

FROM PΑPYRUS TO POSTERITY

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Chapter 1 Greek Beginnings

The Archimedes Manuscript

On October 29, 1998, the gavel fell at Christie's in New York and a one-thousand year-old manuscript changed hands for a total purchase price of \$2,202,500. In this transaction, an anonymous purchaser acquired a precious bit of the cultural heritage of the West. This manuscript, written in Greek, held 174 parchment leaves bound in a book about six by seven-and-a-half inches. Its text consisted of six works by Archimedes that remain of fundamental importance in the history of mathematics.

Legend depicts Archimedes running naked through the streets of Syracuse shouting "Eureka!"—"I have found it!" His discovery of the solution reported in "On Floating Bodies" supposedly occasioned this romp. In this work, Archimedes laid out the basic principles of specific gravity and founded the field of hydrostatics. In "On the Measurement of the Circle," Archimedes computed the value of π within narrow limits, and in "On the Sphere and the Cylinder," he proved that a sphere held in a cylinder whose sides, top, and bottom just touch the sphere has a volume two-thirds that of the cylinder. The very foundations of twenty-first century science and industry rest on these discoveries—without a knowledge of π we could not compute the area of a circle or the volume of a sphere, and without a thorough understanding of specific gravity we could not explain why a boat floats.

Archimedes was born about 287 B.C. in the Greek city state of Syracuse in Sicily. In the struggle between Rome and Carthage, Syracuse

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allied itself with Carthage, and Archimedes died when the Romans captured the city in 212 B.C. According to Plutarch's account, Archimedes was busily engaged in a mathematical proof when Roman soldiers burst in upon him. Archimedes enraged the soldiers by ignoring them and continuing with his work, and the soldiers slew him on the spot.

Archimedes, like virtually all ancient Greeks and Romans, wrote on papyrus scrolls, the standard writing surface of classical antiquity. The manuscript sold at Christie's is the oldest extant manuscript containing any work by Archimedes, but it was produced a full 1200 years after Archimedes wrote. Written on parchment, this manuscript was bound between wooden boards in the form of a book.

How Archimedes' six texts journeyed from his hand to become enshrined in the Christie's manuscript we do not know, although we possess a great knowledge about such voyages in general. The 1000-year history of the auctioned manuscript remains obscure and controversial. The material and handwriting of the manuscript indicate that it was written during the tenth century somewhere in the Byzantine Empire, probably at Constantinople. In the twelfth century, someone disassembled the manuscript, washed off the text of Archimedes, and cut in half the parchment leaves that form the book. The parchment was then used to make a Greek prayer book. (Such a manuscript—one with its original text effaced and its pages reused—is a *palimpsest*. Palimpsests will play a continuing and important role in our story down to the Renaissance and beyond.)

From the twelfth to nineteenth centuries the Archimedes palimpsest was in the Holy Land; for part of this time the manuscript can be traced to the Greek Orthodox monastery of Mar Saba in the Judaeen desert near Jerusalem, where it resided for about 400 years. In the early 1800s, the palimpsest was moved to the library of the Greek Patriarch in Jerusalem. From there it eventually traveled to the Church of the Holy Sepulcher, and to the daughter house of the church, the Metochion in Constantinople.

The great Biblical scholar, Constantine Tischendorf, viewed the manuscript at the Metochion in 1846.¹ We know that Tischendorf saw the

manuscript because he mentioned seeing an Archimedes palimpsest on mathematics, and he apparently took a leaf of this very manuscript, as the leaf has come down among Tischendorf's effects to reside in the Cambridge University Library in England. In 1907, the Danish philologist Johan Heiburg worked with the manuscript in Istanbul and transcribed the Archimedean text using only a magnifying glass. The lower (i.e., older) Archimedean text appears only as faint lines of light brown ink underneath the darker brown ink of the upper (i.e., newer) text of the prayer book.

Sometime after 1907, the manuscript disappeared and wandered in obscurity until the late 1990s. The manuscript came to auction from an unnamed French family that supposedly owned it since 1920. The Greek Orthodox Church claims rightful ownership of the manuscript and sued to block the auction. A United States judge refused to block the sale, citing a French law that gives ownership of a work to anyone who holds it for 30 years. The sale was consummated, and the new owner also remains anonymous. However, the Walters Art Gallery in Baltimore, Maryland exhibited the manuscript for three months in 1999. Now the manuscript has once again disappeared from public view.²

This manuscript holds a place of critical importance for the history of science and for a proper appreciation of Archimedes. It is the only source for "On the Method of Mechanical Theorems," and it is the only known copy of "On Floating Bodies." Prior to the transcription of this manuscript in 1907, our knowledge of the work of Archimedes rested on a single frayed thread that is now entirely lost. In the fifteenth century, the Italian scholar Giorgio Valla owned a different Greek manuscript of Archimedes that was also created in the ninth or tenth century. When Valla died in 1499, the manuscript went to Alberto Pio, Prince of Carpi, and thence to his nephew, Cardinal Rodolfo Pio, in 1544 "after which it seems to have disappeared."³ Before 1907, the three best manuscripts of Archimedes—one in Florence and two in Paris—all stemmed from the now lost manuscript of Giorgio Valla. Thus, before the reappearance of the Archimedes palimpsest, the oldest extant manuscript of Archimedes dated from about 1500.

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As the history of the Archimedes manuscript illustrates, we may liken the great literary and scientific works of ancient Greece and Rome to messages placed in bottles and dropped in the ocean that have somehow landed on our library shelves. In many cases, like that of the Archimedes manuscript, our connection with this ancient heritage depends on inexplicably shifting waves and currents that have miraculously brought the message to us over the interval of 2000 years.

Almost without exception, the works of classical antiquity were written on scrolls made from the papyrus plant, all of which was grown on plantations in Egypt and manufactured into a writing surface there. However, sometime in the Middle Ages, all classical papyri disappeared through age, neglect, or other causes, save the odd scrap of a single sheet from this or that text.

With no ancient manuscripts actually surviving, all knowledge of ancient writing techniques depended on ancient inscriptions, depictions in art that survived from antiquity, or references in classical texts that themselves survived in copies made after the dissolution of the classical world around 500 A.D. Even taken together, these sources provided little information, leaving the early modern world in virtually total ignorance of the material and form of ancient books, the script in which they were written, and the entire book culture of antiquity. This state of relative ignorance persisted into the eighteenth century, but then began a series of astounding discoveries that revolutionized our knowledge of manuscripts and book culture in the classical world.

Discoveries of Papyrus Manuscripts

Surrounding the Bay of Naples spreads some of the most beautiful and graced land on earth. Bountiful produce, magnificent vistas and a gentle climate encouraged settlements here long before humans began to record their history. On the flanks of the coastal mountains and commanding a view of the Bay stands Herculaneum, a city continuously inhabited from long before the Romans down to the present day. There in 1713 workers struggled to dig

a well using only pick and shovel. As they progressed more deeply into the soil, they began to find Roman artifacts, a discovery that highlighted a serious disadvantage of this lovely location—it stands between the sea and the cone of Mount Vesuvius.

In the best known volcanic eruption of all time, Mount Vesuvius exploded in 79 A.D. and buried Pompeii in volcanic debris. Excavations there have uncovered streets, houses, housewares, art, and human remains buried in the ash and mud and left there for many centuries. The same eruption, less famously, buried the smaller nearby city of Herculaneum under a stream of liquid mud and ashes mixed with water. This mass of mud solidified and encased Herculaneum, protecting the remains from air and water. Over the subsequent centuries, at least five series of eruptions added additional layers of volcanic debris, bringing the total covering over the city to the range of 70–100 feet.⁴

And so matters stood until the well diggers began to unearth artifacts that had rested undisturbed for more than 1,600 years. The land owner quickly took control of the excavations and transformed the well-digging project into a slow-motion archaeological treasure hunt and artifact bazaar. Over the next decades of sporadic and haphazard digging, excavators found and sold many statues and other items.

In 1750 excavators stumbled upon a luxurious villa in a remarkably fine state of preservation, filled with splendid frescoes, exquisite and colorful mosaics, along with fine marbles and statues. In a well-preserved room about twelve feet square, shelves with elaborate wood inlay lined the walls; a small table stood in the middle of the room. On these shelves and scattered about the room were many cylinders about three inches in diameter and fifteen inches in length, each resembling a large stick of charcoal. Initially baffled by these unfamiliar objects, a worker eventually dropped a cylinder, and the chunk of charcoal broke open to reveal writing. Only then did the excavators recognize these cylinders as papyrus scrolls—the likes of which had been lost to the world for centuries.

At the time of the finds in Herculaneum, there were no known ancient

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papyrus manuscripts in existence, so virtually nothing was known about the physical form of ancient books, and very little was known about ancient book culture—how books were produced, distributed, and read. Of course, many ancient *texts* had survived through two millennia of copying and re-copying, but before the finds at Herculaneum all ancient physical *manuscripts* were thought to have perished. Before Herculaneum, the oldest extant papyri were some papal bulls, various municipal archives and a Latin manuscript of the sixth century. Thus, the finds at Herculaneum suddenly yielded actual samples of ancient classical manuscripts that were at least 500 years older than anything available.

