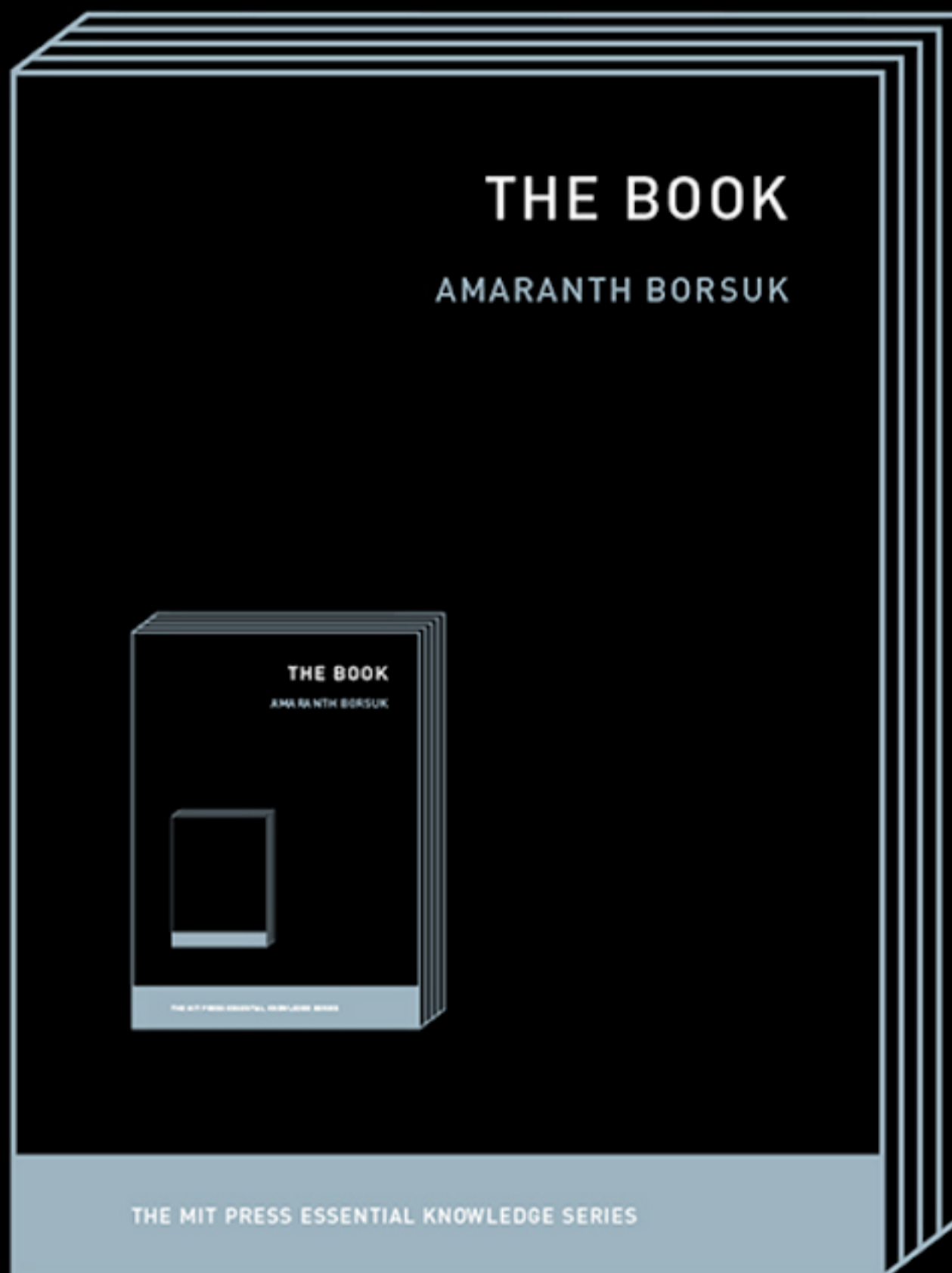


THE BOOK

AMARANTH BORSUK



THE MIT PRESS ESSENTIAL KNOWLEDGE SERIES

THE BOOK

AMARANTH BORSUK

The MIT Press | Cambridge, Massachusetts | London, England

© 2018 Massachusetts Institute of Technology

All rights reserved. No part of this book may be reproduced in any form by any electronic or mechanical means (including photocopying, recording, or information storage and retrieval) without permission in writing from the publisher.

This book was set in Chaparral Pro by Toppan Best-set Premedia Limited. Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data is available.

