



A Clean Sheet: the invention of papyrus

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Ever since Napoleon swept into Egypt at the tail end of the eighteenth century, ushering in the modern era of Egyptology, the outside world has thrilled to successive revelations of golden death masks and boy kings; of beautiful queens and matchless libraries; and of million-ton pyramids aligned to the points of the compass with uncanny precision.¹

In spite of all this, ancient Egypt's most vital commodity is treated nowadays as little more than a souvenir. Papyrus, the paperlike material upon which the ancient world wrote its books and conducted its business, is every bit as Egyptian as the pyramids or mummies that have since eclipsed it—and it was, in its day, considerably more important than either. The intertwined stories of paper, the page, and the book begin not with the glittering wealth of god-kings or their soaring mausoleums but with the weeds that grew abundantly along the Nile's marshy shores.

Cyperus papyrus has always been an interloper in Egypt, if a welcome one. To the south, beyond the country's borders, the banks of the White Nile and the shores of Lake Victoria, its source, are crowded

by stands of papyrus sedge. Here, triangular, grasslike stems crowned by sprays of fine leaves grow from submerged roots to reach around ten feet in height.² Occasionally, a clump of papyrus reeds breaks free from its moorings and drifts off downriver to lodge elsewhere along the river's banks, with some coming to rest in Egypt itself. These temporary islands were (and are) navigational menaces, but ancient Egypt's precious papyrus swamps could not have taken root without them.³

The inhabitants of the fertile Nile delta cultivated papyrus for papermaking purposes from the fourth millennium BCE onward, though papyrus reeds were adapted to a bewildering array of other uses too.⁴ It was a veritable wonder plant: to the ancient Egyptians, papyrus was an essential part of life, and not only as a writing material.

In a country that was marshy and arid by turns and conspicuously devoid of trees, papyrus reeds provided a convenient alternative to importing timber. The roots of the plant were robust enough to be carved into tools and utensils, and, in the form of charcoal, they burned hot enough to smelt iron and copper, reaching temperatures of 1,650 degrees Fahrenheit (900 degrees Celsius).⁵ Early Egyptologists thought papyrus was also burned as a kind of incense: in 1778, a Danish classical scholar named Niels Iversen Schow bought a papyrus scroll from a hoard alleged to have been discovered near the pyramids at Giza, whereupon the "native" sellers reportedly tore up and burned the rest so as to enjoy the pungent smoke.⁶ Schow's scroll was later traced not to Giza but instead to an oasis some miles to the south, leading the Victorian scholar F. G. Kenyon to remark sniffily that "the statements of native discoverers as to the provenance of papyri are not valuable as evidence."⁷ Kenyon was a prominent member of the first wave of "papyrologists," the name given to scholars who study ancient texts written on papyrus, and the tale of Schow's misattributed scroll has since become a cautionary anecdote for students of the subject. Though it has been told and retold in many papyrological treatises, however, it turns out that burning papyrus is no more or less aromatic than burning paper



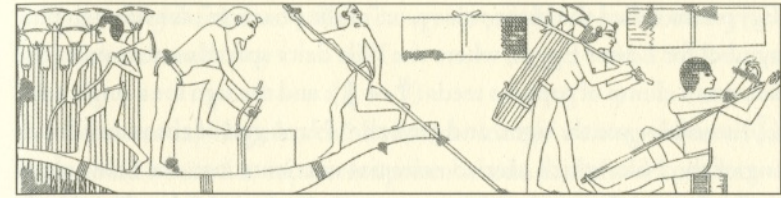
➤ An eighteenth-century depiction of the flowering head of a papyrus reed. The triangular section of the stem is visible at bottom.⁸

(both give off an unremarkable campfire aroma, as this author found out), rather undermining claims of its use as incense.⁹ The statements of colonial antiquarians, too, are sometimes not valuable as evidence.¹⁰

