project, **Perseus** hopes to become a useful conduit through which others working with this new technology can disseminate their ideas and experiences.

Changes in Perspective: 1986 to 1988

The preceding section outlined the history of the project and the influences that other projects and scholars have had on the current developments. In the following brief discussion about how the perspective of the project has changed over the past two years, we will focus on the implications of commercially available hypertexts that significantly reduce the amount of software that the project must provide

When we composed our January, 1986 proposal to Annenberg/CPB, we thought that we would be working on Unix workstations. Not only would we have to oversee an extensive data entry operation but we would also have to do substantial programming before we could fully manipulate the data. As a consequence **Perseus** was originally far more centralized, with a group of staff members who would be responsible for creating and supporting high-level environment for the user and a lower-level set of primary textual and graphic materials, and a group of collaborators who would provide interpretive and informational overviews of the materials. In many cases the groups overlapped and created unreasonable demands on certain members, who would have to make far-reaching initial decisions not only on the capabilities that **Perseus** would or would not incorporate but also on content and contextualizing materials. Because only a small number of programmers would be capable of changing or expanding the system, they would have to be extremely selective in choosing how the system would work and ultimately how the audience would make use of it. We hoped that after the first year the database and user tools would be ready and we could then turn to a small group of people outside of the project in order to test what we had done.

With the advent of *HyperCard* and the promise of similar and better hypertext environments, we have the opportunity to approach **Perseus** in a less centralized and autocratic manner. Because users will have more control over how they wish their data to appear and how they wish to use that information, the project can focus more of its energy on collecting and structuring the data and providing support for a wide range of collaborators. Each new edition of **Perseus** will represent the work of an ever-increasing group of scholars and instructors who use **Perseus** in their research and teaching.

Beyond the central staff of editors, collaborators in the project will come from three principal groups:

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[16] A brief summary of the results from this workshop is part of a panel proposal made to EDUCOM. The proposal is included in the Appendix.

- Authors

We will identify a small number of authors (three to six) each year who will receive financial support for their work in identifying important primary sources for addition to the database and in preparing contextualizing materials. The **Perseus** staff will devote considerable time and energy to supporting and monitoring their activities.

- Developers of Applications

At the same time, **Perseus** will work with scholars and instructors and who use **Perseus** in their research and teaching. Applications that they develop for their particular purposes will gradually form a body of applications that **Perseus** can offer to distribute to other users as examples of how various people have put **Perseus** to work.

- Outside Contributors

If **Perseus** can become a part of the accepted research tools of scholars, **Perseus** will begin to receive scholarly contributions from people outside of the project and eventually become a medium of publication. Given the guidelines for materials that form part of the database, these instructors and researchers will be able to prepare **Perseus** materials without extensive financial or technical support. Their contributions can enter the review process that **Perseus** authors use and eventually become part of subsequent releases of the database.

We view this blurring of author and user with great enthusiasm and look forward to seeing how people in the field will make use of the material we disseminate. The users of **Perseus** will constitute an extended laboratory. People outside the project can influence both the material itself and the way in which we structure it. We, in turn, hope to incorporate as many good ideas as possible into **Perseus**. Every new version of the database will contain not only additional material, but will be organized in increasingly general and powerful ways.

Perseus is no longer a single massive project with one or two major releases planned. It is evolving into a consortium of smaller projects which reinforce and add value to each other. We plan to release new versions of **Perseus** on a yearly basis, and contributors will work continuously at a variety of sites in preparation for new versions of **Perseus** .

There are problems to this approach. The more people we involve in the project, the more difficult it will be for us to keep **Perseus** from disintegrating into a mass of disparate and unconnected pieces. The entire staff must work hard to ensure that the various sections of **Perseus** work together as smoothly and seamlessly as possible. Nevertheless, we have consciously decided that the benefits of this far outweigh the risks.

IV. Tasks and Methods

Introduction

Availability and accessibility are not the same thing where data is concerned. It will not be easy to create a heterogeneous database that contains literary, historical, and philosophical texts, primary reference tools such as a dictionary and atlas, plans of buildings, pictures of archaeological objects or of places in Greece, and various other materials that reflect upon the classical Greek world; but we have done enough work to know that we can create such a database. Ultimately the technology will also evolve to the point where even many students will be able to afford individual systems on which they can use the Perseus database. Data collection and designing an appropriate delivery system are difficult problems, but we feel confident that they can be overcome.

The hardest problem is how to structure the data. The data must be organized in such a way that both the novice and the expert can get useful information on a given topic. Just as the ease of finding a book in a library does not always depend on the skill of the user but can be dramatically streamlined if the library is well organized, the ease and efficiency of finding information in a computer-based system not only depends on the speed of the search programs but also on the structure of the information. No program can wholly make up for poorly organized data. The science of information retrieval truly begins at the point where the inherent structure of the information becomes inadequate, and no structure will ever be so complete that it will put information retrieval specialists out of business. We as humanists seek to organize our data in the most flexible possible manner. Ours is primarily an editorial task.

Basic Strategy

Our approach is conservative. We have based our initial model on the intellectual traditions that have evolved over four thousand years of written material. We have then used our own experience with data bases (both full-text data bases such as the TLG and relational databases such as the *Lexicon Iconographicum*[1]) and our experience with existing hypertext/hypermedia systems (Xerox *Notecards*, Brown's *Intermedia*, Owl's *Guide*, and Apple's *HyperCard*) to extend our model of what tools we can provide to support intellectual activity.[2]

Many familiar categories of information remain: dictionaries, critical editions, an atlas, an encyclopedia, and museum catalogue entries all appear within **Perseus**. But the form of these individual document types has begun to change as a result of our initial work.[3] Thus the dictionary contains some information that might have been included in the notes for the printed edition of a play. By changing the way in which our colleagues view a critical text or the catalogue entry for a museum artifact, we influence the basic forms in which humanists shape and disseminate their knowledge—a major purpose of the project. By emphasizing the familiar and stressing continuity we achieve two things:

- We make our work more accessible and less threatening to instructors and learners who have grown up with printed information.

- We clarify our starting point and make progress easier to measure.

General Goal: opening doors to more sophisticated reasoning. Perseus will ultimately contain information about a wide variety of materials, and the overall database will contain

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[1] On the LIMC, see Chapter III, *Context*.

[2] Chapter III, *Context*, gives a history of the development of **Perseus**.

[3] See "Redefining the Book," p. 40, included in the Appendix.

many smaller databases of various kinds. There will be plays and vases, architectural drawings and inscriptions, sculpture and historians. The widely varying materials and specialties within **Perseus** might at one level seem to exert a tremendous centrifugal force. But given the goals of **Perseus**, diversity of material enhances the unity of the project.

A student thinking about the subject of a Greek vase painting, for instance, may have to go beyond traditional art history. Some have argued that one cannot interpret the hundreds of figures carefully drawn and labelled on the famous François Vase without relating these figures to the poetry of the lyric poet Stesichorus. The specialist in architecture, on the other hand, needs to cite a courtroom speech by the orator Lysias in which a typical Athenian home of the late fifth century is graphically described. The reader of Lysias, in turn, should constantly bear in mind a map of the sites of various law courts. And so on across the entire field of classics. **Perseus** is not only designed to put a vast amount of primary material at the advanced user's fingertips, but has already begun to make this information qualitatively more accessible to those beyond the immediate discipline at hand.

Similarly, illustrations of Greek athletic events in vase paintings provide the necessary cultural context for someone reading Pindar's victory odes. Printed publications of Greek vases, however, can for reasons of space provide only rudimentary indexing of subject matter, and nonspecialists unfamiliar with the scholarly apparatus of archaeological publications are unlikely to find the illustrations they want. For the topics covered in Phase II of **Perseus**, learners can quickly call up details of vases illustrating a particular subject.

The Problem of Orientation

The diversity of information within **Perseus** is its fundamental strength, but the more complex the information, the more carefully that information must be organized. In working with the TLG[4] we saw how disorienting a powerful new tool could be. The TLG opened up whole new domains of information for classicists, and we were able to find useful parallels in authors that we would never otherwise have seen, much less read. Our horizons were measurably broadened. But at the same time, the experience was disorienting. The TLG is so comprehensive and so diverse that even professional classicists had never heard of many of the authors that it contained. Furthermore, even if we did ultimately learn who all the several hundred TLG authors were, we certainly did not know the context of all their works.

Our own painful experience with the TLG has made us sensitive to the problems of learners who are suddenly faced with vast new quantities of information. We recognize that the learner using **Perseus** will encounter the same general problem, potentially to a much greater degree given the greater range of materials within **Perseus**. In a class on Greek tragedy, for example, students may need to read passages in the "Old Oligarch," a tract that outlines the views of extremely conservative members of Athenian society in the later fifth century. This document sheds enormous light on the assumptions of some Athenians about how people should behave. It can give the student of literature a completely different perspective on some problems, but reading tragedy does not prepare learners for evaluating the evidence of a political pamphlet such as that of the "Old Oligarch."

Providing background is thus a major pedagogical problem. But given our present resources, how can we provide sufficient background that students will be able to interpret the passage from the "Old Oligarch"? Without **Perseus**, we might discuss the "Old Oligarch" in class, but class time is extremely limited, and we can do little more than cursorily describe the "Old Oligarch." We could digest the background ourselves and then provide it in a handout, but again in a normal course we do not have time to create handouts about every major figure relevant to Greek tragedy. Students need basic information before they can use a given source, but there is only so much information that we can give without a tool such as **Perseus**. Simple

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[4] The TLG is described in Chapter III, *Context*.

logistics limit the paths we can ask students to take as they pursue complex problems through overlapping disciplines.

Learners need a resource such as **Perseus** if they are to extend their intellectual range. But if **Perseus** is to be useful, learners must be able to orient themselves rapidly and comfortably as they move through the **Perseus** database. We will provide a narrative overview of Greek civilization,[5] and we will also devote much of our work to refining the structures that shape the database and the paths that lead through it. We must make these as clear and as easy to follow as possible. Our progress towards this goal will be a major contribution to others who seek to develop similarly complex hypermedia databases.

Standards and Editorial Control

For the learner to be able to move from place to place within the **Perseus** database, the structure of the information must be consistent and consequently predictable. In other words, once users have seen several descriptions of Red Figure vases, they should have a general idea of how the next description will appear and therefore know precisely where to look in the description for certain information.[6] Consistent formats will enable learners to orient themselves more quickly, to move more fluidly and swiftly on their paths of exploration, and to incorporate ideas and information from a broader and deeper interdisciplinary base.

We must therefore define as precisely as possible the data structures that we are going to use in **Perseus**, and then make sure that this is precisely what we get. Our ideas of what information should accompany a text or vase in **Perseus** will certainly evolve over the course of the project. But when we do change our vision of how some class of information should be stored, the decision should be deliberate and studied. The form of the information within **Perseus** cannot simply drift.

Two kinds of editorial control are needed to insure that the information within the database is accurate and consistent:

- • Continuity of Form. The contributor who includes a Greek vase should have an electronic form to fill out, one category of which would be "divine figures." Someone who adds a poem would complete a template that included "metrical analysis." An editor must ensure that information placed in these forms is consistent, even if some categories of information only contain a warning "relevant, but not included at this stage."[7]

- • Peer Review. Peer review has proved to be a workable and effective model for traditional publications. In consultation with the Executive Committee, the Editor in Chief will locate suitable experts in the field to review the material within **Perseus**. Members of the Academic Advisory Committee will assist in this process either by reviewing material themselves or by helping the Editor in Chief identify suitable referees.

Implementation

Two examples can illustrate the general problem that faces us as we attempt to make **Perseus** as generally useful as possible. Suppose, for example, that someone working on the poet Pindar adds to **Perseus** the picture of a vase containing a chariot race. That vase may also portray Athena overseeing the contest, or the person in the chariot may be a mythological figure such as Antilochus. The person working on Pindar may be primarily interested in the chariot and may only record the fact that this vase includes a chariot. A student working on the goddess Athena might ask, "what vases in Perseus show Athena?" but the chariot vase would not show up in the query.

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[5] A detailed description of Tom Martin's overview is in the Appendix.

[6] To view prototype formats for Greek vases (as well as texts and other objects), see the Sample Materials.

[7] The Sample Materials include our current templates for various kinds of informaion.

No amount of programming can make up for missing data. While we obviously cannot mark everything, we need to have certain protocols within the database so that users can know ahead of time how reliable a query is liable to be. There should be certain conventions associated with every category of data so that when someone enters a new piece of information that category will be represented. Thus, divine figures should always be noted on any vase included in **Perseus**, even if the purpose of entering that particular vase is to illustrate a chariot. Other categories of information may be optional, but optional and necessary categories should be clearly distinguished to prevent the user from misinterpreting the completeness of the information within the database.

Types of Information in *Perseus*
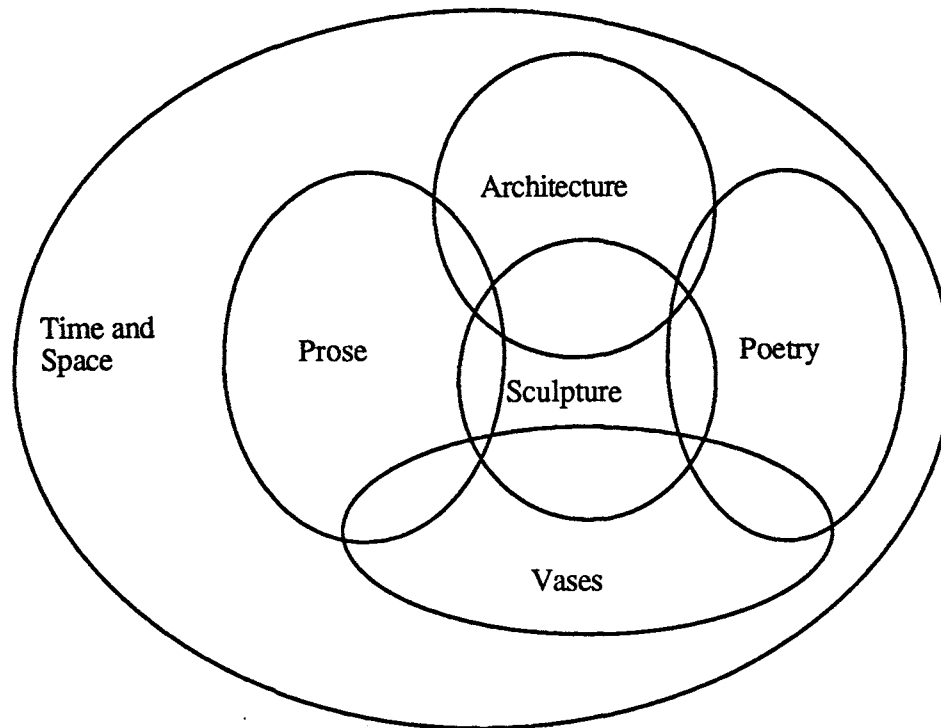
Figure 4.1. Many kinds of evidence about the classical Greek world survive, but individual objects from antiquity often represent more than one kind of evidence. Consider, for example, the treasury built by the Siphnians at Apollo's oracular shrine at Delphi. As a building it belongs in the category of architecture, but a sculpted frieze encircles its top, and these reliefs belong in the category of sculpture. Furthermore, figures in the frieze are labelled and these inscriptions constitute prose texts that contain important linguistic information. In short, prose, architecture, and sculpture all overlap in this particular object

Figure 4.1 illustrates the many kinds of evidence that we must incorporate into **Perseus** if we are to provide the learner with a balanced view of the classical Greek world. Some of the data structures within **Perseus**, such as the atlas or drawings of vases or texts of Greek plays, coincide with the categories above. Other data structures, such as encyclopedia entries or **Perseus** Themes, help relate the various materials in the database to one another. The following section does not discuss the actual data structures that we will include in **Perseus** but instead seeks to outline in general terms some of the principles that we have had in mind while prototyping the basic data structures of **Perseus**.

Audience

Material within **Perseus**, whether a prose text, vase, poem, or building, should serve both the undergraduate in an introductory course and the scholar doing specialized research. Though ambitious, this goal is technically feasible because the compact disk can store far more than a conventional book and because the electronic medium provides a more flexible environment within which to manipulate that information.

Because of its storage capacity a compact disk could, for example, contain a variety of texts, each as elaborate (or more so) than the three closely printed volumes of text, translation,

and commentary that the great scholar Eduard Fränkel published on the *Agamemnon*, Aeschylus' most widely read play. At the same time, we can provide different levels of commentary, so that the freshman can view basic information without being swamped, while the scholar can peruse an argument in exhaustive detail. Furthermore, we will be able to add many **Perseus** Themes at different levels of difficulty that reflect more than one approach to the same material.

Time and money rather than technology will determine how much material we can collect into **Perseus**. Nevertheless, if we can demonstrate that the same material can serve both the novice and the advanced audience, then others will follow our example and similarly ambitious tools will be created not only in classics but in many other disciplines as well.

We expect to place pedagogical and scholarly material on a single disk. In so doing, we hope to break down the distinction between the research and the teaching tool. The diversity of primary material tied together by **Perseus** Themes that may be used to teach different approaches or subjects will allow students to learn more and faster than they could before. Since Themes are independent of the data, instructors can add new ones or modify existing ones to suit their needs.

Scholars in various areas of classics can build new work on the tools and information contained in **Perseus**. Professor David Kovacs, a classicist at the University of Virginia, will work with **Perseus** to create a new text and translation of Euripides. This new work will appear in both printed form, as part of the Loeb Classical Library, and in electronic form as part of **Perseus**. Paul Lipke and the Trireme Trust are incorporating the results of the replication and successful trial of an Athenian trireme, the Olympias, into **Perseus**.[8] This Theme will not only report on the history of the trireme but will also serve as a tool that will allow students to test the different possible configurations of the trireme.

By working closely with specialists we can thus enrich and expand the primary data structures within **Perseus**.[9] We expect that what we learn about electronic publication of critical editions, vases, and other objects will serve an entire new generation of scholars.

Creating information that serves both student and researcher is a challenging task. The major problem is not technical but editorial—an important distinction. Even though we are using computers, selecting and shaping material within **Perseus** is the job of a classicist. An authority on Thucydides may need help from a computer expert before he or she can use *Guide* or *HyperCard* to develop a commentary with various levels of complexity, but programs such as *Guide* and *HyperCard* have vastly increased the amount that a user can accomplish. Although most humanists will want to work closely with someone who understands the technology, this partnership now has considerably greater potential than it did. The technology has evolved to the point where experts within the field can exert greater control over the form that electronic tools will take.

A Point of Departure, not a Conclusion

No object that comes to us from the classical Greek world, whether a Greek temple or an historical document or a work of literature, stands by itself. Temple, tragedy, history— they all can be fully understood only in the context within which they were created. Thus, the Parthenon must be studied in the light of the history of Periclean Athens, of which Thucydides' history provides the best account. Thucydides' history, on the other hand, also sheds light upon the plays of Euripides, while the plays of Euripides illustrate how the people who appear on the Parthenon reliefs lived and thought. Everything is connected. The

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[8] See "Trials of the Trireme, "*Archaeology*, March/April 1988, pp. 22-29.

[9] See Crane, "Redefining the Book: Some Preliminary Problems," *Academic Computing*, 2(1988):5, included in the Appendix.

more we can see of an object's context, the more the individuality and particular characteristics of that object stand out.

Perseus by its size and scope is designed to bring out this aspect of an object. Conventional printed works must often make do with printed cross references, which are closed doors to all but the most dedicated or specialized readers. **Perseus** opens these doors to less advanced learners. Learners can use **Perseus** to pursue associations and links immediately and to deepen their understanding of the matter before them much more rapidly and dynamically. The following sections outline some of the major resources that **Perseus** will provide to help open up this world.

Texts

Data Structures and Procedures

   Primary and secondary textual material will account for approximately one-third (measured in bytes) of the data within **Perseus**. It will consist of Greek and English texts, and will have varying degrees of accompanying secondary material. It will not be possible to develop all texts to the same degree in the first stages of the project; however, all texts will have certain basic components, and more can be added as work on them progresses. The texts will be chosen because they are particularly useful for introductory courses both in classics and in other disciplines.[10]
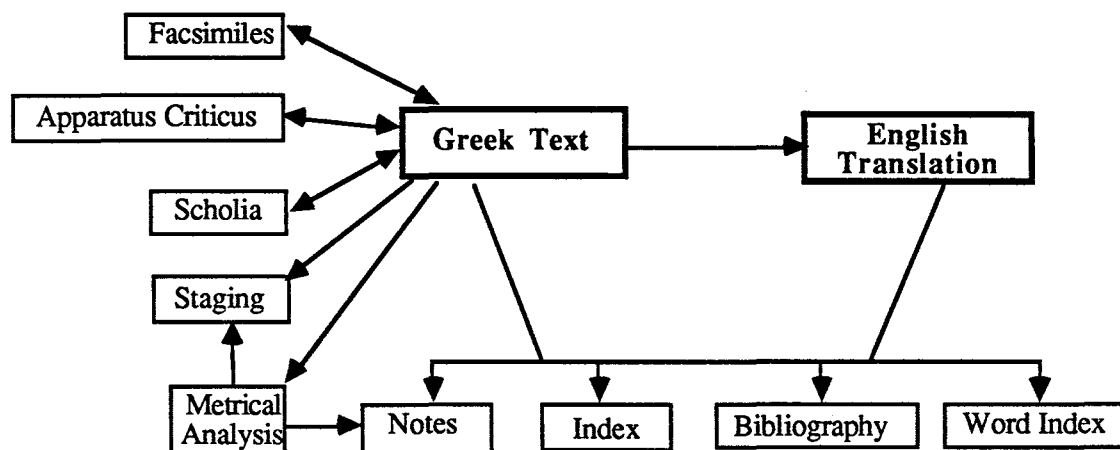
Figure 4.2. The components of a **Perseus** text. Lines show which portions of a text influence each other. Double-headed lines show interaction: thus, the text defines what is in a facsimile (of a manuscript or inscription), the *apparatus criticus* or the scholia, but each of these categories in turn determines what we believe the text to be. The Greek text, however, generally determines the shape and content of things such as metrical analyses or the English translation. Notes, an index, and general bibliography can each be influenced by either the Greek or the translation.

   A **Perseus** text will consist of English translation and if at all possible, Greek text. All texts will follow their conventional reference system, so a user can call up, for example, "Herod. 7.38" or "Sophocles *Antig*. 535". The Greek text will be useful to readers who do not know Greek since it allows them to investigate particular words and concepts that may not be clear from the translation. A student studying the concept of virtue could search for passages containing the Greek word ἀρετή and then see how it is translated not only as "virtue" but also as "skill" and "excellence."[11]

   The most commonly used texts would get a fairly full treatment (we have, for example, already begun to provide this for Aeschylus). Others might lack an *apparatus* or a commentary. The templates for texts will allow for any of the standard secondary material to

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[10] We are beginning with texts that appear in compilations such as Eric Cochrane, *Western Civilization at the University of Chicago: An Introduction for Teachers* (Chicago: University of Chicago Press, 1986). For specific texts and justification, see the following section.

[11] Using *Morpheus* and the lexicon, the student who does not read Greek will be able to find equivalent words in a Greek text. See the section on *Morpheus* in this chapter for a description of how this can be done.

be added to any text so components that are initially lacking may be added later on. Our job is twofold: to provide a basic selection of Greek texts and to show our colleagues what can be done now.

According to our estimates it will take about a month to prepare one play or "book" of a Greek author. Although it is not possible to predict exactly how long it will take to prepare a **Perseus** edition, it took Professor Crane about one month to prepare the *Agamemnon* of Aeschylus once he had received the on-line version of the text. This included (a) revising the translation, (b) typing the metrical schemata, and (c) putting the (synthesized) *apparatus criticus* into *HyperCard*.

The figure of one month is fairly generous. Not only is the *Agamemnon* one of the longest Greek tragedies but Crane was at the same time developing the programs with which to process this and other texts, so that some of his time was not spent actually editing the material. Furthermore, he had not worked closely with the *Agamemnon* (or with Aeschylus) for some time, so that he did not feel that he had any great advantage in this particular area over the average graduate student who is making Aeschylus his or her specialty. Elli Mylonas is now in the process of preparing the *Choephoroi* while Professor Crane is doing the *Eumenides*. This will give us a better idea of the time it will take to do this job.

Preparing prose texts will be far more efficient than preparing drama or poetry. We will rarely have to edit archaisms out of the English translations; we will not need to provide metrical analyses; and the *apparatus criticus* is often much simpler.

The rest of this section presents the individual components of a **Perseus** text in detail. This description assumes that the reader has some familiarity with classical texts and the scholarship that goes into creating them. We include these details because **Perseus** should serve the needs of both students and scholars.

Necessary Components of all *Perseus* Texts

Translation

Every **Perseus** text must have a translation so that it will be accessible to the reader who does not read Greek. On the other hand, we want to be able to sell the basic collection at a price that students can afford (approximately forty dollars). Therefore, we cannot let royalties inflate the cost of **Perseus**, and we will not accept any licensing arrangements that would restrict the dissemination of **Perseus** material.

Perseus must provide translations that are clear and accurate. Converting an existing translation for **Perseus** consists of two steps. The translation itself may need to be edited. We will often be able to use older translations, editing out some of the more striking archaisms, but leaving the basic translation intact.[12] Not every translation contains reference marks such as line numbers or paragraph and section numbers. These must be added so a general reader can locate a reference such as "Aeschylus *Persae* 344" or "Herodotus 7.33." This is a purely mechanical task but must be performed by a person who knows enough Greek to match the English to the relevant passage in the Greek text.

In some cases, it may be necessary to develop an entirely new translation. We will avoid this whenever possible because it is a far costlier and slower process than simply revising something that already exists. There are, however, some examples (such as Homer and Aristophanes) for which neither the Loeb nor any translation in the public domain

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[12] The nineteenth-century translations of Sophocles' plays by R. C. Jebb are good examples of this, since they represent the Greek text accurately yet are not so archaic in sentence structure and diction that they cannot be modernized with relative ease.

provides a reasonable foundation on which to build. In the case of Euripides, for example, we are helping Professor David Kovacs to create a new set of translations.[13]

A teacher might prefer that his students buy and read a paper edition of those plays on which his class will focus, and then assign the **Perseus** compact disk as a further resource. The student could use the **Perseus** translation as an extended index into the rest of the database. Ultimately, publishers might sell machine-readable versions of their translations, which could be imported directly into *HyperCard*.[14] The student would then not have to pay royalties for translations of all of Greek drama and Homer, but would still be able to work with the same translation in the database and in print.

Greek Text[15]

While an English translation will remain the primary tool by which students without the knowledge of Greek will experience the plays of Aeschylus or the history of Thucydides, translation is a derivative work and represents an interpretation of the Greek text. Figure 4.2 illustrates the fact that the original Greek is the center around which all other aspects of the text revolve.

