killed by epidemics beginning with the first European visit, in 1791). Syphilis, gonorrhea, tuberculosis, and influenza arriving with Captain Cook in 1779, followed by a big typhoid epidemic in 1804 and numerous "minor" epidemics, reduced Hawaii's population from around half a million in 1779 to 84,000 in 1853, the year when smallpox finally reached Hawaii and killed around 10,000 of the survivors. These examples could be multiplied almost indefinitely.

However, germs did not act solely to Europeans' advantage. While the New World and Australia did not harbor native epidemic diseases awaiting Europeans, tropical Asia, Africa, Indonesia, and New Guinea certainly did. Malaria throughout the tropical Old World, cholera in tropical Southeast Asia, and yellow fever in tropical Africa were (and still are) the most notorious of the tropical killers. They posed the most serious obstacle to European colonization of the tropics, and they explain why the European colonial partitioning of New Guinea and most of Africa was not accomplished until nearly 400 years after European partitioning of the New World began. Furthermore, once malaria and yellow fever did become transmitted to the Americas by European ship traffic, they emerged as the major impediment to colonization of the New World tropics as well. A familiar example is the role of those two diseases in aborting the French effort, and nearly aborting the ultimately successful American effort, to construct the Panama Canal.

Bearing all these facts in mind, let's try to regain our sense of perspective about the role of germs in answering Yali's question. There is no doubt that Europeans developed a big advantage in weaponry, technology, and political organization over most of the non-European peoples that they conquered. But that advantage alone doesn't fully explain how initially so few European immigrants came to supplant so much of the native population of the Americas and some other parts of the world. That might not have happened without Europe's sinister gift to other continents—the germs evolving from Eurasians' long intimacy with domestic animals.

CHAPTER 12

BLUEPRINTS AND BORROWED LETTERS

NINETEENTH-CENTURY AUTHORS TENDED TO INTERPRET history as a progression from savagery to civilization. Key hallmarks of this transition included the development of agriculture, metallurgy, complex technology, centralized government, and writing. Of these, writing was traditionally the one most restricted geographically: until the expansions of Islam and of colonial Europeans, it was absent from Australia, Pacific islands, subequatorial Africa, and the whole New World except for a small part of Mesoamerica. As a result of that confined distribution, peoples who pride themselves on being civilized have always viewed writing as the sharpest distinction raising them above "barbarians" or "savages."

Knowledge brings power. Hence writing brings power to modern societies, by making it possible to transmit knowledge with far greater accuracy and in far greater quantity and detail, from more distant lands and more remote times. Of course, some peoples (notably the Incas) managed to administer empires without writing, and "civilized" peoples don't always defeat "barbarians," as Roman armies facing the Huns learned. But the European conquests of the Americas, Siberia, and Australia illustrate the typical recent outcome.

Writing marched together with weapons, microbes, and centralized

political organization as a modern agent of conquest. The commands of the monarchs and merchants who organized colonizing fleets were conveyed in writing. The fleets set their courses by maps and written sailing directions prepared by previous expeditions. Written accounts of earlier expeditions motivated later ones, by describing the wealth and fertile lands awaiting the conquerors. The accounts taught subsequent explorers what conditions to expect, and helped them prepare themselves. The resulting empires were administered with the aid of writing. While all those types of information were also transmitted by other means in preliterate societies, writing made the transmission easier, more detailed, more accurate, and more persuasive.

Why, then, did only some peoples and not others develop writing, given its overwhelming value? For example, why did no traditional hunter-gatherers evolve or adopt writing? Among island empires, why did writing arise in Minoan Crete but not in Polynesian Tonga? How many separate times did writing evolve in human history, under what circumstances, and for what uses? Of those peoples who did develop it, why did some do so much earlier than others? For instance, today almost all Japanese and Scandinavians are literate but most Iraqis are not: why did writing nevertheless arise nearly four thousand years earlier in Iraq?

The diffusion of writing from its sites of origin also raises important questions. Why, for instance, did it spread to Ethiopia and Arabia from the Fertile Crescent, but not to the Andes from Mexico? Did writing systems spread by being copied, or did existing systems merely inspire neighboring peoples to invent their own systems? Given a writing system that works well for one language, how do you devise a system for a different language? Similar questions arise whenever one tries to understand the origins and spread of many other aspects of human culture—such as technology, religion, and food production. The historian interested in such questions about writing has the advantage that they can often be answered in unique detail by means of the written record itself. We shall therefore trace writing's development not only because of its inherent importance, but also for the general insights into cultural history that it provides.