Papyrus stood in for wood in ancient Egyptian boatbuilding, especially for the simple, flat-bottomed punts used for hunting and harvesting in the Nile's papyrus swamps. Dried papyrus is around four times more buoyant than balsa wood, and, while it eventually becomes waterlogged and loses that buoyancy, a boat made from sheaves of plentiful papyrus reeds was easily replaced.¹¹ But papyrus boats were prized for more than just their buoyancy. In Egyptian myth, the goddess Isis sailed the Nile on a papyrus boat to search for fragments of the body of Osiris, her husband (and her brother, so the story goes), and it was said that the river's crocodiles feared to attack any such craft lest they encountered a wrathful deity aboard it instead of a cowering human.¹² Other papyrus vessels, both larger and smaller, plied the Nile alongside the simple rafts of hunters and farmers: papyrus barges may have helped transport the colossal stone blocks used to build the pyramids, while some translations of the Old Testament say that the basket in which Moses was hidden among the reeds of the Nile's shores was made from papyrus, not bulrushes.¹³ Moses may have had Isis to thank for preserving him from the Nile's ravaging crocodiles as much as he did his mother.

Also in a nautical vein, cords made from papyrus were famously strong and light. The thin green skin of the reed was peeled off in strips and plaited to make rope, while cables up to three inches in diameter could be woven from whole stems.¹⁴ Papyrus rope was so renowned, in fact, that a number of ancient writers mentioned it by name as they recounted near-mythical events of their recent history. Writing in the mid-fifth century BCE, for example, the Greek historian Herodotus described how the Persian king Xerxes, preparing for an invasion of the Greek mainland, ordered the Hellespont strait in northwest Turkey to be bridged with ropes made of Egyptian papyrus and Phoenician flax. The current proved too strong, however, and the bridge's pontoons were

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➤ Papyrus harvesting, as shown by a carving on the wall of a tomb belonging to Puyemrê, a priest who lived during the fifteenth century BCE.¹⁵ *Left*, workers load reeds onto a boat made from bundles of dried papyrus; *right*, another worker peels or splits a reed along its length in preparation for plaiting the strips into rope.

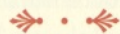
swept away. Displaying the sort of theatrical fury that informed his recent reinvention as a comic-book villain, Xerxes ordered the waters of the Hellespont to be whipped three hundred times. The straits now suitably chastised, two more bridges were built—successfully this time, employing four papyrus and two flaxen cables per bridge—and the invasion proceeded.¹⁶

The papyrus plant was also used in more domestic settings. Herodotus wrote that the Egyptians ate the lowest cubit, or eighteen inches, of the reed's stem, and that "Those who wish to use [papyrus] at its very best, roast it before eating in a red-hot oven."¹⁷ Modern experiments reveal that papyrus contains few calories and is meager in nutrients, though the spongy white pith may have acted as a source of dietary fiber.¹⁸ Aside from its dubious value as a foodstuff, papyrus was a common ingredient in medicinal preparations: papyrus ash healed ulcers; macerated with vinegar, it treated wounds; the pressed juice relieved eye complaints; and, somewhat redundantly, it was mixed with wine to cure insomnia.¹⁹ A patient who imbibed such a draught could sleep it off on a mattress of bundled papyrus reeds, huddled under a blanket woven from papyrus skins.²⁰

Papyrus's centrality in the daily lives of Egyptians was a potent symbol of the land, its traditions, and its social strictures. Ancient

Egyptians called the plant *papuro*, or “of the pharaoh”; the hieroglyphic symbol for Lower Egypt, where the Nile delta spreads out to meet the sea, was a clump of papyrus reeds (𓵟 or 𓵠); and the sign for a single stem (𓵡) stood for youth, vigor, and growth.²¹ Hapi, god of the yearly flooding of the Nile, which carried essential nutrients into the fields along its banks, was depicted with papyrus growing from his head, and leafy crowns of papyrus reeds were used as decorations at religious services and funerals. Priests were forbidden from wearing sandals made from anything except papyrus, and the temples over which they presided featured columns modeled after the papyrus stem.²²

For all this, the eponymous writing material is most enduring and widely known of all.



