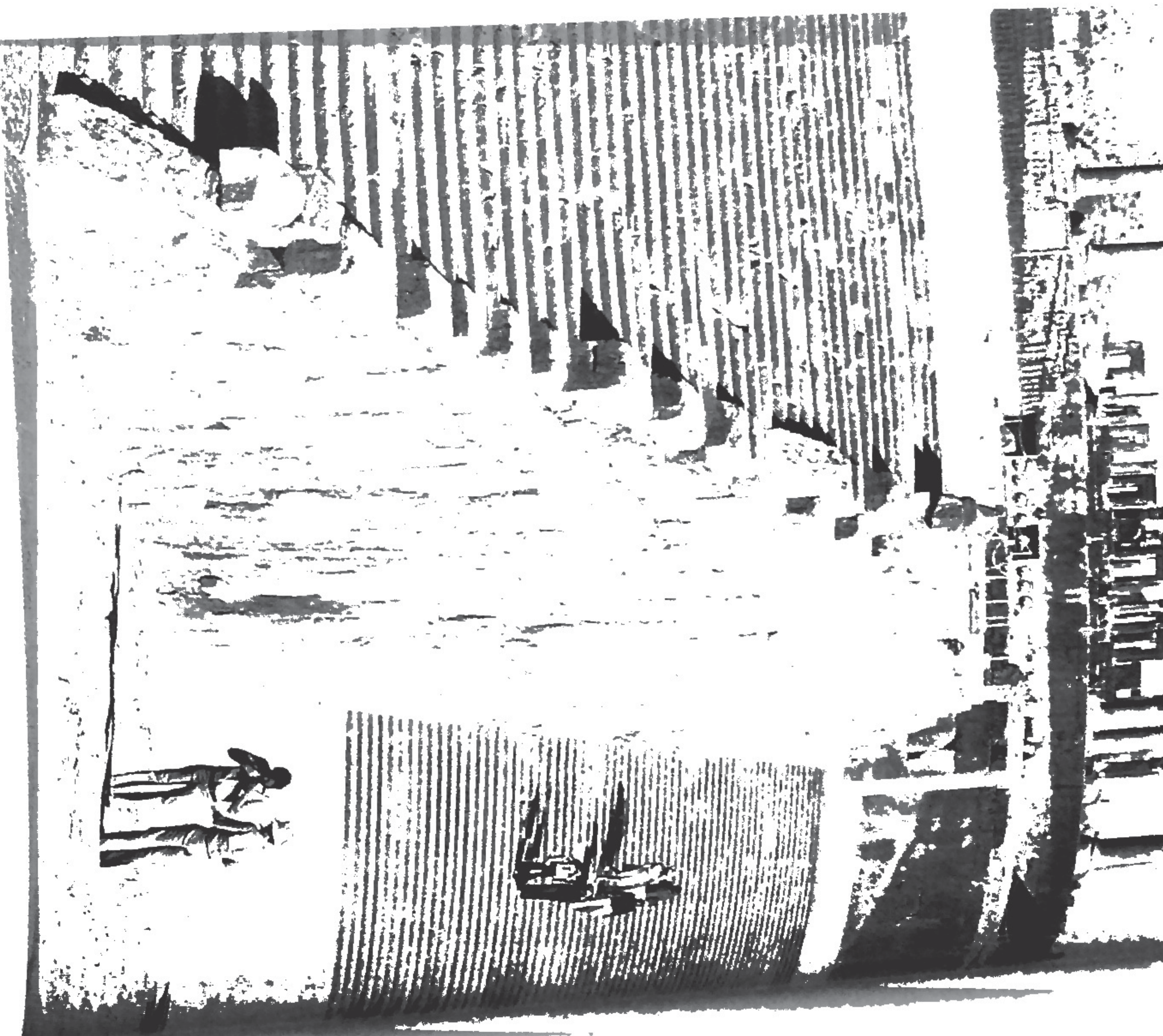


1.17 View of the ruins of the palace, Persepolis, Persia (Iran), ca. 518 BCE.

Seen here are two columns with intact capitals remaining in the audience hall of Darius. The armies of Alexander the Great sacked and burned Persepolis.