THE THREE BASIC strategies underlying writing systems differ in the size of the speech unit denoted by one written sign: either a single basic sound, a whole syllable, or a whole word. Of these, the one employed

today by most peoples is the alphabet, which ideally would provide a unique sign (termed a letter) for each basic sound of the language (a phoneme). Actually, most alphabets consist of only about 20 or 30 letters, and most languages have more phonemes than their alphabets have letters. For example, English transcribes about 40 phonemes with a mere 26 letters. Hence most alphabetically written languages, including English, are forced to assign several different phonemes to the same letter and to represent some phonemes by combinations of letters, such as the English two-letter combinations *sh* and *th* (each represented by a single letter in the Russian and Greek alphabets, respectively).

The second strategy uses so-called logograms, meaning that one written sign stands for a whole word. That's the function of many signs of Chinese writing and of the predominant Japanese writing system (termed kanji). Before the spread of alphabetic writing, systems making much use of logograms were more common and included Egyptian hieroglyphs, Maya glyphs, and Sumerian cuneiform.

The third strategy, least familiar to most readers of this book, uses a sign for each syllable. In practice, most such writing systems (termed syllabaries) provide distinct signs just for syllables of one consonant followed by one vowel (like the syllables of the word "fa-mi-ly"), and resort to various tricks in order to write other types of syllables by means of those signs. Syllabaries were common in ancient times, as exemplified by the Linear B writing of Mycenaean Greece. Some syllabaries persist today, the most important being the kana syllabary that the Japanese use for telegrams, bank statements, and texts for blind readers.

I've intentionally termed these three approaches strategies rather than writing systems. No actual writing system employs one strategy exclusively. Chinese writing is not purely logographic, nor is English writing purely alphabetic. Like all alphabetic writing systems, English uses many logograms, such as numerals, $, %, and + : that is, arbitrary signs, not made up of phonetic elements, representing whole words. "Syllabic" Linear B had many logograms, and "logographic" Egyptian hieroglyphs included many syllabic signs as well as a virtual alphabet of individual letters for each consonant.

INVENTING A WRITING system from scratch must have been incomparably more difficult than borrowing and adapting one. The first scribes

had to settle on basic principles that we now take for granted. For example, they had to figure out how to decompose a continuous utterance into speech units, regardless of whether those units were taken as words, syllables, or phonemes. They had to learn to recognize the same sound or speech unit through all our normal variations in speech volume, pitch, speed, emphasis, phrase grouping, and individual idiosyncrasies of pronunciation. They had to decide that a writing system should ignore all of that variation. They then had to devise ways to represent sounds by symbols.

Somehow, the first scribes solved all those problems, without having in front of them any example of the final result to guide their efforts. That task was evidently so difficult that there have been only a few occasions in history when people invented writing entirely on their own. The two indisputably independent inventions of writing were achieved by the Sumerians of Mesopotamia somewhat before 3000 B.C. and by Mexican Indians before 600 B.C. (Figure 12.1); Egyptian writing of 3000 B.C. and Chinese writing (by 1300 B.C.) may also have arisen independently. Probably all other peoples who have developed writing since then have borrowed, adapted, or at least been inspired by existing systems.

The independent invention that we can trace in greatest detail is history's oldest writing system, Sumerian cuneiform (Figure 12.1). For thousands of years before it jelled, people in some farming villages of the Fertile Crescent had been using clay tokens of various simple shapes for accounting purposes, such as recording numbers of sheep and amounts of grain. In the last centuries before 3000 B.C., developments in accounting technology, format, and signs rapidly led to the first system of writing. One such technological innovation was the use of flat clay tablets as a convenient writing surface. Initially, the clay was scratched with pointed tools, which gradually yielded to reed styluses for neatly pressing a mark into the tablet. Developments in format included the gradual adoption of conventions whose necessity is now universally accepted: that writing should be organized into ruled rows or columns (horizontal rows for the Sumerians, as for modern Europeans); that the lines should be read in a constant direction (left to right for Sumerians, as for modern Europeans); and that the lines should be read from top to bottom of the tablet rather than vice versa.