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The facts surrounding the invention of papyrus as a writing material are lost. Egyptians had been inscribing hieroglyphs on stone and pottery for some time before the arrival of papyrus, and though they were tight-lipped on the subject of writing materials, they had plenty to say about writing itself. Egyptian tradition, as recounted by the Greek philosopher Plato, told that hieroglyphics had been handed down by the ibis-headed god Thoth, and, for the Egyptians and later the Greeks, Egypt’s writing never lost its sacred aura. We still call ancient Egyptian writing by its Greek name of *hieroglyphica*, or “sacred carved [letters].”²³ Thamus, the mythical Egyptian king who received Thoth’s gift of writing, was less reverent. Rather than thank his divine benefactor, Thamus complained that hieroglyphics would condemn humanity to absentmindedness and amnesia:

This invention will produce forgetfulness in the minds of those who learn to use it, because they will not practice their memory. Their trust in writing, produced by external characters which are

*no part of themselves, will discourage the use of their own memory within them.*²⁴

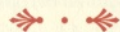
Modern-day linguists think that the idea of writing—that visual signs could be used to represent spoken words, sounds, or concepts—came to Egypt from nearby Sumer, in what is now northeastern Iraq. Inspired by the Sumerian system of cuneiform writing, in which angular symbols were pressed into clay with a wedge-shaped stylus, it is thought that the earliest hieroglyphics were created by one person (or a small number of people) over a short period of time, thus explaining their seemingly miraculous appearance in Egypt toward the end of the fourth millennium BCE.²⁵

Papyrus as writing material, on the other hand, traces no divine origin, and more than two centuries of archaeological excavations have not revealed a single ancient account of its invention. It may have been inspired by woven papyrus matting, as some papyrologists have proposed, or it may not.²⁶ The only thing that experts can say for sure is that it was invented around or before the end of the fourth millennium BCE: an extravagant tomb discovered in 1937 and dated to about 3000 BCE gave up a wooden box containing a blank papyrus roll. The thinking behind this particular funeral offering has not been determined (perhaps the high-ranking official buried there planned to record his impressions of the afterlife), but scholars think that this offering was likely a book, or a representation of one at the very least.²⁷

However and whenever it was invented, papyrus joined with hieroglyphics to create a self-contained mechanism for the storage and transmission of information—a pairing that endured as the premier information technology of the ancient world even as that world changed and expanded. Dated to around 1100 BCE, for instance, an Egyptian text called the “Report of Wenamun” tells of a voyage to Phoenicia, the coastal region of modern Lebanon, to trade papyrus rolls for timber.²⁸ The up-and-coming Greeks knew of papyrus by the sixth century BCE, and possibly earlier (Homer had mentioned papyrus rope two hundred

years before, in connection with Odysseus's vengeful return home to Ithaca), but he never spoke of papyrus as a writing material.²⁹ Curiously, the Roman Republic, founded in 509 BCE, and whose citizens generally strove to emulate the Greeks as closely as possible, lagged somewhat.³⁰ It was not until the third century BCE, by which time Egypt had been invaded by Alexander the Great and colonized by his conquering generals, that the Romans are thought to have obtained a supply of papyrus from Egypt's new rulers.³¹

Thus papyrus flowed out from Egypt and across the Mediterranean for thousands of years, underpinning the workings of the ancient civilization of Egypt, the proud city-states of the Greeks, and the rapacious Roman Republic. And still, in all this time no one thought to write down precisely what this irreplaceable material was or how it was made. Fully three millennia elapsed after the invention of papyrus before a Roman general saw fit to jot down a few notes about the Egyptians' ubiquitous writing material. The description of papyrus penned in the first century CE by Gaius Plinius Secundus, or Pliny, was short, barely a few hundred words in length, but it is the only window we have onto the ancient craft of papyrus making.³² It is a source of endless contention.