Even today, this library is the only ancient library with books ever discovered, and the papyri found here are the only ancient Greek or Latin papyri ever discovered in Greece or Italy. One of the most notable finds in the library is the oldest Latin literary manuscript in existence, which bears a poem on the Battle of Actium—the battle in which Augustus vanquished Mark Antony and Cleopatra in 31 B.C. to found the Roman Empire. The villa is known as the Villa of the Papyri, the reconstructed plan of which was copied for the J. Paul Getty Museum in Malibu, California.⁵

While some rolls from Herculaneum were lost or destroyed, almost 2,000 still exist. To read a roll, one must break through the crust, detach a single thickness of the original, reassemble the resulting pieces, and read them by holding the re-composed sheet obliquely to a light.⁶ While hundreds of these scrolls have been read, the process is so cumbersome and expensive, that 250 years later hundreds of these scrolls still remain in storage unread.

Of the many that have been read, only a few of are written in Latin. Most are in Greek, the favored language among educated Romans of the time. Most of the rolls hold texts by various minor Epicurean philosophers, most notably by Philodemus, a man remembered much more as the teacher of Virgil rather than for his own writings. Philodemus may have owned the villa, given the predominance of his justifiably obscure writings among the recovered papyri. Regrettably, the finds in Herculaneum lack spectacular literary value, but they provide a rich trove of information about the physical

form of ancient papyrus manuscripts.

The finds at Herculaneum began a revolution in our knowledge of books in the ancient world. Beginning with the discoveries at Herculaneum, for the first time modern scholars could measure the dimensions of ancient papyri scrolls and hold in their hands a manuscript actually written in the ancient world.

While tremendously exciting to scholars and profoundly important to our knowledge of the ancient world, the papyri from Herculaneum were nothing new when they were written. In the world of classical antiquity, papyrus was the equivalent of both today's legal pad and laser jet bond. In the Egypt of the Pharaohs, papyrus rolls had been in constant use for writing since about 3,000 B.C., largely containing business accounts, a few literary works, and priestly hieroglyphics.

In 332 B.C. Alexander the Great swept away the old Pharaonic culture when he conquered Egypt and founded the city of Alexandria. This date inaugurated a millennium of Greek cultural hegemony. After Alexander died, his generals carved up his empire to create their own fiefdoms. Ptolemy, perhaps his senior general, became the ruler of Egypt and founded the Ptolemaic dynasty, which ruled Egypt from 323 B.C. to the Roman conquest and the death of Cleopatra, "the last of the Ptolemies," in 30 B.C. Greek culture continued to dominate Egypt under the Roman Empire, through periods of barbarian rule, and control by the Byzantine Empire until the Arab conquest in 642 A.D.

Over this millennium, writers in Egypt produced thousands, or even millions, of Greek papyrus manuscripts, and the Greeks of Egypt collected thousands of Greek manuscripts from other areas throughout the Mediterranean basin. Under Greek control, Egypt continued to produce papyrus scrolls and ship this writing material throughout the classical world.

But even before Alexander and the Greeks took possession of Egypt, this fertile land played host to a civilization of vast power and great creativity. The pyramids of Giza, the mysterious Sphinx, and the hundreds of temples that stretch up the Nile valley all bear testament to this pharaonic culture that

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preceded the Greek conquest.

With the rich treasure trove of ancient Egyptian sites at its doorstep, Cairo had always been a center for legal and illegal trade in Egyptian antiquities. The main trade consisted in sculpture, mummy cases and mummies themselves. In the sixteenth century, Europeans became obsessed with the amazing medicinal properties of genuine petrified mummy flesh. As a balm, it supposedly worked wonderfully well for cuts and bruises, and ingested it was thought to cure nausea and other ailments. The great Renaissance French king Francis I wore a small bag of mummy around his neck as an emergency precaution.⁷ By the nineteenth century, many mummies had been excavated and exported for medicine, but many remained undisturbed. One special mummy awaited the scholar W. M. Flinders Petrie in the graveyard of Hawara.

Petrie, 1853-1942, was born into a family of distinguished achievers in surveying and mapping. His grandfather was the first person to chart Australia and Tasmania, while Petrie's father was an industrial engineer with a strong knowledge of surveying. Petrie's mother, too, was a woman of outstanding intellectual gifts who played a critical role in Petrie's life and education. Petrie was often sick as a child and received virtually no formal education. Instead, his scholarly mother taught him Hebrew, Latin, and Greek beginning when he was only four, while his father taught him how to use a sextant and helped him master the techniques of surveying and mapping. As an adolescent, Petrie devoured a host of books and mastered difficult topics in all areas of learning. He went on to devise his own chemistry experiments, and to survey and map areas around his family home in southern England. In his early twenties, Petrie published his first book based on his own measurements and investigations of Stonehenge.

In the early 1880s, he journeyed to Egypt to measure the pyramids at Giza to test the popular hypothesis that the design of the pyramids proved in some way that they were built with divine assistance. Petrie's accurate measurements destroyed the theological hypothesis that had relied on a series of faulty dimensions. While in Giza he fell in love with Egypt and made a

life-long commitment to studying and excavating Egypt antiquities.

Whatever ailed Petrie as a child, Petrie flourished in the foreign climate of Egypt that destroyed the health of many another European. Petrie married and brought his wife to Egypt—this after their honeymoon spent on a coal barge. Petrie demonstrated other peculiarities as he worked in the pyramids naked and scared tourists away from his excavation sites by running around in red underwear and acting deranged. A woman of her own eccentricities—or great tolerance—Petrie’s wife was his constant companion and colleague.

The late 1880s found Petrie excavating in the ancient cemetery of Hawara, a town in middle Egypt. There, he found the “Hawara Homer,” probably the finest manuscript of Homer’s *Iliad* now in existence. The manuscript dates to the second century A.D., and was found in the simplest manner: “The book was lying rolled up under the head of a mummified woman.”⁸

Beyond the rare manuscript used as a mummy’s headrest, papyrus manuscripts were incorporated more intimately into burial sites. Many mummies were enclosed in a case, examples of which can be seen in many museums around the world. In many instances, these cases are composed of “cartonnage,” a material which resembles papier-mâché and was used to make mummy encasements as a substitute for wrapping the body in linen. Ancient funerary works bought bundles of scrap papyri, layered and molded the papyrus around the body, covered it with plaster, and allowed this cartonnage it to harden into a case. Modern scholars are able to delaminate the papyrus layers of the mummy cases by using chemicals, and then are able to read the papyrus scraps that made up the case. In some instances, the body cavities of mummies were filled with papyrus documents to keep the corpse from collapsing, and these too have been recovered in many instances.

The government of Egypt was the main consumer of papyrus, so most of the papyri found in cartonnage contain government documents. Among this mass of cartonnage documents lurked a few literary gems, including a fragment of Plato’s *Phaedo*, a manuscript a full 1200 years older than the

oldest previously extant manuscript.

In 1778, just a generation after the finding of the papyri at Herculaneum, a papyrus scroll appeared for sale on the antiquities market in Cairo. This single scroll was supposedly one of fifty found by peasants at a location that was never disclosed. The peasants sold this scroll to an antiquities dealer, but the others disappeared without a trace.

The roll the peasants sold had little intrinsic interest, listing only the names of forced laborers working on the dykes in 191 A.D., but this was the first ancient papyrus that ever came to light in Egypt during the modern era. Over the next forty years, not a single ancient papyrus manuscript of any kind was discovered in Egypt. Over a period of fifty years starting in 1820, sporadic finds began to surface on the market in Cairo, including a discovery of a fragment of the *Iliad* and the *Funeral Oration* of Hyperides. In both cases, these newly discovered manuscripts were centuries older than the oldest previously known manuscripts. These finds, while interesting and suggestive, increased our knowledge of antiquity only slightly. All that was about to change, however.

In the 1870s, the Egyptian populations was expanding rapidly, forcing cultivation of poorer lands farther away from the Nile and more out in the desert. In 1877, in one such area south of Cairo, local citizens discovered a large number of papyri dating to the end of the Greek cultural period in the century before the Arab conquest, roughly 550–642 A.D. In the winter of 1877–1878, these newly discovered papyri flooded the antiquities market in Cairo, and European collectors snapped up these new finds. One hungry purchaser, the Imperial Museum in Vienna, acquired more than 100,000 pieces by the end of the nineteenth century. Other European and American museums and libraries also built up their collections by purchase.