ISBN: 978-0-262-53541-0

10 9 8 7 6 5 4 3 2 1

CONTENTS

Series Foreword	vii
Preface and Acknowledgments	ix
1 The Book as Object	1
2 The Book as Content	61
3 The Book as Idea	111
4 The Book as Interface	197
Chronology	259
Glossary	265
Notes	279
Bibliography	297
Further Reading and Writing	309
Index	317

SERIES FOREWORD

The MIT Press Essential Knowledge series offers accessible, concise, beautifully produced pocket-size books on topics of current interest. Written by leading thinkers, the books in this series deliver expert overviews of subjects that range from the cultural and the historical to the scientific and the technical.

In today's era of instant information gratification, we have ready access to opinions, rationalizations, and superficial descriptions. Much harder to come by is the foundational knowledge that informs a principled understanding of the world. Essential Knowledge books fill that need. Synthesizing specialized subject matter for nonspecialists and engaging critical topics through fundamentals, each of these compact volumes offers readers a point of access to complex ideas.

Bruce Tidor

*Professor of Biological Engineering and Computer Science
Massachusetts Institute of Technology*

PREFACE AND ACKNOWLEDGMENTS

The book would, at first glance, seem to be an object about which we all possess essential knowledge. It is, for many children, among the first playthings we encounter, whether in the soft cloth books of contrasting colors and bold patterns often kept in the crib to stimulate vision, or a little later in board books like Dorothy Kunhardt's *Pat the Bunny* (1940), with contrasting textures to activate our sense of touch and simple words and phrases to help us imagine a world arranged neatly into narratives. The book would seem like a solid object, yet it is presently poised to melt into air, or, if we are honest, has been threatening to do so in popular consciousness for at least a decade, thanks to the advent in 2006 of the Sony Reader and in 2007 of the Amazon Kindle, digital reading devices many seem to think will render books obsolete. We might trace fears over the book's decline even earlier, to the first part of the twentieth century, a period of rapid technological change in which the phonograph, film, and television reinvented storytelling on a grand scale. Book history and Victorian studies scholar Leah Price, in a 2012 *New York Times* essay, chronicles such admonitions, following them back to the Romantic period, when Théophile Gautier professed

that burgeoning newspapers would kill the book.¹ Such reports of the book's death are abundant and, perhaps, overstated.

Digital reading devices existed prior to e-readers, but none has challenged our definition of the book in quite the same way or raised as much of an outpouring of print nostalgia on one hand and digital futurist rhetoric on the other. These devices—flat, lightweight screens that can show us any volume in a whole library of texts—look much different from the one most of us picture when we hear the word *book*: a stack of paper sheets printed on both sides, bound on one end, and encased between covers. We seem comfortable assuming the term refers to a single object: the *codex*, whose name comes from the Latin for “tree trunk,”² and whose image is likewise firmly rooted in the Western psyche.

This form, which emerged around 150 CE, has enjoyed a long history. It was predated, however, by the long-standing use of clay tablets and papyrus scrolls, both of which emerged over two thousand years earlier. It seems fitting, then, that e-readers have come to prominence in the twenty-first century, nicely bookending the codex as a hinge in the middle of a four-thousand-year span of textual proliferation. Codex-like forms, in fact, precede the book of bound leaves: accordion-folded scrolls and *polyp-tychs* of wax tablets facilitated the combination of sequential reading and random access the codex made possible.

we know as the book in order to address a historical moment in which many of us are fascinated by it and concerned about its future. Rather than presenting the book's development as a linear path from cuneiform impression to touchscreen interface, I have punctuated this timeline with digressions and hypertextual connections on book structure, fabrication, and culture to allow us to explore the many apparatuses that keep the book in circulation—both in our cultural landscape and imaginations. Bridging history, the book arts, and contemporary electronic literature, this volume reminds us that the book is a fluid artifact whose form and usage have shifted over time under numerous influences: social, financial, and technological.

As the quotations scattered throughout this volume suggest, defining the book is no easy feat. Tracking the book as “material text” helps us see the ways its physical form, readership, and artistic content have inspired one another's evolution, suggesting they will continue to do so in the years to come. To see where books might be going, we must think of them as objects that have experienced a long history of experimentation and play. Rather than bemoaning the death of books or creating a dichotomy between print and digital media, this guide points to continuities, positioning the book as a changing technology and highlighting the way artists in the twentieth and

twenty-first centuries have pushed us to rethink and re-define the term.