We have therefore placed a high priority on delivering both the Greek original and an English translation for all texts in **Perseus**. The cost is substantial: as much as a third of the budget for textual data entry will go to entering, verifying, re-editing, or otherwise manipulating the Greek text. Nevertheless, delivering both Greek and English occupies a crucial part of our strategy.

• The Greek makes the texts that we provide useful not only to the novice but to the expert. A database that only included translations would never attract the expert user as much as a database that included the original as well.

• **Perseus** augments the way in which the expert can manipulate Greek texts. The *apparatus criticus* and metrical analysis described below extend the reach of the advanced student of Greek.

• We have developed tools that allow the student who has little or no experience with Greek to use the Greek text in ways very close to those of the professional classicist.[16]

For reasons of copyright a **Perseus** text may be based on an older edition, but **Perseus** can also incorporate work that has taken place since the source edition was created. Thus, we will use the nineteenth century edition of R.C. Jebb as our base text of Sophocles but we may be able to record those places in which more recent editors[17] differ from Jebb. In many cases, however, little appreciable difference will separate our base text from the most recent edition, and we will have little if any editing to do. We will rely upon our Educational Advisory Committee to help us determine on a case-by-case basis what we need to do to provide an acceptable version of the text.

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[13] See under Euripides in the following section.

[14] Such a strategy would work even today using Apple's *HyperCard*.

[15] On the relationship of **Perseus** texts to the TLG texts, see the discussion of the TLG in Chapter III, *Context*.

[16] For more detail see "Morpheus...," in this chapter.

[17] R. D. Dawe and A. C. Pearson.

Possible Components of *Perseus* Texts

Brief Notes

We will attempt to provide brief annotations for some **Perseus** texts. However, we do not have the resources to commission fully developed commentaries for all texts in **Perseus**: Phase II. Many background annotations (e.g. "who are the Erinyes?" and "where is Melos?") will be automatically cross-referenced into the Encyclopedia. This cross-referencing will require no work on the part of the **Perseus** staff or **Perseus** authors unless they need to add a new entry to the Encyclopedia, because it will be part of the implicit linking structure.[18] These annotations would provide factual explication. For some texts we might also be able to get detailed, scholarly notes on the scale of those in M. L. West's edition of the *Orestes* of Euripides or the *Anthology of Greek Orators* by Edwards and Usher. These would both fall under the category of a **Perseus** Theme, that would be undertaken by a **Perseus** author.

Creating notes associated with a single author can be far simpler than in a normal self-standing translation. Precisely how much material these notes should contain is unclear and will be determined by the author in consultation with the Managing Editor.

Index

Many editions of texts already have good indices which are the work of scholars. References to ancient texts follow a canonical reference scheme, so an index would be valid across editions of a work.[19] We would like to take advantage of the information in these indices by incorporating them into the text. Many of the cross references will already be in the Encyclopedia, but the index may contain less obvious references that would otherwise be lost. The Loeb Library edition of Herodotus, for example, has an extensive index that was turned into a database by Elli Mylonas. The index of mythological references to the Loeb edition of Pseudo-Apollodorus makes the book a useful mythology handbook.

Lemmatized Word Index

Combining *Morpheus* with the Greek lexicon will allow users to go from almost any word in a **Perseus** text to a list of the possible morphological analyses of the word and from there to a dictionary entry with its meaning. It is a fairly easy task to create an index of the words within the text and then to run *Morpheus* on the list to obtain a complete analysis of each word. If *Morpheus* cannot analyze a word, the person supervising this stage of the process can add the appropriate entry to the list (e.g., add "Themistocles" to the Lexicon). One benefit of this operation is that *Morpheus* works as a powerful spelling checker (it occasionally turns up typos in the TLG—which are generally few and far between).

We can run *Morpheus* over every **Perseus** text. A research assistant would then have to make sure that every analysis is unambiguous with respect to its dictionary entry. The analyses could then be stored in a separate file. The user who wanted to see the analysis of or to go to the dictionary entry for "αἰσχύνη" would not have to call *Morpheus* but could work entirely within *HyperCard* or some other hypertext or database system.[20]

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[18] See the section "Navigation...," in this chapter for a discussion of implicit links, and "Document and Hypertext Structures for Perseus and the Advantages of Content Markup" in the Appendix.

[19] See the section "Navigation...," in this chapter for a description of canonical reference schemes.

[20] Nevertheless, *Morpheus* cannot analyze every form (in the manner that Professor Robert Kraft, for example, has done for his *Septuagint* Project). It cannot determine whether a given occurrence of "ἦγον" is the 1st-person singular or the 3rd-person plural, and it cannot tell if "πέμπουσιν" is the 3rd person plural or the dative plural masculine/neuter of the present participle. A human would have to go through the text and disambiguate each occurrence of these forms by hand. This is a difficult and lengthy task which must remain for another project.

Note that this exercise does not merely benefit students learning to read Homer or Plato but allows the student without knowledge of Greek to approach semantic problems in the original language. Thus a freshman could observe how key ideas (such as "shame," a fundamental cultural value) are structured in Greek society, or how a philosopher such as Plato wrestled with utilitarian and ethical views of virtue (as in the Greek word "ἀρετή" which can designate "skill at a particular task" or "moral worth").

Metrical Analysis

All Greek poetry is metrical, and much of that meter is regular and predictable. Once someone has learned to read an hexameter or iambic trimeter, they can pick up any passage in Homer or any iambic section of a Greek play and read that section aloud. This is particularly important in Greek poetry, which was always written to be read aloud: a text of Greek poetry more closely resembles a musical score than it does a modern printed text.

Much Greek poetry, however, was composed to be sung aloud, and the metrical patterns in such "lyric" poetry are unpredictable. Only scholars with specialized training can reconstruct the meter that underlies such songs in Greek drama. But editions normally do not include these analyses, and if they do the analyses are not integrated into the text. At best, the reader must copy out the text, mark the long and short syllables by hand, and then practice reading the passage aloud. As a result, many conscientious readers often disregard the meter and abandon a crucial dimension of the literature.

In **Perseus**, however, we can integrate the metrical analysis of a lyric passage into the main text. Thus, a reader might begin by reading the plain Greek text, then click a button to show the metrical analysis on the screen, and then click the button one more time to hide the analysis.[21] One can actually follow the lyric meter without "turning to the back of the book." This changes the role meter can play in an intermediate Greek class. The more tightly meter is associated with the text, the easier it becomes for a student to use the analyses and understand the metrical qualities of the poetry.

Bibliography

Each text should have basic bibliography. This will include a standard list of major editions, scholia, commentaries, as well as important articles and books. A selective annotated bibliography is often more useful than a more exhaustive bibliography: learners appreciate clues as to what an article or book contains, and why it is of particular interest. (The brief annotated bibliographies in the back of the Twayne's World Author Series provide a useful model.) A comprehensive list of references tends to dissuade all but the most determined researcher.

There is at least one danger in this approach. Authors will tend to follow their own interests and perspectives as they select and annotate major works, and this can confuse the learner, to whom a bibliography might seem an objective resource. Authors and the entire editorial staff will have to strive especially hard to make sure that bibliographies in **Perseus** are as balanced as possible.

If this category were expanded, it would not be a just large database but would become a survey of major scholarship that discusses publications at greater length and could be easily altered or expanded. We have not decided whether the bibliography will be one large database whose references are assigned keywords, or a separate file for each author. The former is more efficient and easier to use but requires more complex retrieval functions than the latter.

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[21] See "Redefining the Book," included in the Appendix.

Staging

Reading tragedy silently in a library or even aloud in the classroom is a modern and anachronistic practice: the plays were always composed with performance in mind. A student reading a Greek tragedy should visualize what is happening on the stage. Our editions of Greek plays will therefore make some attempt to describe the stage action. We plan to extend Neel Smith's *Visualizing Aristophanes*[22] and provide blockings of the action for selected plays. A library of alternate views may ultimately be collected; Neel Smith already has four high quality representations of the *Acharnians* of Aristophanes, from the class that he taught last semester.

Apparatus Criticus
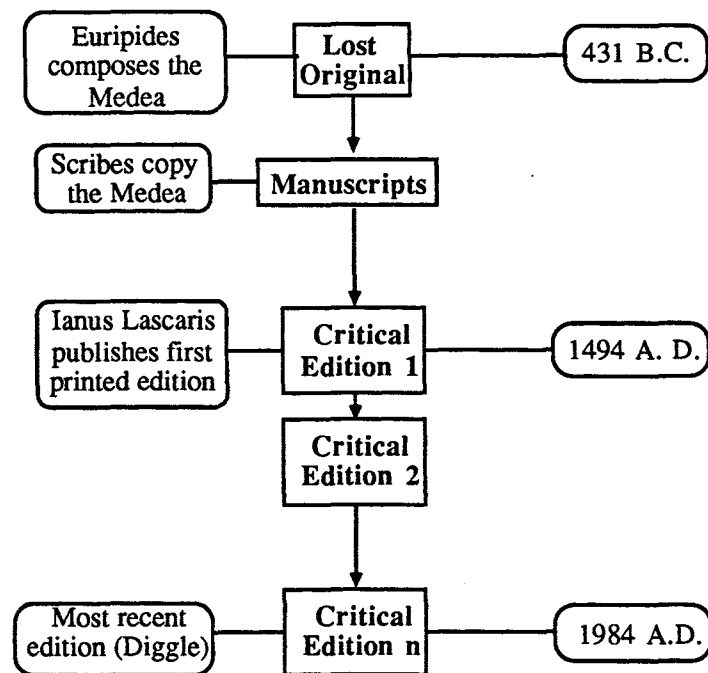
Figure 4.3. For two thousand years all copies of what the author wrote had to be made by hand, and each copy added mistakes that distorted the text. In the Renaissance, scholars began systematically restoring the original, so that the twentieth-century editor must consider not only two thousand years of textual disintegration but five centuries of scholarship.

No one knows or ever will know precisely what Euripides or Thucydides or any other classical Greek author wrote. Sixty generations separated the time when they composed their work and the invention of the printing press. During that time, to make a new copy of Euripides' *Medea* or the history of Thucydides, a trained scribe had to write out the entire work word by word. Sometimes the scribe would slip: perhaps he would accidentally replace one word with another; perhaps an explanation scribbled in the margin would be copied as if it were part of the text; perhaps his eye would skip from one line to another and he would leave out an entire sentence or more. The next scribe would generally take what he found, blindly

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22 See the description of Neel Smith's theater game in his "Teaching with *HyperCard* at Bowdoin College," in the Appendix.

copying old mistakes and inevitably adding his own. Texts disintegrated slowly but relentlessly.

With the advent of printing, this literary entropy was arrested and even in some measure reversed. A scholar could compare manuscripts and ponder the differences between them. Slowly he would begin to see places where one manuscript was more likely to be right than another, or, where no manuscript seemed to be right, he would make his own suggestion— generally referred to as a "conjecture"—as to what had originally been in the text. More importantly, the new version that he had laboriously created could be set in print and thousands of identical copies distributed. For the first time ever, a scholar in England knew that he was reading the same words in the same place on the same page as his colleague in Milan. For five hundred years since then scholars have carried this process further, devoting lifetimes to reconstruct as best they can what the authors actually wrote.

Despite the time and effort made, the editor of an ancient text can never truly claim to have fully reconstructed the original text. All scholarly editions are therefore accompanied by an *apparatus criticus*, which lists the most important manuscript variants and modern conjectures. The conscientious reader of a Greek text must check this list to see the possible alternatives to what stands in the text. Sometimes variants are minor points and do not affect the translation of the text. But for other authors the problems are severe and have a major impact on how we understand the text.

Yet the translations that we assign our students give little or no hint of the conscious decisions or unconscious prejudices that the translator applied to his work. The seamless and elegant surface of the English text deliberately smooths over the harsh and often troubling problems of the text. The reader who has no knowledge of Greek has no idea whether the version of Aeschylus before him is reliable or represents a major (and unspoken) judgment by the translator.

Perseus will include an *apparatus criticus* for several key authors (Aeschylus, for example). Though we will certainly not be able to include this resource for all texts in **Perseus**, we can determine how much effort is required to create an on-line *apparatus criticus*, and what form that *apparatus criticus* could take.

Unlike its printed counterpart, an *apparatus* in **Perseus** can not only include the major variants and conjectures but can also keep track of which editor chose which variant. A reader could then, in a text of the *Agamemnon*, not only see what readings are available, but which one Murray, Fränkel, or Page chose.[23] In this way it is much easier to get quickly a sense of the differences between various major editions. **Perseus** can also augment the value of any given text; even though we use Jebb's text of Sophocles, we could keep track of how this edition differs from Pearson's or Dawe's.[24]

For a few significant conjectures in important texts, we can include not only the Greek variants and conjectures but translations as well. This allows a reader to see the various ways in which the choice of one or another reading affects not only the Greek text but the English as well. Instructors hurrying their students through a wide selection of Greek will not want them to pause over every problem but will be able to point out some of the most important textual issues. The **Perseus** *apparatus* will not only serve the interests of the specialist but will reveal an entirely new dimension of the text to the general reader.

Components of Selected *Perseus* Texts

These components may be provided for only one or two texts, as examples of element in classical scholarship. An understanding of them will help even a beginning student in a

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[23] Editors of the some of the most significant editions of Aeschylus.

[24] Three significant editors of Sophocles. Jebb wrote in the nineteenth century, and his work is still considered one of the better editions. Dawe and Pearson are twentieth-century editors.

Western civilization understand the transmission of texts and the basis of scholarship through the ages.

Scholia

The scholia are the annotations which scholars during antiquity and the Byzantine period wrote in the margin of Greek texts. These notes tended to be copied along with the text. They thus developed over time as various readers and editors made their own changes, but much of the material dates from the great Hellenistic scholars of the third century B.C. Scholia are often our only source for much information about texts and ancient Greek civilization. **Perseus** should contain the scholia for at least one author. A student reading Pindar, for example, might be able to ask the system if there are any scholia for a particular passage.

Facsimiles

Facsimiles for inscriptions or papyri[25] would be an ideal part of any publication. A facsimile is a representation that shows not only the content but also the actual physical characteristics of a text. A facsimile of an inscription is a picture of the original stone. Facsimiles can very important, because they allow the reader to draw their own conclusions about what the document really says. Here it is important to distinguish between our archival facsimile and the facsimile that a user will see on the screen.

For now, there are ways to get around the relatively coarse screen resolution. One can, for example, digitize an entire photograph and then digitize ten subsets of the same photograph. When viewing the image on a screen, clicking on a section of the picture would call up a more detailed view of that same section. There could be more than one level of detail so that for particularly problematic sections of an inscription the screen could focus entirely on one or two characters.

There is no way that we can put all the manuscripts for all the major classical authors into **Perseus**. We might, however, want to include samples of some of the more important manuscripts: a few pages of the Medicean manuscript of Aeschylus and Triclinius' edition could easily be included so that the reader could get a sense of their general form. We suspect that this would be a very attractive addition and might require relatively little effort. The key would be to collaborate with someone who was already doing serious work on the text of an author.

We may be able to include epigraphy, paleography and papyrology as **Perseus** themes—this would make these subjects accessible to students who have no knowledge of Greek and allow an instructor to include them as modules in a translation course.

Expertise Required to Prepare the Components

Most of the components of a **Perseus** text can be prepared by a graduate student under the supervision of a faculty member or by the **Perseus** staff. Once the Greek text and translation have been entered, a graduate student can proofread entered material and revise the archaisms in the English translation. Often graduate students must prepare bibliographies while preparing for examinations or work on a thesis. Such bibliographies would be ideal for Perseus. Graduate students can also disambiguate lemmatized word lists, clean up machine-readable versions of printed name and subject indices, and compile scholia and sample stagings of Greek plays.

The *apparatus criticus* and the metrical analysis can also be done primarily by a graduate student, but would require closer supervision and review by a faculty member. The

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[25] Before parchment, books in the Eastern Mediterranean were written on rolls of paper made from strips of papyrus plant.

student will begin by converting an existing *apparatus criticus* to a structured form. He will then collate the *apparatus* with those of several other editions (we began with Smyth's *apparatus* of the *Agamemnon* and then quickly compared it with those of Murray, Fränkel and Page). Finally, he will have to compare the editions themselves, and record how the editors differed from the current text. Metrical analysis poses a few more problems; it is often necessary to use the printed metrical analysis from one edition and read the text from another, because not all editors of classical texts include printed metrical analyses. In the compiling of an *apparatus criticus* and formulating the metrical analysis, the faculty member would have to be play a more active role.

The brief notes are the one component of a **Perseus** text that can only be prepared by an expert.

Materials and Sources

Basic Corpus of Source Texts

This section surveys the documents that we plan to include in **Perseus**. Each category of text is accompanied by a table which estimates the cost of data entry and editing. The number following each author or work in the tables represents the number of volumes that that author or work occupies in the Loeb Classical Library. Since each volume in that series holds roughly one megabyte, this gives us a preliminary idea of how much space a Greek text, translation, introduction, and brief notes take up. The figure for data entry assumes that each volume will cost approximately $2,500.[26] The estimate for editing is much less firm but reflects our best guess at how much effort it will take for us to produce a useful **Perseus** edition once the basic text and translation are on-line.[27]
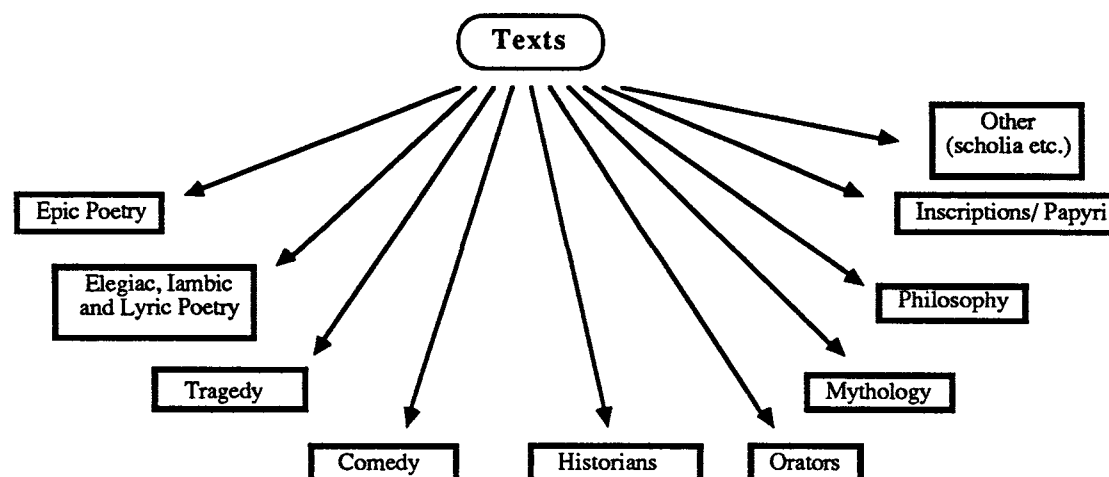
Figure 4.4 Major categories of source texts that **Perseus** will contain

Some of the texts in this section are being entered during the course of **Perseus**, Phase I. These texts appear in bold face in the tables below and are generally not counted in the budgets for Phase II. Note, however, some ancient authors entered during Phase I (such as Aeschylus

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[26] See the "Report on Data Entry," in the Appendix.

[27] See previous section for detailed information on the length of time required to prepare a text.

and Sophocles) are so central that we will probably continue to add to them throughout the course of the project.

Data entry is straightforward: we send the texts offshore and receive back data within a specified time period and with a specified level of accuracy. Texts in English can be scanned on a Kurzweil scanner and then verified electronically.

The editing is a more complex problem. We do not want **Perseus** to represent the work of a small group of individuals. **Perseus** should represent as many different people, with as many different kinds of expertise and at as many different institutions as possible. We believe that scholars outside of the immediate project should edit as many of the texts as possible.

The following is not a precise list of what **Perseus** Phase II will ultimately include. Rather it is a road map that illustrates where and how far we currently think that we might go. We may, for example, spend less on one area and more on another or even add some non-Greek material. The precise texts that we include will depend on how the needs and interests of **Perseus** users develop.

Quantity is an important factor, for **Perseus** learners need simultaneous access to many different sources. Our experiences so far suggests that the scope of the following list is ambitious but possible.[28] Nevertheless, we cannot compromise quality, and we may, in consultation with our Educational Advisory Committee, decide that we should devote more resources to editing a particular author or work.

We have designed the following collection of texts so that it can provide a solid core around which instructors will continue both to improve and to expand long after the completion of Phase II.

Epic Poetry

Homer	4
Hesiod and the Homeric Hymns	1
Data Entry	$15,000
Editing	$35,000

Greek epic poetry is the basis for all Greek literature. Homer and Hesiod defined the pantheon of the Olympian gods, and the plots of most of the Greek tragedies are derived from extant or lost epics. Both the *Iliad* and the *Odyssey* are standard readings in Western civilization courses as well as in introductory courses on classical civilization.

Epic poetry presents a problem because the Loeb translation is unusable, and we know of no out-of-copyright translation that we could immediately use or easily reedit. Commissioning entirely new translations of the entire *Iliad* and *Odyssey* would probably be too expensive. Nevertheless, we must have Homer available, and we may ultimately have to acquire rights to an existing translation.

A substantial portion of the editing budget may be used to pay for rights. An alternative would be to find someone who has already decided to create a new translation and partially support that person's work in exchange for access to his translation.

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[28] For totals and a brief discussion of the costs, see Chapter X, *Budget.*

Elegiac Iambic and Lyric poetry

Pindar[29]	1
Bacchylides	1
Elegy and Iambus	2
Lyric Fragments	3
Data Entry	$18,000
Editing	$5,000

Greek elegiac, iambic, and lyric poetry consists primarily of short fragments—quotations of poets whose work has otherwise vanished. Pindar and Bacchylides, of whom we possess entire poems, are difficult to understand in the original but lose much of their appeal when read in translation.

These poets contribute much to our understanding of how the Greeks thought: convenient access to Pindar, Theognis, and Simonides could provide the learner with an entirely new dimension of many more popular Greek poets. Few learners currently have access to this material and the surprising insights that it can provide. Many instructors will for the first time be able to integrate this material into their work when they know that their students have ready a translation and some secondary aids.

The editing budget here is very sparse but should allow us to do a cursory job of editing the translations and to place this information in a standardized structure.

Tragedy

Aeschylus[30]	2
Sophocles[31]	2
Euripides	4
Data Entry	$12,000
Editing	$28,000

Greek tragedy is one of the most popular subjects in translation courses on Greek civilization. We are already focusing on tragedy in Phase I of **Perseus** as we prototype the form that literary documents would ultimately assume in the database.

The tragedies in the **Perseus** database will be useful not only to courses in Western civilization and Greek literature and history but also may be used by classes that are studying other Western European literatures. From the Renaissance to the present, European literature and art have been influenced by and refer back to the plays of ancient Greece. Greek tragedy also shares subject matter with the paintings on Greek vases, and the two art forms may be used to clarify and explain each other.

We began our work in Phase I with Aeschylus for several reasons. First, his plays are some of the most important literary documents of the ancient world and appear in many courses on Greek literature and civilization. Second, tragedy is the most complex literary form that we are incorporating into **Perseus**: not only does drama include both spoken and sung poetry, but the action on stage is almost as important as the words. Third, Aeschylus offers by far the

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[29] Entered in Phase I.

[30] Entered in Phase I.

[31] Entered in Phase I.

greatest number of technical problems: his poetry is extremely difficult to understand, and the manuscript tradition has filled his plays with errors.

Aeschylus was therefore not only important in his own right, but producing an acceptable **Perseus** text of Aeschylus was perhaps the most challenging task before us. We concluded that this playwright would offer the best proving ground for the procedures that we were developing to collect and store documents for **Perseus**. We are using Herbert Weir Smyth's Loeb text as the basis for the **Perseus** Aeschylus.

• Greek Text: Smyth was an excellent scholar and put some thought into this, but we still need to update the text somewhat so that it takes into consideration editors such as Gilbert Murray, Eduard Fränkel and Denys Page.

• Translation: There the usual archaisms, and the English is quite harsh. Nevertheless, it is an accurate prose translation that can be efficiently reworked. Other translations exist that are more elegant, but these create an illusion that the language of Aeschylus is smooth and easy to comprehend. Smyth often gives a much clearer sense of what Aeschylus wrote and how that difficult poet really sounds.

• Apparatus Criticus: Smyth has included most of the major variant readings. We may still want to update his *apparatus*, but this is an excellent starting point. Because the text of Aeschylus contains so many manuscript errors, the apparatus is more important for this author than for almost any other that we plan to enter into **Perseus**.

Sophocles is at least as important as Aeschylus in any course on Greek literature or civilization. We chose him as the second author to enter in Phase I.

We are fortunate in this case to have an edition that is a century old but still commands the respect of scholars. Other editions have appeared in the past hundred years which are more up-to-date, but none has eclipsed that of R. C. Jebb, who had an unsurpassed feel for the language of Sophocles.

• Greek Text: Excellent. Again, we will need to include references to more recent editions, but Jebb's edition is a very solid foundation.

• Translation: Very close to the original. There are many archaisms and the style is old-fashioned, but it is possible to edit the translation for one play in a relatively short period.

• Apparatus Criticus: Again, an excellent starting point. However, we will have to do a fair amount of work in order to bring it up to date.

We chose to approach Euripides after Aeschylus and Sophocles for two reasons. First, while a total of fourteen plays have come down to us under the names of Aeschylus and Sophocles, the Euripidean corpus contains nineteen plays. Like many other scholars, we chose to do the briefer authors before moving on to Euripides.

More importantly, no source comparable to Jebb or even Smyth exists. The Loeb text and translation of Euripides are weak, and there is no authoritative translation in the public domain on which we could draw.

We are fortunate that Professor David Kovacs of the University of Virginia has begun to prepare a new edition of Euripides for the Loeb Classical Library. We will provide support to facilitate his work, and in return we will receive up-to-date translations, texts, and *apparatus* that were composed with tools provided by **Perseus**, and which will require minimal editing before being integrated into the database.

Professor Kovacs expects to have preliminary translations of the first eight tragedies of Euripides completed by the summer of 1989. Though he will revise these translations as he

works on the Greek text, the preliminary versions will already reflect the most recent edition of the text .[32]

Over the course of the next several years Professor Kovacs will prepare the remaining plays of the Euripidean corpus. In the meantime, we may include, for example, an out-of-copyright prose translation of the other plays, but we will expend little effort modernizing this translation.

For individual plays, we may well acquire access to particular translations. We are exploring the possibility with the Focus Information Group of including Michael Halleran's translation and notes of Euripides' *Heracles*.