The ultimate source of these manuscripts was quickly located—at least in principle. Egyptian peasants were finding papyrus manuscripts in ancient rubbish heaps. But selling these manuscripts was illegal, so the location of these rubbish pits was a closely guarded secret. Soon, nonetheless, numerous ancient papyrus rubbish heaps with thousands of papyrus manuscripts were

being discovered. Not surprisingly, the first large finds of 1877 were concentrated at the very end of the Greek cultural period, because the manuscripts were discovered in the rubbish heaps just as they were deposited—the oldest documents on the bottom and the newest on top.⁹

In the heaps of discarded papyri, the mix of documents was similar to paper trash of today—the bulk of documents consisted of business records, with occasional personal letters and communications, along with the rare jewel of a literary manuscript. In the nineteenth century, collectors focused almost exclusively on manuscripts of classical literary works. This led to a widespread neglect of more recent manuscripts from the Byzantine period, particularly non-literary manuscripts. The bulk of the material, business documents and personal writings, were deemed virtually worthless. This preference led to the destruction of many thousands, perhaps millions, of these more recent papyri.¹⁰ With today's interest in social history and the life of the common person, many of these discarded papyri would be of compelling interest. Nonetheless, while much was lost, much was preserved, and the discoveries of 1877 proved to be just the tip of the papyrus iceberg.

The flood of newly discovered papyri incited western scholars to search for other papyri dumps with an eye to excavating them in an organized manner. Local peasants had made most of the early discoveries in clandestine and unsystematic searches. As a result, the context of the discoveries was lost, while these hasty and illegal excavations destroyed many papyri.

It soon became apparent that excavating on the outskirts of ancient towns and cities would be a promising strategy. Some of these cities were on sites that had not been occupied in the intervening years; others had been built upon repeatedly during the passage of centuries. Almost all of the productive sites were in the desert or on the edge of the desert, and searchers often found papyri dumps in cemeteries. In the populous Nile delta, where one might presume the most intensive use and discarding of papyri, searches uncovered virtually no papyri. The high water table and the continuous history of cultivation apparently destroyed the papyri that might have been deposited in this region.

Other huge finds followed in 1887 and in the 1890s. One of the largest and most productive sites was at Oxyrhynchus, located about 160 miles south of Cairo on the edge of the Libyan desert. Oxyrhynchus grew up during the Hellenistic Age, that period from Alexander's death in 323 B.C. down to the final Roman conquest of Egypt and the death of Cleopatra in 30 B.C. During these 300 years, the southern Mediterranean coast and Asia Minor were dominated by Greek kingdoms that were carved up from Alexander's brief-lived gigantic empire. During this time Oxyrhynchus was a prosperous provincial capital with stone walls three miles in circumference. In addition to its fine walls, it possessed a theater with seats for 11,000 spectators and a grand temple to Serapis in its busy central district. Outside its walls farms and orchards surrounded the city, but between the walls and the agricultural district the city wore a necklace of trash dumps. By the late nineteenth century little of Oxyrhynchus' former glory remained, just a few colonnades and some ruins of the theater—but two millennia of accumulated trash awaited the ministrations of two remarkable savants.

In the 1890s, two Oxford scholars, B. P. Grenfell and A. S. Hunt, formed a working partnership that would persist through Grenfell's three nervous breakdowns, Hunt's military service in the trenches of World War I, many seasons in the desert, and three decades of scholarly collaboration. In 1897 Grenfell and Hunt started to excavate at Oxyrhynchus, perhaps with an inauspicious beginning, as Grenfell relates: "My first impressions on examining the site were not very favourable . . . the rubbish mounds were nothing but rubbish mounds." Nonetheless, Grenfell and Hunt quickly published the first volume of papyri in the series, *The Oxyrhynchus Papyri*. A hundred years and several generations of scholars later, the papyri found by Grenfell and Hunt are still being published, with more than 80 volumes now available.

Most of the finds at Oxyrhynchus and other papyri deposits were non-literary documents of the post-classical period. They are valuable mainly as documents of social history, and in many cases, they provide the most intimate glimpses into ancient life. For example, from one papyrus at

Oxyrhynchus we learn that on November 2, 182 A. D., the eight-year-old slave boy Epaphroditus leaned out of a bedroom window to watch a castanet-player in the street below, slipped, and fell to his death. Another document tells us that Apollonius and Sarapias sent a thousand roses and four thousand narcissuses for the wedding of a friend's son.¹¹

These papyrus dumps also yielded some literary manuscripts of compelling interest and importance, and fall into two basic categories—manuscripts of works that were thought completely lost forever and older and better manuscripts of works that have been preserved from inferior copies.

Handwritten manuscripts generally have many errors introduced over numerous generations of copies, and scholars trying to determine the authentic original text prefer older manuscripts as they lie closer in time to the author's *autograph*—a manuscript written in the author's own hand.

No autograph of a classical work has survived, but numerous manuscripts from antiquity—ancient copies descended from the author's autograph—have come down to us, and the most significant ones have come from trash pits in Egypt. Through these discoveries, literary works that were thought to be lost forever have made a sudden reappearance after a hiatus of almost 2000 years. Manuscripts of works that were thought to be completely lost found at Oxyrhynchus and other trash pits include the songs of Sappho, the exquisitely crafted elegies of Callimachus, and some plays of the great comic poet Menander.

Menander was one of the major literary figures of the Greek world, and one of the least fortunate. Working in the fourth century B.C., Menander wrote more than 100 plays, that were extremely popular, often performed, and whose texts were widely circulated. Nonetheless, for centuries they were all lost and presumed to be gone forever. One of the most stunning discoveries in all the papyri of Egypt is a third century B.C. manuscript of Menander's play, *The Man from Sikyon*. This manuscript was written just sixty years after Menander's death.¹² Other finds of Menander's plays followed in the twentieth century, and in 1958, Menander's first complete

play known to the modern world reached print. Now eight almost complete plays have been printed, although the vast majority of his dramas remain lost. Nonetheless, the retrieval of eight plays from this important playwright after two millennia represents a remarkable retrieval of treasures that were surely given up as permanently lost.

Perhaps the most amazing discovery of all ancient manuscripts occurred in the winter of 1890. In January of that year the young scholar, F. G. Kenyon, was working in the British Museum and was summoned to the laboratory. Some of the first finds of papyrus scrolls had just arrived from Egypt and were spread out under glass on a table. Kenyon was assigned the task of examining them. We can imagine the young Kenyon, fresh from graduate school, confident in his skills and anxious to prove himself, coming up from the basement to handle the first big assignment of his career.

Looking through these papyri, Kenyon's attention eventually fell on one set of four scrolls. Like so many other pedestrian scrolls, the front side (or *recto*) held the daily accounts from an Egyptian farm for the 78–79 A.D. season. These rolls are about 11 inches high and range from 3-7 feet to comprise a total length of almost 19 feet. Looking over these banal records, Kenyon must have wondered if all his hard Oxford training had merely prepared him to read 2,000-year-old accounting statements.

But hard work sometimes pays. On February 26, 1890, on the back side (or *verso*) of these rolls, Kenyon found a virtually complete text of Aristotle's *Athenian Constitution*—one of the most important works of political theory in antiquity. Aristotle had written a series of studies of various constitutions of Greek city-states, and of these, the study of the constitution of Athens was probably the most important, just as Athens was the most important city in ancient Greece. Scholars knew of this work from references and short quotations in other extant texts, but the complete work had not been seen for 1800 years. Suddenly, thanks to Kenyon's careful work, this critical document had suddenly popped back into existence. The next year, Kenyon was able to publish the first edition of the *Athenian Constitution* along with his own English translation. Kenyon's preface to that

edition is perfectly proper and restrained, giving no indication of any excitement or pride, but we can only imagine the stupendous glee he must have enjoyed when he realized the magnitude of his find. In one brief moment, not only had Kenyon managed to restore to the world an ancient Greek work of the first rank, he had also made his career and earned a place in the history of classical scholarship.

Because the farm records were written on the recto in 78–79 A.D., the *Athenian Constitution* must have been written after that date, and this manuscript is the most famous of all opisthographs, an *opisthograph* being a roll containing writing on both the recto and verso. Based on an analysis of the four handwritings that appear in the manuscript, Kenyon concluded it was probably written in the late first or early second century A.D., making it the oldest manuscript of Aristotle ever discovered. In his edition of the *Athenian Constitution*, which appeared in 1891, Kenyon observes in the introduction: “It is now certain that beneath the sands of Egypt, in its tombs and its buried cities, manuscripts written on papyrus have been preserved, to an extent which cannot be fairly estimated as yet.”¹³ As we have seen, his conclusion proved true in the next seventy years as scholars unearthed tens of thousands more manuscripts, but Kenyon himself had made the greatest discovery of all.¹⁴

The Glory of Greece

These discoveries by Petrie, Kenyon and others embellished and enriched our understanding of the great works of Greek classical antiquity that stand as the very foundations of Western culture. The Greeks laid down this cultural bedrock from the time of Homer down to the conquests of Alexander and the rise of Hellenism—a period from about 750 B.C. to 325 B.C. But the period of the greatest Greek achievement occurred in the fifth and fourth centuries B.C., truly founding the culture of the west in drama, historiography, and philosophy. In the same century, this incredible people would create sculpture and architecture that has never been surpassed and form political institutions that find an enduring echo in our own constitution.