Providing a focused exploration of the manifold artifacts we think of as “books” alongside short forays into the interdisciplinary arenas that have influenced the study of book history, I take the artist’s book, which uses its content to interrogate book form, as an instructive paradigm for thinking about the way forward for digital books. Rather than inscribing a teleological story of ever-improving legibility, distribution, and engagement, the book’s mutations tell us about our highly contingent cultural ideals of authorship and art. In mapping these shifts, I hope to offer a path forward for those interested in shaping the book’s future. Perhaps our hand-wringing over the death of the book is as misplaced as fears regarding the decline of reading a decade ago, when the National Endowment for the Arts published its study *Reading at Risk*, documenting a “decline of ten percentage points in literary readers from 1982 to 2002.”³ The losses that report bemoaned have since been debunked—we are not reading less, but simply differently. Humans’ interaction with language and literature necessitates certain kinds of portable reading experiences. It seems only natural that the book should grow and change with us.

My own growth as an artist and thinker on these issues has benefited greatly from a community of collaborators with whom I have had the opportunity to explore the

book's boundaries. I am grateful to Brad Bouse, my partner in all things, who first encouraged me to make my study of electronic literature material. I am also indebted to Nick Montfort, a rigorous thinker and generous friend who introduced me to regular expressions and who was this work's first reader. Sandra Kroupa, special collections librarian and living index to the University of Washington's artists' books collection provided invaluable guidance. A number of interlocutors have influenced and inspired my creative and critical thinking about the juncture of print and digital media, especially Jessica Pressman, Dene Grigar, Kathi Inman Berens, Stephanie Strickland, Élika Ortega, and Alex Saum-Pascual. I am grateful, as well, for invitations to the Reva and David Logan Symposium on the Artist's Book in San Francisco, *Máquinas de inminencia: estéticas de la literatura electrónica* in Mexico City, the Digital Technologies and the Future of the Humanities at City University Hong Kong, and *Sprint Beyond the Book* at ASU's Center for Science and the Imagination. Some of the ideas between these covers began gestating during my time as a Mellon Postdoctoral Fellow at MIT, where I had the honor of co-hosting the symposium *UNBOUND: Speculations on the Future of the Book* with Gretchen Frances Bennett. My completion of this volume was made possible through the generous support of the School of Interdisciplinary Arts and Sciences at the University of Washington, Bothell, as well

as a Worthington Innovation Fellowship, which provided much-needed time to focus on writing. Part of this manuscript was completed at the University of Washington's Whitely Center, which served as both refuge and scriptorium, for which I am deeply thankful. Finally, my own love of books in all their forms started with my family: thanks, Practive Associates.

THE BOOK AS OBJECT

The story of the book's changing form is bound up with that of its changing content. The book, after all, is a portable data storage and distribution method, and it arises as a by-product of the shift from oral to literate culture, a process that takes centuries and is informed through cultural exchange, both peaceful and forcible. In the development of the book from clay tablet to codex, each medium's affordances—the possibilities for use presented by its form—facilitate certain kinds of expression. As certain modes of expression—whether they be iconographic Egyptian alphabets or interactive video clips—gain prominence, the medium that best supports them develops and, in some cases, supersedes the one that preceded it.

We know this intuitively, but it would be incorrect to think of this series of shifts as determined solely by the expressive needs of scribes or authors (whether they

influence one another's development. The use of clay to record information arose in Sumer (modern Iraq), which shifted from a nomadic to an urban culture between 8500 and 3000 BCE. As people settled in villages and a system of kingships formed, Sumerians needed a way to track trade and record information about their governance. Cuneiform writing developed in Southern Mesopotamia around 2800 BCE thanks to a confluence of material availability, linguistic development, and utility.² Sumerians had long relied on clay, an abundant and renewable material supplied by the Tigris and Euphrates, the two rivers that give Mesopotamia (which means "between two rivers" in Greek) its name, in their architecture and crafts. While their region did not provide stone or wood in any great quantities, they had highly developed techniques for sifting and working with clay to create durable and lasting artifacts, making it a natural fit as a support for writing.

Initially, Sumerians used clay tokens in various shapes for their accounting, in some cases tying together groupings with string. Around 3500 BCE, they began containing these tokens in spherical clay envelopes, or *bullae*, impressed with each token's shape to demonstrate the sealed pod's hidden contents (see figure 1).³ Rather than associating three conical tokens with three sheep in the world, for instance, this system associated three impressions of tokens with the tokens themselves, a level of abstraction



Copyrighted image

a.

b.