Comedy

Aristophanes	3
Comic Fragments	1
Data Entry	$12,000
Editing	$28,000

Aristophanes is an extremely popular and difficult comic author. Unlike tragedy, the plots of which are normally drawn from mythology, Aristophanic comedy often selects its subjects and its characters from contemporary Athens. Greek comedy therefore sheds light not only on history and literature but on popular culture as well. Aristophanes supplements the information on daily life that we have from Greek vase paintings and from the speeches of the orators.

The Greek text is fairly straightforward. We can base our text either on Rogers' 1924 Loeb edition or the 1906 Oxford Classical Text by Hall and Geldart that is out of copyright. Professor Jeffrey Henderson of our advisory committee is an expert on Aristophanes, and we can work with him to determine what further work we would need to do.

The English text is, however, problematic, since translations of comedy become dated even more quickly than do those of tragedy. The Loeb edition offers an accurate verse translation, but it is so archaic that it is incomprehensible. Aristophanes is often obscene, and generally only recent translations of his plays idiomatically reflect what he actually wrote.

We may have to adopt a mixed strategy: for the most widely read plays we might be able to acquire new translations. For the rest, we will probably have to edit older translations.

Although there is no Loeb text of the comic fragments, we think that they are worth entering because they provide a valuable source for much information about fifth century Athens. The above table contains an approximation of the amount of material we would need to enter from the comic fragments. We would have to produce our own translation.

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[32] J. Diggle, Oxford University Press, 1981.

Historians

Herodotus[33]	4
Thucydides	4
Xenophon (all works)	7
Plutarch	2
Misc.	2
Data Entry	$45,000
Editing	$15,000

There are three major contemporary historians of classical Greece: Herodotus, Thucydides, and Xenophon. Selections of at least the first two appear on the reading lists of many Western civilization, ancient history, and Greek civilization classes. We would like to include the complete works of all three in order to allow instructors to choose their own selections. Although Plutarch wrote much later than the other three historians, his work contains information about individuals and events that is found in no other source, and selections from his works are often assigned in introductory classes for this reason. We cannot enter all of Plutarch; however, we will choose the more popular sections and enter as much as possible of those.

There are also some smaller fragments of Greek historians that are important to include in Perseus. The Old Oligarch, also known as Pseudo-Xenophon, is an unknown writer of the mid-fifth century, who is one of the earliest sources on the Athenian state. His brief work, the "Constitution of the Athenians," is often read in history classes. These and other extant fragments of Greek historians such as Hekataeus and the Oxyrrhynchus Historian can provide much useful information to the general learner but are not easily available. Making these accessible would be a major contribution to many courses.

Orators

Aeschines	1
Demosthenes	7
Isaeus	1
Isocrates	3
Lysias	1
Minor Attic Orators	2
Data Entry	$45,000
Editing	$5,000

Greek orators are a mine of information on many aspects of ancient Greek civilization. Demosthenes, for example, is read in history classes that cover the rise of Macedonia. Lysias and Isocrates contain facts about the later years of the Peloponnesian War. The orators are also used to study the role of women in antiquity and to shed light on daily life in ancient Greece. Since many of the orations that we have were actually delivered in court, selected speeches can also be used to lend perspective to the *Apology* of Socrates. The moral statements that pepper these speeches give us an insight into popular morality and provide an entirely new perspective on the views of philosophers such as Plato and Aristotle.

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[33] Possibly entered in Phase I.

Except for Demosthenes and Isocrates, these authors are all fairly small; the total corpus is not enormous (about six megabytes). Most of the Loeb translations of these authors are perfectly adequate, and the *apparatus criticus* is often minimal.

Mythology

Pseudo-Apollodorus	2
Diodorus (selections)	1
Data Entry	$9,000
Editing	$4,000

Pseudo-Apollodorus composed a handbook on mythology. Diodorus wrote a history that includes much information that we would now class as mythological. Although they wrote at the end of the the classical era or later, they contain sources that are not elsewhere available. Pseudo-Apollodorus is the source of many modern handbooks of Greek mythology and is an invaluable resource for any student, researcher, literary scholar, or art historian, who needs to learn about a Greek god or hero. Diodorus is also commonly used as a source of mythological and topographical information. Neither author is commonly read from start to finish, but both are valuable reference tools. Perseus would be offering to the non-classicist two sources that were previously difficult to find and use.

Philosophy

Plato (selected works)	7
Aristotle (selected works)	10
Xenophon (see Historians)	
Other	3
Data Entry	$60,000
Editing	$20,000

The most often read texts from classical Greece are the works of Plato and Aristotle. They are studied in beginning and advanced courses in philosophy, Western civilization, Greek civilization and Western thought. Plato is studied in literature classes as well.

Although we will not be able to cover all of Plato and Aristotle during **Perseus** Phase II, we plan to include the equivalent of seventeen Loeb volumes. We will include many of their most important works such as the *Republic* of Plato or the *Nichomachean Ethics* of Aristotle.

We will also provide access to material that is important but often inaccessible to learners. Xenophon, for example, composed his own Platonic dialogues that complement those of Plato. **Perseus** will allow instructors to compare Plato's Socrates with the very different Socrates of Xenophon.

Inscriptions and Papyri

Data Entry	$15,000
Editing	$15,000

Texts preserved on stone or on papyrus offer us our most direct window into the ancient world. A papyrus can show the state of a literary work as it existed more than a thousand years before the earliest manuscript. Many papyri and inscriptions are concerned with day-to-day matters, such as treaties, letters, administrative documents, and contracts. They deal with many of the particulars of life that do not appear in literary texts. Inscriptions, for example,

are critical even in introductory history classes, since they are often the only primary evidence we have[34] for events in the fifth century. These will generally be collected ad hoc for particular topics.

There is often no available translation for important inscriptions and papyri, so we will often be forced to translate them ourselves. Our projections that editing and data entry will cost the same are optimistic, and we may end up spending far more on translations than on data entry. Nevertheless inscriptions and papyri are precisely the kind of hard-to-use and inaccessible documents that **Perseus** can make available to new audiences, so the expenditure is well justified.

Miscellaneous

Data Entry	$15,000
Editing	$15,000

Most **Perseus** Themes will require material, such as scholia or relevant passages from later authors, that does not fall into any of the above categories. The above figure is a rough estimation. Predicting the cost of such data entry is also tricky: some pieces of evidence (such as scholia) may have to be translated for the first time.

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[34] A translation of important Greek historical inscriptions, Charles Fornara's *Archaic Times to the End of the Peloponnesian War* (Baltimore: 1977), is often assigned to beginning ancient history classes.

Architecture, Art and Archaeology

Importance of the Material

Physical remains, the archaeologist's primary material, are a vital source for interpreting classical Greece. Without the great public monuments of the Athenian Acropolis, for example, our understanding of Athens' cultural imperialism in the fifth century B.C. would be immeasurably impoverished. Contemporary houses and the artifacts discovered in their ruins tell us about the activities that formed the daily life of women, freedmen, slaves, artisans, foreigners, and other social classes of which literature only rarely speaks.

In addition, the cultural achievements of classical Greece have had a formative influence on the visual arts throughout later Western history. The architecture of ancient Greece, for example, has often served as a standard by which other buildings have been measured and continues to be a source of inspiration to the modern architect. The accomplishment of Greek architects in perfecting a system of proportions and refinements, in blending shadow and light, and in relating their constructions to the natural landscape has always been recognized. The Greek orders (Doric, Ionic, and Corinthian) have endured, as have the institutions the orders adorned: theaters, gymnasia, stadia, the hippodrome (or racetrack), and libraries all owe much of their modern form to their ancient counterparts.

Studying classical Greece can remind us that, despite the pre-eminent place of Greek culture in the western tradition, there was a time when Greek art and architecture did not yet exist. The study of the development of Greek art and architecture is a useful paradigm for understanding how a society fosters invention and change.

Nature of the Evidence and of the Discipline

The archaeological remains of ancient Greece are diverse, ranging from monumental architecture and sculpture, to "minor arts" (such as jewelry or coins) and everyday objects (like lamps, weights and measures, and loom weights). Scholarly approaches to the study of archaeological material are perhaps even more diverse. The study of Greek painted pottery, for example, provides a useful example of this. In the eighteenth century, scholars were attracted to Greek vases primarily for their illustrations of literary or historical subjects. The iconography of Greek vases continues to provide unique documentation of domestic and everyday life, religious ritual, myths, literary subjects and traditional stories, but that is not all. With the sophisticated connoisseurship that the great Sir John Beazley pioneered for Attic vase painting, one can often identify the hands of individual painters and even distinguish the work of masters and pupils. Beazley even identified workshops and complex relationships among vase painters. His studies went beyond pure art history and evolved into the reconstruction of an ancient industry. Other everyday objects, e.g., cooking ware and storage vessels as well as table crockery, occur in great quantity, and can be analyzed by a variety of statistical methods that often lead to exciting insights.

Importance of Perseus for the Discipline

Perseus will make the basic documentation of this material—textual descriptions, drawings and photographs—more easily accessible than ever before, particularly to the non-specialist. Even more significantly, the position of this material in the broader web of Perseus will encourage the kind of questions that archaeologists.ask, for much of the archaeologist's interpretive thinking is an attempt to relate archaeological objects to some meaningful context. It might begin with a seemingly simple question, Why are the early silver coins of Athens (the "Wappenmünzen") found almost exclusively in Attica, while "owls" (Athenian coins nicknamed after the standard device on the reverse) appear all

over the Greek world from their earliest issue in the late sixth and fifth centuries B.C? The answer to such a question has enormous economic and political implications and contributes to our overall understanding of the relations between Greek city-states. In another example, the student might be asked to look at the first representations of the race in armor (the ὁπλιτόδρομος) that appear in Attic red figure vases dated around 530-520 B.C. This unusual athletic event is known to have been introduced in the quadrennial competition at Olympia in 520 B.C. Is there a connection? Are the red figure vase painters of Athens depicting a popular and current subject? The student will learn to ask how artistic representations indicate cultural change, to think about how style changes and evolves, and to follow paths that explore the relations between art and society.

Selection of Material

Given the sheer quantity of material, we shall have to be extremely selective: Perseus' archaeological catalogues will represent a much smaller proportion of extant archaeological material than the Perseus texts will represent of surviving Greek literature. To match the scope of the textual materials, we would have to include tens of thousands of images. Nevertheless, the several thousand images in our catalogue will be of great value:

- By providing a representative sample of important material, Perseus will be useful for teachers and scholars, who want a survey of a problem. Even without an exhaustive list of examples, a teacher or student could discover that Heracles is a very popular hero in the sixth century, but tends to be a less common subject in sculpture and vase painting of the fifth century.

- By placing the material in a richer context Perseus will facilitate studying an individual object or small group of objects. While some research involves surveying broad domains of information, many kinds of research focus intensively on small quantities of material.

- As an illustration of the potential of electronic cataloguing and publication, Perseus will provide an important model for other archaeologists, who are actively teaching and conducting research.

The process for selecting material grows from our goal to create a structure that encourages interdisciplinary work. Thus, since so much of the written record is Athenian, Perseus must begin with the monuments, topography, and artifacts of Athens. Next in importance will be the city-states in closest contact with Athens, i.e., her allies and rivals. Third, we will emphasize the great Panhellenic sanctuaries which served all Greeks and are of paramount archaeological significance.

Our core of material must provide a good selection of material for an introduction to classical Greek archaeology and, at the same time, provide a sufficiently thorough coverage of selected topics (like athletics, or images of Dionysus) to be useful for students and scholars pursuing those topics. Thus, although we have defined a core of material, Perseus authors will be able to delve more deeply into important subject manner, and this will help Perseus grow and expand.

Our plans must also leave room for change: the Educational Advisory Committee will play a crucial role in helping us decide how to select and balance our coverage of topics. In addition, we have begun to poll teaching archaeologists about what material they consider essential. We are asking them to rank lists of specific objects they feel are most useful in teaching and to provide more general advice as well: would it be more helpful, for example, to provide coverage of red figure pottery in greater depth or cover black figure, red figure and non-Attic pottery evenly?

Sample Topics

Below is a list of topics that users of **Perseus** will be able to cover using the basic material (see a list of the basic material below under "Materials and Procedures"). The list is, of course, not exhaustive but serves to illustrate the range and goals of our material. The goal is to complete the collection of primary material in the first two years of Phase II so that authors will be able to fully incorporate these sources into organized topics as soon as possible.

House (Examples from Athens, Corinth, Halieis, and Olynthos)

- Public and private spaces in Greek Houses

- Activities in Greek houses: worship, entertainment, and household industry

- The planning of Greek houses at Olynthos

Propylaea (Examples from Athens, Delos, Eleusis, Epidauros, Miletus, Priene, Samothrace, and Selinus)

- The Old Propylon of the Athenian Acropolis

- The Propylon of Mnesicles at Athens

- Influence of the Athenian Propylon at Selinus, Delos, the precinct of Athena at Rhodes, and at Eleusis

- Ionic Propylaea at Samothrace, Priene, and Epidauros

- Corinthian Orders at Epidauros, Miletus

Stadia (Examples from Delphi, Olympia, Isthmia, Nemea, Corinth, Athens, Epidauros, Messene, Miletus, and Priene)

- Distance and measurement in the Greek stadia

- Running events

- Stadia at the Panhellenic Sanctuaries: Delphi, Isthmia, Nemea, and Olympia

Stoa (Examples from Assos, Athens, Corinth, Miletus, Olympia, and Priene)

- Development of the Agora and civic centers in Ionia: Priene and Miletus

- The Greek orders and multi-storeyed facades

Temples and Sanctuaries (The Acropolis at Athens, the Hephaesteum at Athens, Temples of Hera and Zeus at Olympia, Temple of Apollo at Bassae, Temple of Apollo at Corinth, Temple of Poseidon at Isthmia, Temple of Hera at Perachora, Temple of Poseidon at Sounion, Temple of Apollo at Syracuse, Temples C and D at Selinus, Temple of Aesclepius at Epidauros, Temple of Zeus at Nemea, Temple of Apollo at Delos, Temples of Athena and Dionysos at Pergamum, Temple of Artemis at Epidauros, Temple of Hera at Samos, the Mausoleum at Halicarnassos, and Temple of Apollo at Didyma)

- Sanctuaries and religious ceremonies

- Civic responsibility in the Greek polis

- Oracles and Festivals at the Panhellenic Sanctuaries

Invention and refinement of an Architectural Idiom (Examples from Athens, Corinth, Corcyra, Delphi, Isthmia, and Olympia)

- Invention of the Doric order

- Refinements: scale and proportion, column proportions and entasis, *scamilli impares*

- Scale and Proportion

Theaters (Examples from Athens, Epidauros, Sikyon, and Thasos)

- Theater as a place of public assembly

- Components of the theater

- Problems of design and staging

- Vitruvius's commentary on theater design

Topography (Examples from Marathon, Salamis, and Thermopylae)

- The battle at Salamis

- The battle at Thermopylae

- The location and carrying capacity of agricultural regions in Greece

- The location and function of mountain sanctuaries

Town Planning (Examples from Peiraeus, Miletus, Priene, and Olynthos)

- Orthogonal planning in new towns and colonies

- Hippodamus of Miletus: planning at Peiraeus

Artists and artisans:

- The social status of artists and artisans in classical Athens

- Wage scales for sculptors, architects, and other artisans working on the Parthenon

- Workers' dedications at Greek sanctuaries

- Social origins of Greek artists and foreigners in Athens

Greek athletics

- The mechanics of athletic competition

- The athletic events and equipment

- Social status of Greek athletes

- Panathenaic vases

Daily Life

- Funerary representations on lekythoi

- Banquet scenes

- Functions of Greek vases

Stylistic development in Greek Art

- Archaic Kouroi

- Attic red figure vases

Data Structure

Links: Archaeological and Art Historical Objects

Each object of the basic corpus will contain standard information: medium or material (metals, ceramics, stone sculpture, etc.), style and period, provenance, and dimensions. The major publication on the piece will appear in a bibliography. Thus an Attic Red Figure Vase would have accompanying information including: its date, painter (if known), subject matter of the painting, the type of vase, and its dimensions. As **Perseus** authors create Themes from the data, they may add a host of other information that might include: important stylistic features that identify the artist, vases of similar style, comparanda of the subject matter, literary references, and a more extensive bibliography.

Fields in the textual component of an entry for the archaeological catalogue will be automatically linked to other parts of the overall **Perseus** database. As currently implemented in *HyperCard*, these links include the following:

- *Illustrated archaeological glossary/encyclopedia.* The user can click on technical archaeological terms to look them up in the glossary/encyclopedia.

- *Encyclopedia of classical sites with accompanying atlas.* Fields for the provenance of an object are now automatically linked to a simple version of the atlas.

- *Chronology tool.* Fields for date ranges are automatically linked to a chronology tool for viewing time lines of events that the user can filter in a variety of ways.

- *Bibliographies.* References to secondary material are automatically linked to full bibliographic information.

- *Classical texts, with their full complement of aids.* References to ancient texts that are part of the **Perseus** corpus will be automatically linked to those texts as well as to the lexica, translations, commentaries (if available), and bibliographic references for material that is not on-line.

- *General encyclopedia entries and Themes.* Links from encyclopedia and various **Perseus** themes[35] to the archaeological material will help orient the non-specialist user.

Visual components

Perseus will include illustrations from photographic slides, video collected at selected sites, and maps and drawings that are compiled from original drawings or other primary sources. **Perseus** will permit users to move easily from primary to more detailed views.[36] Users of **Perseus** must also be able to locate similar kinds of details easily: a user looking at vase paintings of athletes might want to find other representations of athletes. Drawings and photographs are therefore being tagged with a controlled vocabulary of terms. This not only associates them with the proper object, but identifies what kind of view they represent (e.g., an axonometric vs. isometric view of a building). In the present

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[35]On **Perseus** Themes, see below.

[36] See sample materials.

HyperCard implementation of **Perseus**, this information allows users to find parallel details at the click of a button.

In contrast to photographs and impressionistic renderings, measured drawings represent quantitative data, and **Perseus** users must be able to find and use this information in a systematic manner. For archaeologists and architectural historians, proportional relations of the different elements of the classical orders provide a clue to their dating. A tall, thin Doric column, for instance, is generally later in date than a short, squat one. The archaeologist should be able to query the database for examples of Doric columns, or for Doric columns with a proportion of height to base diameter (a measure of its slimness) that falls within a specified range. In short, the challenge is to make **Perseus** a true visual database, rather than a collection of images linked to other data.

We have not yet attempted to implement this aspect of the archaeological catalogues in *HyperCard*, but we have already begun recording the necessary data as we assemble standard two-dimensional measured drawings. The **Perseus** staff has developed formats for each category of drawing, and the results are original drawings with a clear and readable style. All objects are recorded as named objects defined by points in an *x* and *y* coordinate system. This is most important for plans and topographic drawings. These drawings are made from digitized polygons created in an *x-y* coordinate system, stored as files in ELAS format. ELAS is the Earth Resources Laboratory Applications Software developed by NASA/ERL. The data is readily converted into a variety of display formats with the Utah RLE (Run-Length Encoded) software, and can be geo-referenced with processed Landsat images.

Materials

Archaeological descriptions are inherently selective and incomplete: no catalogue entry for an ancient vase, no matter how sumptuously illustrated and thoroughly documented, can ever substitute for first hand experience with the object. Ideally, any object would be represented by textual description, standard measured drawings, and several photographs from different viewpoints. Key monuments in **Perseus** will be documented this richly. But even in these "ideal" cases, the job of documenting the object is never complete. For example, a Red Figure vase included in **Perseus** initially with a textual description, measured drawings of profile and figured scenes, and one or two photographs might later have additional photographs and drawings, or an expanded description.

We will initially provide "ideal" catalogue entries for only a select group of important objects. We must ensure that documentation for every object, however, meets a minimum standard of complete textual documentation, as outlined in the preceding section, and of visual material appropriate to the type of object. Architectural monuments will always be documented with a plan and a photographic view. In the case of extremely well-known and well-preserved monuments, the documentation might include several plans showing the state of the monument at several points in its history, elevation and section drawings, perspective (isometric, axonometric, or vanishing point perspective drawings),[37] and photographic views from each direction. The Parthenon would obviously be at one end of the spectrum with ca. 80-120 representations, a large portion of which would illustrate the many fragments of sculpture. A poorly-preserved monument like the Temple of Poseidon at Isthmia might be represented by a single plan and only one or two views. For vases, a drawing or photograph of important figured scenes is required, and a profile drawing is commonly included. Beyond these principal standard views, detailed photographs or drawings are common.

Conventional publications of excavated material, in fact, rarely achieve this minimum standard for a **Perseus** catalogue entry because of the exorbitant expense of

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[37] The sample materials contain a number of axonometric drawings.

publishing drawings and photographs on paper.[38] As **Perseus** evolves and Authors not only add new archaeological material but enrich existing catalogue entries, more and more objects will be ideally documented. This high minimum standard and the continuing enrichment of the database are major reasons that the selective catalogue in **Perseus** will be valuable as a teaching aid, as research, and as a model for future publication.

Materials for *Perseus*

Architecture:

We will include approximately twenty-five well-preserved cities and sanctuaries that include approximately 90 buildings and their topographic settings. While the list could obviously be expanded to include lesser known sites in Crete, Italy, and Asia Minor, that task is more appropriate for the research specialist. Once these major monuments are integrated into **Perseus**, however, the additions and refinements necessary to extend **Perseus** to lesser known monuments and topics will be relatively minor. The following list forms the core of essential sites.

Athens	Halicarnassos	Perachora
Aegina	Isthmia	" Pergamon
Bassae	Kerkyra	Priene
Corinth	Messene	Samos
Delos	Nemea	**Selinus
Delphi	Olympia	Sikyon
**Didyma	Olynthos	Sounion
Epidauros	**Paestum	Syracuse
Halieis	Peiraeus	

Vase painting

We will include approximately 150 Red Figure vases of the late sixth and fifth centuries. The following lists indicate monuments we will certainly include. Beyond these, we will add such additional objects as our poll of teachers suggests would be most useful. Material already entered in Phase I or definitely to be entered in Phase II includes representative and important works by the following Red Figure painters of the late sixth and fifth centuries:

Achilles Painter; Andokides Painter; Berlin Painter; Brygos Painter; Douris; Early cup painters including Oltos, Epiktetos, Bowdoin Eye Painter; Eretria Painter; Foundry Painter; Kleophrades Painter; Makron; Meidias Painter; Myson; Niobid Painter; Onesimos; Pan Painter; Penthesilea Painter; Pioneer group including Euphronios, Euthymides, Phintias, Smikros; Polygnotos and his circle.

Architectural Sculpture

Aegina, Temple of Aphaia

Athens: Erechtheion, Hephaistion, Nike temple, Parthenon

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[38] See *Archaeological Catalogue and Related Material*, in the Sample Materials. This shows how, even in a relatively simple hypermedia system such as *HyperCard*, we can examine many different views of a single *PostScript* drawing.

" These sites will not be included among the locations to be photographed during the field trip in the fall of 1989.

Bassae, Temple of Apollo

Olympia, Temple of Zeus

Other relief sculpture

Funerary reliefs, Record reliefs, Votive reliefs

Free standing sculpture

Delphi charioteer, Diadoumenos, Doryphoros, Lemnian Athena, Nike of Paionios, Pericles (from Kresilas' statue), The bronzes found at Riace, The Tyrannicide group, Zeus/Poseidon from Artemision

Sources of Material

Catalogue Entries

Because the monuments in **Perseus** are the critical monuments for the study of classical Greece, they are already well published. Our staff and authors will base the textual components of the catalogue entries on information easily available in any good research library.

Perseus staff, authors or research assistants will enter the basic textual information for archaeological material. Experience at Bowdoin College this year suggests that on the average we should budget for three hours of time by a research assistant (graduate student level) per entry, and an average of one hour review per object by a junior level scholar (post-doctoral, or **Perseus** Author).

Slides

Most photographic images in **Perseus** come from 35mm slides. In addition to the collections of individual scholars, we will shoot new pictures of topography and monuments during Phase II, and will continue actively to seek existing slide collections. We have received permission to make unrestricted use of the slide collection of the American Institute of Archaeology, the principal archaeological organization in this country, and of the J. Paul Getty Museum in Malibu, California. Marion True, Curator of Antiquities at the Getty, has expressed enthusiastic support for the **Perseus** project, and would be willing to have additional slides made if the **Perseus** staff thought this were necessary.

These slides will be archived in one inch video format and indexed for inclusion in each edition of the videodisc as well as in the digital delivery medium. For the digital formats, hardware and software will evolve over the next several years, and the quality of this class of images will correspondingly improve. We do not expect to repeat the digital conversion, but we do expect improvements to the color lookup tables so that the same digitized files will produce steadily clearer images.[39]

Drawings

Good drawings are expensive to produce, and new ink drawings published today rarely match the quality of the best work of the late nineteenth and early twentieth centuries that was published in oversize folio volumes. As a result, archaeologists often reproduce the same drawings generation after generation. We can take advantage of this by reproducing out-of-copyright works of the great turn-of-the-century artists.

We have already begun redrawing in electronic form selected plates from Furtwängler and Reichhold's monumental *Meisterwerke der Griechischen Vasenmalerei*,

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[39] See Hemans, "Image Acquisition: Technical Issues," in the Appendix for a description of the image capturing and archive structure.

54

an elaborate three-volume series of oversized plates that illustrate almost 200 "masterpieces" of Greek vase painting.[40] This long out of print work is still used for teaching and research at those institutions fortunate enough to own a copy and remains a regular source for slides and illustrations in paper publications. Reichhold was one of the great engravers of his day, and devoted years of his life to this Herculean labor: he was most productive when he created the first volume, which contained 60 plates (with about 100 drawings). This one volume had to be published in six installments of ten plates each, spread over four years from 1900 to 1904.

We have found Adobe *Illustrator* to be a cost-effective and flexible software package for producing archaeological drawings to scale. *Illustrator* is excellent for measured drawings of vase painting because of the precise control of curved forms its Bezier curve tool allows. The amount of time required for a drawing varies according to the complexity. For illustrations in Furtwängler-Reichhold, each drawing requires approximately 20 hours of drafting time by an experienced artist and one hour of review by a second artist or **Perseus** Author. We have intentionally begun with comparatively straightforward drawings, but we estimate that as we gain experience we will be able to move on to more and more complex drawings.

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[40] This particular project is part of **Perseus** 1.0 and is supported by funding from Apple Computer. It nevertheless serves to illustrate how existing measured drawings of excellent quality can be converted into an electronic format.