By 479 B.C., Greek victories over the Persians at Marathon, Salamis, and Plataea had turned away the threat of this vast eastern empire for good, and the century proceeded to the golden Age of Pericles (c.495–429). Under the leadership of Pericles, Athens strengthened its democracy, moved toward empire, and began to build the Parthenon.

Drama flowered first in the spectacular fifth century, led by Aeschylus (c.525–c. 456) as he reworked many Homeric themes into tragedies of the most compelling power. With Aeschylus still in his prime, Sophocles (c.496–406) and Euripides (c.484–406) entered the scene to extend the genre, with Sophocles' *Oedipus Rex* standing as perhaps the greatest tragedy of all time. While Sophocles and Euripides dominated the dramatic scene, the slightly younger Aristophanes (c.450–c.388) raised comedy to similar heights, even daring to make Euripides the butt of jokes.

In history, Herodotus (c.484–c.425) established the genre and earned the title of the “father of history” with his narrative of the Persian wars. Herodotus' younger contemporary, Thucydides (c.460–c.404), became the greatest of all ancient historians, by putting history on a more scientific foundation with his *History of the Peloponnesian War*. Himself a general in this long struggle (431–404), Thucydides chronicles the fratricidal war between Athens and Sparta that debilitated the Greek world and drew the magnificence of the fifth century to its close.

But even while the Greeks fought among themselves, they created another gift for the world in philosophy. Socrates (c.470–399) never wrote himself, but he gave a method and inspiration to his student Plato (428–348). In his dialogues, works of great literature as well as philosophy, Plato became the first philosopher in the west to address the full world of nature and human experience. Plato also taught Aristotle (384–322), who extended the foundations of Plato in the direction of system and rigor. In the view of many even today, Plato and Aristotle created two competing world visions that have alternately dominated the thought of succeeding ages.

Alexander the Great died in 323 B.C., after conquering an empire that stretched from Greece westward to Egypt and eastward to India. By the next year, when Aristotle followed his student to the grave, Alexander's generals were already dismembering the empire into more manageable fragments. The death of Aristotle and the rise of various Hellenistic kingdoms under Alexander's generals together provide a convenient demarcation of the transition from the age of classical Greece to the Hellenistic age.

Early Greek Book Culture and Custom

Through the fifth century, these great thinkers wrote against the background of a society that was generally illiterate. Plato depicts a world still dominated by oral instruction and argument, but his time, the early fourth century, marks the dividing line between a principally oral society and a nascent culture of writing and books.¹⁵ Plato mentions that books are widely and cheaply available.¹⁶ Aristophanes implies that some members of the audience at a tragedy might have their own copies of the play.¹⁷ We can imagine members of the audience lounging in the wonderful open air theaters and following the action in their own copies of the script—noting where actors add their own lines to pad their parts, as they tended to do.

Around 400 B.C. only a tiny, but growing, proportion of Greeks could read, and the potential readers in large Greek towns such as Athens, Miletus, and Corinth might be numbered only in the hundreds. The ancient Greek world certainly did not enjoy any mass literacy, although Athens must have

had the largest reading public of any Greek city.¹⁸ This movement toward literacy and written literature plays a key role in the story of how the magnificence of Greek literature has reached our age. With writing, the physical vessel was created that would preserve the Greek texts to carry them to our age.

Even with written documents coming into more general use, oral declamation and public speaking were always highly prized in the Greek world, as the numerous speeches in Homer attest. Perhaps this explains the striking custom of reading texts aloud in the ancient world, a custom that persisted for centuries. A solitary reader might mumble the words, but the ideal form of reading was a declamation. The typical reader would be seated, holding a papyrus scroll with the completed portion in his left hand and the remaining manuscript in his right. He reads a text that lies in narrow columns of letters without punctuation or spaces between words. As he reads, he pronounces each word. This experience of reading differs vastly from our own. Most importantly, perhaps, reading ancient texts must have been quite slow, with the reader having to extract each word from the stream of letters in the text and then to say the word aloud. This process gave the reader a much greater intimacy with the text and must have resulted in greater comprehension.

We know of the custom of reading aloud due largely to the astonishment of those who happened to witness silent reading—Alexander the Great silently read a letter from his mother in the presence of his amazed soldiers. In 383 A.D., St. Augustine witnessed St. Ambrose reading silently and recorded this event with surprise: “But when he was reading, his eye glided over the pages, and his heart searched out the sense, but his voice and tongue were at rest.”¹⁹ The first person we know to prefer silent reading was the encyclopedist Isidore of Seville in the sixth century A.D.²⁰ We know few details of the transition to silent reading, but it seems to parallel the movement from classical to Christian culture. Whereas an ideal classical figure might address a group in a polished speech that displays his personal qualities and oratorical gifts, the ideal Christian would avoid calling attention

to himself. Not surprisingly, then, the classical reader might declaim aloud, while the Christian reader would scan the text silently.

Private individuals produced most manuscripts in the ancient Greek world, often for their own use. Wealthy book collectors owned educated slaves to copy books for their personal libraries, but businesses also produced manuscripts. According to the best evidence, privately copied manuscripts contained more copying errors than commercially produced manuscripts, particularly in the fourth to third centuries B.C. Sometimes copyists introduced errors or changes intentionally. Extant actors' copies of Greek plays often reveal that lines were added or changed, often to embellish the role of the actor. Many copies of Homer from this early period have lines missing, added, and changed. The lack of punctuation or spaces between words in the texts of this time must have added to textual corruption.²¹ In ancient times as well as now, books became obsolete, and the ancients had their own way of dealing with remaindered books—they gave the rolls of discarded books to children so they could write their exercises on the verso.

The Beginning of Libraries

It seems clear that Sumer and Egypt possessed libraries or archives well before the rise of the Greeks, while Greek libraries can be traced to the sixth century B.C. at the very earliest. Private libraries most likely preceded public libraries. Euripides reportedly possessed his own library in the fifth century B.C. , as Aristophanes reveals when he pokes fun at Euripides for his bookishness,²² a trait Aristophanes displayed himself. Plato collected manuscripts, and Demosthenes, the great orator and contemporary of Plato, copied books for himself.²³

Aristotle was most likely the first individual to build up a large private library oriented toward research, and it seems quite possible that books from Aristotle's library made their way to the great library in Alexandria and were copied there to become the ancestors of some of today's existing manuscripts. Aristotle loved books and generally receives the greatest credit for developing libraries and stimulating personal book acquisition. He also succeeded in

imparting his love of books to Alexander the Great. According to Plutarch (*Alexander*, 8), Aristotle corrected a copy of the *Iliad* and gave it to Alexander, who kept it under his pillow with his dagger at all times.²⁴ Even while on his campaigns of conquest in Asia, Alexander sent to Athens for books.

The great Greek schools of philosophy in the fourth century B.C.—Plato’s Academy and Aristotle’s Lyceum—not only produced great original work, they formed the first tentative libraries of the Greek world, with both schools persisting for centuries. The Lyceum closed only in the fourth century A.D., while an edict of the Emperor Justinian closed Plato’s Academy in 529 A.D.

By 330 B.C. Athens had a public library, and in the third century B.C. the city had enough books and libraries to provide resources for research. Polybius chastises Timaeus the Sicilian for researching from the comfort of Athens rather than conducting research at the sites featured in his history: “You can busy yourself among books with very little danger or hardship, provided only that you have taken care to have access to a city which is well supplied with records or to have a library close at hand. After that you need only pursue your researches while reclining on your couch. . . .”²⁵

In a world of very few manuscripts, each of which had to be copied by hand, libraries served a crucial role as repositories of originals and as centers for producing new manuscripts. A library not only possessed and copied books—a library also attracted scholars and provided a focus for readers in search of manuscripts.

Greek Linguistic Debts

The early Greeks achieved literacy in the second millennium B.C., but inexplicably lost the ability to read and write some time after the demise of Mycenaean civilization in the twelfth century B.C. In the first millennium B.C., they again performed the difficult feat of gaining literacy by borrowing from the Sumerians for the invention of writing and from the Phoenicians for the beginnings of the alphabet.