But the crucial change involved the solution of the problem basic to

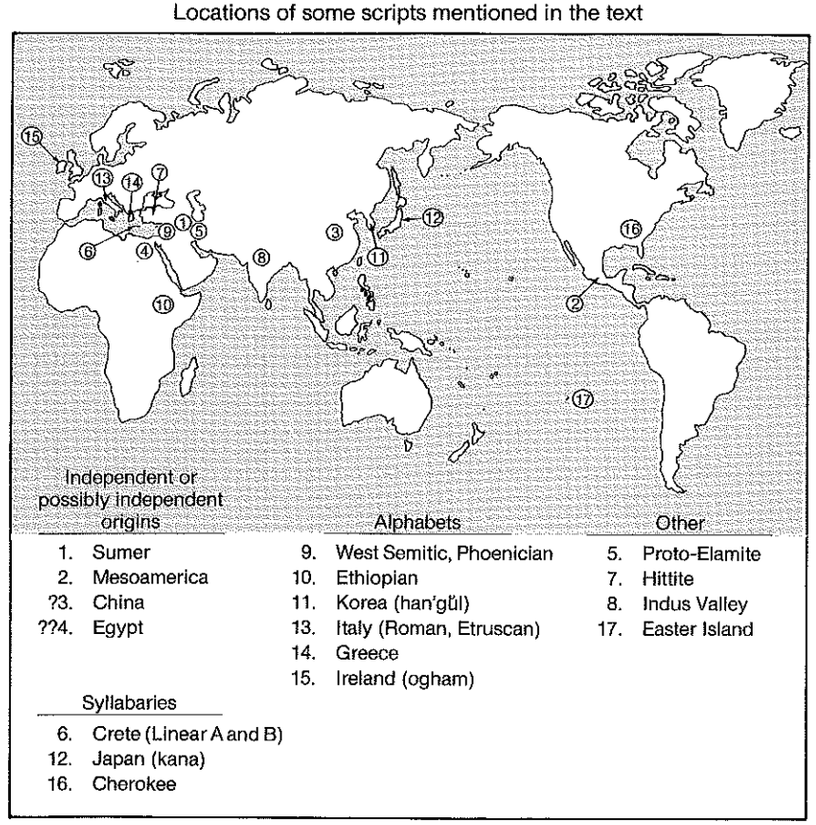


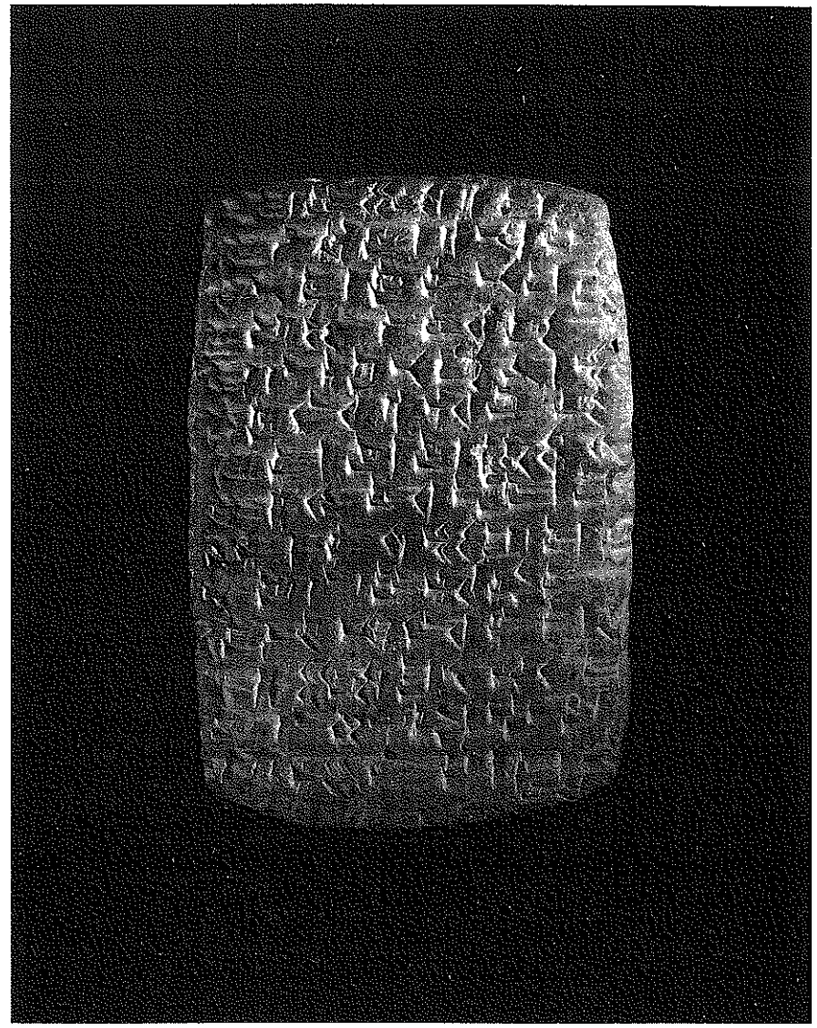
Figure 12.1. The question marks next to China and Egypt denote some doubt whether early writing in those areas arose completely independently or was stimulated by writing systems that arose elsewhere earlier. "Other" refers to scripts that were neither alphabets nor syllabaries and that probably arose under the influence of earlier scripts.