1.18 Staircase to the upper terrace, Persepolis, Persia (Iran), ca. 518 BCE.

Isolated columns from the audience hall of Darius are visible, with doorways from Darius's palace in the background and the palace of Xerxes beyond.

beginning of spring, occupied a terrace 1500 by 900 feet; it contained reception courts, banquet rooms, and audience halls in a loosely organized orthogonal layout. King Xerxes's throne room, known as the Hall of a Hundred Columns and completed by Artaxerxes, was the largest roofed space in the palace, able to contain 10,000 people within its 250-foot square plan. Most of the construction was in stone. Stone columns supported wooden roof beams resting on the unique double-headed capitals carved in the form of bulls and lions (Fig. 1.17). Access to the terrace was gained via a flight of stairs flanked by relief sculptures representing delegations from twenty-three nations bringing tribute to the sovereign (Fig. 1.18). These stone figures, shown engaged in the same kind of activities as real-life visitors, provided a foretaste of the pageantry and banquets waiting in the palace above.

The conquests of Alexander the Great ended Persian dominance in 331 BCE. Alexander's armies eventually reached India, where Persian craftsmen appear to have accompanied them and then remained. They helped build the capital at Pataliputra (now Patna) for Chandragupta, where the many-columned halls and animal capitals recall

the palace at Persepolis. Persian architecture became one of the major influences for the early stone architecture of India.

## ANCIENT EGYPT

Popular culture suffers from no shortage of ancient Egyptian images, be they from epic movies depicting Moses and the pharaohs or classic horror films where Boris Karloff, playing the mummy, wanders around menacingly, doling out ancient justice to naïve archaeologists and greedy tomb raiders. All of this is fun, as is wild speculation about the Egyptian pyramids being built by visitors from outer space using anti-gravity beams, but it threatens to obscure the real accomplishments of everyday men and women in the Nile Valley, albeit those of 5000 years ago. Like the Mesopotamians, the ancient Egyptians produced a great architecture by marshaling the forces of their entire civilization and directing those forces in the service of widely held cultural values. This architecture is much more varied than you may imagine, but it is not only largely under-

standable to the modern mind but also highly informative about design ideas applicable in any era.

The geography of Egypt is dominated by one great river, the Nile, which originates in the highlands of Uganda and passes through the Sudan and Ethiopia as it traverses more than 2000 miles before flowing out into the Mediterranean Sea to the north. Within the 600 lower miles of the river valley, agriculture is facilitated by the warm climate and the annual flood deposits of organic silt, which renew the fertility of the fields. On the margins of the valley in dynastic times there were marshes and open lands rich in game. (Today the desert encroaches on these areas.) Outside the rather narrow fertile band bordering the Nile, great expanses of inhospitable desert provided security from outside invasion, just as the Mediterranean served as a barrier for settlements on the Nile Delta. The culture that developed along the banks of the river was thus predominantly rural agricultural, in contrast to urban-oriented settlements in turbulent Mesopotamia. Egyptian life was organized around the annual flooding of the river, and the cyclical rhythm of the seasons fostered a civilization that remained remarkably stable for more than 2000 years. Two centers of Egyptian civilization, with differing cultural practices, arose in pre-historic times: Lower Egypt in the broad Nile Delta, and Upper Egypt in the more narrow southern river valley. At a very early stage, Egyptians also developed writing in the form of hieroglyphs, a system using both pictorial and phonetic symbols to record information.