Western writing systems were invented about 3000 B.C. in the area between present-day Baghdad and the head of the Persian Gulf—that “Cradle of Civilization” or “Fertile Crescent” that lies between the Euphrates and Tigris rivers. There the ancient culture of Sumeria flourished and took its place at the very head of the history of western culture. One book title claims, *History Begins at Sumer*,²⁶ as it proceeds to document thirty-nine “firsts” in man’s recorded history. These range from the first lullaby to the first aquarium to the first schools. But the greatest “first” of the Sumerians the invention of the first system of western writing.²⁷

Early Sumerian writing used a pictographic system of writing that differs sharply from the alphabetically based writing systems of modern western languages. In the Sumerian writing system, named *cuneiform*, symbols “picture” the objects to which they refer—that is the written symbol looks like the object it names. This early form of writing suffered from severe limitations. Since each symbol was an actual picture of an object, it was quite complicated to draw and could refer only to a particular concrete object. Gradually, the Sumerians evolved a more phonetically based system, so that a pictograph for a particular object came to stand for the sound of the name of the object. For example, the pictograph for water came to denote the spoken sound for water. Thus, by assembling a series of pictographs, each standing for a particular sound, the Sumerians created a richer writing system. By about 2250 B.C., Sumerian writing advanced from a purely pictographic system to a phonetic system of writing, and they began to create truly literary works, such as hymns, myths, epics, fables, and proverbs.²⁸

Semitic peoples soon entered this area and came to dominate the region about 2350 B.C. These new arrivals established their own empires, such as those of Babylonia and Assyria, and adapted Sumerian cuneiform to their own languages and cultures. Two of the most notable written works of these early Semitic cultures were the *Epic of Gilgamesh* and the *Code of Hammurabi*. The *Epic of Gilgamesh* tells of a king who quests for knowledge of the Babylonian flood and the secret of eternal youth, who struggles against mythical beasts, and rejects marriage with the goddess of love. Hammurabi’s

Code is one of the oldest written systems of law yet discovered and is the source for the maxim: “An eye for an eye and a tooth for a tooth.” The *Code* enforced the prevailing rigid hierarchy of classes, but gave the lower classes some legal standing and provided some very meager protection for women against their husbands. On the whole, however, the very modest liberal elements of the *Code* stand out against a general background of almost unrelenting harshness.

These Semitic invaders took the next important step in the history of writing, by creating the North Semitic “alphabet.” This proto-alphabet had 22 symbols, all for consonantal sounds. Because this system had no symbols for vowels, some deny that it was a true alphabet. The North Semitic alphabet may have been created by the Phoenicians after they arrived in the area of modern day Lebanon around 3000 B.C. After Persia conquered Mesopotamia, cuneiform writing gradually disappeared, but at the same time, the Phoenicians, a great trading people, carried their goods and alphabet around the Mediterranean littoral.

From about 1000 B.C. to the eighth century B.C., Greeks adopted the Phoenician alphabet and adapted it to the Greek language, a debt that Herodotus clearly acknowledges in his *Histories*.²⁹ The close commercial contact between Greece and Phoenicia provided an important impetus to this development, in which the Greeks created signs for vowels to complete a fully realized alphabet. Due to the lack of vowels in the Phoenician alphabet and to the Greek addition of them, the honor of creating the first alphabet is disputed between Greeks and Phoenicians. The English word “alphabet” is composed of the names of the first two letters of the Greek alphabet, but these names were derived from the names of the first letters of the Semitic script, *aleph* and *beth*, and the names of many other letters of the Greek alphabet also reflect their Semitic origin.³⁰

Slowly, from the eighth to fifth centuries B.C., variations in the Greek alphabet and letter forms fell away, and Athens officially adopted the Ionic alphabet in 403 B.C. This alphabet, already in widespread use, became the standard Greek alphabet. The oldest surviving Greek papyri date to the fourth

century B.C., and these manuscripts carry fragments of literary works that reflect a fully developed system of writing. Thus, they do not reveal how the Greek alphabet and script evolved from their Phoenician predecessor. With only minor modifications, this Greek alphabet remains the standard. The Greeks, then, acquired the techniques of writing from the Sumerians and their Semitic successors, adapted it to their own language, and bequeathed their writing system to us as a model for the Latin and English alphabets, as well as most of the other alphabets of the West.³¹

Writing Surfaces and Instruments

Contrasted with the modern system of gliding a pen across the page in a flowing motion, in Sumerian cuneiform the writer created symbols by pressing a stylus down into a soft clay tablet that was then hardened by firing in a kiln. This process gave the script a very distinctive angular appearance, reflected by the word *cuneiform*, coined from Latin and French and meaning “wedge-shaped.” On occasion, Sumerians wrote on other materials, such as stone and clay cylinders, with the same angular script.

The earliest writings of many cultures were carried on almost any material that came to hand, as the human need to write seems to have always confronted and overcome a lack of fine writing materials. Around the Mediterranean basin we know of writing on palm leaves, sheets of lead and linen, and waxen tablets.³² The Dead Sea Scrolls were written on thin leather between the fourth and second centuries B.C. and left in sealed jars in caves to await discovery in the twentieth century, and the Koran was originally written on a variety of surfaces including shoulder blades of animals, palm leaves and stones.³³

Both wood and bark have a particularly long and important history as surfaces for writing. Solon, the great law-giver of Athens, wrote his laws on wooden tablets in the sixth century B.C. Modern discoveries in the Roman fort of Vindolanda (Chesterholm) in Britain have uncovered hundreds of tablets written by soldiers there around the time of Christ, proving that soldiers stationed everywhere have the same concerns of food, weather, duty,

fear, love and homesickness.

The etymologies of Greek, Latin, German, and English words clearly betray the use of earlier materials, many associated with trees. For example, Pliny the Elder says that early writers wrote on tree bark, *arborum libris*, and both Cicero and Virgil use the word *libris* with this meaning in the first century B.C. This Latin word provides the origin of our word “library.” The Latin word “folium” and the English word “leaf” both refer literally to the leaf of a plant and metaphorically to a page in a book.³⁴

While this variety of early writing surfaces played an important role in the history of writing, virtually all classical Greek and Latin literature was written on papyrus, a writing surface invented by the Egyptians as early as 3000 B.C. and later transmitted to the Greeks. The Greeks began to write on papyrus very early, perhaps by 1200 B.C., and depictions on pottery show that Greeks used it widely by the sixth century. Latin literature developed through Greek influences in Italy, notably among the Etruscans, and the Romans began to write on papyrus quite early in their history. In the Roman imperial period, the march of conquest carried papyrus throughout the Mediterranean basin, into northern Europe, and beyond.

The choice of papyrus, pen, and ink as the virtually universal technology of writing for both the Greek and Roman classics went a long way toward determining the physical form of the book, which had a critical importance for the survivability of manuscripts and for the book culture of antiquity. For instance, the choice of papyrus implied that books would be written on scrolls and that their physical unit of the book would be restricted to a certain length. Because all handwritten books require periodic recopying for long-term survival, the choice of papyrus as a writing surface required much more frequent recopying than would have been true for a writing technology that stayed with cuneiform and its clay tablets. Scholars who study papyri—papyrologists—use their detailed knowledge of the material and the book culture of antiquity to extract all possible shreds of information from the papyri that have survived to reach the modern world.

Papyrus Book Making

The papyrus plant of ancient Egypt was a large reed-like plant with a triangularly-shaped stem found in the shallow marshes of the Nile delta. At its base, the stem of a mature plant has the thickness of a man's arm and the papyrus plant attains a height of about fifteen feet, being surmounted with a crown of lacy fern-like fronds.

Although harvested throughout the year, the main harvest was concentrated in the summer when the ebbing Nile made access to the plants easier. Papyrus grew wild, but the ancients also grew it on huge plantations, particularly during Roman times. After food production, papyrus manufacture was the second largest industry in ancient Egypt. (Beyond paper-making, papyrus was used to construct everything from boats and shoes to bridges and Pharaonic tomb decorations.) Huge production implies huge consumption, and we know of one large estate in Egypt that bought papyrus rolls in lots of 1000 or more. Just one of this estate's accounting offices used between ten and twenty rolls a day.³⁵

Making a papyrus writing surface from the papyrus plant is a simple but laborious process. Because the cut papyrus plant dries quickly, facilities for processing papyrus were located near papyrus groves. The stalks were harvested and cut into lengths of about fifteen inches. These lengths were then cut into thin slivers starting from the outside. Because the stalk was triangular in cross-section, the slivers closest to the outside of the stalk were the broadest, and successive slivers became more narrow as the cutting progressed to the center of the stalk. Throughout the cutting process, the paper maker kept the slivers moist. When he was ready to make a sheet, the paper maker laid out the slivers on a flat surface with one long edge of each sliver overlapping that of the next. A completed course of slivers might have a dimension similar to a standard sheet of modern paper, say about eight-and-a-half inches wide by ten to thirteen inches high. However, size varied considerably, with a tendency toward very small sheets.

The paper maker next laid out a second course of slivers on top of and perpendicular to the first layer. As a final step, the paper maker ran the sheet

through rollers to press the two layers together, with the natural stickiness of the fibers providing the only needed glue. The sheets were then allowed to dry.