virtually all writing systems: how to devise agreed-on visible marks that represent actual spoken sounds, rather than only ideas or else words independent of their pronunciation. Early stages in the development of the solution have been detected especially in thousands of clay tablets excavated from the ruins of the former Sumerian city of Uruk, on the Euphrates

River about 200 miles southeast of modern Baghdad. The first Sumerian writing signs were recognizable pictures of the object referred to (for instance, a picture of a fish or a bird). Naturally, those pictorial signs consisted mainly of numerals plus nouns for visible objects; the resulting texts were merely accounting reports in a telegraphic shorthand devoid of grammatical elements. Gradually, the forms of the signs became more abstract, especially when the pointed writing tools were replaced by reed styluses. New signs were created by combining old signs to produce new meanings: for example, the sign for *head* was combined with the sign for *bread* in order to produce a sign signifying *eat.*

The earliest Sumerian writing consisted of nonphonetic logograms. That's to say, it was not based on the specific sounds of the Sumerian language, and it could have been pronounced with entirely different sounds to yield the same meaning in any other language—just as the numeral sign *4* is variously pronounced *four, chetwíre, neljä,* and *empat* by speakers of English, Russian, Finnish, and Indonesian, respectively. Perhaps the most important single step in the whole history of writing was the Sumerians' introduction of phonetic representation, initially by writing an abstract noun (which could not be readily drawn as a picture) by means of the sign for a depictable noun that had the same phonetic pronunciation. For instance, it's easy to draw a recognizable picture of *arrow,* hard to draw a recognizable picture of *life,* but both are pronounced *ti* in Sumerian, so a picture of an arrow came to mean either *arrow* or *life.* The resulting ambiguity was resolved by the addition of a silent sign called a determinative, to indicate the category of nouns to which the intended object belonged. Linguists term this decisive innovation, which also underlies puns today, the rebus principle.

Once Sumerians had hit upon this phonetic principle, they began to use it for much more than just writing abstract nouns. They employed it to write syllables or letters constituting grammatical endings. For instance, in English it's not obvious how to draw a picture of the common syllable *-tion,* but we could instead draw a picture illustrating the verb *shun,* which has the same pronunciation. Phonetically interpreted signs were also used to "spell out" longer words, as a series of pictures each depicting the sound of one syllable. That's as if an English speaker were to write the word *believe* as a picture of a bee followed by a picture of a leaf. Phonetic signs also permitted scribes to use the same pictorial sign for a set of related words (such as *tooth, speech,* and *speaker*), but to resolve the ambiguity



An example of Babylonian cuneiform writing, derived ultimately from Sumerian cuneiform.

with an additional phonetically interpreted sign (such as selecting the sign for *two, each,* or *peak*).