Encyclopedia, Overview, and Atlas

Encyclopedia

If students are to move rapidly through material within **Perseus** they will need easy, reliable access to a wide variety of information. An instructor would like students who have come upon a passage in the Athenian orator Aeschines to make the effort to learn who Aeschines was, when he lived, and what the general context of his work was. This information may not always be covered in class by the instructor, or the student may need to be able to look it up again later. For example, a student in a course on fifth-century Athens will learn that Plutarch was not a contemporary of Pericles, but the same information might not be made explicit in a course on Greek tragedy. Students exploring a topic associated with Greek tragedy are, however, very likely to encounter a passage in Plutarch. When they are reading traditional printed books, they often do not take the trouble to look up Plutarch or find out when he lived, because it is too time-consuming. However, if this information has been placed at their fingertips, students will be more likely to look it up, and the instructor can build on the expectation that they have done so.

Description

The encyclopedia is the single most important feature of the **Perseus** database. Without it, **Perseus** would be a collection of interesting but unconnected data. The encyclopedia will play a pivotal role in unifying the various pieces of the overall **Perseus** database and in making the creation of a linked **Perseus** database more feasible.

The encyclopedia contains universally accessible pieces of information. An initial list of entries will be derived from a standard reference work such as the *Oxford Classical Dictionary* or *Harper's Classical Dictionary*. New items will be added as they are needed by **Perseus** authors. A user should be able to point at the word *Pericles* (the famous Athenian statesman) anywhere in the **Perseus** database and call up the entry on Pericles, which will then be linked to images of Pericles, or point to *Decelea* (the infamous choke point in Athenian territory) and see the entry on Decelea, which will be linked to a map showing its location within Attica and to any photographs of it in the database. **Perseus** will thus combine the traditional classical dictionary with an atlas and a collection of images.

The encyclopedia will, in some cases, go beyond the standard reference works. It will include not only conventional items such as descriptions of people or things, but also specialized data such as vase types and Greek meters. When a reader sees the word *dochmiac* associated with a line of Aeschylus or Euripides, he will be able to call up the same description of dochmiacs. Rather than having brief descriptions of the primary meters attached to every individual play, there will be a single body of information about Greek meter.

Even the Greek lexicon can be linked to the encyclopedia. The student who has looked up a form of the Greek word for *trireme* (the warship of the golden age of Athens) in the lexicon will be able to select the English word *trireme* in the definition and go to the entry in the encyclopedia. So, if the need or interest should arise, the student will be able to move from the definition of the word *trireme* in the Greek lexicon to the entry in the encyclopedia.

The encyclopedia will consist of entries and links. An entry will consist of a conventional encyclopedia article on the topic, and of a set of links that will be visible to the user as a list of possible selections. These are the electronic equivalent of the cross references that follow a traditional encyclopedia entry. The links will provide the means to see related information, whether it be a map, a textual reference, illustration or another related encyclopedia entry. These links are the hypertext extension of the database, and are the crucial device that ties the database together.

Problems in Building the Encyclopedia

- Serving different levels of audience

We will have to devote considerable energy to establishing editorial standards so that we can represent information in a way that is not too obscure for the freshman in a translation course nor too insipid for the expert. Serving both the scholar and the introductory student is one of the primary goals of the project as a whole, but it is also one of the most challenging. Creating encyclopedia entries that serve this disparate audience is perhaps the single greatest editorial problem that we must solve.

We have been studying how other hypertext and information retrieval systems handle this problem and the methods described in the scholarship on the problem,[41] and hope to find a solution that draws on their results. We are aware, however, that a solution may not be possible within the restricted bounds of **Perseus**.

- Versioning

Defining the relationship between various categories of information and even discrete databases will be challenging. The text of Thucydides, for example, will refer to the encyclopedia, but the encyclopedia will both point to maps and also cite passages in Thucydides: everything in **Perseus** will be interconnected—this is one of the great technical problems facing any hypertext system. What happens, for example, to a note on Thucydides that refers to an encyclopedia article on Pericles, if the relevant section of the article on Pericles is updated or deleted? In the absence of sophisticated versioning software, we will have to develop editorial procedures that can handle this.

This thorny editorial problem can be divided into two parts. The first is theoretical: we must establish clearly defined conventions to which all contributors must adhere. We will certainly not define the ultimate model for such conventions, but we can make considerable progress. The second is managerial: we must make sure that contributors really do follow these conventions.

- Controlling new entries

New entries to the encyclopedia will be added as **Perseus** authors decide they are needed, or users request them. Authors who decide that an old entry should be updated or that a new entry is needed will have to consult with the editorial staff to make sure that work is not being duplicated. Variant words—*rock* for *stone*—and different spellings of the same word—*Perikles* for *Pericles* are also problems for the editorial staff. We do not want one contributor to write an article on *boats* because he did not see the article that another contributor had written on *ships*.

We will apply the following techniques to the creation of new material. First, Authors will be provided with a list of the information already available in **Perseus**, so they will know on what they can draw. Then, Authors will be asked to submit lists of the data they will want to create and include. Finally, the editorial staff will work with them to help determine what existing material can be incorporated into their Theme and what should be revised or created anew. When we incorporate material that has not been explicitly created for **Perseus**, we know that this problem will be more complex. We may, in fact, be

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[41]Gary Marchionini and and Ben Schneiderman, "Finding Facts vs. Browsing Knowledge in Hypertext Systems," *IEEE Computer* 21(1988):1.70-80; Mark Edwin Frisse, "Searching for Information in a Hypertext Medical Handbook," Tim Oren, "The Architecture of Static Hypertexts,"(Papers delivered at Hypertext '87, University of North Carolina, November, 1987); Nicole Yankelovich, Norman Meyrowitz and Andries Van Dam, "Reading and Writing the Electronic Book," *IEEE Computer* 18(1985):10.15-30, etc.

created for **Perseus**, we know that this problem will be more complex. We may, in fact, be forced to incorporate material that does not fully match our criteria, since we will not have the resources to fully process it all.

• Sources

We do not have the resources to develop an entirely new encyclopedia. Instead we may have to begin working with existing materials that are out of copyright (e.g. *Harper's* , *Smiths*,[42] or others.) The editorial staff, in consultation with the Educational Advisory Committee, will decide which of the out-of-copyright editions provides the highest-quality information and is most feasible for data entry.

Much of the information in these works is still useful—after all, the reader of Plato's *Apology* who wants to know who Anytus (one of the accusers of Socrates) is will get the information he needs in the entry in *Harper's* or *Smith's* . The articles most likely to raise objections are those on major authors and topics, such as Aeschylus, Thucydides, etc. These are the topics on which opinion has changed most, and will be the first articles that will be rewritten. One important task for **Perseus** Authors will be editorial: revising and updating old encyclopedia entries.

An Overview of Greek Civilization

A combination of source materials, Themes, and the encyclopedia still does not support one major task relevant to the rapid orientation of users in a large data base such as **Perseus**. That task is to provide a readily accessible tool for learners to use in situating themselves in the historical context of the subject that they are studying. Students in an introductory course on Greek civilization, for example, are often assigned reading in Athenian tragedy such as Sophocles' *Oedipus the King*. To be able to understand the full significance of this play, students should have a general sense of the history of Periclean Athens. Reading the encyclopedia articles on Pericles, Sophocles, or Oedipus in **Perseus** is not the way to acquire this necessary contextualization because such a procedure yields a picture that is too fragmented for the introductory student. Rather, such students must be able to begin with a general, narrative introduction to Periclean Athens that points the way to further exploration in the data base.

In the spring of 1989 on a grant from Apple Computer, Inc. Thomas Martin will create a three-section overview of Greek civilization to serve as this tool for **Perseus**. The sections will be (1) "The Crystallization of Greek Civilization in the Dark Age and the Archaic Period (1000 TO 490 B.C.)"; (2) "The Golden Age of Greece (490 to 377 B.C.)"; and (3) "The Reshaping of the Classical World (377 to 275 B.C.)." Each section will present, in addition to a continuous narrative, a set of ancient sources including both textual materials and archaeological objects. These sources will be selected for special emphasis to illustrate the different kinds of primary materials that are included in **Perseus** and to demonstrate the ways in which users can analyze ancient sources to increase their vertical learning in the subject. The discussion of these sources in the overview will thus serve as introductory glimpses of the kind of investigative work that users can do with the resources of **Perseus**. The equivalent of approximately one hundred to 150 printed pages, the overview will be prepared as a hypertext and will initially be presented in *HyperCard*. A comprehensive outline of the overview is presented in the Appendix.

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[42] *Harper's Dictionary of Classical Literature and Antiquities*, edited by Henry Thurston (New York, 1896); *A Dictionary of Greek and Roman Biography, Mythology and Geography* edited by William Smith (London, 1890); *A Classical Dictionary of Biography, Mythology and Geography* edited by William Smith (London, 1891); *A New Classical Dictionary of Greek and Roman Biography, Mythology and Geography* revised by Charles Anthon (New York, 1895).

The overview cannot, of course, represent a complete cultural and political history of classical Greek civilization, but it will provide a rapid orientation in the subject for users who need one. The learner who wishes to see a succinct description of sixth-century Sparta or to quickly grasp the main issues of the Peloponnesian War will be able to refer to Professor Martin's work. In the sense that any writing represents the views and interests of its author, the overview will necessarily present an interpretation of Greek civilization that speaks with the authorial voice of Professor Martin. But, recognizing the introductory and contextualizing function of the overview as a tool, Professor Martin will strive to present a balanced interpretation that will serve the needs of nonspecialist users. Peer review will serve to verify that the overview achieves this balanced treatment of Greek civilization. The overview is the first example of a well developed "super Theme" of which we hope to be able to commission more in the course of **Perseus**.

Atlas

Another essential component of **Perseus** will be the atlas. Students need to orient themselves to the topographic and geographic setting of ancient Greece. It has often been stated that the mountainous landscape of Greece was one of the most important factors in the development of the city-states and created the need to develop maritime trade routes and naval power. By incorporating the complete series of Landsat satellite images and topographic maps the **Perseus** atlas will make an important contribution to the study of Greek topography. Scholars and students will have available to them the very best images, images that have previously only been available in extremely expensive printed volumes. Furthermore, **Perseus** will enable its users to annotate these maps to illustrate their specific subjects.

The atlas is being created from maps and satellite images that are compiled at several different scales for the user (see summary below). Basic information in the atlas will include three series of maps: topography, land-use, and Landsat images. Included with the maps will be a database of toponyms. Users will be able to select the toponyms from the database that he wishes to appear on the maps. The goal is to create a series of base maps that the user can modify according to his needs. By providing outline and color maps (some with a minimum of information) we hope to encourage their use as a chalkboard for other information.

Methods for Creating the Atlas

The atlas is being compiled from Landsat Multispectral Scanner imagery and from 1:250,000 scale maps that we have digitized by hand. To date, two Landsat images covering the eastern Peloponnesus, Attica, and Euboea have been used to develop the format for the color images and to design *HyperCard* stacks.

The Landsat Images are processed from four-band images to 8-bit color composite images that closely approximate natural topographic color. Individual Landsat scenes cover approximately 180 x 180 kilometers—collectively the twenty scenes that cover mainland Greece, the Aegean Sea, and the coast of Asia Minor will make up approximately sixty megabytes of data. The imagery will be divided into subscenes at scales described below. Image processing at the Center for Remote Sensing is conducted in a variety of image formats: SUN raster format, ELAS image processing format, and Targa format. For display on the Macintosh II the images are converted to PICT format (a run-length-encoded format).

In addition to Landsat images at a resolution of eighty meters we are proposing to acquire SPOT satellite data at a resolution of twenty meters for a few selected areas (Attica, Marathon, Salamis, and Thermopylae) to illustrate the important localities of the specific historical events (e.g. the Persian Wars). The much greater resolution of these images will allow very specific topographic references and orientation.

A number of tools will be provided that will allow the user to select what information will be displayed with each map. If a user, for example, wants to display the monuments

described by Pausanias, those names will be called from a geo-referenced list that will place them on the maps. In this manner a user can display precisely the toponyms he is interested in. Similarly, routes, battle scenes, and other historical events will be programmed to appear as overlays upon base maps.

Other tools include the ability to browse from one image to its geographic neighbor, to change scale, and to "zoom" in on an area of interest. Preliminary versions of these tools have have already been developed. We expect the basic atlas to be completed by June 1989 and to be incorporated into **Perseus 1.0.**

Scales and Information in Atlas

1) 1:15,000,000 — *Map of Mediterranean*
Information: 1,000 m. contours; major geographic toponyms

2) 1:5,000,000 — *Map of Greece and Aegean Coast*
Information: 400 m. contours; major geographic toponyms

3) 1:1,000,000 — *Greece and Aegean Coast* (divided into approximately twenty-five sections)
Information: 400 m. contours; toponyms will be selected by the user from lists that will include cities, mountain ranges, bodies of water, islands, etc.

4) 1:250,000 — *Mainland Greece* (divided into approximately one hundred sections)
Information: 400 m. contours; toponyms as described in item three but with more detail; land-use maps derived from processed Landsat images

5) 1:50,000 — *Selected Sites of the Persian Wars*
Information: 20 m. contours; descriptive information on historical events

60

Morpheus and the Greek-English Lexicon

Summary

During Phase I of the project we created the first full version of *Morpheus*, a morphological parser for Greek. We have also entered a forty thousand-word Greek-English lexicon and are in the process of integrating this into **Perseus**. Gregory Crane's article in the February, 1988 issue of *Academic Computing* provides a general outline of this work.[43] The following section provides additional information about how *Morpheus* and the Greek-English lexicon make a particularly strong contribution to students who have no knowledge of Greek.

Background

The "philologist" loves words—that is the literal meaning of the term "philology," which comes from the Greek roots "philo-" (to love) and "logos" (spoken language). Such Greek etymologies are often misleading and sometimes embarrassing—who (except perhaps for aristocrats) believes that "aristocracy" is truly the "rule of the best"? But philology has retained its natural meaning more than two thousand years after it was coined.

Words are, in many respects, our surest and most vivid witnesses for Greek civilization. Of course, much of what we know comes down in written texts. Historians such as Herodotus and Thucydides tell us much, and poets such as Aeschylus or Sophocles reveal other facets of the Greek mind. We can even learn as much from Plato's dialogues about the world in which he lived as we can about the great philosopher's ideas, for he presents us with a vivid and in some ways very modern picture of Socrates and his friends.

But words are often more important because of what they leave unsaid. English translations of Platonic dialogues, for example, are filled with references to "virtue," a translation for the Greek term *aretê*. But *aretê*, though it can have a moral dimension, really denotes something more similar to "excellence" or "skill." This particular overlap of practical and moral values is a feature that distinguishes Greek thought from that of current America and Western Europe. At the same time, if we view the Greek language solely as words to be translated into English and do not focus upon the individual words out of which that language is constructed, then *aretê* becomes nothing more than "virtue" or "excellence," whichever English word fits best with the passage at hand. We lose the complexity of the idea behind the word, and with it we lose a window into a different world.

Philology is an attempt to probe and explore the way in which words and meaning overlap. Literary critics are philologists insofar as they base their ideas upon a close understanding of a writer's words. Philosophers are philologists when they seek to untangle a philosophical system from the language that describes it. Even deconstruction can be seen as a refined form of philology, in which the practitioner abandons the possibility for precise meaning and wrestles instead with the limits and ambiguities of spoken language.

From a practical point of view, the student of ancient Greece must reconstruct the shifting and elusive associations that native speakers take for granted when they hear a term. Small points can have serious consequences, for many ideas are interconnected and even the smallest shift in nuance can set in motion an ever-widening series of repercussions.

Consider, for example, the Greek term *hamartia*. High school students with particularly ambitious teachers may encounter this term in its traditional English translation "tragic flaw." Aristotle, the student learns, described tragedy as drama in which an ordinary human being, not much different from ourselves, encounters disaster because he has a "tragic flaw," a sort of crack in his moral structure. Ultimately, under the barrage of circumstances, this flaw opens and the hero's life collapses. Oedipus, for example, was too proud—that was

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[43] See "Redefining the Book," pp. 9ff., included in the Appendix.

his flaw—and as a result he was destroyed. All we need do is identify the problem and we can see that the hero got what he deserved. Tragedy presents us with object lessons from which we may extract the morals.

This is a neat system and is far and away the most popular explanation for tragedy. Because this point of view has influenced generations of subsequent dramatists, it has become a viable interpretation of tragedy in general. Unfortunately, it has little to do with Greek tragedy or even with Aristotle. The term *hamartiâ* does not indicate an inborn, malignant weakness, like a cancer waiting to spread. A *hamartiâ* is simply "a mistake," or "miscalculation." It does not have a moral dimension.

The consequences of this distinction are profound. Oedipus does not get what he deserves. Killing his father and sleeping with his mother did not result from some hidden character flaw. These were mistakes, committed in ignorance. In no way can one argue credibly that he has earned his ultimate doom. The fate of Oedipus is not an object lesson from which to draw a moral; it is a disaster, a malicious joke, mysterious and disturbing at once. Remove the moral dimension from *hamartiâ* and the science of moral arithmetic no longer adds up. We must rebuild our entire view of tragedy, and we will never view any play, Greek or English, in precisely the same way.

Philologists—or critics functioning as philologists—have a simple basic technique that they apply when trying to determine what *hamartiâ* really means. They look at the places in which this word occurs, they examine the way in the word is used, and thus they inductively develop a semantic model. They may look at a handful, several dozen, hundreds or even thousands of instances. They may study a common word in a single author, or a relatively infrequent word in all of Greek literature. The subject may be literature, philosophy, or history. The investigator may be more or less sophisticated, and the results will vary. But the method is always essentially the same.

Tools and their Limitations

The TLG is an extremely simple resource: a collection of basic source texts that now contains more than three hundred megabytes of data. Likewise, the tools that classicists have applied to this resource have been straightforward: simple string-based queries with little or no sophisticated content-based information retrieval techniques.[44] But classical scholars have flocked to use the TLG. More than two dozen departments spent tens of thousands of dollars each to gain access to TLG on mini-computers. Now hundreds of classicists have purchased *Ibycus* personal computers so that they can use the TLG on compact disk. Many others practically clamor for programs that will allow them to attach the TLG Compact Disk to their Macintoshes and IBM PC's.

Classicists are eager to use the TLG because the collection of texts offers them the opportunity to find every single occurence of a particular word because they know that after examining 327 uninteresting passages, the next instance may place in an entirely different light the word or concept they are studying. However, raw string searches in Greek (as in most languages) are an imperfect tool. Because Greek is highly inflected (a single verb stem can have more than one hundred forms), the user must type in a stem, but many words share the same stem. A three or four character stem (e.g. "gen" or "pemp") can bury the user with strings that could not possibly be forms of the requested word. Furthermore, a single Greek verb can have six different stems. Finally, Greek has many dialects, so that retrieval must consider many subtly different variations in stem and inflection: finding all the forms of *lêthê* does

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[44] Much effort has, however, gone into making retrieval efficient. David Packard's *Ibycus SC*, for example, has a custom IC that allows it to perfom a sequential search at great speed—the hardware can search up to several megabytes per second. Only the throughput of the compact disk on which the data is stored (roughly 150 kilobytes per second) limits the speed at which this personal computer can search the TLG database.

little good unless one searches also for *lâthâ*, the Doric form of the word. The user must therefore search for information using a number of imprecise key words and be willing to process an unwieldy mass of results.

Intelligent string searches can be far more effective in Greek than in English. Because Greek morphology is far more complex and contains far more information than English morphology, there are very few Greek words that could derive from more than a single dictionary entry as often occurs in English (e.g., the word "fly"). Even when the letters of a noun and verb form are the same, the accent will usually disambiguate between the two (thus φυγᾷ is a noun, whereas φύγᾳ is a verb). A system that can understand Greek morphology can retrieve all the possible forms of a Greek word, and include very few strings that could derive from another dictionary entry.

These problems, however, have traditionally had no direct impact on those who do not know Greek. After all, how can one study the concept of *aretê* or *hamartia* without knowing the language? Even if the English translation had a printed concordance, or were kept in an on-line database, the student who does not know Greek still could not study the concept *aretß*, because "skill," "excellence," "virtue," "moral worth" or any number of English phrases are translational equivalents. There has simply been no way for such learners to find all the passages in which *aretê* occurs. They can do nothing but accept the pronouncements of those who can move with the ebb and flow of the language in which the texts are composed. Entirely dependent on their guides, they are classic "innocents abroad."

Morpheus, the Lexicon and the Greekless Learner

In Phase I of the project, we have developed a functioning version of *Morpheus*, a system that can analyze Greek morphology. Written in the C programming language, *Morpheus* currently consists of approximately six thousand lines of code and includes a database of 7,500 endings in several Greek dialects. Initially developed under Unix, *Morpheus* can run on a Macintosh Plus.

Morpheus itself is not a complete system: it requires a database of stems and the information that defines how a stem can be inflected (e.g., "this is an omega class, Doric verb stem"). We have therefore entered a forty thousand-word Greek-English Lexicon, from which we are in the process of extracting the morphological information. The resulting database of Greek morphology will allow *Morpheus* to serve a variety of purposes.

For experts, *Morpheus* and the Lexicon will comprise a unique resource. Ultimately, a scholar will be able to retrieve from the TLG all the forms of a particular Greek dictionary entry without being overwhelmed by morphologically inappropriate results.

Morpheus and the dictionary allow the general learner to interact with Greek texts in an entirely new way. Consider students working on Socrates' discussion of the word *hosios*, "holy" in the *Euthyphro*. They could search the dictionary for all those words that contained "holy," "sacred," or "pious" in their definitions. They could then read about related terms (such as *hieros* or *hagios*) and thus acquire a more general idea of what is "holy" or "sacred" in Greek thought. They could then turn to an index that *Morpheus* had generated for a Perseus text (perhaps other dialogues of Plato or the tragedies of Aeschylus) and ask to see all those places in which *hosios* or *hieros* or *hagnos* appeared. The system would search the Greek, but students would look up the corresponding translation. Thus, even though *hosios, hieros* and *hagnos* might all be translated as "holy," the students could see where each of these terms was used and begin to explore how the different kinds of "holiness" in Greek thought.

When the students had completed this exercise and turned their attention back to Plato's *Euthyphro*, they would have a completely different perspective on the problems and issues that that dialogue considers. They would not only have a much clearer idea of what *hosios* (as opposed to *hieros* or *hagnos*) meant but would also realize more generally that languages other than English can reflect values very different than their nearest English equivalents. The immediate problem may be linguistic, but as all language teachers know

linguistic issues are intimately associated with the culture as a whole. Studying *hosios* can offer students a precise and dramatic way of learning how cultures differ.

Practical Issues

We are still in the process of collecting our initial corpus of Greek texts and extracting from the Greek-English lexicon the morphological data that *Morpheus* needs. We have only begun to test this technique on-line. Nevertheless, Gregory Nagy has used this technique with conventional technology for years. His students use a printed concordance of Homer to find all the passages in which a particular word appears, then flip through the pages of their translation to find the corresponding passage in English. This process is clumsy. Students can only examine those authors for which printed concordances or detailed indices exist. Even when such tools exist, paging through several concordances is slow and restricts how much material a student or scholar will cover.

Our experience has alerted us to some of the limitations of this technique. From a practical point of view, students who have very little or no knowledge of Greek may not always be able to identify the English translation that corresponds to the Greek word. Related terms such as "holy" and "sacred" may occur in the same sentence, and the student may be unable to decide which word is *hieros*. Furthermore, the reference schemes of Greek literature vary in their precision. A line of poetry is a precise unit, but a chapter of Herodotus can cover an entire page. Therefore, we must make sure that all texts in **Perseus** have the most precise possible reference system so that the student who cannot read Greek will have to search as little English as possible to find the equivalent of *hosios* or any other word.

However, even in print technology this is a powerful technique for learning. At worst, the instructor may have to go through and mark the relevant passages, but by placing all the texts and translations in the same system **Perseus** will make this more efficient and much easier for instructors to do such preprocessing.

A *Perseus* Theme

In addition to primary material made up of text, maps and images, **Perseus** will contain a set of secondary materials called Themes that will be the contributions of Authors and other **Perseus** users. Themes are a flexible category and subsume several different types of contribution. A **Perseus** Theme might be a post-structuralist essay on the *Bacchae*, a tragedy by Euripides, or a straightforward collection of sources that illustrate Greek athletics. All Themes guide the user along a particular path in the database: thus the post-structuralist essay on the *Bacchae* would lead the user through many passages of Euripides, while the source book on Greek athletics would lead to a wide variety of texts, vase painting and other kinds of data. A Theme is a guided tour through the database and illustrates not only its immediate topic but what kinds of materials the database contains. Typical **Perseus** Themes might cover the following topics:

- *An Overview of Greek Civilization*: This will be a general introduction to Greek civilization.[45] This will be an exceptional case of a very well developed and extensive Theme.

- *Close reading of Plato's Apology*: In contrast to the overview, this will be a set of intensive notes and questions to Plato's dialogue to help the learner focus on a single text.

- *Oedipus the King and Folklore*: This might draw from the folklore of many cultures a number of stories similar to that told in *Oedipus the King*. This Theme might explore the relationship between folklore and conventional literature and might illustrate how modern psychological theory has been used to explain both.

- *Women in ancient Greece*: What role did women play in the fifth-century Athens? What can we learn about this subject from the court room speeches of the Greek orators, the plays of the tragedians, the vases with pictures of daily life?

- *Speeches in Ancient Historiograpy*: What do we know about the historical veracity of the speeches that Herodotus and Thucydides include in their histories? What does this tell us about ancient views of history?

- *An Athenian Trireme*: What can we learn from the reconstruction of an ancient warship?

Since a **Perseus** Theme organizes materials such as vases, sculpture, poetry, maps and encyclopedia entries according to a general topic, it will occasionally be difficult to determine the distinction between Theme and encyclopedia entry. Generally speaking, however, Themes are more subjective and allow authors to express their individual interests and ideas. The encyclopedia entry on Euripides, for example, will provide background information about that playwright, while an Author could use a **Perseus** Theme on Euripides to describe his own controversial ideas about Euripidean tragedy. The Theme would make reference to the encyclopedia entry on Euripides as well as to other material from the database. If **Perseus** continues to develop beyond Phase II, it will probably contain several Themes on Euripides and allow contributors to present differing viewpoints.

Perseus Themes can also expand the database beyond the commonly used primary materials listed earlier in this proposal. An Author working on Attic law, for example, may need portions of texts that are not often read and have not been included in **Perseus**, or a few images of inscribed potsherds from the Athenian Agora. These primary materials would be entered into the database of primary materials.