Born in 23 or 24 CE in the far-flung Roman province of Gaul, Gaius Plinius Secundus was a model citizen, serving as a cavalry officer, a lawyer, and later as governor of one of Rome's Spanish provinces. Later still, in 79 CE, while commanding the Roman fleet anchored at Misenum, near Naples, word reached Pliny of a natural disaster unfolding almost on his doorstep. Only a few leagues away from the naval base, Mount Vesuvius had erupted. Pliny immediately took a squadron of ships across the Bay of Naples to aid the beleaguered towns of Herculaneum and Pompeii, but disaster awaited him. In a letter written many years later, Pliny's nephew explained that his brave

uncle succumbed to the volcano's noxious fumes after landing on the threatened coast. Given that Pliny's companions survived, the general's asthma and obesity likely hastened his demise.³³

As remarkable as his life had been, Pliny is best remembered for the writings he left behind. Among the many books he wrote, one work stands apart: his thirty-seven-volume *Naturalis historia*, or "Natural History," is one of the most important surviving records of ancient Roman knowledge and culture.³⁴ The significance of *Natural History* as a whole has never been doubted, but Pliny's writings were put under fresh scrutiny in the twentieth century by an Egyptian diplomat named Dr. Hassan Ragab. Appointed as Egypt's ambassador to China in 1956, while serving there Ragab had visited the birthplace of the revered Cai Lun, the purported inventor of paper, and began to entertain the idea of resurrecting Egypt's dormant papyrus industry.³⁵ But though he combed the works of Herodotus, Strabo, and other ancient historians, Pliny's was the only one that contained what he was looking for: tucked away in its thirteenth volume, among stories of exotic trees and unguents, is a passage that remains the only contemporary description of how to make papyrus.³⁶

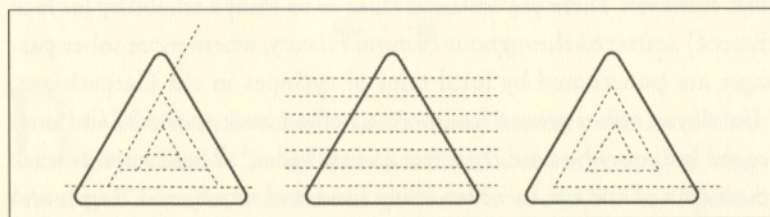
Ragab's resurrection of papyrus was not to be a straightforward task, however. There are ominous clues as to Pliny's reliability (or lack thereof) scattered throughout *Natural History*, where more sober passages are punctuated by lurid tales of cyclopes in the Carpathians, Himalayan tribes whose feet were attached back to front, and one-legged Indians who used their feet as sunshades.³⁷ These serve as stark reminders of the age in which Pliny lived and wrote, and Ragab and his colleagues approached Pliny's account of papyrus making with a healthy dose of skepticism. This was just as well, because they found themselves tied in knots almost from his first sentence on the subject. The original Latin reads as follows:

Praeparatur ex eo charta diviso acu in praetenuas sed quam latissimas philyras.³⁸

This begins plainly enough. Pliny writes that “paper [*charta*] is prepared by dividing, with a needle,” and it seems reasonable to assume that the things to be divided are papyrus reeds. The last three words, however, are more opaque. *Quam latissimas* relates to width—“as wide as possible” or “as broad as possible,” as two translations have it—while *philyra* translates literally, and unhelpfully, as “linden tree.”³⁹

Clearly, Pliny did not mean that reeds averaging a scant inch or two in diameter could somehow be “divided” to become as wide as linden trees, but what he did intend to say remains open to interpretation. The reading arrived at by Ragab and most others is that the pith of the reed must be sliced lengthwise into thin strips. With reference to the figure below, one of two methods is employed: either the triangular stem of the reed is peeled face by face, rotating it between each slice, or it is peeled top to bottom without changing its orientation.⁴⁰ In both cases a sharp knife is required, rather than Pliny’s needle, and both methods produce a series of strips of varying width.