Higher quality sheets received considerable finishing to smooth the surface, by pounding the sheet with a mallet, burnishing it with pumice stone, or polishing it with a piece of ivory or shell. The narrow strips of papyrus from near the center of the stalk made the highest quality papyrus; lesser quality papyrus came from the broad strips near the outside of the stalk. The resulting sheets were slightly thicker than modern paper and turned a light brown or tan with age, but the tanning did not impair the readability of the text. The paper maker assembled individual sheets of papyrus into rolls by attaching the sheets side by side, joining the individual sheets with a glue made of wheat paste.³⁶

Papyrus Books and Ancient Book Culture

Papyrus rolls varied considerably in length. Older Egyptian rolls tended to be quite long, but among Greek papyri, the length of a roll seldom exceeded 35 feet, a length that just accommodates two or three books of the *Iliad*, a single book of Thucydides, or one of the longer gospels of the New Testament. (In the Penguin edition, the text of Thucydides' *Peloponnesian Wars* is divided into eight books and occupies about 580 pages. On this standard, a Greek papyrus roll would accommodate about 70-75 pages of a modern small-format paperback.) Roman rolls customarily were made of twenty sheets. While some rolls were longer, these were often made by joining two or more standard twenty-sheet rolls. A typical roll of papyrus cost about the equivalent of two days of a laborer's wage.

Contrasted with the stylus and clay tablet of cuneiform, writing the Phoenician alphabet on papyrus required pen and ink. The ancients made pens from reeds and rushes, with the highest quality pens coming from Egypt. Scribes used a knife to trim pens and papyrus, pumice to smooth papyrus and put a fine point on a pen, and a sponge to erase errors. The ancients made black ink by mixing lampblack and gum.³⁷ A sepia ink came from the ink of

the cuttlefish as well.

Ancient inks were very durable, yet these inks did not sink into papyrus and could be erased easily. To make a papyrus palimpsest requires only washing the ink off of the surface. Sometimes the ink was cleared by washing with vinegar. By contrast, palimpsesting a manuscript written on parchment, such as the Archimedes palimpsest, is considerably more complicated, as the ink sinks into the skin, which must be carefully washed or even scraped to prepare the surface for a second use. Parchment palimpsests are a major source of texts from antiquity.³⁸

With the adoption of the Phoenician alphabet and its adaptation to pen and papyrus, writing came to have more gentle and flowing lines, particularly compared to cuneiform. Handwriting was much more of an art in antiquity than today, yet the ancients distinguished between the “book-hand” used for formal writing and less formal scripts that could be written more quickly. Plato tells us that calligraphy was practiced in ancient Athens, but thinks that it might not deserve the utmost attention.³⁹

The oldest extant Greek papyri come from about 300 B.C., and their texts are written in a large and awkward script. The writing consists only of capital letters, with no word divisions or punctuation. Nonetheless, to a reader familiar with today’s printed Greek alphabet, the letters are immediately discernible. Thus, the capitals of the Greek alphabet have changed very little over the last 2300 years. In the next two centuries down to 100 B.C. Greek script came to embody more curved elements, and these later scripts even more closely approximate today’s printed Greek alphabet.

Only in medieval times did a lower case, or minuscule, Greek alphabet develop, so all of the Greek and Roman classics of antiquity were written strictly in capitals. Throughout classical times, manuscripts generally contained almost no punctuation. Some early Greek manuscripts did use a small vertical mark, rather than a space, to separate words, and so did the early Roman writers of Latin. Later the Greeks abandoned word divisions entirely, and the Romans followed them slavishly to create a text more difficult to read.

In Latin writing, the *paragraphus* was a stroke that separated lines of text, while a *dicolon* (similar to our colon) indicated a change of speaker in dramas and Platonic dialogues. Punctuation for effect was extremely rare. Thus, the typical Greek or Roman manuscript of antiquity consisted entirely of capital letters written without a single division between words. This practice was known as *scriptura continua*, and left the reader to divide this unending flow of letters into words mentally, a requirement that must have slowed reading tremendously. This lack of punctuation, also made it quite difficult to copy a manuscript accurately, thereby introducing errors that would plague millennia of scholars.⁴⁰

Titles on papyrus scrolls were located at the end of the roll. Often rolls were stored with a leather tag, a *sillybos*, attached to the roll. The *sillybos* (origin of our word *syllabus*) typically gave the title of the work and the total number of lines in the scroll.⁴¹ Scribes were compensated based on the amount of writing they completed, and this was measured by the *stichos* (pl. *stichoi*), equaling about 15-16 syllables or a single line of text. Besides providing a check on the number of *stichoi* for paying the scribe, the notation on the *sillybos* also ensured the completeness of the text.⁴² In addition to the *sillybos*, particularly pretentious rolls were attached to wooden rods with knobs on the end. The entire roll might even have a wrapper of parchment with some kind of decoration.⁴³

A papyrus roll was quite durable. In a well prepared roll, the two layers of papyrus strips would very seldom come apart and the seams between the sheets in the roll would be barely visible.⁴⁴ Galen, a famous Greek physician of the second and third centuries A.D., read rolls that were 300 years old, although this was much longer than most rolls would stay in active use.⁴⁵ Naphtali Lewis tells the story of Wilhelm Schubart, curator of the Berlin papyrus collection, who would amaze visitors by unrolling and re-rolling papyri that were 3000 years old.⁴⁶ Very tough when new, papyrus ages with use and becomes fragile, however. Papyrus normally does not withstand the elements so well, particularly moisture, and papyrus is really durable only in very dry climates. It is highly susceptible to attack by insects, and cedar oil

was applied to papyrus to deter insects.⁴⁷

In antiquity, income inequalities between rich and poor were truly vast. Therefore, papyrus was very cheap for some users and very expensive for others. Huge quantities of papyrus were consumed in a manner that was often lavish and wasteful, suggesting that it was relatively cheap. For example, decent quality papyri was sometimes used as wrapping paper. Also, there were apparently few palimpsests, suggesting that it was so cheap that it did not pay to wash off the ink and reuse the papyrus. Not only was papyrus generally not palimpsested, but typically only one side received writing, and often only a small portion of that side. Based on discovered papyri, papyri often contained trivial notes, suggesting that it was quite inexpensive. In favor of the argument that papyrus was expensive, users sometimes wrote on both sides and sometimes parchment was employed as a cheaper substitute.⁴⁸

We have already noted that fine papyrus comes from the center of the stem. Pliny tells us that the Romans divided papyrus into ten standard grades named after imperial personages.⁴⁹ For papyri found in modern times, it is impossible to determine their original grade.

Usually the individual sheets were joined to prepare a roll before writing on the papyrus, creating a roll about two-and-a-half inches in diameter. The written roll was organized so that the reader would hold the unread portion of the roll in the right hand and take up the completed portion with the left. The ancients wrote on papyrus rolls in columns about three inches wide. The number of letters on a line varied. Prose works tended to have more characters on a line, while lines of poetry followed the meter of the poem. As a general rule, a line might contain about 18-25 letters and a column about 25-45 lines.⁵⁰ The size of margins around the columns varied depending on the pretension of the manuscript, similar to modern practice.

Typically, only one side of the papyrus roll contained writing. On the recto the fibers of the papyrus strip run horizontally with the length of the roll; on the verso the papyrus strips are vertical. This construction made writing on the recto easier, because the pen would have fewer seams to cross. In antiquity, all papyrus used in book production came from Egypt and all

manufacturing was concentrated there.

Beginning in the second century A.D., parchment began to gain popularity and eventually outpaced papyrus as the preferred writing surface of Europe. After the Arab conquest of Egypt in 640–641, the export of papyrus was disrupted, which perhaps accelerated the transition to parchment as the dominant writing surface. Nonetheless, papyrus continued in widespread use throughout Europe well into the Middle Ages. Gradually over the Middle Ages, the demand for papyrus slowed and then ceased; marshes were allowed to silt up, and the plant gradually disappeared. The last papal bull on papyrus was written in 1057. In the twelfth century the Byzantine author, Eustathius, wrote: “Papyrus making has lately become a lost art.” By about 1100, parchment had completely supplanted papyrus throughout Europe and the Mediterranean.