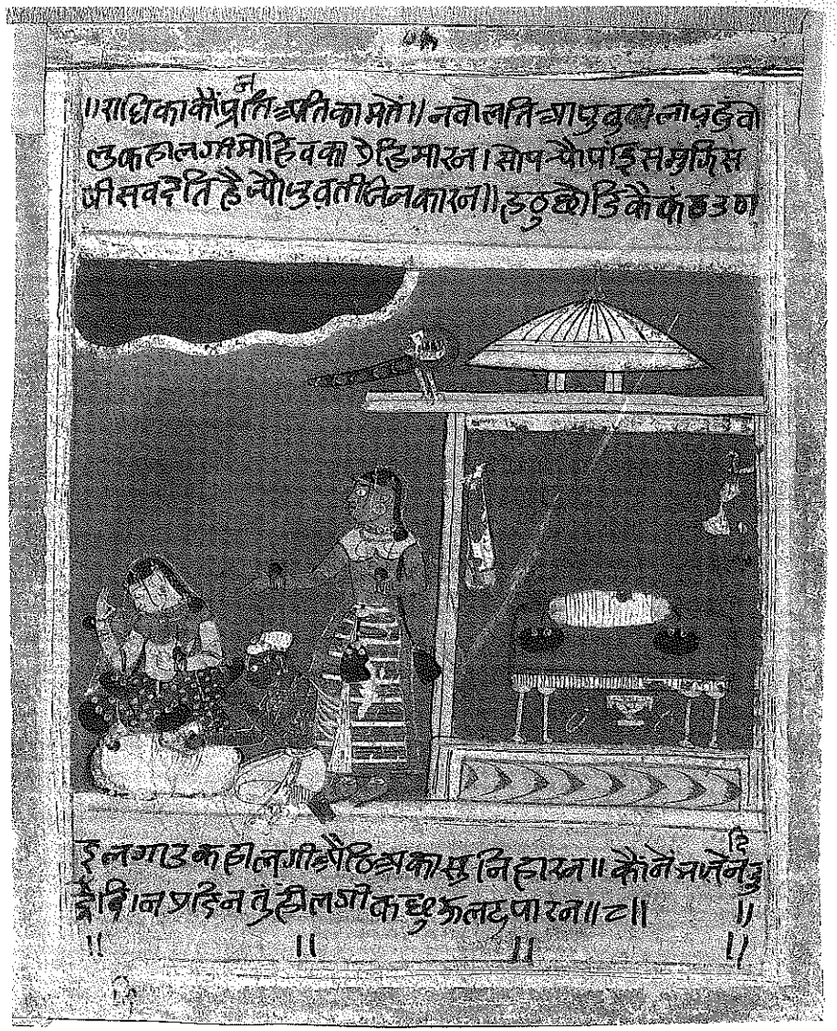
Thus, Sumerian writing came to consist of a complex mixture of three types of signs: logograms, referring to a whole word or name; phonetic signs, used in effect for spelling syllables, letters, grammatical elements, or

parts of words; and determinatives, which were not pronounced but were used to resolve ambiguities. Nevertheless, the phonetic signs in Sumerian writing fell far short of a complete syllabary or alphabet. Some Sumerian syllables lacked any written signs; the same sign could be pronounced in different ways; and the same sign could variously be read as a word, a syllable, or a letter.

Besides Sumerian cuneiform, the other certain instance of independent origins of writing in human history comes from Native American societies of Mesoamerica, probably southern Mexico. Mesoamerican writing is believed to have arisen independently of Old World writing, because there is no convincing evidence for pre-Norse contact of New World societies with Old World societies possessing writing. In addition, the forms of Mesoamerican writing signs were entirely different from those of any Old World script. About a dozen Mesoamerican scripts are known, all or most of them apparently related to each other (for example, in their numerical and calendrical systems), and most of them still only partially deciphered. At the moment, the earliest preserved Mesoamerican script is from the Zapotec area of southern Mexico around 600 B.C., but by far the best-understood one is of the Lowland Maya region, where the oldest known written date corresponds to A.D. 292.

Despite its independent origins and distinctive sign forms, Maya writing is organized on principles basically similar to those of Sumerian writing and other western Eurasian writing systems that Sumerian inspired. Like Sumerian, Maya writing used both logograms and phonetic signs. Logograms for abstract words were often derived by the rebus principle. That is, an abstract word was written with the sign for another word pronounced similarly but with a different meaning that could be readily depicted. Like the signs of Japan's kana and Mycenaean Greece's Linear B syllabaries, Maya phonetic signs were mostly signs for syllables of one consonant plus one vowel (such as *ta, te, ti, to, tu*). Like letters of the early Semitic alphabet, Maya syllabic signs were derived from pictures of the object whose pronunciation began with that syllable (for example, the Maya syllabic sign "*ne*" resembles a tail, for which the Maya word is *neh*).