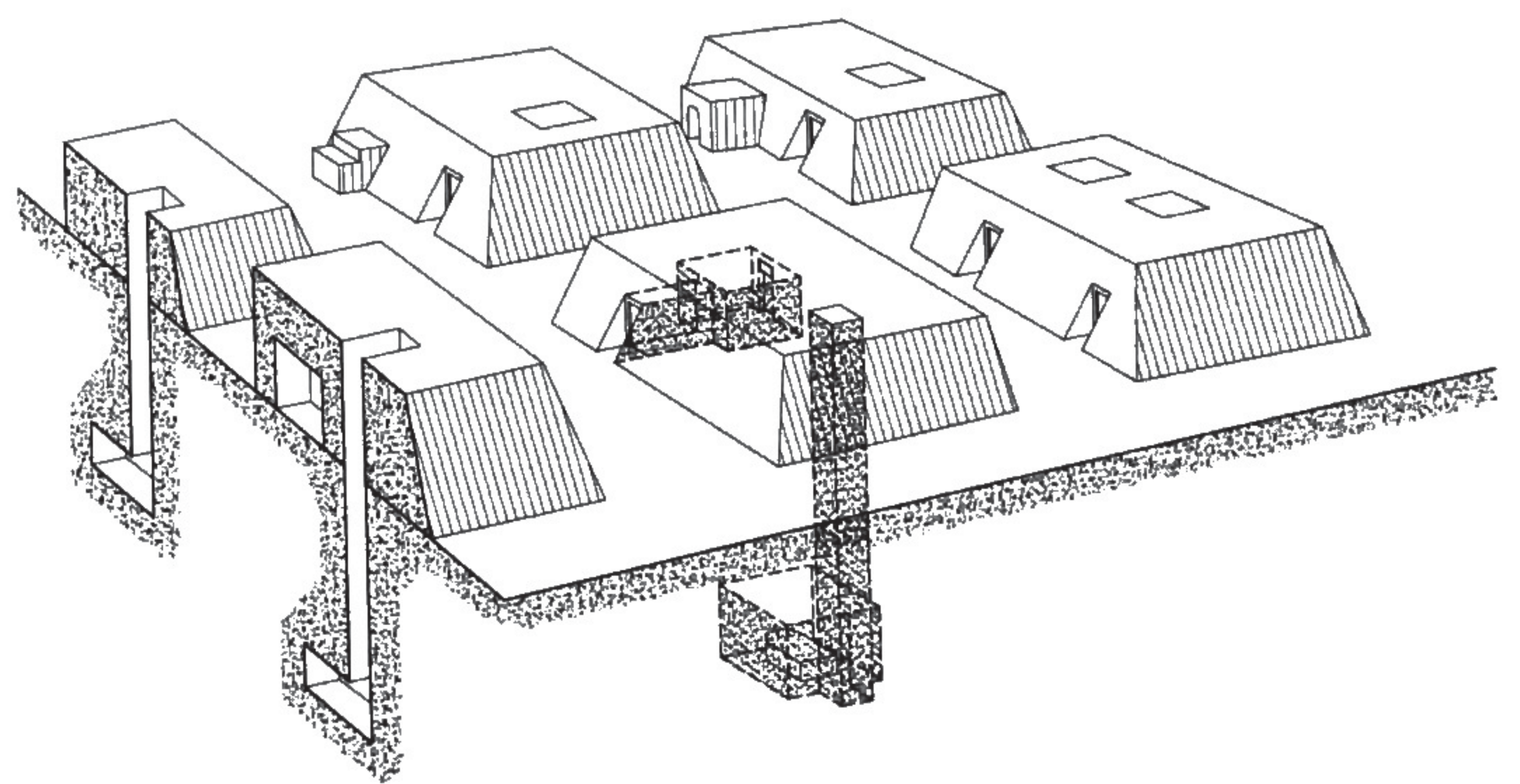
The history of Egypt begins in about 3000 BCE with the union of Upper and Lower Egypt by Menes, the pharaoh king of Upper Egypt, who established his capital at Memphis, near the junction of the two lands. (Please note that dates in Egyptian history, especially for individual pharaohs in the early dynasties, are still matters of scholarly debate. All dates given here should therefore be treated as approximations.) Menes, like all his successors, was both a temporal ruler and a manifestation of the falcon-headed god Horus, the god of pharaohs. When the pharaoh died, he became identified with Osiris, father of Horus and lord of the underworld, and his successor as pharaoh assumed the Horus role. Egyptian theology linked both Osiris and Horus with the sun god Ra, whose symbol in the ancient temple at Heliopolis was the phallic, cone-shaped ben-ben stone, later stylized as a pyramid. The use of pyramid shapes at the top of stone shafts (**obelisks**) or as the building form itself (as in the pyramids) was thus a visual symbol of the connection between the ruler and the sun god.