By the time of Napoleon’s expedition to Egypt in 1798–1801, papyrus had died out in the Nile valley, although it still grew in Upper Egypt. Today, the original papyrus plant is apparently extinct, but related strains persist in Syria and scattered regions of Africa. In Europe, papyrus grows today only in Sicily, near Syracuse, apparently transplanted to Sicily by Arabs during the tenth century. Today in Syracuse papyrus is cultivated and papyrus is made in small ateliers solely for the delectation of tourists—a rather ignoble end for this critical vessel of Western culture.⁵¹

NOTES

1. Constantine Tischendorf was a great nineteenth century German Biblical scholar who is responsible for bringing to the west one of the best, perhaps the very best, manuscripts of the Bible. He found this famous *Codex Sinaiticus* at a Greek monastery at the foot of Mount Sinai in 1844 and acquired this for the czar of Russia under somewhat dubious circumstances. The Communist government sold the manuscript to Great Britain, and it may now be viewed in the British Library in London. For his own account of his discovery, see Constantine Tischendorf, *Codex Sinaiticus*, translated by R. Mercer Wilson, Eighth Edition, London: Lutterworth Press, 1934. A more objective account is offered by James Bentley, *Secrets of Mount Sinai: The Story of the World's Oldest Bible—Codex Sinaiticus*, Garden City, New York: Doubleday, 1986.
2. This account of the history of the Archimedes palimpsest relies on a variety of sources. The web site of the Walters Gallery (www.thewalters.org) has extensive coverage of the history of the manuscript. The auction was widely covered in major media. Stories by Malcolm W. Browne appeared in *The New York Times* on October 26, 1998, “Ancient Archimedes Text Turns Up, and It’s for Sale,” and October 30, 1998, “Archimedes Text Sold for \$2 Million.” Reuters and the Associated Press also reported the events surrounding the sale.
3. Archimedes, *The Works of Archimedes*, edited by T. L. Heath, Cambridge: University Press, 1897, p. xxiii from the introduction by T. L. Heath.
4. David Diringer, *The Book Before Printing: Ancient, Medieval and Oriental*, New York: Dover Publications, Inc., 1982. (Reprint of *The Hand-Produced Book*, London: Hutchinson’s Scientific and Technical Publications, 1953), p. 251.

5. On Herculaneum and the finds there, see: F. G. Kenyon, *Ancient Books and Modern Discoveries*, Chicago: The Caxton Club, 1927; Leila Avrin, *Scribes, Script, and Books: The Book Arts from Antiquity to the Renaissance*, Chicago: American Library Association, 1991; David Diringer, *The Book Before Printing: Ancient, Medieval and Oriental*, New York: Dover Publications, Inc., 1982. (Reprint of *The Hand-Produced Book*, London: Hutchinson's Scientific and Technical Publications, 1953); Naphtali Lewis, "Papyrus and Ancient Writing: The First Hundred Years of Papyrology," *Archaeology*, July-August, 1983, pp. 31-37; and H. L. Pinner, *The World of Books in Classical Antiquity*, Leyden: A. W. Sijthoff, 1948.
6. E. G. Turner, *Greek Papyri: An Introduction*, Oxford: Oxford University Press, 1980, p. 17.
7. See Brian M. Fagan, *The Rape of the Nile: Tomb Robbers, Tourists, and Archaeologists in Egypt*, New York: Charles Scribner's Sons, 1975, pp. 44-47.
8. R. W. Hunt, *The Survival of Ancient Literature*, Oxford: Bodleian Library, 1975, p. 2.
9. These papyri deposits are similar to the famous Cairo Geniza. Under Jewish religious law, one cannot discard any paper with the name of God on it, so synagogues long had a special repository where such papers could be deposited. Often these papers had other writings. In a synagogue in Cairo masses of discarded documents were discovered where they had been deposited over many centuries. These have proven to be wonderfully valuable for the social history of the Mediterranean in general, and Jewish life in particular, over many centuries. See S. D. Goitein, *A Mediterranean Society*, Berkeley, 1967-1988, 5 volumes.

10. See E. G. Turner, *Greek Papyri: An Introduction*, Oxford: Oxford University Press, 1980, p. 21, where he says of the papyri in these rubbish heaps: “Naturally the strata reached first were those offering Arabic, Coptic, and Byzantine Greek papyri; collectors had little regard for products of so late a period, and many thousands, perhaps millions, of texts must have been destroyed.”

11. See the University of Oxford’s web site for Oxyrhynchus and the Oxyrhynchus papyri, specifically:

<http://www.csad.ox.ac.uk/POxy/frame1.htm>.

12. For the story of the cartonnage finds see: F. G. Kenyon, *Ancient Books and Modern Discoveries*, Chicago: The Caxton Club, 1927 and “Fifty Years of Papyrology,” in *Actes du V^e Congrès International de Papyrologie*, Oxford: 30 Août– 3 Septembre 1937, Bruxelles: Fondation Égyptologique Reine Élisabeth, 1938, pp. 1-11; Roger S. Bagnall, *Reading Papyri, Writing Ancient History*, New York: Routledge, 1995 ; and Naphtali Lewis, “Papyrus and Ancient Writing: The First Hundred Years of Papyrology,” *Archaeology*, July-August, 1983, pp. 31-37.

13. F. G. Kenyon, *Aristotle on the Athenian Constitution*, London, George Bell and Sons, 1891, p. vii.

14. For an account of the various discoveries of Egyptian papyri, see: F. G. Kenyon, *Ancient Books and Modern Discoveries*, Chicago: The Caxton Club, 1927, *Books and Readers in Ancient Greece and Rome*, Oxford: Clarendon Press, 1932, and “Fifty Years of Papyrology,” in *Actes du V^e Congrès International de Papyrologie*, Oxford: 30 Août– 3 Septembre 1937, Bruxelles: Fondation Égyptologique Reine Élisabeth, 1938, pp. 1-11; E. G.

Turner, *Athenian Books in the Fifth and Fourth Centuries B.C.*, London: H. K. Lewis & Co. Ltd., 1952, *Greek Papyri: An Introduction*, Oxford: Oxford University Press, 1980, and *The Papyrologist at Work*, Durham, N. C.: Duke University Press, 1973; Richard Parkinson and Stephen Quirke, *Papyrus*, Austin, Texas: University of Texas Press, 1995; E. J. Kenney, "Books and Readers in the Roman World," in E. J. Kenney and W. V. Clausen, eds., *Cambridge History of Classical Literature*, Cambridge: Cambridge University Press, 1982, Vol. 2, pp. 3-32; Roger S. Bagnall, *Reading Papyri, Writing Ancient History*, New York: Routledge, 1995; David Diringer, *The Book Before Printing: Ancient, Medieval and Oriental*, New York: Dover Publications, Inc., 1982. (Reprint of *The Hand-Produced Book*, London: Hutchinson's Scientific and Technical Publications, 1953); Naphtali Lewis, "Papyrus and Ancient Writing: The First Hundred Years of Papyrology," *Archaeology*, July-August, 1983, pp. 31-37; and Peter Van Minnen, "The Century of Papyrology," *Bulletin of the American Society of Papyrologists*, 30, 1993, pp. 5-18.

15. As F. G. Kenyon summarizes: "The general conclusion would therefore seem to be that at the end of the fifth century and in the early part of the fourth, books existed in Athens in considerable quantity, and were cheap and easily accessible. A habit of reading was growing up, but was not yet very firmly established." F. G. Kenyon, *Books and Readers in Ancient Greece and Rome*, Oxford: Clarendon Press, 1932, p. 24.

16. *Apology*, 26; *Phaedo*, 97.

17. (*The Frogs*, 1114).

18. William V. Harris, *Ancient Literacy*, Cambridge, Mass.: Harvard University Press, 1989, pp. 22,49. For a somewhat contrary view, see E. G. Turner, *Athenian Books in the Fifth and Fourth Centuries B.C.*, London: H. K. Lewis & Co. Ltd., 1952, p. 8, where he says: "The ordinary Athenian is a

literate person . . .”

19. Augustine, *Confessions*, Chicago: Encyclopedia Britannica, 1952, Great Books, Vol. 18, p. 35. (VI.3)

20. Plutarch, “On the Fortune of Alexander,” Fragment 340a, in *Moralia*, Vol. IV, Frank Cole Babbitt, ed., (Cambridge, 1972), quoted in Alberto Manguel, *A History of Reading*, New York: Penguin Group, 1996, p. 43. See also M. B. Parkes, *Pause and Effect: An Introduction to the History of Punctuation in the West*, Berkeley: University of California Press, 1993, pp. 1, 9.

21. E. G. Turner, *Greek Papyri: An Introduction*, Oxford: Oxford University Press, 1980, pp. 7-8, and L. D. Reynolds and N. G. Wilson, *Scribes and Scholars: A Guide to the Transmission of Greek and Latin Literature*, Third Edition, Oxford: Clarendon Press, 1991, p. 4.

22. (*The Frogs*, 943) .

23. Edward Alexander Parsons, *The Alexandrian Library: Glory of the Hellenic World*, Amsterdam: The Elsevier Press, 1952, pp. 11-12.

24. Plutarch also tells us that Alexander sent to Athens for books to be shipped to him on his Asian campaign. While Athens was certainly a major, if not the major, book market of the time, the island of Rhodes and Ephesus in Asia Minor were also known as book centers.

25. Polybius, *The Rise of the Roman Empire*, translated by Ian Scott-Kilvert, Penguin Books: New York, 1984, pp. 447-448. (XII.27).

26. Samuel Noah Kramer, *History Begins at Sumer: Thirty-Nine Firsts in Man's Recorded History*, 3e, Philadelphia: The University of Pennsylvania Press, 1981.