Copyrighted image

Copyrighted image

c.

d.

Copyrighted image

Copyrighted image

e.

f.

Figure 1 (a) Clay bulla, based on Louvre Museum SB1940 (ca. 3300 BCE); (b) cuneiform tablet, based on Metropolitan Museum of Art 11.217.19 (ca. 2041 BCE); (c) scroll (ca. 2500 BCE); (d) *jiance*, based on The Museum of the Institute of History and Philology, Academia Sinica 128.1 (ca. 95 CE); (e) palm leaf manuscript/*pothī* (ca. 200 BCE); (f) *kipu/quipu* (ca. 1500 CE). Illustration by Mike Force for Lightboard.

necessary to make the representational leap from spoken language to writing. With impressions standing in for objects, they no longer needed the receipt to serve as a container, so around 3200 bullae became solid, a shape that gradually flattened to create the clay tablet that would serve as a portable recording device for several millennia. Around 3100, scribes began to add designs inscribed with a *stylus* depicting the goods these token impressions represented, and a pictographic writing system in clay was born.⁴

While impression in clay worked well, the medium was not really suited to drawing, given the resistance of wet clay to the stylus tip and the challenge of standardizing drawn forms—your sheep and my sheep will likely look quite different unless we have a shared approach to drawing it. Working with the affordances of the clay, Sumerians developed a special wedge-shaped stylus (hence *cuneiform*, from the Latin *cuneus*, or “wedge”), also drawn from the material they had in abundance: reeds, which could be easily split and peeled to generate one of these beveled implements ready-made.

With the stylus in one hand and the damp tablet in the other, a scribe impressed a corner of the reed into the clay at an oblique angle, using combinations of wedge shapes to make characters, thus transitioning from pictographic to syllabic writing. This shift from shapes depicting words to signs representing sounds had the additional

benefit of reducing the number of characters required to convey information. Rather than a one-to-one correspondence of drawing to object or idea, language could be abstracted from the things it represented, and this reduced phonetic character set could be adapted to represent other spoken languages in the region during the second millennium BCE, facilitating the spread of writing across the Near East.

This early medium, the tablet, takes on epic proportions in popular imagination. The term conjures up images of Charlton Heston as Moses, bearing the Ten Commandments on two stone slabs the size and shape of small headstones. While the Mesopotamians did carve texts into stone, because it was rare in the region it is thought to have been reserved for recording important events.⁵ The reality of the clay tablet was far more modest—most were small enough to fit comfortably in the palm of the scribe's hand, and their shape, generally rectangular with a slightly convex bulge, suggests the cupped palm that formed them (see figure 1). Ranging from the size of a matchbook to that of a large cell phone, cuneiform tablets were highly portable, could be inscribed on multiple sides, and could rest stably on a flat surface for storage or consultation. Some were cured in ovens, but most were simply allowed to dry in the sun.

As the need for written documentation of law, commerce, religion, and cultural history increased, so too did

sidekick Enkidu. Their escapades include war, rivalry, romance, and brotherhood—all the makings of a great road movie.

The version of *Gilgamesh* found in Nineveh, spanning twelve tablets, forms the basis for most contemporary translations and reveals much about the ways cuneiform literature was shaped by the tablet structure. To facilitate reading, scribes sometimes marked off sections with horizontal lines (easily made by impressing the side of the stylus into the clay) and indented the opening line of the subsequent section. They used special marks to separate words and to indicate a word was a name, and they developed determinative marks that categorized the words to which they were appended (as, for instance, related to people, place names, divinities, or specific materials). These latter are a particularly fascinating case in that they would not be voiced, but rather served as a kind of readerly metadata for disambiguation of words with multiple possible meanings.

Scribes developed finding aids for works spanning multiple tablets like this one, using the tablet's reverse to provide, in some cases, summaries, a *colophon* with the scribe and/or owner's name, the work's title (generally its first line), and the opening line of the subsequent tablet (known as an *incipit*) if the text continued. Incidentally, these terms, colophon and incipit, come from manuscript studies, and while they are useful to us in mapping the

shifting conventions of the book, they would not have been applied to such texts by their creators. *Colophon*, Greek for “finishing stroke,” suggests the use of pen and ink to close a text with information about its production on the final page. *Incipit*, Latin for “here begins,” comes from the scribal tradition of beginning a text with this term to name what follows.