## THE EARLY DYNASTIC PERIOD AND OLD KINGDOM (FIRST-EIGHTH DYNASTIES, ca. 2920–2134 BCE)

Egyptian history is divided into thirty dynasties, encompassing the period from Pharaoh Narmer's accession (ca. 3000 BCE) to the conquest of Egypt by Alexander the

Great in 332 BCE. What we know of this early period comes largely from funerary monuments and inscriptions, where the focus is on the transition from the world of the living to that of the dead. Egyptians believed strongly in an afterlife in which the *ka*, or life-force, was reunited with the *ba*, or physical manifestation, to become an *akh*, or spirit. Elaborate rituals were performed inside tomb chambers to ensure that the transformation from life to death was successful. Preservation of the physical body (or at least a temporary forestalling of its putrefaction) after death was of great importance, as was the provision of household furnishings, surrogate servants, food, drink, and a suitable permanent chamber. The *ka* of an important person, especially the pharaoh, who was inadequately prepared for the afterlife might wander unsatisfied about the world and cause mischief for the living. It was therefore in society's interest to ensure that the pharaoh's body and spirit were well served. This goal led to the construction of enduring tombs for royalty and the development of mummification to preserve the body. Tombs, rather than temples or palaces, became the most lasting religious structures.

**Mastabas**, the earliest tombs, were built as eternal houses for the departed and were in all likelihood based on the design of the dwellings of the living. Ordinary houses were constructed of reed, thatch, and wood, materials wholly unsuited for a permanent residence, so the builders of mastaba tombs sought greater durability by using brick while retaining characteristic details provided by the customary bundled reeds and wooden supports. The basic mastaba (Fig. 1.19) was a blocklike structure above ground containing a small room for offerings and another chamber for the body and a statue of the deceased. Worldly goods entombed with the dead soon attracted thieves, so an early revision of mastaba design added a deep shaft under the building. The body was placed at its base, and the shaft was then filled with stone and rubble to deter would-be robbers. In the above-ground chamber, or **serdab**, a statue of the deceased would receive offerings. A later change toward increasing permanence involved using stone in the construction of the mastaba.



1.19 Drawing of the mastaba tombs.

This aerial view shows the burial chambers beneath the structures and small chambers, or serdabs, provided at ground level for offerings to the spirit of the deceased. It is thought that these tombs, constructed of sun-dried brick or stone, were based on designs of actual dwellings constructed of less durable materials.