All of these parallels between Mesoamerican and ancient western Eurasian writing testify to the underlying universality of human creativity. While Sumerian and Mesoamerican languages bear no special relation to each other among the world's languages, both raised similar basic issues in reducing them to writing. The solutions that Sumerians invented before



A painting of the Rajasthani or Gujarati school, from the Indian subcontinent in the early 17th century. The script, like most other modern Indian scripts, is derived from ancient India's Brahmi script, which was probably derived in turn by idea diffusion from the Aramaic alphabet around the seventh century B.C. *Indian scripts incorporated the alphabetic principle but independently devised letter forms, letter sequence, and vowel treatment without resort to blueprint copying.*

3000 B.C. were reinvented, halfway around the world, by early Mesoamerican Indians before 600 B.C.

WITH THE POSSIBLE exceptions of the Egyptian, Chinese, and Easter Island writing to be considered later, all other writing systems devised anywhere in the world, at any time, appear to have been descendants of systems modified from or at least inspired by Sumerian or early Mesoamerican writing. One reason why there were so few independent origins of writing is the great difficulty of inventing it, as we have already discussed. The other reason is that other opportunities for the independent invention of writing were preempted by Sumerian or early Mesoamerican writing and their derivatives.

We know that the development of Sumerian writing took at least hundreds, possibly thousands, of years. As we shall see, the prerequisites for those developments consisted of several features of human society that determined whether a society would find writing useful, and whether the society could support the necessary specialist scribes. Many other human societies besides those of the Sumerians and early Mexicans—such as those of ancient India, Crete, and Ethiopia—evolved these prerequisites. However, the Sumerians and early Mexicans happened to have been the first to evolve them in the Old World and the New World, respectively. Once the Sumerians and early Mexicans had invented writing, the details or principles of their writing spread rapidly to other societies, before they could go through the necessary centuries or millennia of independent experimentation with writing themselves. Thus, that potential for other, independent experiments was preempted or aborted.

The spread of writing has occurred by either of two contrasting methods, which find parallels throughout the history of technology and ideas. Someone invents something and puts it to use. How do you, another would-be user, then design something similar for your own use, knowing that other people have already got their own model built and working?

Such transmission of inventions assumes a whole spectrum of forms. At the one end lies "blueprint copying," when you copy or modify an available detailed blueprint. At the opposite end lies "idea diffusion," when you receive little more than the basic idea and have to reinvent the details. Knowing that it can be done stimulates you to try to do it yourself, but your eventual specific solution may or may not resemble that of the first inventor.

To take a recent example, historians are still debating whether blueprint copying or idea diffusion contributed more to Russia's building of an atomic bomb. Did Russia's bomb-building efforts depend critically on blueprints of the already constructed American bomb, stolen and transmitted to Russia by spies? Or was it merely that the revelation of America's A-bomb at Hiroshima at last convinced Stalin of the feasibility of building such a bomb, and that Russian scientists then reinvented the principles in an independent crash program, with little detailed guidance from the earlier American effort? Similar questions arise for the history of the development of wheels, pyramids, and gunpowder. Let's now examine how blueprint copying and idea diffusion contributed to the spread of writing systems.

TODAY, PROFESSIONAL LINGUISTS design writing systems for unwritten languages by the method of blueprint copying. Most such tailor-made systems modify existing alphabets, though some instead design syllabaries. For example, missionary linguists are working on modified Roman alphabets for hundreds of New Guinea and Native American languages. Government linguists devised the modified Roman alphabet adopted in 1928 by Turkey for writing Turkish, as well as the modified Cyrillic alphabets designed for many tribal languages of Russia.

In a few cases, we also know something about the individuals who designed writing systems by blueprint copying in the remote past. For instance, the Cyrillic alphabet itself (the one still used today in Russia) is descended from an adaptation of Greek and Hebrew letters devised by Saint Cyril, a Greek missionary to the Slavs in the ninth century A.D. The first preserved texts for any Germanic language (the language family that includes English) are in the Gothic alphabet created by Bishop Ulfilas, a missionary living with the Visigoths in what is now Bulgaria in the fourth century A.D. Like Saint Cyril's invention, Ulfilas's alphabet was a mishmash of letters borrowed from different sources: about 20 Greek letters, about five Roman letters, and two letters either taken from the runic alphabet or invented by Ulfilas himself. Much more often, we know nothing about the individuals responsible for devising famous alphabets of the