27. There were, of course, other inventions of writing. Egyptians developed writing soon after the Sumerians, perhaps under their influence. The Chinese developed their writing system about 2000 B.C. in complete independence of the Sumerian achievement. In addition, inscriptions on stone tablets in Mexico may date to 5000 B.C. As recently as 2001, new evidence emerged of a culture in central Asia that appeared to have at least a rudimentary writing system as early as 2300 B.C., several centuries before the Chinese developed their writing system. See F. G. Kenyon, *Ancient Books and Modern Discoveries*, Chicago: The Caxton Club, 1927, p. 13. For an account of the decipherment of ancient Mayan writing, see Linda Schele and David Greidel, *A Forest of Kings: The Untold Story of the Ancient Maya*, New York: William Morrow and Company, Inc., 1990, pp. 45-55, and for the recent discoveries of ancient writing in central Asia see John Noble Wilford, "In Ruin, Symbols on a Stone Hint at a Lost Asian Culture," *New York Times*, internet edition, May 13, 2001.

28. Samuel Noah Kramer, *History Begins at Sumer: Thirty-Nine Firsts in Man's Recorded History*, 3e, Philadelphia: The University of Pennsylvania Press, 1981, pp. xxi-xxii.

29. Herodotus, *The Histories*, translated by Aubrey de Sélincourt, New York: Penguin Books, 1954, p. 361. (Book V.58.)

30. F. G. Kenyon, *Our Bible and the Ancient Manuscripts*, Revised by A. W. Adams, New York: Harper and Row, 1958, p. 28.

31. B. L. Ullman, *Ancient Writing and Its Influence*, New York: Cooper Square Publishers, Inc., 1963, p. 31. Turner, E. G., *The Papyrologist at Work*, Durham, N. C.: Duke University Press, 1973, p. 6.

32. Much of what we know about early writing comes to us from Pliny the Elder, a Roman aristocrat and official writing in the first century A.D. His *Natural History* is a vast encyclopedia of information about the ancient world. Pliny tells us: "First of all, people wrote on palm leaves, then on bark of certain trees, afterwards sheets of lead were used for public documents, then also sheets of linen or waxen tablets for private documents." (*Natural History*, 13:69).

33. F. G. Kenyon, *Books and Readers in Ancient Greece and Rome*, Oxford: Clarendon Press, 1932, pp. 42-43, 76. David Diringer, *The Book Before Printing: Ancient, Medieval and Oriental*, New York: Dover Publications, Inc., 1982. (Reprint of *The Hand-Produced Book*, London: Hutchinson's Scientific and Technical Publications, 1953), p. 45.

34. David Diringer, *The Book Before Printing: Ancient, Medieval and Oriental*, New York: Dover Publications, Inc., 1982. (Reprint of *The Hand-Produced Book*, London: Hutchinson's Scientific and Technical Publications, 1953), pp. 24-25. Leila Avrin, *Scribes, Script, and Books: The Book Arts from Antiquity to the Renaissance*, Chicago: American Library Association, 1991, p. 165.

35. Naphtali Lewis, *Papyrus in Classical Antiquity*, Oxford: Clarendon Press, 1974, p. 101.

36. Naphtali Lewis, *Papyrus in Classical Antiquity*, Oxford: Clarendon Press, 1974., p. 51.

37. Pliny *Natural History*,13:20.

38. The sources for the technology of these early books are: Leila Avrin, *Scribes, Script, and Books: The Book Arts from Antiquity to the Renaissance*, Chicago: American Library Association, 1991, pp. 146, 148; David Diringer, *The Book Before Printing: Ancient, Medieval and Oriental*, New York: Dover Publications, Inc., 1982. (Reprint of *The Hand-Produced Book*, London: Hutchinson's Scientific and Technical Publications, 1953), pp. 129, 132; F. G. Kenyon, *Ancient Books and Modern Discoveries*, Chicago: The Caxton Club, 1927, p. 30; Naphtali Lewis, *Papyrus in Classical Antiquity*, Oxford: Clarendon Press, 1974, p. 54, pp. 84-85; Richard Parkinson and Stephen Quirke, *Papyrus*, Austin, Texas: University of Texas Press, 1995, p. 19; C. H. Roberts and T. C. Skeat, *The Birth of the Codex*, Oxford: Oxford University Press, 1983, p. 18, and Leila Avrin, *Scribes, Script, and Books: The Book Arts from Antiquity to the Renaissance*, Chicago: American Library Association, 1991, p. 168; James Westfall Thompson, *Ancient Libraries*, Berkeley, Calif.: University of California Press, 1940, p. 69 (Westfall provides the quotation from Pliny *Natural History*, xxxv.41-43.); and E. G. Turner, *Greek Manuscripts of the Ancient World*, Princeton: Princeton University Press, 1971, p. 8.

Some have seen the technology of writing on papyrus with pen and ink as leading to the development of the alphabet: "The need to adapt the cuneiform script of the Fertile Crescent to the pen-and-ink technique of papyrus undoubtedly was a factor in the Phoenicians' development of the world's first alphabet." (Lewis, pp. 84-85). Others view the technology of pen and ink on papyrus as leading to curved or "cursive" script in contrast to the angular forms of cuneiform. (Diringer, p. 159.)

39. Plato, *Laws*, 810, in *The Dialogues of Plato*, translated by B. Jowett, New York: Random House, 1937, vol. 2, p. 564.

40. See E. G. Turner, *Athenian Books in the Fifth and Fourth Centuries B.C.*, London: H. K. Lewis & Co. Ltd., 1952, p. 5; B. L. Ullman, *Ancient*

Writing and Its Influence, New York: Cooper Square Publishers, Inc., 1963, pp. 48-49; and E. J. Kenney, "Books and Readers in the Roman World," in E. J. Kenney and W. V. Clausen, eds., *Cambridge History of Classical Literature*, Cambridge: Cambridge University Press, 1982, Vol. 2, p. 17. See also the variety of plates illustrating various scripts in E. G. Turner *Greek Manuscripts of the Ancient World*, Princeton: Princeton University Press, 1971, pp. 1-9, 18.

41. Leila Avrin, *Scribes, Script, and Books: The Book Arts from Antiquity to the Renaissance*, Chicago: American Library Association, 1991, p. 149.

42. Frederick W. Hall, *A Companion to Classical Texts*, Salem, New Hampshire: Ayer Company, Publishers, Inc. Reprint of 1988. First published 1913, p. 11, and Felix Reichmann, "The Book Trade at the Time of the Roman Empire," *Library Quarterly*, 8, 1938, pp. 40-76. See p. 45.

43. F. G. Kenyon, *Books and Readers in Ancient Greece and Rome*, Oxford: Clarendon Press, 1932, p. 58.

44. Naphtali Lewis, *Papyrus in Classical Antiquity*, Oxford: Clarendon Press, 1974, pp. 50, 52.

45. Galen is quoted in E. G. Turner, *Greek Papyri: An Introduction*, Oxford: Oxford University Press, 1980, p. 7. See also L. D. Reynolds, and N. G. Wilson, *Scribes and Scholars: A Guide to the Transmission of Greek and Latin Literature*, Third Edition, Oxford: Clarendon Press, 1991, p. 34.

46. Naphtali Lewis, "Papyrus and Ancient Writing: The First Hundred Years of Papyrology," *Archaeology*, July-August, 1983, p. 32 and Naphtali Lewis, *Papyrus in Classical Antiquity*, Oxford: Clarendon Press, 1974, p. 58.

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47. Hall, Frederick W., *A Companion to Classical Texts*, Salem, New Hampshire: Ayer Company Publishers, Inc. Reprint of 1988. First published 1913, p. 13.

48. Naphtali Lewis, *Papyrus in Classical Antiquity*, Oxford: Clarendon Press, 1974, p. 130.

49. Pliny, *Natural History*, translated by H. Rackham, in ten volumes, Cambridge, MA: Harvard University Press, 1942, Book XIII.xxiv.78-81.

50. F. G. Kenyon, *Books and Readers in Ancient Greece and Rome*, Oxford: Clarendon Press, 1932, pp. 54-57.

51. On papyrus production and uses see: David Diringer, *The Book Before Printing: Ancient, Medieval and Oriental*, New York: Dover Publications, Inc., 1982. (Reprint of *The Hand-Produced Book*, London: Hutchinson's Scientific and Technical Publications, 1953), pp. 126, 154; Naphtali Lewis, *Papyrus in Classical Antiquity*, Oxford: Clarendon Press, 1974, pp. 5-20 *passim*, 90-95 (where he quotes Eustathius, *ad Od.* xxi.391); Richard Parkinson and Stephen Quirke, *Papyrus*, Austin, Texas: University of Texas Press, 1995, pp. 9,13, 72; E. G. Turner, *Greek Papyri: An Introduction*, Oxford: Oxford University Press, 1980, p. 16; and F. G. Kenyon, *Books and Readers in Ancient Greece and Rome*, Oxford: Clarendon Press, 1932, p. 45.