The Papyrus Scroll

While the Sumerians were developing a book from the materials at hand, the Egyptians reached to their own river for a support to writing: papyrus, which only grows in the Nile Valley. Egyptians used the plant widely: for building materials, clothing, and even food. The earliest Egyptian writing appears on stone faces inscribed with *hieroglyphics* that date from the fourth millennium BCE.¹² Hieroglyphics are sure to be familiar to many readers as a system in which drawings of figures and objects are combined to represent things (*pictogram*), ideas (*ideogram*), and sounds (*phonogram*).¹³ Hieroglyphs were inscribed on temple walls and obelisks, providing religious and historical records, but they also appear on potsherds as more ephemeral notes. As the need for documentation increased and Egyptians sought a more portable surface for writing, they developed an ideal material from *papyrus*: a paper both

smooth and flexible that could be sized to the needs of a given document.

To write on this surface, they developed a water-soluble, charcoal-based black ink and a red ink from oxidized iron, as well as a brush-like rush pen that allowed for smooth and rapid transcription, which gradually transformed hieroglyphics into a simplified script known as *hieratic*. One of the many ways the material form influenced its content was the indistinguishability of up-and-down strokes in hieratic, which some scholars associate with concern for piercing the papyrus.¹⁴ The uniform thickness of the line suggests even pressure, unlike the thick downstrokes and hairline upstrokes associated with calligraphy on paper and parchment. It might also be attributed to the reed pen itself, a soft brush with a fine tip. Whatever the case, in the fifteen hundred years in which papyrus prevailed, scribes took great advantage of their chosen medium.

Pliny the Elder (23–79 CE) provides a useful, if limited, explanation of Egyptian papermaking (a description he copped directly from Theophrastus) as part of his *Natural History*.¹⁵ The *cyperus papyrus* plant, which was used so extensively in ancient Egypt that it was nearly eradicated by the first millennium CE, consists of clusters of long, triangular stems (up to eighteen feet tall) with tasseled heads. Papyrus was made by cutting the stalks into uniform lengths, removing the outer green rind, and making

strips from the plant's pith using one of two methods. According to Pliny, papermakers sliced the pith into strips that gradually decreased in size (given the triangular shape of the stalk), discarding the smallest section. Contemporary research, however, suggests that in some cases the triangular stems were carefully peeled, working inward in a spiral fashion.¹⁶ This would have resulted in a wider continuous sheet and less waste. In both methods, these strips were laid out in two layers—one vertical, the other horizontal—and beaten until the fibers fused, using the plant's natural sap as an adhesive. The resulting sheets averaged between eight to thirteen inches high and eight to ten inches wide, much like contemporary office paper. These were dried and bleached by the sun, then burnished with a piece of stone or shell, leaving behind a smooth white surface with natural flecks.

Egyptians glued these sheets end to end using starch paste to make rolls of twenty, which could be trimmed into shorter widths as needed and for easier handling.¹⁷ Such rolls were generally inscribed on only one side and in columns so they could be held open to reveal a narrow portion of text, much like a newspaper. The two layers of pith created a natural paper *grain* that dictated how papyrus could be inscribed and rolled: with the horizontal grain on the inside and the vertical on the outside to prevent cracking as the sheet curled.¹⁸ Once a scroll dried, its curvature would set, making curling it the other way difficult, so in

drawback to the scroll form, its tendency to snap shut due to its curled shape, required readers to use both hands to hold it open or lay it on a flat surface and place objects on it, tactics that sounds cumbersome to us today, but that scholars point out would have become second nature among Egyptian readers.²² This normalization of reading practices bears remembering, since from the vantage point of the twenty-first century, our own codex book has been normalized to such a degree that we question the “bookness” of anything that challenges our expected reading experience, with little regard for the fact that reading in one direction rather than another, scanning text silently, and putting a title and author’s name on a book’s cover are all learned behaviors.

Mineral, Vegetable, Animal

Despite their drawbacks, scrolls persisted for more than two millennia as the dominant book form in Egyptian and Greek culture, to which it was exported. Parchment, developed around 1600 BCE, provided a durable alternative to papyrus and ensured a long life for the scroll in Greece and Rome, where the Latin name for such a roll, *volumen*, gives us an important foundational term for the book.²³ The term *parchment* itself comes to us from the Latin *pergamum*, for Pergamon (in modern Turkey), a key center of

its production in the fourth century BCE.²⁴ Made from animal hide rather than plant fibers, parchment was flexible, strong, could be cut in larger sizes than papyrus, provided an exceptionally smooth writing surface, and was opaque enough to allow clear writing on both sides. These features helped it eventually replace papyrus, but its greatest asset was mobility: parchment could be made wherever there was land to raise cattle, goats, and sheep—unlike papyrus, whose manufacture and export Egypt had cornered.