Since new Themes will constantly be created, a small number of those that are done well in the beginning can serve as examples of how to create more. **Perseus** might, for example,

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[45] This will already be a part of **Perseus** 1.0. Thomas Martin will develop the first version of this overview in the spring of 1989. For a fuller description, see "Encyclopedia, Overview, and Atlas," in this chapter.

contain a rich selection of material that illustrates Attic law or fifth- and fourth-century views on Athenian imperialism, but it might not have much material on how Greek tragedy was performed. Users of **Perseus** would see from the treatment of Attic law or Athenian imperialism not only how useful a Theme can be, but also how to create their own.

Scope of a Theme

When experts study a play by Aeschylus or a vase by Cleophrades, they are really asking a series of questions determined by some thematic problem such as "What does this scene contribute to the play as a whole?" or "How does this vase exemplify the style of Cleophrades, as opposed to some other painter?" Few learners, whether undergraduates or professors, study primary materials without some objective; even when reading a play or viewing a painted vase they have some set of questions in mind. A Theme is meant to model the connections that one brings to a primary source.

One type of Theme may be instructional material that tries to make the information in **Perseus** comprehensible to a particular category of readers. The overview and close reading of Plato's *Apology* listed at the beginning of this section are examples of this type of Theme. Others might consist of a tutorial introduction to Greek sculpture for the adult learner or an in-depth analysis of a particular architectural form intended for the art student.

Other **Perseus** Themes may be more general in nature and contain enough material so they can be useful to a wide audience of nonspecialists. Greek athletics, for example, is an almost inexhaustible topic. Although a classicist who is writing a book on Greek athletics might find that the **Perseus** Theme on Greek athletics does not offer him any further insights, the nonspecialist might find the same Theme a very useful and interesting approach to the topic.

Navigation and Authoring in *Perseus*

The navigation and authoring tools in **Perseus** are still at an early stage of development. During the first year of work we have primarily focused on individual pieces of **Perseus**: we felt that we could not build a realistic model of how we would move around in the database as a whole until we had a clear idea of what the individual pieces of the database would look like. Now that we have a general idea of what objects the database will contain, we can begin designing the structure that will link them together. Structuring the first version of the database, **Perseus 1.0**, will provide the focus for the next meeting of our Technical Advisory Committee.[46] This section describes our preliminary thoughts about the types of action and movement that we want to provide through the database, and the way in which all the parts fit together.

Moving Around in *Perseus*

Perseus Themes will lead the learner through the database. A Theme on "Women in Fifth-Century Greece" would, for example, lead the learner through the literary passages, vase paintings, historical documents and other pieces of evidence relevant to this particular topic. But important as Themes will be, they cannot alone provide the structure that we need. We expect that **Perseus 4.0**, when it is released in 1992, will contain between forty and one hundred megabytes of textual data, and several thousand images. This collection will include a large percentage of our most important data about the ancient Greek world. **Perseus** staff, authors and contributors will clearly not have time to duplicate in the electronic medium the hundreds of thousands of links that scholars have made among the materials within this database over the past five hundred years. We will therefore depend upon general schemes that will allow users to move around within **Perseus** and that are independent of any particular hypertext system.

Implicit Links

An implicit link is essentially a standard keyword (e.g., "Pericles" or "Corinth"). The encyclopedia will serve as the central clearinghouse for implicit links: any learner will be able to select a word or type in a keyword such as "Pericles" (the great Athenian statesman of the fifth century) or "Corinth" (the major city located in the north-east corner of the Peloponnese in Greece) and then jump to the relevant Encyclopedia articles. The entry in the encyclopedia will not only describe these terms but will lead to further relevant materials: the article on "Pericles" will include references to the important literary discussions of that figure (e.g. "Thucydides 2.22"); the article on "Corinth" will point out that "Corinth" is a toponym (place name), that the word "Corinth" is "pre-Greek" (i.e., just as "Massachusetts" and "Connecticut" are pre-European geographical names), and that the user can call up the atlas to view Corinth's location.

Since we will most likely create the encyclopedia from an edition of a classical dictionary or encyclopedia that is currently out of copyright,[47] we will adopt the list of entries it contains as our initial list of words that will be "live" in the database.[48] In this way, we can

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[46] This will take place some time during early 1989, and will be paid for by funds from Phase I.

[47] See section "Encyclopedia... " of this chapter.

[48] Such keyword based retrieval has its limitations (Gary Marchionini, who is in charge of our external evaluation, has had considerable experience studying this type of hypertext). We have, however, found that we can produce adequate results with just the list of words in the classical encyclopedia, and a good set of synonyms to pick up alternate spellings. We have not yet decided on how to indicate to users that words such as "Pericles" or "Corinth" are implicit links (e.g., should the user be able to switch a feature on and off that indicates such words?). From a practical point of view, however, this is not an issue, as *HyperCard* will not support multiple fonts or text styles in a single field until version 2.0 is released at the

draw on the collected opinion many scholars over decades to determine what the important names, places, events, and concepts of the classical world are. As **Perseus** progresses, more and more entries will be added to the encyclopedia.

Though important, the encyclopedia will not be the only source for implicit links. *Morpheus* and the Greek-English lexicon will also allow Greek words to serve as implicit links so that the learner who has no knowledge of Greek will be able to pursue the interconnections of culture and semantics.[49] Strings such as "428 B.C." and "Beazley, *Attic Red Figured Vases*," should suffice to call up relevant sections of a time line or bibliographical database. **Perseus** thus tightens the connections between the data in the encyclopedia, in bibliographies, in the Greek-English lexicon, and in other traditional reference works.

Standard References

There is a standard reference system for virtually every piece of primary evidence about the ancient Greek world. The string "Soph. *Antig.* 338" designates line 338 of the play *Antigone* by the Athenian tragedian Sophocles; "Herod. 6.52" designates chapter fifty-two of the sixth book of the Herodotus's *Histories*. Not only a trained reader but a moderately intelligent program can use these strings to locate the appropriate passages.[50]

Works of art also have standard reference systems. For example, Attic painted pottery is classified by painter according to the monumental work of J. D. Beazley: ABV 151, 22 refers to the twenty-second black figure vase attributed to a particular painter on page 151 of his *Attic Black Figure Vase Painters*. Other objects are also reference by museum number or by the excavation publication in which they were first described.

Standard references, such as "Thucydides 2.22" or "*ABV* 146, 22" can serve as simple links because they contain all the necessary information: the user selects "Thucydides 2.22," calls a lookup function, and jumps to Book two, chapter twenty-two of Thucydides' *History of the Peloponnesian War*. Key words such as "Pericles" and "Corinth," discussed above, can also serve as simple links, insofar as the user can always go to the relevant encyclopedia articles.

Authoring tools

HyperCard, our current delivery system, is not the most powerful environment in which to create complex hypertext documents. It cannot match the powerful linking facilities of more elaborate systems such as *Intermedia* and Xerox's *NoteCards*. Users of *Intermedia* or *NoteCards* who begin working with *HyperCard* immediately miss such amenities as editable browser windows, and they are normally shocked at the fact that they can open only one *HyperCard* window at a time.[51] Those developing **Perseus** earnestly await the time when either a more advanced version of *HyperCard* or some entirely new hypertext/hypermedia system appears that can support **Perseus** on a relatively small machine (i.e., a Macintosh SE) and provides more elaborate authoring tools.

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earliest. On more general issues, see David C. Blair, and M. E. Maron, "An Evaluation of Retrieval Effectiveness for a Full-Text Document-Retrieval System," *Communications of the ACM* 28(1985):3.289-299, who give a very pessimistic view of full text retrieval in general. But also note, however, that all users are not interested in the same thing: contrast the attitude that classicists have towards simple string searches of the TLG (described in "*Morpheus* and the Greek-English Lexicon").

[49] On this, see "*Morpheus* and the Greek-English Lexicon."

[50] The *Persian Wars* stack included in the Sample Materials illustrates how standard references can be used.

[51] For a list of desired improvements to *HyperCard*, see the discussion of delivery systems in Chapter VI, *Delivery/Distribution*.

We should stress, though, that many have gone a long way in developing materials on the ancient Greek world in *HyperCard* without special authoring tools. Many of those with whom we have spoken are primarily interested in being able to call up standard kinds of information by means of the standard references and implicit links outlined above.

Nevertheless, we can already provide simple tools in **Perseus 1.0** to help authors link pieces of information in the **Perseus** database. These authoring tools will take the place of a fully developed explicit linking structure and allow users to create arbitrary linear paths through the data, to annotate as they read, and in advanced cases to add some functions of their own.

Paths

Paths are cards that associate up to thirty cards and create a linear tour through a *HyperCard* database.[52] Instructors can create Paths for their students to guide them through a particular subject.[53] Students or readers can also use Paths to store locations they find interesting as they browse, and finally, a hypertext "paper" can be written using this authoring tool.[54] Small **Perseus** Themes may also be created as Paths.
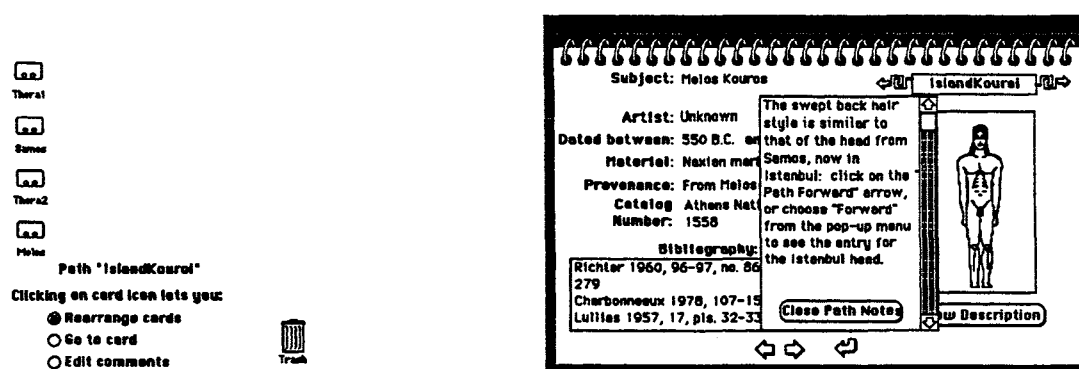
Diagram 4.5 On the left, a *path* card contains icons that refer to different stops on the tour that a student has built through a set of stacks. The right hand card illustrates how Paths allow students to superimpose their personal annotations on a static reference work such as a museum catalog. The annotations in the center window are stored with the rest of the data for the Path, not with the catalog card.

Each **Perseus** card contains a Path icon that allows the user to move forward and backward on the current Path, add cards to the Path, or create a new Path.[55]

Although Paths are a *HyperCard* feature, the way in which they store the information for the various card locations allows one to extract that information and transfer it to another.

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[52] Since we began to work on pPaths, we have learned that *NoteCards* has also added a similar feature called "Table Tops."

[53] Professors at Rhode Island College pointed out that too much information can be confusing for the student who has little background. See "Using **Perseus** in a Variety of Educational Settings," in the Appendix.

[54] Neel Smith's students at Bowdoin already did this. See "Teaching with *HyperCard* at Bowdoin College" in the Appendix.

[55] Elli Mylonas initially implemented *Paths* in *HyperCard*, and Neel Smith extended her design.

Perseus Authors

No centralized staff alone can possibly build an entity as diverse as **Perseus**. Without doubt, the best people to determine what can be done to promote the study of a particular area are the people writing and teaching in that area. Ideally, a group of three to six Authors, each of whom has a particular area of responsibility, will collaborate to create **Perseus**.[56] The project will be as collegial as possible and should not serve the interests of a narrow group of scholars or institutions.

The **Perseus** staff will help Authors to accomplish better what they are already doing, and to apply new technology to their familiar methods. As a general principle, **Perseus** will maintain the smallest possible central staff and channel as much of its resources as possible to the Authors who are actively engaged in research and teaching. Members of the **Perseus** staff may also, at times, work as Authors. Among the services we will provide to our Authors are the following:

• *Academic leave* When an Author's project requires a substantial amount of time, it may be possible to provide support for that person to work full time on the project for a summer or semester. Since it is relatively expensive, we will provide this level of support only in a few cases.

• *Research Assistants* Graduate students can help support much of an Author's work. A part time research assistant generally would represent a large expenditure.

• *Computer Support* We are currently doing much of our work with *HyperCard*. **Perseus** staff will provide templates in *HyperCard* or in another application that is suited for a particular type of information. For example, Authors will have templates for the different types of texts: literary (including drama and history among others), encyclopedia entries, commentaries, *apparatus criticus*, and image descriptions; and for various types of data: images and maps. Since we will not be able to anticipate the best possible form for every type of information, we will try to adapt the templates to their needs.

The **Perseus** staff will also provide support by telephone. We will try to establish a working relationship with the Authors' local computing facilities, so they can take care of problems with hardware. The **Perseus** staff will assist with problems relating to **Perseus** materials and software. Although we are currently developing **Perseus** on Macintosh computers, some of our Authors may work on other types of computer. Authors can collect a great deal of information on any system as long as the data conforms to **Perseus'** guidelines. The **Perseus** editorial staff will be responsible for ensuring that such data is consistent with the rest of the material in the database. In the very limited number of cases where an Author does not have access to any system, it may be possible for the project to provide a Macintosh.

• *Translations* If a particular Author wants to incorporate material from scholia or grammarians to illustrate some point, but this information only exists in Greek, the **Perseus** staff will provide translations or provide means for the Author to hire a graduate student to do the translation.

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[56] Many people will contribute to **Perseus**, but we will not have the time and resources to collaborate closely with more than a small number of people. For this reason, we distinguish between "authors" and "contributors." Note that some contributors may provide substantial amounts of material to **Perseus**, e.g., an article or monograph.

• *Iconography* An Author working on Aeschylus's play, *The Libation Bearers*, might want to include illustrations of Orestes, a central character in the drama. The Perseus staff will work with him, not only finding the pictures but helping him also incorporate those pictures into his teaching or research.

• *Maps and Drawings* If Authors need one or more maps to illustrate their topic, we will provide support for drafting these. The division of labor will depend on a variety of factors. Authors who need many maps and drawings might hire their own research assistants to do them. Those who need only one or two can get them from Perseus. Often Authors only need a fairly general template (e.g. Mainland Greece, Attica) on which they can place their own information. We will work with Authors to provide actual drafting when necessary or to distribute to an Author maps that have already been prepared. In this case, the editorial staff will serve as a clearinghouse, coordinating the efforts of the various contributors.

For each of the three Perseus releases we will choose an small group of people (perhaps between three and six) who will serve as Perseus Authors. A Perseus Author will take the primary responsibility for some classical text or Perseus Theme. Authors will be expected to collect the basic materials that they would use to teach a course. Ideally, the course would not only be of general appeal (e.g. useful in a translation course or a Western civilization course) but would also reflect the Author's research interests. By helping faculty members bridge the gap between their own interests and their teaching, Perseus will improve the quality of both.

The range of the Authors' activities will vary considerably. In some cases, they will revise translations, create new *apparati critici*, assemble bibliographies, provide metrical analyses and other forms of commentary and contextualizing information. Others may have materials that can be incorporated into Perseus with relatively little effort. For example, a specialist in Greek popular morality might have already collected a list of the most important materials. His activity as a Perseus Author would involve describing intellectual problems and designing pedagogical approaches for the classroom.

Authors will also be responsible for testing and refining their materials through use: translations may be initially difficult to read, the selection of materials may be insufficient, or other unexpected problems may arise. Authors should use the material that they collect at least twice in the same course. A person working on Aeschylus might use the same material in a translation course and in a seminar but should try to teach either the translation course or the seminar at least twice.

A scholar's involvement with Perseus may increase by stages. Thus, Perseus might provide material to a particular Author so that he can teach a class with Perseus. The second time he teaches the same subject, he might receive more materials. Before teaching the subject a third time, he might spend a semester on paid leave, systematically expanding and refining the materials that he used the first two times he taught the course.

Authors should come from a variety of different institutions and backgrounds. An historian of science might wish to incorporate material about Greek mathematics or natural science. An instructor from a community or junior college might wish to prepare pedagogical material for teaching Aristotle. Authors provide the Perseus staff with the best opportunity to make Perseus as useful as possible to a number of different audiences. We must emphasize the need for diversity when we select Perseus Authors. Ideally, at least half of the Authors would *not* come from classics departments in large research institutions.[57]

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[57] Perseus will make every effort to support authors at institutions where support for research is limited.

Some Examples:

Neel Smith at Bowdoin College

In the first year of the project, Neel Smith was teaching full time at Bowdoin College and functioned as one of the first **Perseus** Authors. Moderate amounts of support allowed him to become a major contributor to the project. His experience illustrates some ways in which we can work synergistically with instructors outside of our immediate facilities in Boston. His work is outlined in the Appendix "Teaching with HyperCard at Bowdoin College."

Professor Smith was not only able to design basic data structures for **Perseus** and to contribute material to the project but also integrated his work into two courses. His activities were prominent at Bowdoin, and he was able to acquire a small lab with four Macintosh SE's for his department, a Macintosh II for his own research, and a number of peripherals (e.g. CD player, scanner, 24 bit screen, Laserwriter, etc.). He has also received a $15,000 grant from Apple to develop a core of images for teaching Classical art and archaeology with **Perseus**.

Perseus contributed a relatively small amount of money to pay for data collection (one play of Aristophanes and a fair amount of drafting). By providing the means for Professor Smith to be involved in a multi-disciplinary effort carried on by people at a variety of institutions, **Perseus** not only strengthened Professor Smith's work and but also gain through his contributions. Bowdoin College has evolved into a partner rather than a client. We have already begun to see signs that others who collaborate with **Perseus** will use our support as a starting point for their work rather than a definition.

Christopher Biffle at San Bernadino Valley Community College:

Christopher Biffle is a professor at San Bernadino Community College and has taught philosophy and Western Civilization for over seventeen years. He has developed several prototype *HyperCard* stacks. His *Time Throttle*, for example, provides a visual overview of world history from 4 million B.C. to 1988. The concept is similar to that employed in the **Perseus** *Persian Wars* stack. Another stack contains a text of Plato's *Euthyphro* with plentiful notes, suggestions, helpful diagrams, questions and other tools. The stack is designed not only to help the reader follow the argument but to stimulate the learner's ability to read closely a subtle, complex text.

Professor Biffle's experience as a teacher and as a *HyperCard* developer will help us make **Perseus** as broadly useful as possible. The needs of his students will help to define the shape that **Perseus** assumes and the direction that the project takes. Although students at a community college often have different needs and expectations than students in larger research institutions, we have already begun to see that all learners share most of the same problems. Few insights into the process of learning benefit only one group. **Perseus** can help Professor Biffle in several ways:

- *He can extract basic data from Perseus and use it as a foundation for his own work.* **Perseus** will contain copyrighted material, and although material may not be freely redistributed, the **Perseus** Project will provide a means to make it available.[58] Professor Biffle's *Time Throttle* stack, for example, contains a number of maps from the Mediterranean that he entered himself. He could copy **Perseus** maps and place his own data on them. Likewise, he entered a translation of Plato's *Euthyphro* by hand whereas he could have simply exported the translation from **Perseus**.

- *He can create links to information in Perseus.* Rather than having to write his own background information on the date and context of Plato's *Euthyphro*, he can create a link to an equivalent summary in **Perseus**. Or, if he wants his students to be able to examine a parallel passage in some other major work of Plato, he does not have to enter that passage

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[58] See Chapter VIII, *Rights*.

or count on his students to have the text at home. His students can select the reference (e.g. "Plato *Republic* 338d") and call up the passage from within **Perseus**. Or again he might want his students to jump into a **Perseus** time line or any other basic tool that we support.

• *He can use Perseus as a medium for collaborating with people of similar interests.* Many people are now using tools such as *HyperCard* but are working entirely in isolation. Sometimes, this isolation fosters creativity and exciting things result, but often instructors spend solving basic problems that others have solved many times over. We can serve as a clearinghouse for such expertise.

• *He may be able to receive some financial support from Perseus.* We will have to husband our resources carefully if we are to accomplish the goals of the project, but Professor Biffle might well become a **Perseus** Author and receive some direct support for faculty release time or research assistants.

• *He can use Perseus as a publication medium.* Once he has created a stand-alone application that might be of interest to others, he can submit it for publication in the next version of **Perseus**.

David Kovacs at the University of Virginia:

We badly need a readable translation of Euripides. The current Loeb Library translation is not suitable for **Perseus**, and translating the nineteen tragedies that have survived and are attributed to Euripides is a substantial job.

Professor David Kovacs, a classicist at the University of Virginia, has begun to create a new Loeb edition of Euripides that can be incorporated into **Perseus**. We have access to a limited number of machines from Apple and will provide him with an Macintosh SE 20 sometime at the end of May. In return, **Perseus** will receive access to translations of the first eight plays by the summer of 1989.

During the course of the 1988/89 academic year **Perseus** may come to an arrangement with the Loeb Library to pay for some leave time in 1989/90 for Professor Kovacs to accelerate his work on the remaining plays.

Building Perseus: Stages of Construction

Chapters II and III gave descriptions the significance and development of the **Perseus Project**. This section will explain the process by which **Perseus** will be constructed and assembled. Most of those who use **Perseus** over the years will be learners, and we expect that many of these learners will be able to produce material useful to it. However, it is the instructors in various fields, who are already familiar with the materials in **Perseus**, who will be the first to use it, and who will play a major role in defining the database. Finally, the experts will create much of **Perseus**, and will review any material created by novice learners before it can be included.

By presenting **Perseus** as a new medium for publishing information and ideas, we can begin to draw upon some of the energy now devoted to conventional publications. If we can make even a small degree of progress in this direction, many people will build paths through and structures for the database, and these will tie **Perseus** data together. The following section describes some of our views on this process.
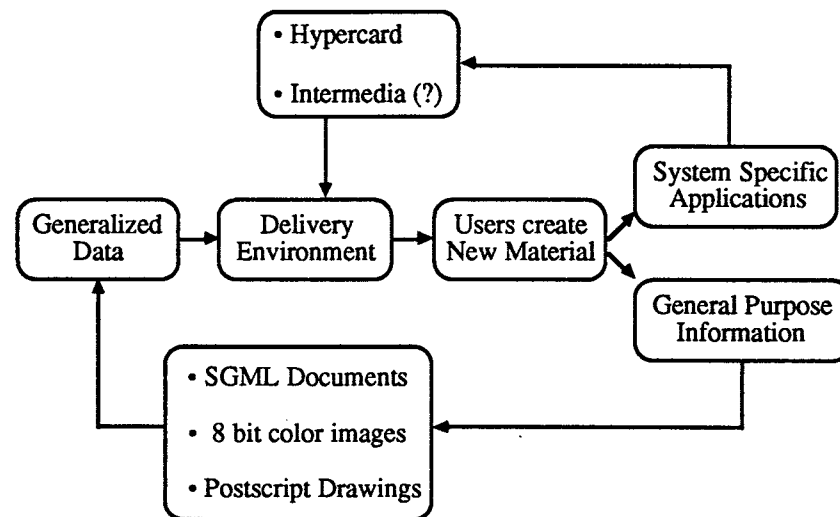
Figure 4.6 **Perseus** is conceived as a living entity, in which the project disseminates material to users who in turn submit work to be included in subsequent versions of **Perseus**.

Perseus 1.0: Fall 1989

While we have devoted the majority of our efforts to planning and prototyping, we will, at the conclusion of Phase I, nevertheless have produced a substantial body of material. With additional support from Apple Computer during the 1988/89 academic year, we will be able to round off our work and produce **Perseus 1.0** in the fall of 1989. **Perseus 1.0** will include the following components:

- The overview of Greek civilization.◆ This will be a three section overview written by Professor Thomas Martin and will make **Perseus** as a whole more accessible to the general student.

◆ Indicates that this work was done primarily with funding from Apple Computer.

• *Morpheus.*[*] This will be an official release of the classical Greek morphological analysis system called *Morpheus*,[59] which currently consists of approximately six thousand lines of code in the C programming language, and a database of more than seven thousand Greek endings.

• The Greek-English dictionary.[*] We have had the entire Liddell/Scott *Intermediate Greek-English Lexicon* placed on-line by an offshore data-entry firm. Most of our work at present is, however, being spent on extracting the morphological information that *Morpheus* requires from the dictionary.

• The atlas. By the fall of 1989 the two major data components of the Atlas will be completed: 1) the topography of Greece and the lands adjacent to the Aegean Sea, digitized from 1:250,000 maps with contours at four hundred meter intervals, and 2) the processed Landsat images covering Greece and the Aegean at a the same scale as the topography. The atlas at this point will be approximately sixty megabytes of image data.

• **Perseus texts.** This will include Greek texts and translations of Aeschylus, Sophocles, Pindar, and all of Herodotus. A total of six to nine megabytes.[60]

• Core Collection of Images of Classical Art and Archaeology. Approximately fifteen hundred images of topography, architecture, art and archaeology from the collections of scholars, from our own work in Greece, and from museum collections.

• Software to access the **TLG** and **PHI** Compact Disks.[*] We will provide software that will allow classicists to use the Greek and Latin databases developed by the *Thesaurus Linguae Graecae* and the *Packard Humanities Institute.*

• Themes and sample teaching materials. We have begun to develop a substantial amount of secondary material, mostly in *HyperCard* stacks, that makes use of the **Perseus** database. Some of it is applications or data that fall into the category of **Perseus** Themes, and the rest is examples of teaching material that can be distributed with **Perseus.** These materials include Kenneth Morrell's course materials for Nagy's course, *The Concept of the Hero in Hellenic Civilization,* Neel Smith's *Visualizing Aristophanes* and tutorial on archaeological drawing,[61] and Gregory Crane's *Introduction to the Greek Tragedy.* Others will appear during the next fifteen months, and **Perseus 1.0** will help distribute them.

• During this time, **Perseus** materials will be used in at least six courses at Harvard, Bowdoin, and Boston University, and their performance and effects will be evaluated.

Perseus 1.0 will be distributed as *HyperCard* stacks, but we will consider creating an additional version that runs with some other software package as well, if a suitable system materializes during this time frame. We will decide on the precise delivery media for **Perseus 1.0** during the course of the 1988/89 academic year.

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[*] Indicates that this section will be complete during **Perseus 1.0.** Note, however, that nothing in **Perseus** is fixed. We invite revisions of, and additions to, existing material.

[59] See the description of *Morpheus* in earlier this chapter.

[60] Note that we base our estimates on the assumption that a single volume in the Loeb Classical Library contains roughly one megabyte.

[61] Morrell and Smith describe their experiences teaching with **Perseus** materials at length in the Appendix. See Morrell, "Teaching with *HyperCard*," and Smith, "Teaching with *HyperCard* at Bowdoin College."