A competing interpretation, proposed by Dutch papyrologist Ignace H. M. Hendriks, is more unexpected. Hendriks took Pliny’s mention of a needle at face value and proposed that the triangular pith



◆ Simplified sections of papyrus reed stems, showing how reeds may have been “divided” before being pressed into sheets. *Left*, a slice is peeled off, the reed is rotated, and the process repeated; *center*, the reed is cut into slices from top to bottom; *right*, Ignace H. M. Hendriks’s painstaking “unwinding” of the reed using a needle. Modern examination confirms that all of these methods are compatible with ancient papyrus manufacture.

should be painstakingly unwound, not sliced, to produce a wide, flat sheet with protruding ribs where the needle must change direction at the corners of the stem.⁴¹ As time-consuming and fiddly as this procedure sounds, microscopic comparisons of ancient papyri with modern sheets show that the ancient Egyptians may have both sliced and unwound their papyrus reeds.⁴²

With détente reached as to how reeds should be “divided,” the next difficulty in parsing Pliny’s words lay in working out how these strips or sheets of pith should be assembled into a finished sheet of papyrus. Pliny’s description of this next step is more easily translated than the first—there is no incongruous “linden tree” to argue over—but it is not without perplexities. “Various kinds of paper,” Pliny writes,

*are made upon a table, moistened with Nile water; a liquid which, when in a muddy state, has the peculiar qualities of glue. This table being first inclined, the leaves of papyrus are laid upon it lengthwise, as long, indeed, as the papyrus will admit of, the jagged edges being cut off at either end; after which a cross layer is placed over it.*⁴³

extract

A sheet of papyrus, in other words, comprises two layers of papyrus pith. The first is made by placing strips of papyrus on a table so that they abut along their long edges, and a second layer running at right angles to the first is laid atop it. Ancient scrolls readily reveal this laminated construction: held up to the light, a crosshatched pattern caused by the two perpendicular layers is easily seen. The reed’s vascular bundles, which transport nutrients through the stem, stand out as dark lines against the paler parenchyma, or filler cells.

But what of the need for “Nile water” to glue the layers together? Papyrologists have detected starch between the layers of some early Egyptian papyri, a telltale sign of vegetable-based adhesives such as wheat paste, but the papyrus of Pliny’s time is conspicuously free of starch.⁴⁴ In the absence of any kind of adhesive, then, the bonding

mechanism at work remains mysterious. Hassan Ragab advanced a convoluted theory that ovoid parenchyma cells, bisected by the cutting process, form “dovetail” joints with air pockets in the opposing strips, while botanists at Kew Gardens in London suggested that the reed’s sap binds the strips together as it dries.⁴⁵ Whatever the truth, a two-ply sheet of papyrus pressed firmly together and left until dry will hold itself together for centuries.⁴⁶ Nile water, muddy or not, is not required.

Yet Pliny may not have been entirely incorrect. The waters of the Nile *do* possess a miraculous quality when applied to the papyrus-making process, though it has nothing to do with gluing layers together. Corrado Basile, a papyrologist working in Syracuse, Sicily (one of the few places outside Egypt to possess an indigenous papyrus industry), found that modern papyrus sheets were missing one particular compound found in their ancient counterparts.⁴⁷ Aluminum sulfate, the missing compound, is abundant in Nile water, and Basile found that soaking his papyrus strips in aluminum sulfate produced whiter finished sheets.⁴⁸ As a bonus, the clay in muddy Nile water may have helped regulate the absorption of ink, a useful property that in modern paper is managed by means of a range of additives—with none other than aluminum sulfate and clay among them.⁴⁹ Pliny’s cryptic clue about “muddy Nile water” has proven invaluable for modern papyrologists.

The last stage of the papyrus-making process is the least controversial. Having soaked strips of papyrus pith in Nile water (or a solution of aluminum sulfate, depending on one’s proximity to that river), Pliny says, “the leaves are pressed close together, and then dried in the sun; after which they are united to one another.”⁵⁰ The end result is a thin, light sheet perhaps ten or twelve inches on a side, its surfaces textured by the fine lines of the reed’s vascular cells.⁵¹ Durable, flexible, and portable, this, at last, is papyrus.