Like Egyptian papyri, Greek and Roman scrolls were inscribed in columns, which the Greeks called *paginae*, providing both the foundational term and the concept of the page, establishing what scholar Bonnie Mak calls its “cognitive architecture.”²⁵ While we associate the word *page* with trimmed sheets sold by the ream or bound in volumes, we might, instead, think of it as ancient scribes did, as a means of guiding the reader’s eye and containing information for easy access. These *paginae*, after all, were similar in size to the content of an 8.5 × 11 in. page, though scroll dimensions varied with content and quality. Works of Greek poetry, for instance, were trimmed to around five inches in height, and epigrams appeared on short, two-inch scrolls suited to their pithy texts.²⁶ With the development of *concertina* scrolls, discussed in this chapter, the shape of the page as we know it emerges. Folding the parchment between each *pagina* emphasizes its discrete edges while still allowing continuous reading.

Some scrolls were wound around rods that extended beyond the top and bottom of the roll to facilitate opening and closing. This *umbilicus*²⁷ (a term that points to the rollers' centrality but also suggests a Cronenbergian connection between the hand at one end of this cord and the text at the other) could act as a weight if allowed to drape over a table's edge, holding the scroll open.²⁸ Generally, readers would unroll a scroll with the right hand while rolling it with the left, an active process revealing only a column or two at a time, which meant that to read it again one had to rewind it, much like a reel-to-reel, cassette, or VHS tape. This process takes a ceremonial form in Judaism, where the Torah scroll is publicly rewound on a holiday known as *Simchat Torah*, or "rejoicing of the Torah." After the final portion is read, the scroll is paraded around the congregation before being returned to the start so the opening portion can be read as well, symbolizing the cyclical nature of both the year and the text.

While one might expect parchment to have quickly superseded its more fragile counterpart, scrolls of both kinds existed side by side for centuries, much as tablets and scrolls did. Some scholars attribute this parity to the difficulty of systematizing and scaling its production. Parchment and *vellum*, its highest-quality exemplar (typically of calfskin), were made by skinning an animal, removing the hair from its pelt, bathing the skin in lime, stretching and drying it slowly, then treating the surface

to make it hard and smooth. In addition to requiring utmost care, the process necessitated the slaughter of great quantities of livestock, a costly prospect. Much as in our own technological moment, where print books and e-readers continue to be used despite staunch proclamations in favor of the portability, durability, and cost-effectiveness of one or the other, established systems of production and use take time and resources to change.

The Alphabet

The material text, as we have seen, arose largely for administrative purposes: it helped burgeoning cities keep records and accounts, established the power of rulers, and codified ceremonial practice. The movement from orality to literacy plays a central role in the further development of writing to produce literature and its necessary audience: readers. It is through the Greek development of the alphabet that writing gained enough of a foothold to foster the book in the West, so we'll take a short diversion here to establish how Greeks revolutionized the written word.

Much like Egyptians, early Greeks initially relied on pictographic writing (ca. 2200 BCE), from which a syllabic system (peppered with a few *logograms*: symbols representing a word, phrase, or concept) developed in the seventeenth century BCE. Syllabics, in which characters

Scrolls and the Advent of Paper

Like Mesopotamians with clay and Egyptians with papyrus, the Chinese developed their earliest book form, *jiance*, from the plant fiber they had in abundance: bamboo. A versatile material, it supported architecture, agriculture, and the arts before its adoption as a writing substrate. At around the same time King Ashurbanipal was amassing his library, Chinese artisans were cutting bamboo stalks at their natural joints, splitting them into strips about half an inch wide, cutting these into slips of equal length, and curing them over a fire. They polished these slips smooth on one side (known as the yellow side), and tied them together with cords of silk, hemp, or leather so they could be rolled up like a mat for storage and transport (see figure 1).³¹ Though in most cases their cords have disintegrated, some *jiance* include gaps in the text or notches in the bamboo that indicate where such bindings would have been placed. The very name for these Chinese scrolls, scholar Liu Guozhong points out, “*ce*,” which translates loosely to “volumes [of strips]” (as in *jian*/bamboo strip + *ce*/volume), is a pictogram representing uneven strips of bamboo encircled with string: 册.³² Incidentally, this form provides an excellent model for the idea of *grain*: the direction in which a sheet of paper’s fibers lay. One folds paper parallel to this grain to get the smoothest crease and ensure pages will turn easily. As book artist Scott McCarney

demonstrates to his students with a sushi mat, folding a *jiance* against the grain will snap it like a bundle of twigs and likewise crack the paper's surface.³³