Perseus 2.0 - 4.0: **1990 - 1992**

During the span of **Perseus: Phase II**, we plan three additional releases of **Perseus**. The production cycles for these, scheduled for the fall of 1990, 1991, and 1992, will define the shape of **Perseus Phase II**. This pattern would run as follows for **Perseus 2.0** (planned for release in the fall of 1990).
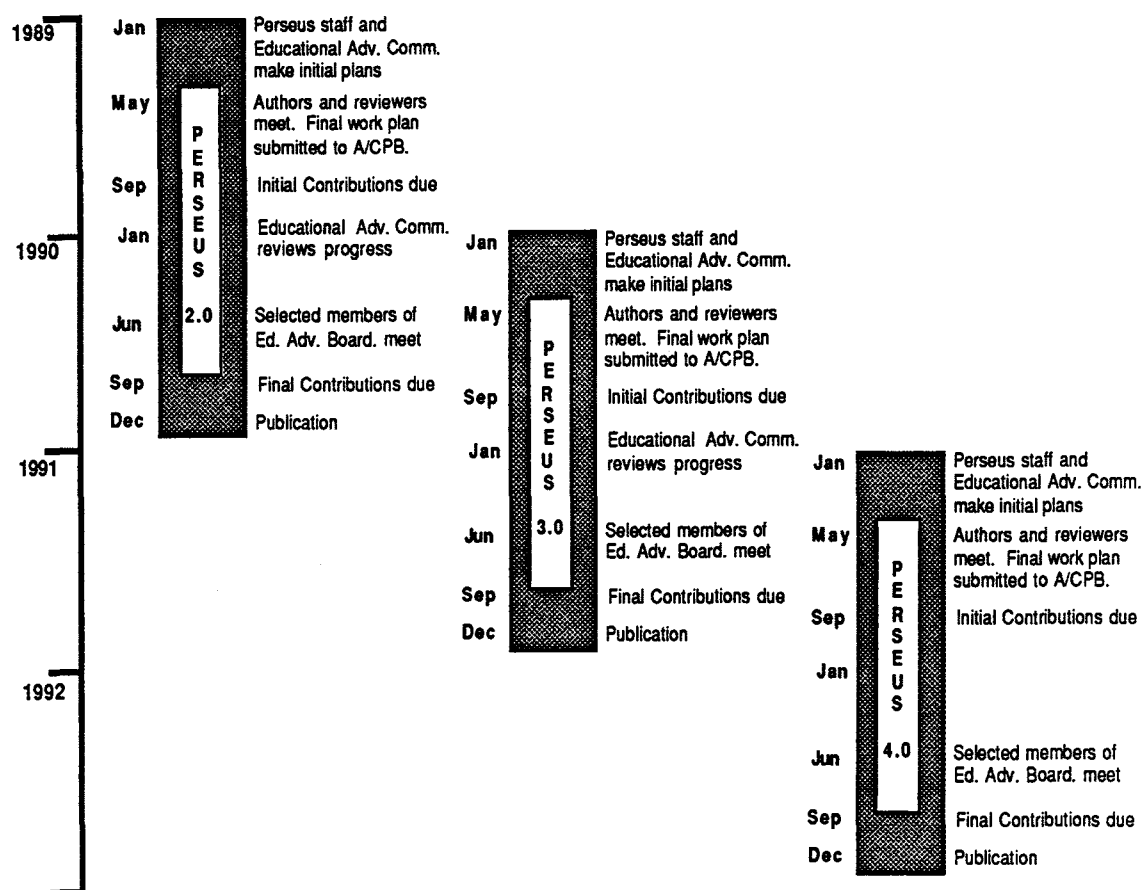
Figure 4.7: Milestones in **Perseus 2.0 - 4.0**.

January 1989

Educational Advisory Committee meets in Boston where the agenda will include the following topics of discussion:

• *Choosing subjects for Perseus 2.0.* The subjects and materials on which this phase will focus will be chosen. The outline of materials will be open to discussion, and we should have the freedom to shift our emphasis at various stages of the project. If, for example, we find that our audience is more interested in Homer than in tragedy, we might wish to shift some of our resources over to Homeric epic. Similarly, we may want to add and subtract from the list of sites that we will photograph, or we may find that we want to create a fairly elaborate series of maps or plans for some subject.

We will base any such shifts in emphasis upon our Educational Advisory Committee, and on the informal comments and expressions of interest that central staff members receive. Generally speaking, we will seek input from as many users of **Perseus**, present and potential, as possible.

• *Identifying collaborators for Perseus 2.0.* We will want to match our needs to the interests of those who wish to collaborate with us. Faculty may wish to work in year two of the project because they have scheduled leave at that time, or they may have a particular course planned for year one that would allow them to collaborate effectively with **Perseus** .

We expect that some members of our educational advisory committee will want to work on the project. Others can suggest to us the names of possible collaborators. In the end, we will identify a variety of contributors and three to six people with whom to work intensively, and who will receive the largest share of the available resources.

• *Determining Academic Evaluation for Perseus 2.0*: The central project staff cannot provide detailed, authoritative review for all the material that **Perseus** will include. Like our colleagues who disseminate printed material, we need to identify experts who can monitor and review the work that our contributors are doing.

The Educational Advisory Committee should help us identify suitable referees, and should help us define what particular criteria these referees should apply. We will work together to define as precisely as possible what Authors are supposed to accomplish in this new medium so that we can minimize the number of misunderstandings that will occur.

Contributions to **Perseus** will, we hope, have a novel or innovative form. The precise criteria for evaluating a particular person's work may, therefore, not become clear until later in the production cycle when we have received sample materials

• *The progress of Perseus 1.0.* We will report on where we stand and what we have left to do. We will solicit advice about mid-course changes that are still feasible.

February 1989 - May 1989

Authors begin preliminary work. Though they may often do much of their work during the summer, they must have sample materials by May. These materials will help insure that project staff and major contributors both understand what the author will do.

May 1989: Meeting of authors and reviewers. Final Work Plan submitted to the Annenberg/CPB Project.

We will bring those authors with whom we are working most closely and the reviewers to Boston. We will then review the initial progress that the Authors have made and go over their problems and progress. Final details for major contributions (such as the precise methods and criteria for evaluating their work) will be worked out at this time.

Authors should meet with **Perseus** Staff at least one more time during the course of their work.

June 1989: Selected members of the Educational Advisory Committee meet in Boston

Progress towards **Perseus** 2.0 is discussed.

The Special Associate Editor for **Perseus** 2.0 is selected, and begins to work with the Editor in Chief and the Managing Editor.

Work for **Perseus 1.0** is reviewed, and any final plans for the summer are made. This meeting gives us our final opportunity to adjust our plans if necessary (e.g., an author proves, for whatever, reason unable to produce the expected material) during the final summer of work.

September 1989 Initial Contributions due for Perseus 2.0:

Perseus is not a conventional printed publication, and our contributors will often have to explore new ways of expressing their ideas. This fluidity is one of the most appealing features of **Perseus**, but it will necessitate continual contact between the **Perseus** staff and contributors to ensure that final submissions meet the needs and standards of the database.

All contributors who are receiving **Perseus** support must submit some segment of their contribution for review at this time. If someone is translating six plays, then two or three plays should be done at this point. If an archaeologist is preparing a **Perseus** theme, a correspondingly substantial portion of this theme must be submitted.

This review allows us to catch major problems that our contributors may be having. The material that we have at this point and the comments of the reviewers should allow Perseus, Annenberg/CPB and our contributors to understand precisely what needs to be done over the coming twelve months.

January 1990 Educational Advisory Committee meets and reviews progress.

Review of progress towards **Perseus 2.0**.

Preliminary planning for **Perseus 3.0**.

February 1990

Authors begin work on **Perseus 3.0.**

June 1990: Selected members of the Educational Advisory Committee meet.

Work for **Perseus 2.0** is reviewed, and any final plans for the summer are made.

The design of **Perseus 2.0** must be frozen and debugged at this time. The shape and format of the contributions to **Perseus 2.0** are also frozen. From this point on, authors will be adding data to existing templates. Any improvements in the structure of **Perseus** will be added to **Perseus 3.0** or some later release.

The Special Associate Editor for **Perseus 2.0** begins working full-time to assist the Editor in Chief and Managing Editor.

Progress towards **Perseus 3.0** is discussed.

June - September 1990: Submissions to Perseus 2.0 are due.

Most of the material to be included in **Perseus 2.0** should already have been submitted by June 1990. All contributors must submit final versions of their work no later than the summer of 1990. September will be the latest time at which final submissions will be accepted.

November 1990: Perseus 2.0 is sent to be mastered.

The data is shipped off, disks are mastered and **Perseus 2.0** is created.

December 1990:

Perseus 2.0 is released. Promotional copies will be distributed during the conventions of the American Philological Association, the Archaeological Institute of America, the Modern Language Association Meetings, and the American Philosophical Society.

Versions 3.0 and 4.0 of **Perseus** will follow the same time cycle: creation and collection of data will start in February of each year and end in September of the following year, with the disk being produced in November and ready to distribute in December. This allows for overlapping cycles of approximately twenty months for the creation of the database, and three months for final collation and debugging. We anticipate that the Managing Editor and the editorial staff will be testing early versions of each system by June of each year.

V. Evaluation

Introduction

The evaluation of this project is, like the project itself, complex. First, there are problems of "quality control." Is the data in **Perseus** accurate? How well can those contributing to **Perseus** accomplish their tasks? Second, there are educational questions. These are especially important because **Perseus** is, among other things, an elaborate experiment in changing the way people learn. Our educational evaluation seeks above all to explore two questions:

• Do learners who use **Perseus** assimilate more information about the Ancient Greek world?

• Do learners who successfully assimilate more information also improve the higher-order thinking skills that allow learners to analyze and restructure what they have learned?[1]

Our evaluation will provide assessment and direction for each step in the development of **Perseus**. In the end, evaluation will play two crucial roles. First, it will help us produce a viable educational resource and ensure its long-term success. Second, the information we gather during the evaluation process (surveys, videotapes, etc.) will be a valuable resource for further educational research which will have direct application to many different computer-based projects.

We will organize the people and resources for evaluation into two teams: one team internal to the project and another for external evaluation. Methods, instruments, and data will be shared by both teams but each team will emphasize distinct aspects of the project and produce independent interpretations and reports. Under the direction of Kenneth Morrell, the Associate Editor for Evaluation, the internal evaluation team will focus on the process of creating and editing the database and applying it to various learning environments. Gary Marchionini, the Director of External Evaluation, will independently select and direct the external evaluation team. He will collect and interpret data, and will independently assess the effects of the project.

We need to develop a rigorous system of evaluation. This system must be flexible enough so that it can consider many different aspects of **Perseus**, and so that it can itself evolve during the course of the project. Because **Perseus** promises unique and broad-based educational experiences, we will use a variety of traditional and innovative evaluation methods. We will develop evaluation plans for each of the three releases of **Perseus** scheduled for Phase II.[2]

During the planning stage of **Perseus** 2.0 (roughly January to May 1989), we will prepare a full evaluation plan for the first year and submit the plan along with the appropriate instruments to a panel of educational research experts for criticism and validation.[3] We will also select from the group of end users (instructors, students, and independent users) those who will actively take part in the evaluation. The evaluation plans

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[1] There is another question that is much more difficult to pose but which will play a role in the general success of computer-based learning environments: if learners can more efficiently acquire the basic skills and background knowledge needed to pursue sophisticated problems, will they find learning a more exciting and enjoyable experience? For a discussion of this, see Chapter II.

[2] **Perseus** 2.0 (fall, 1990), **Perseus** 3.0 (fall, 1991), **Perseus** 4.0 (fall, 1992). "Building **Perseus**," in Chapter IV, outlines the development cycle for these releases.

[3] Robert Kozma of the *National Center for Research to Improve Postsecondary Teaching and Learning* at the University of Michigan, Al Bork of the University of California at Irvine, Richard Clark, Professor of Educational Psychology and Technology at UCLA, and Karen Sheingold of the Center for Children and Technology at Bank Street College have agreed to serve on the panel.

for the subsequent years, **Perseus 3.0** and **Perseus 4.0**, will incorporate the experience we gain during the course of the evaluation process.

The following section of this proposal outlines our preliminary approach. We will first discuss the evaluation for the data entry and editing segment of the project. Secondly, we will outline how we intend to ensure that the authors' computing environment and contact with the project administration make their collaboration as productive as possible. Third, we will consider three main groups of end users: the instructors who develop classroom applications with **Perseus**, students who use **Perseus** in their coursework, and independent users. Fourth, we will present our plans for evaluating **Perseus** as a medium of publication and for knowledge representation and learning. Finally, we will outline various specific problems we wish to address in the evaluation.

Methods and team responsibilities for the four objects of evaluation are described below.

Quality Control: Entering and Editing Information

The project will devote a substantial amount of its resources to collecting source material. During the exploratory phase we have experimented with methods of text entry (keyboarding and optical scanning) and of image acquisition (color images in analog and digital formats and Postscript line drawings). Results of the initial data entry have provided the project staff with benchmarks to estimate the rate and accuracy of each method. Contractual agreements with data-entry subcontractors will stipulate a minimum level of efficiency based on those benchmarks.[4]

The Associate Editor for Evaluation will monitor the performance of data-entry sites to ensure that the efficiency of a given site does not fall below the minimum level. In the event that the productivity falls below that level, the staff will make an on-site evaluation and recommend steps either to increase efficiency or change the contractual agreement with the subcontractor. This aspect of the evaluation will be conducted by the internal evaluation team.

Perseus Authors[5]

The **Perseus** staff will ensure that Authors fulfill their commitments in a timely manner and that the quality of their contributions is high. Three to six authors will collaborate with **Perseus** during each phase.[6] When a **Perseus** Author is ready to begin working on his contribution to the project, the **Perseus** staff will arrange for the on-site delivery and installation of any computing equipment that he receives in connection with his work. The staff will also provide training and a basic support system to which all **Perseus** Authors will have access.[7] Under the direction of the Managing Editor, the **Perseus** staff will conduct tutorials on using the equipment and preparing contributions that will be compatible with all other **Perseus** materials. The staff will also meet with representatives of the university computing facilities to arrange for on-site hardware support.

While Authors are collaborating with the project they will have access to telephone support during working hours at the project center in Cambridge. Their calls will be logged, with the **Perseus** staff recording information on the types of inquiries, and the Authors will receive assistance with any problems they may have with the software or distributed materials. By monitoring the inquiries that are received from the authors, the project staff will have the necessary information to make adjustments in the software, materials, and

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[4] See the "Report on Textual Data Entry," included in the Appendix.

[5] See the discussion of **Perseus** Authors in Chapter IV. Note that we will have many contributors but only a limited number of Authors, precisely because the kind of support and evaluation described in this section will, if not carefully controlled, place an excessive strain on staff time.

[6] See section "Building Perseus," in Chapter IV.

[7] See "User Support," in Chapter VI.

editorial process, thus increasing the efficiency and productivity of the Authors' participation in the project. Members of the project staff will also make occasional visits to the Authors to gather information on how the Authors are using the materials and the software and how the staff can improve the support.

Perseus will establish a system of independent evaluation for the Authors' contributions. In consultation with the Executive Committee and the chairman of the Educational Advisory Committee, the Editor-In-Chief will select at least two outside referees to review the authors' work. In September, the ninth month, of each phase,[8] Authors will submit their initial contributions for review. No materials will become part of the distributed Perseus database until the referees have judged them acceptable for inclusion. The Associate Editor for Evaluation will direct the submission, review, and revision of the contributions.

Learning with *Perseus*

The evaluation teams will consider two groups of end users: instructors and students. The ultimate success of the Perseus Project depends on how users are able to apply the information and benefit from both the materials and the process of using them. Thus, both evaluation teams will consider this aspect of the evaluation plan, with the external team devoting its primary resources to it.

The evaluation will examine both what end users produce with Perseus and the processes they apply while working with Perseus. Products include the lesson plans and assignments of the instructor, examinations and assignments written by the students, and questionnaires or written evaluations to be submitted by members from each group of users. Processes include the behavioral traces of use, which will be captured by passive techniques such as videotape and system software, and inferences about cognitive and affective activity, which members of the evaluation team will make based on their active participation with end users while they work with Perseus. Where appropriate, we will make comparisons across groups and conduct active and passive studies of selected individuals.

Evaluation of Instructors Who Use *Perseus* for Courses.

The Perseus staff will work with a selected number of instructors who wish to use Perseus to prepare materials or courseware for the classroom. Initial interviews before the instructors use Perseus will focus on their usual methods of preparing course materials and their expectations about how they will use Perseus. An interview with the instructor at the conclusion of the course will provide the evaluation team with information on how well the Perseus materials fulfilled the user's expectations and needs. The degree to which Perseus meets the instructor's expectations will indicate whether the descriptions of the materials and the instructions for using them are sufficient. The extent to which Perseus meets the needs of instructors in varying contexts will document the appropriateness of the contents and the flexibility of the system. The evaluation teams will conduct interviews using structured protocols specifically designed for the project.

The Perseus staff will also provide software routines that will, with the user's permission, record the user's basic movements through the database. These records of user activity will be useful for instructors as they review and organize the sequence of their instructional activities. The records will also serve as a means for the Perseus staff to evaluate the organizational and functional aspects of the database.

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[8] The Perseus phases run from January of one year to November of the next, i.e., twenty-three months.

Evaluation of Students Who Use *Perseus* in Courses.

Using a multifaceted approach, we will make a major effort to evaluate the use of Perseus by students. We will consider several levels of learning: concepts, skills, attitudes, and higher-order thinking skills. We will also assess the student's facility with the system itself.

The staff will work with the students in courses that make use of **Perseus** materials. The evaluations will expand on the same basic techniques as mentioned above in the evaluation of the instructors. Whenever possible we will attempt to gauge the impact of **Perseus** by comparing the results of our evaluations with those from students in control or parallel groups that do not use **Perseus** within the same courses. We will base the comparison on written tests, essays, and questionnaires. The examinations will be the primary evaluative tool for determining the skills and concepts, while questionnaires will provide information on the attitudes of the students.

The essays will help us evaluate how the use of **Perseus** affects higher-order thinking skills. A panel of experts will evaluate random selections of essays from students in **Perseus** and non-**Perseus** courses according to criteria such as number and quality of relationships established among key concepts (a measure of **Perseus's** linking features), number and quality of concepts included (a measure of **Perseus's** scope of coverage), and level of synthesis (a measure of **Perseus's** overall integrated, multimedia form).

User-based Evaluation

In our experimenting with **Perseus** materials in the classroom, we have seen that among students who have used elements of **Perseus**, expectations and background have often determined the way in which they responded to computer-based materials. Interviews with students before they begin coursework will examine such initial biases, both positive and negative, and will thus establish a basis for further aspects of the evaluation. Before the course begins, we will ask students about their existing knowledge with respect to the content of the course, their learning strategies, and the **Perseus** system. We will also ask what they expect to learn in the course and what role they expect **Perseus** to play in their learning strategies. The initial interviews will enable evaluators to compensate not only for initial biases but for how familiar students were with the materials and traditional research methods.

After the course is completed, we will ask students in a concluding interview to comment specifically on what they learned and whether their approach to learning changed as a result of their experience in the course. We will also ask questions that focus on the materials themselves—the formatting, interface design, accessibility and organization of information, means of navigating in the network, and other factors that may have influenced the students' ability to use the materials, e.g., access to a suitable computing environment. The evaluation teams will construct and validate protocols for conducting these interviews.

Evaluation of the Learning Process

Selected students will be actively involved in the evaluation process. Since a major goal of **Perseus** is to promote higher-order thinking skills, we will ask these students to reflect on their learning and their experience with **Perseus** in a formal ongoing manner. We will ask these students to maintain a journal on their experience with **Perseus** throughout a semester and write summaries of how **Perseus** influenced their learning in subsequent courses. We will invite one or two students from several colleges and universities who have used **Perseus** in courses to participate in discussion groups on a periodic basis over the course of the project.[9] Their contributions will help the **Perseus** collaborators understand the long-term impact of the

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[9] We envision these discussion groups to take place once a year at regional locations, so that travel expenses will be minimal.

materials and system. This is a unique and potentially valuable evaluation strategy that will involve both evaluation teams.

With a select group of participants we will observe learning sessions and record information through structured queries. We will space the observation sessions over the course of the semester to gain a longitudinal view of their learning. A set of queries will solicit responses at critical junctures during the interactive process, e.g., calls to *Morpheus*; movements from texts to encyclopedias, chronologies, and lexica. We will analyze these data to determine whether patterns of user-system interaction emerge that constrain or aid the learning process.

The staff will arrange to videotape user sessions whenever possible. We will also use software routines that capture and time-stamp the sequence of moves through the database. Videotape sequences will be particularly valuable for assessing the role of student interactions in a laboratory setting and in capturing the nonverbal aspects of human-computer interaction, for example—frustration, exuberance. We will analyze sequences of moves through the Perseus database to identify any common patterns that may occur in the use of the system or in the type and frequency of errors. We will use this information to make inferences about the students' learning in dynamic, electronic environments (e.g., the extent and effects of disorientation in hypermedia and the ability of students to create and follow links in personal and innovative ways, etc.). The data will also indicate how the designers might augment or improve Perseus in future editions (e.g., how often *Morpheus* is used, how easy it is to navigate the encyclopedia, etc.), and how they might improve the user interface or prepare learners for idiosyncrasies in the system.[10]

Evaluation of *Perseus* as a Medium of Publication and a Medium for Representing Knowledge

In *Significance*, we discussed how Perseus could provide researchers with a flexible medium for publication. To evaluate this, we first wish to determine how attractive Perseus is as a means of creating and distributing research materials. Initial reactions from scholars of Greek suggest that many of the tools we develop will help the advanced scholar produce works such as critical editions. By monitoring the frequency of inquiries and submissions as well as the types of scholarly material submitted to Perseus, we will gauge the degree to which specialists accept Perseus as an ongoing medium of publication. Secondly, through the user questionnaires we will determine whether end users obtain Perseus for the scholarly contributions or other reasons, e.g., the scope of the materials. As Perseus goes into wider distribution, each copy will contain a registration form and user questionnaire. Users will be encouraged to return the registration card to ensure that they will be notified of subsequent releases and news of other available applications. The questionnaire will focus on the user's background and reasons for using Perseus. The returned registrations and questionnaires will provide information on how well Perseus is received as a medium for scholarly contributions to the field of classical studies. The internal evaluation team will conduct this phase of the evaluation.

Examples of Specific Problems for Evaluation

System Design

Observing user sessions, videotaping, and generating records of the users' movements will help the Perseus staff evaluate how well users navigate in both limited and expansive domains within the database. We want to learn, for example, whether a student of Greek tragedy can access the necessary information about a particular play more efficiently using Perseus than using printed resources, or whether users experience any disorientation when

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[10] Deborah Tatar of Xerox PARC, a member of our technical advisory board, did extensive work with this type of evaluation as a part of the CoLab project. She has volunteered her help and advice as we integrate this into our evaluation.

moving from a tragedy to an historical text, an illustration of a Greek vase, or an encyclopedia entry on Attic festivals.

In addition to issues of movement and orientation, we wish to observe how the user relates **Perseus** to traditional printed resources in study and research. Will the user view **Perseus** as a fully integrated environment for study or as another reference work to augment printed materials? How comfortable will users eventually become in reading from the display, or will they continue to read from printed texts and use **Perseus** for limited purposes, e.g., morphological analyses or access to contextualizing materials? These questions are of great importance for other disciplines, and their answers will help assess **Perseus's** usefulness as a general model of a medium and approach for publication, learning, and knowledge representation in general.

Impact of *Perseus* on Language Skills

What is the impact of *Morpheus* on users who have little or no experience with Greek, and students who are using **Perseus** to learn the Greek language? How effectively will *Morpheus*, the lexicon, and the referencing system enable users with no knowledge of Greek to identify a key term in the Greek text, and the corresponding English translation?[11] How does **Perseus** qualitatively affect that process?[12]

Will **Perseus** improve the process of learning Greek? We will evaluate the performance of beginning Greek students to determine whether rapid access to morphological information through *Morpheus* increases their ability to master the morphology or prevents them from developing an adequate understanding of the systems of declension and inflection. For intermediate students, will **Perseus** enable them to read more efficiently and accurately?[13] Will using **Perseus** have a long-term impact on students' retention, and will it better prepare them to comprehend passages in examination contexts where they will not have access to reference materials? These evaluations will test **Perseus's** strengths as a medium of learning a language, and may have implications for other similar educational problems.

The Influence of the Hypertext Environment

We are particularly interested in evaluating how a hypertext environment affects the user's learning experience.[14] A rich hypertext will, we suspect, encourage the instructors to devote more attention to scholarship than to presenting information. Once the students learn more about scholarly methods and apply them to a database, we believe that the roles of teacher and student will become less distinct. We will use the observations of instructors using **Perseus** as they prepare for courses and the observations of the students who use **Perseus** in the same course to see if student work does begin to resemble more closely that of their instructors.

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[11] For a discussion of this function and its importance to the study of the ancient Greek world, see "*Morpheus*, and the Greek-English Lexicon" in Chapter IV.

[12] Many researchers have studied the effectiveness of computer assisted language learning. Although the application of CAI to the teaching of Greek is very limited, we will draw on the findings of researchers in this area. Furthermore, the techniques for learning classical Greek differ from those used to learn modern languages, because classical Greek is no longer spoken. We will, nevertheless, work closely with those actively engaged in building systems to teach modern languages (such as Janet Murray of the Athena Language Learning Project, and Judith Frommer of Harvard University, the author of *MacLang*) to help us evaluate the effect of **Perseus** on language acquisition.

[13] For a discussion of some of our concerns as we integrate *Morpheus* and the on-line Greek lexicon into the study of Greek, see Gregory Crane, "Redefining the Book," in the Appendix.

[14] For a brief discussion of hypertext and learning, see "**Perseus** and Other Experiments in Interactive Learning," in Chapter III.

We will also monitor how **Perseus** influences the students' intellectual range. Our initial experiences suggest that a large network of information will enable students to draw from a far wider base of knowledge than they normally would with traditional printed materials. But increased accessibility of information sources does not guarantee that students will use that information without suitably structured assignments and projects. We will study the students' movements in the database to determine how much students browse and explore beyond the immediate domain of the course or assignment.

Finally, we wish to study how the increased access to contextualizing materials influences the students' understanding of the primary sources. We can assume that students will understand the text of Plato better if they have a greater familiarity with the economic and social conditions of Athens in the late fifth and early fourth centuries B.C. However, we have a less definite idea about the types of contextualizing materials that will prove to be most effective, and why.

In conclusion, the issues of systems design, language learning, and the influence of hypertext on learning represent just three areas of immediate concern to us. Because **Perseus** covers such a clearly defined domain of knowledge and is unique to that domain, there are few parallels that can provide a proven way of evaluating the impact that **Perseus** will have. We believe, however, that the experience we have gained over the last two years provides us with at least a preliminary approach which we will continue developing, testing, and refining in anticipation of **Perseus**: Phase II.