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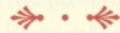
Fortunately, given the sheer necessity of their existence (Pliny could write, without exaggeration, that “all the usages of civilized life depend [...] upon the employment of paper”), papyrus scrolls regularly lived productive lives of hundreds of years. The best scrolls were supple enough to be rolled and unrolled many times, provided that their readers took care to not fray their exposed edges.⁵² The books of Aristotle’s library, for example, written on papyrus scrolls in the fourth century BCE, were still in use 250 years later when the Roman general Sulla spirited them from Athens to Rome.⁵³ Even when a papyrus scroll reached the end of its useful life, it might yet live on: Flinders Petrie, an Egyptologist working at the end of the nineteenth century, discovered that many sarcophagi were made from a papier-mâché-like material composed of layers of used papyrus, leading to the recovery of lost works by the philosopher Plato and playwright Euripides.⁵⁴ And



➤ A modern sheet of papyrus trimmed to 5½ by 4½ inches in size.

all this is to say nothing of the countless bookrolls that survived for millennia in tombs, rubbish heaps, and caves, entombed or discarded without thought of preservation or protection, and without which the field of papyrology could not exist.

Papyrus sheets hold together in all but the wettest environments (as long as it is dried under pressure, it is possible to soak a sheet of papyrus in water for days without causing irretrievable damage), though the mold and bacteria that thrive in damp conditions are hazardous to its well-being.⁵⁵ The emperor Tacitus, keen to have the works of a favored historian made available in all Roman libraries, had to have ten additional copies made up annually to replace those lost to the soggy weather of Gaul and Germania.⁵⁶



What is it like to work with this fabled writing material? Both Hassan Ragab's "Pharaonic Village" in Cairo and Corrado Basile's Museo del Papiro in Sicily manufacture papyrus according to their founders' instructions, and it is possible to buy sheets of blank papyrus that bear at least a passing resemblance to their ancient ancestors.

Modern papyrus is crackly, rigid, and scratchy in a way that is at odds with the smooth, pliable material described in *Natural History*, and putting pen to paper reinforces the gulf between papyrus ancient and modern. The pens of Pliny's time were made from hollow, dried reeds cut to form a nib like that of a fountain pen, and the meeting of the pen's angular tip with the textured surface of modern papyrus makes for a raspy, shuddering writing process.⁵⁷ This writer shivers at the idea that Pliny, or more likely a long-suffering slave, scratched out the 400,000-odd words of *Naturalis historia* with a reed pen on papyrus. Despite their best efforts, papyrologists have not yet cracked Pliny's ancient code.⁵⁸

There is still hope, however. Once cultivated across ancient Lower

Egypt, today's papyrus reeds are grown on a much smaller scale and the reeds themselves have returned to a wild state: papyrus sheets suffer as a result, but at the very least there is room left for improvement.⁵⁹ Nor were the ancient Egyptians immune to producing subpar papyrus: Pliny enumerated nine separate grades of papyrus sheet, from *hieratica*, the fine, "sacred" papyrus that Egypt kept for itself, down to the coarse, widely available *emporetica*, or "shop paper," good only for wrapping goods for sale.⁶⁰ The enterprising Romans got around the embargo on *hieratica* by purchasing used scrolls and washing off the water-soluble ink; we, of course, cannot take the same shortcut. Perhaps our current level of skill is equal to producing *emporetica* but not *hieratica*, and we should be using it to wrap fish and chips instead of griping about its qualities as a writing surface. Ultimately, even Pliny conceded that papyrus making was not an easy process: "there is so much trickery in the business!" he complained, as if dimly aware of the struggle that would face papyrologists seeking to interpret his words long after they had been divorced from any surviving industry.⁶¹

Though the contemporary experience of writing on papyrus is a frustrating one, it must not be forgotten that the concept of papyrus itself was momentous: a light, flexible, and durable writing material such as papyrus was an absolute necessity for the existence of the scroll, and without the scroll the book would never have come about. But for the book to live, papyrus had first to die.