This preliminary form influenced the very shape of Chinese writing. *Jiance* were inscribed in ink using a fine, stiff-bristled brush. As with Egyptian and Greek scrolls, a knife was used to scrape away mistakes, though saliva and water also did the trick. The traditional Chinese style of writing from top to bottom arises directly from the book's materiality—a bamboo slip was too thin to permit more than one character per line. They were thus inscribed from top to bottom in a column of single characters, and the text continued to the left. One would expect scribes could just as easily have developed a top-to-bottom, left-to-right orientation, but here the form again impacts the content. Because scribes wrote with their right hands, blank slips were held in the left. Moving the painted strip to the right to dry and adding a blank slip to the left was the most expedient approach, and thus they were bound in this fashion.³⁴ In addition to this columnar orientation, scribes established other characteristics that would continue into manuscript and printed books at this point, numbering their slips either at the bottom of the yellow side or on the back, including chapter numbers and titles on the outermost slips of a roll, and inscribing titles or colophons on the reverse (much as we saw with clay tablets).

The narrowness of the strips contributed not only to the way texts were laid out but also to the evolution of the characters themselves. Because the strips were so thin, scribes developed vertical ideograms that could be written more easily on them. Guozhong gives the example of the characters for horse and pig, both of which appear to be standing on their hind legs, rather than on the ground, as we might expect.³⁵ In addition to fitting comfortably on their supports, figures for humans and animals also face to the left, indicating the direction in which writing and reading will proceed.³⁶

While writing on other surfaces, including tortoise shells, pottery, bronze artifacts, and seals, appears as early as 1400 BCE, *jiance* provide the first portable method for distributing information in China, including funeral lists, divinations, and civic records early on, before expanding to include medical books, philosophical and scientific treatises, and literature (a pattern that repeats in nearly every culture to develop writing). The best-known example of a book composed of slips might be the *Yijing* or *I-Ching* (*Book of Changes*, ca. 1000 BCE), a divinatory text consulted by casting lots to generate hexagrams whose meaning must be interpreted. The oldest complete *jiance*, whose seventy-seven intact strips are threaded together with hemp cord, dates from between 93 and 95 CE and consists of a monthly weapons inventory for the platoon to which it belonged.³⁷ While bamboo slip scrolls were durable and portable, in

lengths over two feet the rolls would have been cumbersome to transport and read. Light, durable silk, another fiber whose production the Chinese perfected, was also used for writing and illustration, particularly between the third and fifth centuries, but it was far more expensive to produce, and those silk scrolls that have been found are thus thought to have been luxury goods.³⁸

For the book to take hold, a cheaper, lightweight alternative to bamboo and silk had to be developed: paper, attributed to Cai Lun, a eunuch of the Han imperial court, though examples precede him by two centuries. Cai Lun reportedly presented a method to the emperor in 105 CE whereby a mash of hemp, mulberry bark, fishing nets, and rags was suspended in water (known in papermaking as a slurry) and then sifted through a fine screen to lift out the matted fibers, which were then dried and bleached.³⁹ The random orientation and interlocking of the fibers made paper durable and flexible. These sheets were adhered into scrolls much like those in use in Egypt and would be inscribed in the same method as *jiance*. Once again, while we might expect this new technology to have quickly superseded its predecessor, scrolls of paper and bamboo continued to be used alongside one another through the fifth century, when Emperor Huan Xuan felt the need to issue an imperial decree commanding bookmakers to use paper and stop relying on what he believed were antiquated techniques.⁴⁰

arises elsewhere, outside the lineage of the codex. The South American *kipu* (or *quipu* in the Spanish spelling) provides an entirely different method of recording—knots (*kipu* in the Quechua language) in string. While our earliest samples come from the first millennium, most archaeological specimens represent the Inka Empire (roughly 1400–1532).⁴⁴ At least one proto-*kipu*, which includes twigs knotted into the strings, likely dates to the third millennium BCE, making it concurrent with cuneiform tablets.⁴⁵ These devices consist of a main cord of cotton or wool with pendant strings affixed to it, most descending, while a few are attached in the other direction (see figure 1). Some of these pendants include further, subsidiary strings dyed in a range of colors and spun in multiple plies. When displayed in museums, *kipu* are often mounted linearly, like a timeline on the wall, or radially, like a clock face or dramatic rope necklace. While some are relatively simple, a handful include over fifteen hundred pendants, making them intricate and beautiful objects of study.