VI. Delivery/Distribution

Delivery Systems and Media

Technology has moved a considerable distance since we began planning **Perseus** in the summer of 1985, and our thinking has undergone a comparable development. But our general goals have remained the same: we wanted to make **Perseus** available to as many learners of all levels of expertise, and in as many different kinds of institutions as possible. Practically speaking, this means that we have to target low-end, generally available systems. Personal computers are becoming available to an increasingly large and disparate segment of the population. We therefore want **Perseus** to run on the most standard possible configuration so that the widest number of people can use it. Ultimately we hope that entry-level systems will evolve to the point that they will be able to support **Perseus** without requiring any nonstandard options.

Choosing Delivery Software

During the course of the past three years, we have considered a variety of different environments within which to deliver **Perseus**. Although we found the Xerox *NoteCards* hypertext system to be extremely flexible and to contain many attractive features, few of our potential users would have access to the hardware required to run that system (Xerox workstations). The *Intermedia* system, developed at Brown, did run on general purpose Unix workstations such as the Sun and the IBM RT PC, but *Intermedia* was not yet a viable product and licensing restrictions prevented its developers from distributing copies of it even for testing purposes. More importantly, for our purposes, few of our potential users will have access to the hardware that *Intermedia* requires. We felt that few deans would support humanities computing on systems that cost $7,000 to $10,000 each.

Early in 1987, we acquired a copy of *Guide*. This was, as far as we know, the first commercially available hypertext system for the Macintosh. It allowed the user to build up complex documents and to create different types of links. It worked well with text, allowing for sticky buttons of various kinds, and could incorporate PICT images as well. It had the right general capabilities and it ran on the right hardware platform.

Equally important, the developers of *Guide* had developed a marketing plan perfectly suited to our needs. There was little point selling a **Perseus** compact disk for roughly forty dollars if learners would also have to spend one hundred dollars on special purpose software before they could use the data on that disk. Instructors using *Guide* could distribute read-only versions of the program to all of their students for a nominal fee. But *Guide* had at least two drawbacks that prevented us from choosing it at the time as a probable delivery system:

- There seemed to be no way to import entire documents into *Guide*. It was easy to cut and paste text and pictures into *Guide*, but users had to create the hypertext links by hand: there was no file format into which links could exported or from which they could be imported. It appeared that if we did all of our work in *Guide* there might be no way for us to port that work into any other hypertext system without either doing a lot of specialized programming or rebuilding our documents almost from the ground up.

- *Guide* could not handle more than several thousand links—a figure that **Perseus** would have quickly exceeded.

Nevertheless, the appearance of *Guide* was a good sign and suggested to us that software development was moving in the right direction and that hypertext systems were being built that could make a CD ROM full of data available to the owner of a personal computer.

In May of 1987, Tim Oren of Apple Computer visited us in Boston and made us a beta test site of *HyperCard*. We did not begin serious work with *HyperCard* until late June, but we

soon found that we could do many things much faster and more efficiently than we had previously imagined. We were able to display and link English, Greek, and graphics. We could search for key words with moderate efficiency. And, most importantly, we could quickly prototype the fundamental data structures out of which **Perseus** would be built.

HyperCard had a dramatic impact on the entire structure of the project. Previously we had expected to learn a complex windowing toolkit and then to develop sample applications in C. Now, we found ourselves exploring new ways of representing the information that we use in our teaching and research. The effects of *HyperCard* went beyond the central staff members. For the first time, people who did not have access to high-powered Unix workstations were able to collaborate directly with the central **Perseus** staff. The rhythm and structure of the project changed dramatically.[1] *HyperCard* still has drawbacks and we hope that Bill Atkinson and his colleagues will continue to develop it. From our perspective these are some features that it lacks:

- *Multiple fonts:* A single text field in *HyperCard* can contain only a single font and text style. We cannot therefore truly show a literary text or a multi-lingual document such as the Greek-English Lexicon, which needs to display both English and Greek as well as at least one character attribute.[2]

- *Multiple Windows:* We cannot see more than one *HyperCard* screen at a time. It is not possible to compare two cards on the screen at the same time.

- *Color: HyperCard* does not support color or gray-scale images. One bit deep digitized photographs are not sufficiently clear for much of the work that archaeologists and art historians do. We need to be able to display eight-bit color images.

- *Sticky Text Buttons:* The user can select a key word (e.g. "Pericles," "Athens") and then perform an operation on the key word (e.g., "look up the encyclopedia entry on 'Pericles' ", "show me a map that contains 'Athens' "), however, we cannot really attach a link to a particular word or phrase in a scrolling field.

- *Object-oriented Data Structures for Graphics and Text:* All *HyperCard* images are bitmaps. If we wish to maintain our graphic data in a more powerful format, we must develop our images in programs such as Adobe *Illustrator* and *MacDraw*, then transfer bitmaps of our drawings into *HyperCard*. Likewise, we plan to store our documents in a format that conforms to SGML, but we will have to import them into *HyperCard* as text files.

- *Full Integration of the Script Manager:* We cannot now search accurately for Greek words in *HyperCard* (or any other standard Mac application) because of the peculiarities of the Greek language. The Apple Script Manager will allow us to design a "Classical Greek Script" that will fix this problem at a system level. We could solve this problem for *HyperCard* through creating an XCMD, but we would prefer to work with the Script Manager.

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[1] For a description of how *HyperCard* has changed the way in which the project is structured, see Chapter III.

[2] At the moment, we have a single font that contains all Roman alphabetic characters and all Greek characters with accents—but no capital letters. A capital letter is tagged with a "•", so that "Athens" appears as "•athens". Furthermore, all characters that should be italicized are now stored between double brackets (*"italicized word"* appears as "[italicized word]"). We have therefore retained all the character information, and we will therefore be able to show the capitals and italics when *HyperCard* finally handles multiple fonts.

• *A more powerful inheritance scheme:* **Perseus** will contain hundreds of bilingual English-Greek documents, and these will be stored in a single generic stack type. There is, however, no good way for us to globally update extant stacks. There should be some more powerful inheritance scheme that lets us update our basic stack templates.

Generally speaking, *HyperCard* is not designed for collaborative work nor does it allow users as much flexibility in annotating material and creating new links as the more elaborate systems such as *Intermedia.*

Nevertheless, *HyperCard* lacks many features precisely because it is aimed at a low-end system. In practice, we have found that while there are many things that could be improved, still we can accomplish what we need. A workable system on available machines is more valuable to us than an ideal system to which our collaborators and their students do not have access. We have already been able to improve our teaching, to annotate material, and support collaborative projects. Everything can be improved, but all the major functions are available. *HyperCard* is a remarkable achievement and has done more for the **Perseus Project** than any other single technological advance of the past year.

Delivery System

Entry Level System		High Level System	
Mac SE wih two floppy drives	$1,750	Mac II HD 40	$3,400
Apple Keyboard	$90	Apple Extended Keyboard	$160
Apple CD Player	$800	Apple Hi Res Color Monitor	$700
		Apple Video Card	$350
		Video Expansion Kit	$100
		2 mbyte expansion	$500
		Apple CD Player	$800
		Videodisc Player	$800
		Color Monitor	$600
Total	$2,640		$7,410

Figure 6.1: *Two possible delivery systems based on 1988 technology.*[3] Most institutions and individuals will probably start out with an entry level system, and only add a videodisc later. Some will base their systems on a Macintosh SE with a twenty megabyte hard disk (approximately $2,500). Likewise, the Macintosh II may be be further enhanced by adding additional memory, disk storage or a more elaborate monitor. For the next several years, many different variations of the above systems will allow people to use **Perseus.**

The current version of **Perseus** will run on a Macintosh Plus equipped with a compact disk player, and an optional videodisc player and monitor for displaying color images. The term "optional" here is problematic. On the one hand, **Perseus** is a unified entity, in which all of the data plays an important role. At the same time, a database that requires a single $1000[4]

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[3]Prices are approximate and assume an academic discount. This level of pricing has become available to a steadily wider collection of academic institutions over the past year, as Apple has widened its market share. Prices on the videodisc player and color monitor can also vary.

[4] Prices clearly vary. People at Harvard, Boston University and Bowdoin College pay about $800 for the Apple CD player.

peripheral (such as a CD player) will reach many more people than a database that requires a CD player, and a videodisc player and a color monitor.

If at all possible, we would like to distribute all of our material on a single medium in the spring of 1988. Technologies such as CD-I and especially DVI may well make this possible, but they remain unproven. In order to make **Perseus** widely available, a limited version will run on the Mac SE, but will not display color images. Our delivery software is currently Apple's *HyperCard*.

Portability of data is, however, one of our major goals—we do not want to bind **Perseus** too tightly to any one system or hardware base. We plan to take advantage of other comparable information management systems that appear for the Macintosh and, if appropriate, for the PS/2 line. As Unix workstations become more economical and as *Intermedia* evolves into a fully developed product, an *Intermedia* based **Perseus** becomes extremely attractive. Ideally, **Perseus** 4.0 would run in two different hypertext systems (e.g., *HyperCard* 5.X?, *Intermedia*?). But until the status of other delivery systems becomes clearer, we cannot specify precisely how **Perseus** will work in another system. We are, however, storing our data in a system-independent format to facilitate shifting our work to other application bases.[5]

Ultimately, we would like **Perseus** to run on a Macintosh II level machine with at least 5 megabytes of memory and a high resolution monitor that can display 8 bit color and that costs approximately as much as a Macintosh SE. It would be delivered on a single medium, which in today's terms might be some form of DVI. This would restrict the number of peripherals to one, the player for the single disc. Nevertheless, we should stress that even a system such as a Macintosh SE with *HyperCard* 1.2 can support excellent work.

Distribution

Initially, we will handle distribution ourselves. We will maintain a stock of **Perseus** disks in our office and have an administrative assistant mail them out. In this we will be following the example of the **TLG**, which currently stocks its own supply of disks and provides them on demand to classicists. Publicity will be handled through the newsletters and meetings of such professional organizations as the American Philological Association, American Classical League, Archaeological Association of America, Modern Language Association, American Philosophical Association, etc., and through direct mail.

If interest in **Perseus** continues to increase, it may not prove feasible for us to handle our own distribution for long. We would in this case be forced to find a commercial distributor. An educational software distributor like Kinko's seems a more natural distribution channel than a conventional publisher. Publicity would also be turned over to the third-party distributor at this point.

Marketing compact disks seems to require expertise that is similar but not quite the same as that involved in marketing traditional paper books. No one with whom we have spoken seems to feel that the optimal distribution schemes have yet emerged. We are therefore uncertain what our best marketing path will be in the next several years.

User Support

During the course of the project, the **Perseus** staff will provide support for the teachers and scholars collaborating with the project. We will try to restrict that support to those problems that are **Perseus**-related, and, wherever possible, to foster a good working relationship with the local computer center so they can handle routine Macintosh problems. Tools such as *HyperCard* make this much more feasible than was formerly the case, but we

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[5] See the minutes of the Technical Advisory Committee meeting in the Appendix; see also "Navigation...," in Chapter IV.

anticipate that we will still have to provide some training and support for colleagues around the country working on **Perseus**.

The number of potential **Perseus** users is vast, and we have not yet decided how best to support them. We have designed **Perseus** to require little specific support. We are emphasizing standard delivery systems—the Macintosh SE with *HyperCard*—precisely because we want our users to use their normal support systems, not have to add a new one.

Perseus will be distributed with user manuals that will try to answer questions on several levels. On the one hand, it will have a standard user manual and reference guide, that will list what is in the system and explain how to use it. This may also include a step by step tutorial. Perseus will also be distributed with printed and electronic aids for the potential author. It will have samples of teaching materials that have already been used in several different classroom situations, and also will explain how to use the more advanced authoring tools to create new ones. Preliminary versions of these manuals will be distributed with **Perseus 2.0**.

Ultimately, we may want to hold meetings of **Perseus** user groups and training sessions at the major professional conventions. Apple Computer has expressed a willingness to support one or more such workshops. If **Perseus** becomes widely used and the demand for support grows, we may have to follow the example of commercial software firms and charge a fee for telephone support.

VII. Personnel and Facilities

Administrative Structure

This section serves two purposes. First, it describes the lines of authority that will govern the project. Second, it specifies the staff time commitments that we believe **Perseus** will require. The time commitments reflect our best estimates and are based on our experience during the first year of the project. If, in fact, we need more central staff time, we will shift our budget to arrange for that. Any such decisions would be made as part of the work plan for releases of **Perseus.**[6] The most likely source for additional funding would be the "Authors" budget.

The Editor in Chief: Gregory Crane

The project director at the contracting institution will, in the capacity of Editor in Chief, make the final decisions on all matters pertaining to the project.

The Editor in Chief will be responsible for coordinating the overall direction and strategy of the project. He should not generally interfere with the day-to-day work of the various Authors, but should help maintain and develop the consensus among those working on the project. The Editor in Chief will be responsible for securing additional funding for the **Perseus** Project, and for formally representing that project.

The Editor in Chief will devote approximately 20 per cent of his time during the academic year to overseeing **Perseus.** If additional time is necessary, the Editor in Chief will seek course release time. He will focus most of his attention during the summer to supervising the creation of new releases and will correspondingly receive a summer stipend. He will also be reimbursed for appropriate expenses. If appropriate, the Editor in Chief can also serve as an Author and receive the corresponding support.

The Executive Committee: Martin, Nagy, Smith

The Executive Committee will meet regularly on a quarterly or semi-annual basis as appropriate to consider policy matters, and will then make recommendations on overall policy to the Editor in Chief. The Executive Committee will decide on its recommendations by vote. Minutes of the Executive Committee meetings will be presented to Annenberg/CPB. The Editor in Chief will consult with and solicit the advice of the members of the Executive Committee before making decisions on other matters as specified below.

Members of the Executive Committee will serve at the pleasure of the Editor in Chief. Members of the Executive Committee will receive no stipends, but will have their expenses to the meetings paid. Members of the Executive Committee can, if appropriate, also serve as Authors and receive the corresponding support.

The Managing Editor: Elli Mylonas

The Managing Editor will direct the efforts of the Authors. She will coordinate the collecting and organizing of all data included in deliverables and will supervise an inventory of the data. The Managing Editor is responsible for ensuring that data meets the requirements of the project. The Managing Editor will, in collaboration with the other members of the project, orchestrate the creation of the overall system design and see that it fulfills the needs of the project. The Managing Editor will consult with the Executive Committee on matters of compatibility and will report regularly to the Editor in Chief.

The Managing Editor work full-time on the project, and will be chosen by the Editor in Chief after consultation with the Executive Committee. The Managing Editor will serve at

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[6] On the various **Perseus** releases, see "Building **Perseus,**" in Chapter IV.

the pleasure of the Editor in Chief. The terms and the remuneration of this position will be determined by the Editor in Chief after consultation with the Executive Committee.

After consulting with the Executive Committee and the Managing Editor, the Editor in Chief will have authority to hire appropriate staff to support the work of the Managing Editor. These staff members will serve at the pleasure of the Editor in Chief.

Associate Editors

Associate Editors will provide specific kinds of expertise to the project. As an Associate Editor, Frederick Hemans, for example, will supervise the collection of topographical and architectural information for the database. Kenneth Morrell will be the Associate Editor for evaluation. He will supervise internal project evaluation and will work with Gary Marchionini as Marchionini performs the external evaluation.[7] Associate Editors will be reimbursed for appropriate expenses, and will serve at the pleasure of the Editor in Chief.

The Special Associate Editor

The Editor in Chief will, in consultation with the Executive Committee, choose someone to serve as Special Associate Editor who will work with the Editor in Chief and Managing Editor on each Perseus edition. The Special Associate Editor will provide additional manpower at critical times in the project, for example, reviewing Author's submissions, working closely with Authors, or debugging and preparing data for mastering the compact disks. The same person may serve as Special Associate Editor for each Perseus edition, or a different person may fill this function each year. The Special Associate Editor will receive a summer stipend for his work and will serve at the pleasure of the Editor in Chief. If additional time is needed, the project will look into securing course release time for this person.

Educational Advisory Committee

The Editor in Chief, after consultation with the Executive Committee, will invite appropriate persons to serve on the Educational Advisory Committee.

The Educational Advisory Committee should provide differing points of view so that Perseus will serve the widest possible audience. Ideally this committee should contain not only classicists but also representatives of other disciplines (Literature, History, Linguistics, Religion, Philosophy etc.). The optimum size for the Committee is probably seven, a number that allows for diversity of viewpoints without becoming unwieldy.

Members of the Educational Advisory Committee will serve at the pleasure of the Editor in Chief. Members of the Educational Advisory Committee will receive no stipends but will have their expenses paid for the meetings specified in the contract. Members of the Educational Advisory Committee can, if appropriate, also serve as Authors and receive the corresponding support.

Technical Advisory Committee

(analogous terms as for Educational Advisory Committee)

Authors

The Editor in Chief will invite Authors to contribute to the project. Authors will then submit a written plan for their participation, to be approved by the Editor in Chief in consultation with the Executive Committee and the editorial staff. The Editor in Chief will

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[7] For an estimate of how much time the various Associate Editors will spend, see "Institutional Cost Sharing" in the Chapter X.

then, after consultation with the Executive Committee, determine the nature of the author's administrative and financial relationship with the project.

Authors will agree to work closely with the Managing Editor to ensure compatibility of data. The Editor in Chief will have the responsibility to oversee the work of Authors, and the authority to terminate their participation in the project if necessary.

Research Staff

The Editor in Chief will, after consultation with the editorial staff, hire the equivalent of one full-time post-doctoral research fellow. The duties of the post-doctoral fellow will consist of working with the Managing Editor, organizing and verifying the data that comes in from the Authors, collecting additional data that has been requested by the Authors, and helping to construct the database. The post-doctoral fellow may also work with Authors to help them use the material that is already in the database. This position may be filled by two part-time post-doctoral fellows if this arrangement will better serve the needs of the project.

The Editor in Chief, after consultation with the Managing Editor, will hire additional research staff on an *ad hoc* basis during the course of the project. This staff will be needed for both the technical and the academic aspects of the project, and may include programmers as well as Classicists or other academic personnel. Research staff, often not stationed at Harvard, will perform much of the data preparation during the course of the project.[8] Research Staff may also be hired to help with particular **Perseus** Authors or to help expedite the creation of **Perseus** releases. Research staff will serve at the pleasure of the Editor in Chief.

Administrative Staff

Project Administrator - Kenneth Morrell

The Project Administrator will serve in a part-time supervisory capacity. He will report to the Editor in Chief on financial matters, and supervise the administrative assistant who will perform the daily bookkeeping. He will also oversee the preparation of any financial reports. This position will initially require substantial effort, but should ultimately require between 5 per cent and 20 per cent of the Project Administrator's overall time. The Project Administrator will serve at the pleasure of the Editor in Chief.

Administrative Assistant

The Editor in Chief will, after consultation with the Managing Editor and the Project Administrator, hire an Administrative Assistant. The Administrative Assistant will be responsible for the day-to-day functioning of the **Perseus** office, and will work full-time. This will include correspondence, bookkeeping and other such tasks. The Administrative Assistant will serve at the pleasure of the Editor in Chief.

Key Personnel

Gregory Crane: Editor in Chief

An assistant professor of Classics at Harvard University, Gregory Crane has been integrating computers into instruction and research in the Classics since 1982. He initially focused on making the **TLG** available on a general-purpose Unix system, and ultimately

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[8] The current arrangement with the University of Chicago, in which three graduate students work under the supervision of Professor George Walsh, provides an example of how this can work. For a description, see the report on textual data entry in the Appendix.

developed a set of utilities to index the TLG texts (which now consist of more than three hundred megabytes) and a full-text retrieval system to access this material. His system is still in use at a variety of institutions in the United States and Europe.[9]

He began planning **Perseus** in the summer of 1985. At that time he received an equipment grant from Xerox so that he could use the *Notecards* system to prototype a hypermedia database about the ancient Greek world. In the fall of 1985 he began working with the Annenberg/CPB Project to design the environment now known as **Perseus**.

To facilitate his participation in the project, he has systematically integrated his own teaching and research into other aspects of **Perseus**. He will test *Morpheus* in a language course this fall, and **Perseus** materials in special computer sections of a translation course next spring. He is focusing his current research on the interaction of fifth-century literature and society precisely because that is a central theme for **Perseus**. Many aspects of the project, from editing texts to working with **Perseus** Authors in their teaching and research, will naturally blend with his other activities. This synergy will allow him to support the project far more than would otherwise be possible.

Frederick Hemans: Associate Editor

Frederick Hemans has been involved in archaeological field work and the study of Greek and Roman architecture since 1973, when he was still an undergraduate student of architectural design at Cornell University. Over the past fifteen years he has conducted field work in Egypt, Greece, Turkey, Yugoslavia, Saudi Arabia, and New England. In 1980 he enrolled in the department of Archaeology at Boston University, and, in addition to pursuing his degree, designed and taught the Archaeology department's course in field methods, archaeological survey, and illustration. Upon completing his degree in 1986, Hemans was appointed assistant professor of Archaeology and director of Archaeological Applications in Remote Sensing at the newly formed Center for Remote Sensing (CRS).

Hemans currently teaches an undergraduate survey course on Greek and Roman Archaeology (1988-89), a course on Remote Sensing Applications in Archaeology that includes both geophysical survey methods and satellite-image processing, a course on Surveying and Drafting for Archaeologists, and a graduate seminar on Roman Archaeology. The teaching and research experience that Hemans brings to **Perseus**, especially in areas that have traditionally been outside the boundaries of Humanities Curricula, give him a unique perspective on the problems and issues of adapting new technologies to solve traditional problems.

The research interests that Hemans is pursuing reflect his wide-ranging interests as well as the ever-increasing application of scientific method to archaeology. In 1986 he designed a multispectral video camera for archaeological reconnaissance with which he has conducted field tests at Corinth, Greece. More recently, he used his expertise in spectral analysis and image processing to help deduce the causes of deterioration that are destroying the wall paintings within the tomb of Nefertari, Luxor, Egypt. A fifteen-minute video tape describing the efforts sponsored by the Getty Conservation Institute and the Egyptian Antiquities Organization to save these paintings was produced last fall by Hemans for classroom demonstration. Also, part of the Ramesses exhibit currently at the Boston Museum of Science describes for the general public this research and other applications of remote sensing in archaeology.

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[9] Current sites include Brown University, Dartmouth College, Harvard University, Johns Hopkins, UCLA, the University of California at Berkeley, the University of Chicago, and die Universität Zürich. For more information on this system, see Paul Kahn's "Isocrates: Greek Literature on a CD ROM" in *CD ROM: The New Papyrus* (Redmond WA: Microsoft Press, 1986) pp. 577-584, which describes how his work served as the basis for the *Isocrates* project at Brown. A photocopy of this owrk is provided in the Appendix.

Hemans's first love, however, is the study of Greek and Roman architecture. He is currently analyzing the remains of the early 7th-century Temple of Poseidon at Isthmia. This is the earliest Greek temple built entirely of stone, and its reconstruction is vital to our understanding of the transition between early Iron Age architecture and the fully developed Doric order. Hemans and Neel Smith will serve as editors for the art, architecture, and archaeological material in **Perseus**.

Albert Henrichs: Associate Editor

Albert Henrichs has long taught courses on Greek religion aimed at general audiences, both in the regular academic year and during the Harvard summer school. He is regarded as one of the most serious scholars in this highly technical field, and he has managed consistently to make his knowledge vividly real to those who are not themselves classicists.

Greek religion is an extraordinarily difficult subject to teach: the evidence draws upon every category of information regarding the ancient world that we have or that we can reconstruct. Simply gathering—much less organizing and presenting—the evidence is a major task. Conventional reference works do not contain enough texts and images to support such a bold intellectual endeavor. So, for Henrichs and his students, **Perseus** represents a revolutionary new tool. Not only will it enhance the experience of current students; it will open up this challenging but forever rewarding field to countless individuals.

In the spring of 1990, Professor Henrichs will deliver the Sather lectures at Berkeley. Not only is the Sather Professorship one of the most prestigious honors in the field of classics, but the Sather Lectures are aimed at a wide audience and must, if they are to be successful, appeal to many outside of classics. **Perseus** and the Sather Lectures share, in many regards, a common audience. Further, Henrichs' topic, the interaction between Greek tragedy and religion, sheds light on an area of central importance for **Perseus**. We plan to work with Professor Henrichs as he develops his lectures so that he can simultaneously produce a **Perseus** Theme. This will provide an excellent example of synergy between conventional paper publication and electronic publication within **Perseus**.

Generally speaking, Professor Henrichs will provide editorial guidance on topics within his range of interests. As an Associate Editor he will also help review the quality of the material that we collect.

Gary Marchionini: Director of External Evaluation

Gary Marchionini is an assistant professor in the School of Library and Information Services at the University of Maryland. Since the mid-seventies, when he was a teacher of high school mathematics, he has been involved in curriculum development and in developing instructional computing. More recently, Marchionini has been studying how effectively people use various types of on-line knowledgebase—traditional bibliographic databases, electronic encyclopedias, and other full-text retrieval systems. He has also collaborated with Ben Schneiderman in using and teaching with *Hyperties*, a hypertext system that runs on the IBM PC and that has been in place since 1984.

Marchionini has received several grants to study the cognitive aspects of human-computer interaction, and retrieval strategies. His experience with hypertext and database projects, and his professional credentials as an evaluator make him a most appropriate choice for director of external evaluation for the **Perseus Project**. Over the next three years he will perform a wide-scale evaluation of the implementation and interface design of the **Perseus Project** and its success or failure as a teaching and research tool.

Thomas Martin: Executive Committee, Associate Editor

Now an associate professor at Pomona College, Thomas Martin was a faculty member at Harvard when we first began developing the **TLG** retrieval system. For several years he

supervised this effort, and he deserves much of the credit for its ultimate success. His experience as an administrator has already played a crucial role during Phase I: he made special visits to Boston during March and April as we developed an organization that could support a project such as **Perseus** Phase II. His ongoing support and advice are one of our greatest assets.

Professor Martin's ability as a teacher is also an invaluable resource for the project. He has always been able to convey his excitement and ideas about the ancient world to people far outside the field of Classics. He was one of the original professors to participate in Harvard's Core Curriculum, and his course on *Periclean Athens* had the highest rating of any course in its section of the Core. He is now a reviewer for the *History Book Club*, and, as one of a team of scholars creating a new textbook on Western civilization for D. C. Heath, he is developing the segments on the ancient world. He now teaches courses in classics, ancient history, and Western civilization at Pomona College.

At Pomona, he is a leading force in curriculum design. He was, for example, the chairman of an application committee that received $500,000 from the Pew Charitable Trust. This grant was designed to explore ways in which technology could enhance the curriculum of a small liberal arts college.

He has received a grant of approximately $30,000 from Apple Computer so that he will be able to create the **Perseus** Overview.[10] In subsequent years of the project, he will refine the overview and integrate **Perseus** into his classes on classics, ancient history, and Western civilization. As an associate editor, he will particularly focus on ancient history but will advise other project members on a wide variety of subjects within his range of interests. As a member of the Executive Committee, he will help the Editor in Chief set policy for the project as a whole.

Kenneth Morrell: Associate Editor

As a third year graduate student during the 1985-86 school year, Kenneth Morrell served as a member of the Harvard Classics Computer Project. In that role he was responsible for maintaining the department's network connections, managing the Xerox workstations, and providing computer support for members of the department. Morrell began his affiliation with the **Perseus** during the summer of 1986 when he and Christopher Smith used *NoteCards* to explore the possibility of applying hypertext technology to **Perseus**. During the past year, he has worked as project administrator for **Perseus** .

During the fall semester of the 1987-88 school year, he designed courseware for a section of Gregory Nagy's course, LAC-14: The Concept of the Hero in Hellenic Civilization. He is currrently formulating improvements in the courseware for the coming fall semester when he will once again direct a computer-based section. The section will provide **Perseus** with an opportunity to field-test an expanded subset of **Perseus** materials and new evaluation techniques. His experience with classroom applications of *HyperCard* and interest in computer-based collaboration makes him particularly well suited to work with Gary Marchionini in the evaluation of **Perseus**.

He is currently working as a research associate with the Prodicus Project at M.I.T.'s Athena Language Learning Project. He is formulating spelling rules for ancient Greek and writing the lexicon for use with the natural language processor, *Lingo*. He is beginning work on a dissertation that will study the phrase structure of early Attic prose. In the coming years, he intends to put his academic training in the classics to use as an Author for **Perseus**.

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[10] The historical overview is described in Chapter IV, and a complete outline is in the Appendix.

Elli Mylonas: Managing Editor

While a graduate student at Brown University, Elli Mylonas started to use computers for text programming and complex document preparation, which led to her knowledge and experience with SGML (Standard Generalized Markup Language), a recently adopted ANSI standard for encoding text, and to her introduction to hypertext. For two and a half years, she provided departmental computer support for the classics department, which included consulting, writing documentation and the support and enhancement of a database of Latin texts and its accompanying search programs. At the same time, she was working for Computing and Information Services developing and teaching computer minicourses, and eventually took a position there as user services specialist. She also has programming experience and wrote a user interface program in C, for Greg Crane's search programs.

Mylonas is a classicist who has moved sideways into the world of computing and particularly humanities computing. **Perseus** can draw on her user services background and her technical knowledge for interface design, support and documentation. She will be able to ensure that all textual material is stored and structured so that it will be system-independent and therefore outlast current hardware and software configurations. She will also work on the hypertext part of the database structure, since that is intimately linked to the structure of the data.

Although Mylonas is still in the process of writing her dissertation, she plans to finish it during the 1988-1989 academic year. Over the course of the past year she has already been functioning as managing editor of the **Perseus Project**, and she will continue to do so in name as well as in fact. This summer she will also be the project leader for the project to produce software that will make the TLG database available on a Macintosh.

Gregory Nagy: Member of the Executive Committee, Associate Editor

Gregory Nagy specializes in early Greek poetry and thought. He might be termed an intellectual linguist, for his work has mapped out the paths travelled by the archaic Greek mind that produced the Homeric poems and Greek lyric poetry. He has provided fundamental new insights into such topics as the *Iliad*, *Odyssey*, and the nature of the Greek city state.

For more than a decade he has labored to explain the archaic Greek mind to diverse audiences from the most technical scholars to teachers from small colleges, and from Harvard Phd candidates to extension students. His Harvard Core Course, *The Concept of the Hero in Hellenic Civilization*, has become one of the most respected and popular courses at Harvard. Barely behind Martin's *Periclean Athens*, Nagy's course was tied for the third highest rating overall. Enrollment in this course averages between four and six hundred. This class was the first in which prototype **Perseus** material was used to teach one section, and the experiment will be repeated in the fall semester of 1988.

Like both Henrichs and Martin, Nagy chafes at the limitations of ordinary materials. His work thrives by synthesizing widely disparate types of information. Above all, he can, perhaps better than anyone else in our field, teach students who do not read Greek to transcend the barrier of language. His students learn how to recognize and look beyond differing English translations of a Greek word in order to discover not only the underlying meanings but the systems of thought that these meanings represent.[11] Under his guidance, undergraduate students have often passed deeper into the archaic Greek mind than the most veteran scholars.

D. Neel Smith: Member of the Executive Committee, Associate Editor

Neel Smith has developed computer applications for classicists, taught programming to humanists at the University of California, Berkeley, and used computers in Greek and archaeology courses at Bowdoin College since his unconventional introduction to computer

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[11] See *"Morpheus* and the Greek-English Lexicon" in Chapter IV.

programming in 1984. Smith had no previous experience with computers when he was selected by Professor David Patterson of the Department of Computer Science for a radical experiment. Patterson wanted to create a course that would teach nontraditional learners how to use and program computers. Graduate students from the humanities with the necessary programming skills were scarce, however, so Patterson devised a novel solution: he taught the course on an experimental basis to a small group of students who would then become his TAs. Smith took rapidly to the subject, and while teaching the course three times at Berkeley began writing a textbook with Patterson and a fellow TA (now in press: Kiser, Denise, Dave Patterson and D. Neel Smith, *Computing Unbound: An Introduction to Computing in the Liberal Arts*, New York: W.W. Norton, with two companion volumes: *Computing Unbound: Hands-on Exercises for the IBM-PC* and *Computing Unbound: Hands-on Exercises for the Macintosh*).

While still a graduate student, Smith also began a project of major importance to Greek scholarship and teaching. In the summers of 1985 and 1986, with funding from Harvard and UCLA, he began collaborating with Joshua Kosman on *Morpheus*, a system for analyzing and generating Greek words. (See *Morpheus* in chapter IV.) Not only can a single Greek word have thousands of different forms, but many forms may also derive from stems that bear no relation to the main dictionary lemma. *Morpheus* has since been extended and ported to the Macintosh by Greg Crane, and is already being integrated into **Perseus**. *Morpheus's* ability to work precisely with the complex prefixes, suffixes, and shifting diacritics of Greek morphology represents a major breakthrough for research, teaching, and instruction.

In the fall of 1987 Smith began teaching in the classics department of Bowdoin College with the primary charge of developing a new curriculum in classical archaeology. He has directed the installation of a computer lab for classicists (see chapter X, *Budget*, on Bowdoin's commitment to **Perseus**), and has begun to incorporate **Perseus** material into the Bowdoin curriculum, drawing heavily on **Perseus** in teaching upper level courses in Greek and archaeology this past spring semester (1988). For a course on Greek Comedy he developed a *HyperCard* stack allowing the user to integrate a mechanism for graphically staging a Greek drama with other textual aids. ("See the Teaching with *HyperCard*: Bowdoin College" in the Appendix for fuller details.) This staging tool was part of the **Perseus** sample published by Apple Computer on its *Learning Disk* this spring, and will become a regular part of **Perseus** documentation of ancient drama. (See "Text" section of chapter IV.)

The Technical Advisory Committee

We know of no hypermedia database comparable in scope and complexity to **Perseus**. We have assembled a technical advisory board with leading designers of hypertext and hypermedia systems. They are helping us avoid the more obvious pitfalls, but at the same time we are providing them with empirical evidence about how specific systems and general organizing techniques work. At present this Committee consists of:

- *Chairman: Frank Halasz, MCC, Austin.* Developed the Xerox *NoteCards* system while at Xerox PARC with Tom Moran and Randy Trigg. He is now continuing his work on hypertext at MCC.

- *Norm Meyrowitz, Institute for Research in Information and Scholarship, Brown University.* Meyrowitz has been co-director of the **Intermedia Project**, one of the first implemented hypertext systems since 1983. His research interests are text processing, user-interface design, and object-oriented programming. Meyrowitz's experience with hypertext and the technical side of the academic computing environment will be a great help to **Perseus**.

- *Steve MacKay, Sun Microsystems.* MacKay is manager of the New Media Workstation group at Sun Microsystems.

• *Tim Oren, Apple Computer. Inc.* Formerly a software engineer working on Knowledgeset's *Knowledge Retrieval System*, he is currently working on hypertext and CD ROM projects at Apple Computer. He has particular expertise in the problems of low-end delivery systems.

• *Deborah Tatar, Xerox PARC.* Debbie Tatar is an expert in user-interface design. Her experience in educational computing as a senior software engineer at DEC will prove particularly crucial to **Perseus** because her interests and expertise focus on how people interact with computer systems. Currently a member of the System Sciences Lab at Xerox PARC she is working on the *Colab* project. Having a B.A. in English literature, she understands the problems associated with a computing project in the Humanities.

• *Randy Trigg, Xerox PARC.* Trigg's work in hypertext began with his Ph.D. thesis in which he combined hierarchical and network organization, "paths," and link types in a single framework. For the last four years he has been at Xerox PARC, where he was one of the developers of the *NoteCards* system. His research into hypertext/hypermedia issues has focused on user interfaces, user tailorability, hypertext support for collaborative research and writing, and studies of hypertext user communities. Trigg is also concerned with the system development process and how research in the social sciences can contribute to a better understanding of the relation between the design of technology and its use.

The Educational Advisory Committee

We have deliberately established a large advisory committee. The size of the committee guarantees that **Perseus** will have wide exposure in the university world. Members of the committee represent different groups and academic institutions; some are departmental chairmen or play major roles as policymakers for their respective institutions; some have fought successfully to provide their departments with first-class computing facilities. Others are not even classicists, so they can help us expand the range of audiences that **Perseus** can serve.

The members of Educational Advisory Committee reflect several different interest groups: some are distinguished Classicists and administrators, and can help **Perseus** to gain recognition in its own discipline; others are experienced teachers, and can influence the way **Perseus** is designed and used. At various times in the course of the project we will assemble the most appropriate members of the committee for meetings on issues of project progress and policy. The following is a partial of the members of the Educational Advisory Committee.

• *Chairman: A. Lowell Edmunds, The Johns Hopkins University, Professor of Classics, Chairman of the Classics Department.* When Professor Edmunds first arrived at Johns Hopkins in 1983, he immediately began to champion the use of new technology in instruction and research. He has acquired formidable facilities for his department and has rallied colleagues from such departments as near Eastern languages, romance languages, and comparative literature to lobby for support.

• *Christopher Biffle, San Bernadino Valley Community College.* Christopher Biffle has taught philosophy and Western civilization for over seventeen years. He was principle investigator for a successful FIPSE grant that explored new methods of pedagogy, and is the author of several books. He is currently in charge of interactive teaching technology at San Bernadino Community College, and is negotiating with publishers to distribute several *HyperCard* stacks on which he is currently working.

• *Robert Connor, Princeton University, Andrew Fleming West Professor of Classics, and Chairman of the Council for the Humanities Program.* Professor Connor has seriously interested himself since the late seventies in the problem of applying high technology to his field. He was a prime mover in the decision to purchase a large minicomputer system for his department in 1982. Equally distinguished as a scholar and as an administrator, he

holds a high position in both areas and is a key figure in establishing academic policy at Princeton.

• *George Dunkel, University of Zurich, Professor of Classical Philology.* Professor Dunkel has just been awarded one of the worlds premier positions in historical linguistics. An American by birth and training, he has nevertheless secured a senior appointment at a major European university. He has a mandate to bring with him computer technology and to integrate computers into his own and his colleagues' research and instruction.

• *Mark W. Edwards, Stanford University, Professor of Classics and former Chairman of the Western Culture Program.* In 1985/86, Professor Edwards presided over the large Western Culture Program (approximately 1500 students per year). Teaching fellows from all branches of the humanities teach this course, and students of the nineteenth century English novel thus find themselves teaching Homer. Perseus could provide a badly needed resource not only to the students but to the instructors as well, as they prepare themselves to spend twelve weeks teaching about the classical world in the Western Culture Program. These instructors will then carry their knowledge of and experience with Perseus to every area of the humanities as they move on to careers in their respective specialties.

• *Bernard Frischer, the University of California at Los Angeles, Professor of Classics, Chairman of the Classics Department.* Under Professor Frischer's leadership the UCLA department has moved rapidly to the forefront in classics computing. Funded by a large grant from the Getty Trust, his department currently has the finest facilities in the country. His efforts have challenged neighboring institutions such as USC and other segments of the UC system (such as Berkeley) to provide comparable facilities to their own students and faculty.

• *Jeffrey Henderson, The University of Southern California, Professor of Classics, Chairman of the Classics Department.* Professor Henderson arrived at USC from Ann Arbor last year and has been given the task of building up his department and curriculum. He has extracted funding for additional positions and facilities, and is engaged in long-term planning for computer resources, both for his department and for USC as a whole.

• *David W. Packard, Jr., Director, Packard Humanities Institute.* For over twenty years Packard has been a pioneer in Humanities computing, especially as it applies to classics. In the seventies he developed the Ibycus, the first commercially available system that could manipulate the TLG. His Ibycus personal computer, released in 1986, has made the TLG available at more than a hundred sites and has brought computer technology to new prominence in the field of classics. Packard is now director of the Packard Humanities Institute, which is supporting a major database of Latin literature, as well as other initiatives.

• *Kurt Raaflaub, Brown University, Professor of Classics, Chairman of the Classics Department.* Professor Raaflaub has worked to see new technology integrated into his field and his department. He secured funding from the Mellon foundation that made possible a collaborative effort on CD ROMs between IRIS and the *Harvard Classics Computing Project* .

• *George Walsh, The University of Chicago, Associate Professor of Classics.* Professor Walsh is one of the most technically competent and innovative members of our profession. By rapidly providing crucial software, he allowed the Macintosh to become the personal computer of choice among classicists in both Europe and America. He has begun a long-term bibliographic data base project and has won from his dean the funds to create a powerful computing center for the humanities.

• *James R. Wiseman, Boston University, Professor of Archaeology, Classics, and Art History, Chairman of Archaeology.* Professor Wiseman has been a bold innovator in the field of Classical Archaeology. In 1982 he established the first department of of archaeology in the country that combines the degree programs normally found scattered among departments of classics, geology, anthropology, and religion. Professor Wiseman has a world-wide reputation for his field work in Yugoslavia and Greece, and currently serves as President of the Archaeological Institute of America.

• *William Wyatt, Brown University, Professor of Classics, Former Chairman of the APA Committee on Computing.* Professor Wyatt has for over two decades championed the growing use of computer technology in classics and has become one of the field's most respected spokesmen. He is a key figure in the coordination and dissemination of emerging ideas and technologies within the field and with his university.

Facilities

Harvard

The **Perseus Project** is centered in Vanserg Hall at Harvard University, where the project has approximately eight hundred square square feet of space. This area includes a Xerox laserprinter and three Xerox 1186 workstations running Interlisp-D. These played a key role in earlier stages of the project, as they allowed us to create our earliest prototypes of **Perseus** material with the *Notecards* hypertext system.

Two Unix workstations, an IBM RT PC, and a Macintosh II with A/UX provide communications support. Both have Sun's Network File System, and they currently provide approximately a total of 240 megabytes of disk storage. Both can communicate with the outside world via a broadband network connection that leads into the office. (Professor Crane paid for part of the installation cost of this network, and currently receives free access to this.)

Most work is done on three Macintosh II's and one SE that are permanently located in the office at Vanserg. Each Macintosh II currently has between 120 and 160 megabytes of disk, and between four and eight megabytes of memory. The Macs communicate with each other via *Tops* networking software. All the Macintosh II's in Vanserg contain EtherTalk cards, so that when more powerful networking software appears on the Macintosh (such as a new version of *Tops* expected this summer) the Macintosh II's will be able to use the Unix workstations as additional file servers. The Vanserg facility also contains a number of useful peripherals such as an Apple LaserWriter Plus, three Compact Disk players, and an Apple forty megabyte streaming tape drive.

The Faculty of Arts and Sciences (FAS) has purchased six Macintosh II's specifically to help integrate **Perseus** material into the teaching of Gregory Crane and Gregory Nagy. These have already been delivered and will be installed early in the summer. We will then have a small instructional lab available in the fall of 1988. These will be the most powerful (and expensive) single computers that FAS has ever made available to individual students. (Computer Science has its own lab of Sun and MicroVax workstations.) This purchase represents a new step in university policy.

Boston University

The Center for Remote Sensing (CRS) will continue, as in Phase I, to provide image processing and, to some extent, video processing facilities for **Perseus**. Many of the purchases that CRS has made over the last two years were made with the expected needs of **Perseus** in mind. This spring the CRS has also completed an expansion of their facilities for the **Perseus** project. The remodeling includes five hundred square feet of space, furnishings, office equipment, and networking that will provide a modern and comfortable environment for the project for many years to come.

The CRS has three image-processing workstations that operate with the Center's Digital Equip. Corp. VAX 11/750 computer under the VMS operating system. These workstations will be employed by **Perseus** to process digitized map data and Landsat Multispectral data for the atlas. These sophisticated image processors, the remote sensing software, and the expertise at Boston University give **Perseus** access to some of the most up-to-date remote sensing technology developed by NASA and other research institutions.

Increasingly, CRS has been moving toward a working environment based on the SUN computer workstations. The Targa Video Image Processing system that **Perseus** will use to convert video images to digital format (based on an IBM AT) uses the SUN 3/160 as a file server. The SUN server will manage the enormous data archive involved in this conversion. In addition, this spring two optical disk drives manufactured by Optotech were purchased that will allow two hundred megabytes of imagery to be stored at a media cost of sixty dollars.

CRS and the College of Communication's Video Laboratory have also made their expanding base of video equipment and expertise available to **Perseus**. The project has already made use of their cameras and recorders to videotape artifacts at the Fogg Art Museum last fall, and Hemans will do video work this summer at several sites in Greece. Another facility that Boston University will make available to the project is the Geddes Language Center (GLC) in the College of Liberal Arts. The GLC laboratories offer a well supervised and secure environment for testing and evaluating **Perseus** course offerings.

Bowdoin

The Bowdoin College Classics Department currently supplies office space in Sills Hall for contributors to the **Perseus** project working on three machines: a Macintosh Plus and a Macintosh SE, each with twenty megabytes of disk storage, and a Macintosh II with eighty megabytes of disk and two monitors (Apple RGB, and Apple monochrome monitors). These computers share a Laserwriter II NT, a MacScan flatbed scanner, and an Apple forty megabyte tape drive is used for backup. The Macintosh Plus is connected to a ROLM Dataphone, which connects to an outside modem or directly to Bowdoin's campus Ethernet, where communication support is provided by a VAX 8650 (bowdoin.bitnet). The SE has been modified to produce standard video output, and is carried to nearby classrooms where it is used with a Limelighter Projector owned by the College's Computing Center. Also located in Sills Hall is the nearby Language Media Center, where the Classics Department this year installed four Macintosh SE's with twenty megabyte disks in each for student use. These four stations are networked to the three machines in the Classics Department with *Tops* networking software, so instructors can easily make assignments or other material available to students without leaving the Classics Department office.

Additional hardware has recently been ordered and should be in place before the beginning of the fall semester, 1988. These additions include:

- putting Macintosh SEs in the remaining two classics department offices in Sills Hall, and tying them in to the existing *Tops* network.

- a nineteen inch gray scale monitor for the second Macintosh II expected from Apple Computer this summer (see below).

- an Apple CD-ROM reader.

- a Panasonic video disk player.

- a large-screen, high-resolution monitor for a small classroom space in the Language Media Center that can be driven by the Department's modified SE; this will be adequate for seminars or other small classes, without tying up the Computing Center's projector.

Chicago

Professor George Walsh, a Classicist at the University of Chicago, has supervised a substantial portion of our data entry. Three graduate students under his direction have used a Kurzweil Optical Character Reader available on campus to enter approximately four megabytes of data so far. The text, once entered, is manipulated on a Sun 3 workstation. Project staff at Harvard log directly on to this Sun (sophist.uchicago.edu), by means of the internet, to review work in progress or to transfer completed files back to Harvard.[12]

Apple Support for *Perseus* Research

Apple Computer will provide up to four Macintosh II-level systems per year for use by people collaborating with **Perseus** who do not work in the main Harvard office. This will allow us to support **Perseus** authors who might not otherwise have access to such computing resources.

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[12] For a description of the data entry process as it takes place at Chicago, see the "Report on Data Entry," included in the Appendix.

VIII. Rights

Distribution Rights for the Database

Generally speaking, Harvard and the Annenberg/CPB Project will each possess non-exclusive distribution rights to the **Perseus** deliverables. Other institutions supporting work that is included in **Perseus** will also retain nonexclusive distribution rights to that material. The specific details of this will be based on the contract between Harvard and Annenberg/CPB for the exploratory phase of the project.

Rights to Include Material in the Database

Texts and Translations

Where ever convenient, we will use material that is out of copyright. (R. C. Jebb's text and translation of Sophocles, familiar to all Hellenists, are one example of high-quality material that is in the public domain.)

Major publishers have expressed reluctance to release their translations in machine-readable form, and one firm, which earns a large amount of money from its translations of Greek literature, expressed skepticism that **Perseus** could provide adequate royalties if we sell compact disks at a price that students could afford (we estimate forty dollars). We suspect that we will ultimately come to an arrangement with a publisher, but such an arrangement might, at this stage, compromise our flexibility and our pricing.

The Loeb Classical Library. We are currently working with the Loeb Classical Library, a series of books that contain Greek texts and translations. Their format is perfect for **Perseus**, and the series is exhaustive—more than ninety per cent of the material that we need is available in the Loeb.[13]

Discussions have been underway between the Loeb Classical Library and **Perseus** for over two years. A letter from Brian Murphy, Associate Business Manager for Harvard University Press, outlines one possible royalty arrangement, given a list price of forty dollars for a CD containing primarily Loeb material.[14]

The TLG Database of Greek Texts. We will be able to use a number of Greek texts that already appear in the TLG database.[15] The TLG cannot, however, simply give us access to a portion of its vast collection, as many of the texts that are in the database are copyrighted by presses in Europe and America. Nevertheless, we estimate that up to ten megabytes of material that we need and that the TLG contains is, or will be out of copyright, by the conclusion of **Perseus** Phase II. Securing rights to additional material within the **TLG** will require case-by-case review.

The Loeb Library and the TLG together provide a powerful foundation on which we can build the collection of source texts within the **Perseus** database.

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[13] Some of the Loeb translations are, however, out of date and badly need to be revised or replaced. The most important gaps are Homer, Aristophanes, and Euripides. We have, as mentioned above, begun to help the Loeb by providing Professor David Kovacs with a Macintosh SE 20 which he will use to compose the Euripides translation that will appear in both the Loeb Library and **Perseus**. For further information on the ancient works we will include in **Perseus** and the problems involved in getting reasonable translations, see section "Texts," of chapter IV.

[14] This letter is included in the Appendix.

[15] A letter from Ted Brunner, director of the TLG, is included in the Appendix.

Topographic, Architectural, and Archaeological Materials

During the first nine months of **Perseus** we have obtained the rights to around four thousand slides, illustrations, and drawings. The majority of the slides are from the collections of the Archaeological Institute of America (AIA). Many years ago the AIA made plans to distribute slide collections from the numerous important excavations and projects conducted by its members (the AIA is the largest archaeological organization in the U.S. with roughly three thousand active members). This project was abandoned for various reasons but several senior scholars had given the AIA full rights over their collections. Dr. James Wiseman, current president of the AIA, is a member of the **Perseus** Educational Advisory Board and enthusiastically supports this opportunity to make these collections available through **Perseus**.

Perseus will enable the AIA to fulfill its original goals of disseminating these important and irreplaceable collections. In fact **Perseus** will create greater accessibility than the AIA had ever hoped for.

The AIA collections are large, (around seven to eight thousand slides) but many illustrate material outside the scope of **Perseus**. We conservatively estimate that one thousand to fifteen hundred cover material suitable to **Perseus** *and* are of sufficient quality and merit to include in the data base. Maintaining a high standard is of great importance to the goals of **Perseus**.

Other Collections

In addition to the AIA, numerous scholars have made their collections available. The collection of **Perseus** participants alone (Martin, Hemans, and Smith) represent around fifteen humdred slides. More valuable, however, are the collections of senior scholars who have spent a lifetime in the field. Several senior archaeologists have expressed their desire to contribute and will formally grant rights in the next few months.[16]

Material from Museum Collections

In the early stages of this project we believed that obtaining the cooperation of museums for the reproduction of important works of art would be difficult. In fact, that has not proven to be the case. While communication and negotiation with museums has been extremely time consuming, once the purpose, methods, and requests of **Perseus** have been made clear, cooperation has been forthcoming. The difficulties that **Perseus** will have in obtaining rights are primarily constraints of time and the expense of great amounts of correspondence, meetings, and research that is required by the **Perseus** staff to determine exactly which portions of the collections are most relevant to our audience.

In some cases we expect that museums will allow direct access to the objects for new video-taping and filming. We have been able to do this, for example, at the Fogg Art Museum on Mondays when the galleries are closed to visitors. A similar arrangement has been made with the Boston Museum of Fine Arts.[17] We have been constrained by the need not to disrupt regular museum activities, and the limited hours in which museum staff can work with us.[18] In Phase II, these activities will continue and the **Perseus** staff will need to travel to selected

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[16] University lawyers are currently drafting documents to assign formal rights and permissions.

[17] See "Rights Negotiations: Institutions" in the Appendix for a list of museums contacted and a description of materials for which **Perseus** has obtained rights.

[18] We have been in touch with the Registrar, Curator of Collections and Acting Director at the Bowdoin College Art Museum, and have received permission both to draw and film objects in the collection: we will not be able to discuss the question of unrestricted rights until the permanent director returns from sabbatical this summer, but for drawings made so far, the Museum has asked only that we credit them. This summer we plan to begin filming material from this collection as part of **Perseus** 1.0.

museums at greater distances from our home base. This activity is worthwhile to include the very best art objects in the **Perseus** database, even if only a limited number of objects can be shot on a single trip.

Illustrations: Line Drawings

For the most part we are creating our own original architectural illustrations. The number of essential architectural monuments is relatively small (around ninety) and this allows us complete freedom in their reproduction as well as important quality control.

Perseus will also include previously published drawings, especially finely detailed perspective and reconstruction drawings. Publishers have cooperated in granting these rights as a normal scholarly courtesy. Total numbers of these illustrations will number less than one humdred.

IX. Revenue Sharing

The formula for revenue sharing will be generally based on the terms of the contract for the exploratory phase of **Perseus**.