Scholars are still deciphering these dense systems of knots, based on around 750 specimens found in burial chambers in the Peruvian Andes and on descriptions of their use by the Spanish colonists who first encountered them. The opacity of the *kipu* is a legacy of colonization: Spanish authorities outlawed their use in the sixteenth century, destroying many of them in the process. The only *kipu* to have remained within their community are those

of Rapaz, Peru, where they were kept until the 1930s.⁴⁶ While they are still maintained and used in ritual, they are no longer updated. In 2012, Chilean artist Cecilia Vicuña published a contemporary, conceptual artist's *kipu*. Produced in an edition of thirty-two, her *Chanccani Quipu* (2012) takes the knot-book as metaphor, in her words, for "the clash of two cultures and worldviews: the Andean oral universe and the Western world of print."⁴⁷ Knotted to a bamboo spine, four-foot cords of unspun wool cascade like soft white hair to the ground when the piece is hung. Stenciled in rust-colored ink onto their surface, fragmented Quechua phonemes extend across and down each strand, inviting eye and ear to sound the chords of language.

Khipu were maintained by a specialized bureaucratic class of knot-makers, *kipukamayuc*, who understood the conventionalized signs represented by different configurations of knots, colors, and types of string. Their role was to breathe life into the threads, conducting the census, documenting taxation and labor, and maintaining calendars of ritual practice. The chief question, whether their knots served as mnemonics or as a written system that could be read, remains unanswered. These devices were certainly portable, like a book, and they could contain both accounting records and narratives. Scholar Gary Urton, founder of Harvard's Khipu Database Project, contends that the system represents a form of binary coding

that helped keepers recount narratives based on relational pairs.⁴⁸ On some quantitative *kipu*, knots are arranged in a decimal hierarchy based on distance from the primary string, with the 1s being furthest, then 10s, then 100s, and so on. Other *kipu* have a more complex arrangement, which suggests they were used to record some other kind of information, like images, ideas, or sounds.

While the *kipu* represents a distinct departure from the kinds of record keeping we have so far traced, it is knitted to the history of the book's changing forms by its materiality. Like the clay tablet, papyrus sheet, and bamboo scroll, it was made from a material both abundant and highly refined within the culture in which it arose: cloth. The cultivation of alpacas, llamas, and other camelids in the Andes provided raw material for the perfection of weaving. Incan cloth was pliable, three-dimensional, visual, and already embedded in the culture as a marker of status.⁴⁹ Colored embroidery and geometric designs had clear symbolic significance, and knotted tapestry patterns in royal clothing were used to establish authority. As in each of the other early book forms we have looked at, the chosen material formed part of the fabric of existence for its users and likely shaped not only how information was transmitted but also the very nature of thought itself. Our challenge, as students of the book, is to think about the way its materiality is both a product and constituent of its historic moment.

From Roll to Accordion to Codex

Given this range of antecedents, where does the codex, that ubiquitous structure we all recognize, come from? How do bookmakers transition from continuous scrolls to bound volumes, and why? There are a few different ways to answer this question, depending on which material you used to make your scrolls. In China, paper's strength and malleability led to the development in the eighth century of sutra-folded books, named for their use in producing copies of the Buddhist sutras. Scrolls were folded back and forth in even widths to create an accordion (see figure 2). Such folded books facilitated reading by allowing access to any part of text and would play a key role in both spreading Buddhism throughout Asia and establishing the codex in China. Incidentally, the term "role" itself is a legacy of the scroll, a reference to the rolls on which actors' parts were written during the Renaissance.⁵⁰

The folded book, also known as an *accordion* or *concertina*, was a flat, rectangular volume, and its height came directly from the scrolls that preceded it, since the paper sheets used were generally the length of the papermaker's arm. The format may also have developed from the *palm leaf manuscript*, or *pothī*, carried by monks between India and China starting at the beginning of the Common Era. Produced in many scripts and languages, such collections of Hindu and Buddhist teachings were copied and