# “HYDRAULIC” CIVILIZATIONS

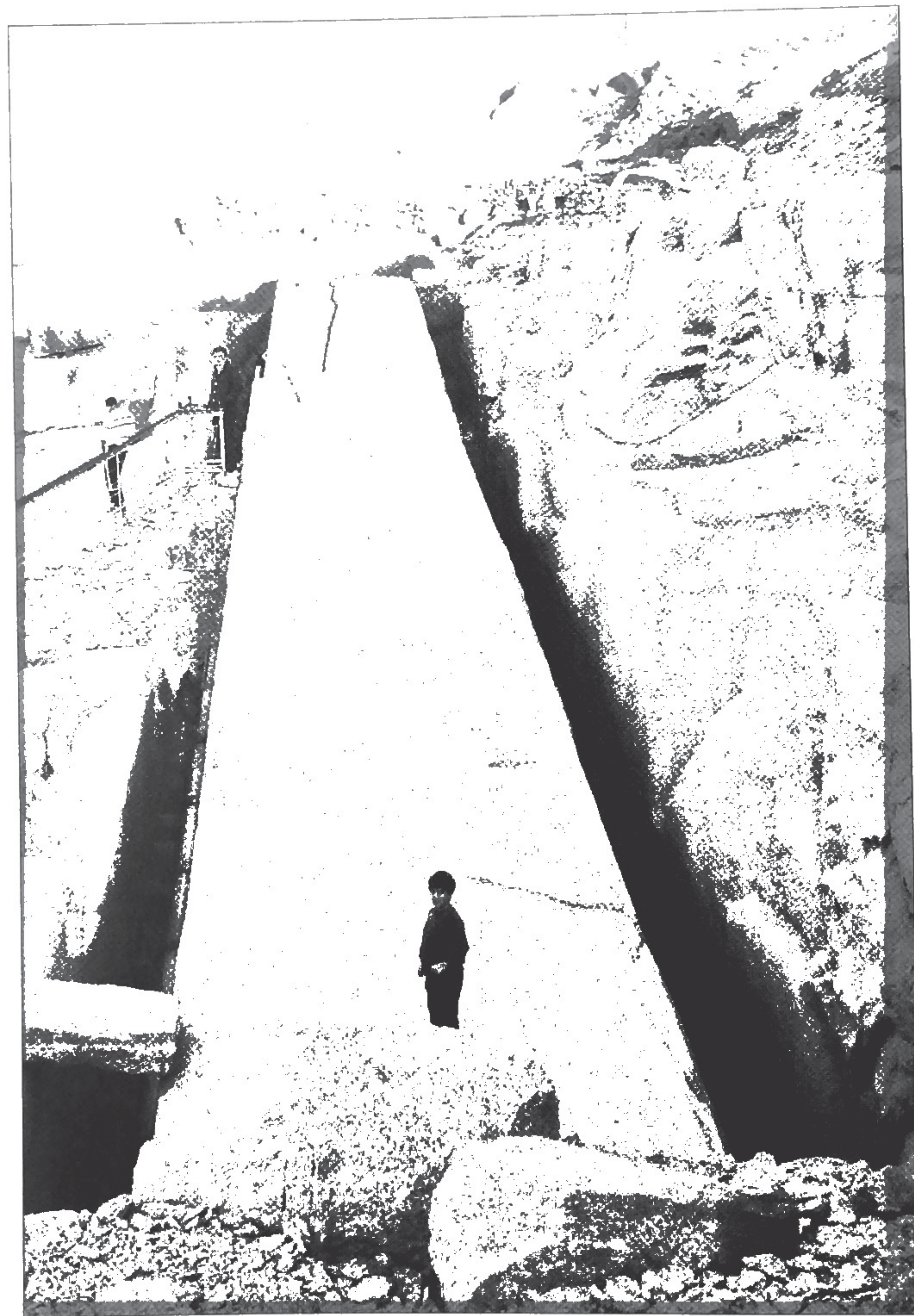
by Dan MacGilvray

*There is but little rain in Assyria. It is this which nourishes the roots of the corn; but it is irrigation from the river that ripens the crop and brings the grain to fullness: it is not as in Egypt, where the river itself rises and floods the fields: in Assyria they are watered by hand and by swinging beams. For the whole land of Babylon, like Egypt, is cut across by canals. The greatest of these is navigable: it runs . . . from the Euphrates to the Tigris . . . all the land . . . watered by the Nile in its course was Egypt, and all who dwelt lower down than the city Elephantine (Aswan) and drank of that river's water were Egyptians.*

*. . . there are no men, neither in the rest of Egypt, nor in the whole world, who gain from the soil with so little labour; they have not the toil of breaking up the land with the plow, nor of hoeing . . . the river rises of itself, waters the fields, and then sinks back again; thereupon each man sows his field and sends swine into it to tread down the seed, and waits for the harvest . . .*

**T**he Greek historian Herodotus (484–425 BCE) traveled extensively throughout the ancient world and wrote the first narrative history. He was a keen observer of culture, and these quotations define one of the essential characteristics of Mesopotamian and Egyptian civilizations: their dependence on rivers. Water is an essential ingredient of all life, and flowing water is required for the development of civilization, not only for drinking and irrigation, but also to remove the human waste that accumulates in areas of dense population. Thus, all of the early civilizations from that of the Indus to the Mayans were founded on rivers. We refer to these as “hydraulic” civilizations.

Of necessity, a hydraulic civilization is a cooperative federation, in contrast to, say, a group of squabbling city-states. In a given watershed, strong centralized control is required for the construction of an inter-dependent system of canals to divert water for irrigation and drain swamps for cultivation, or dams and levees for flood control and water retention. Early hydraulic engineers learned the techniques of



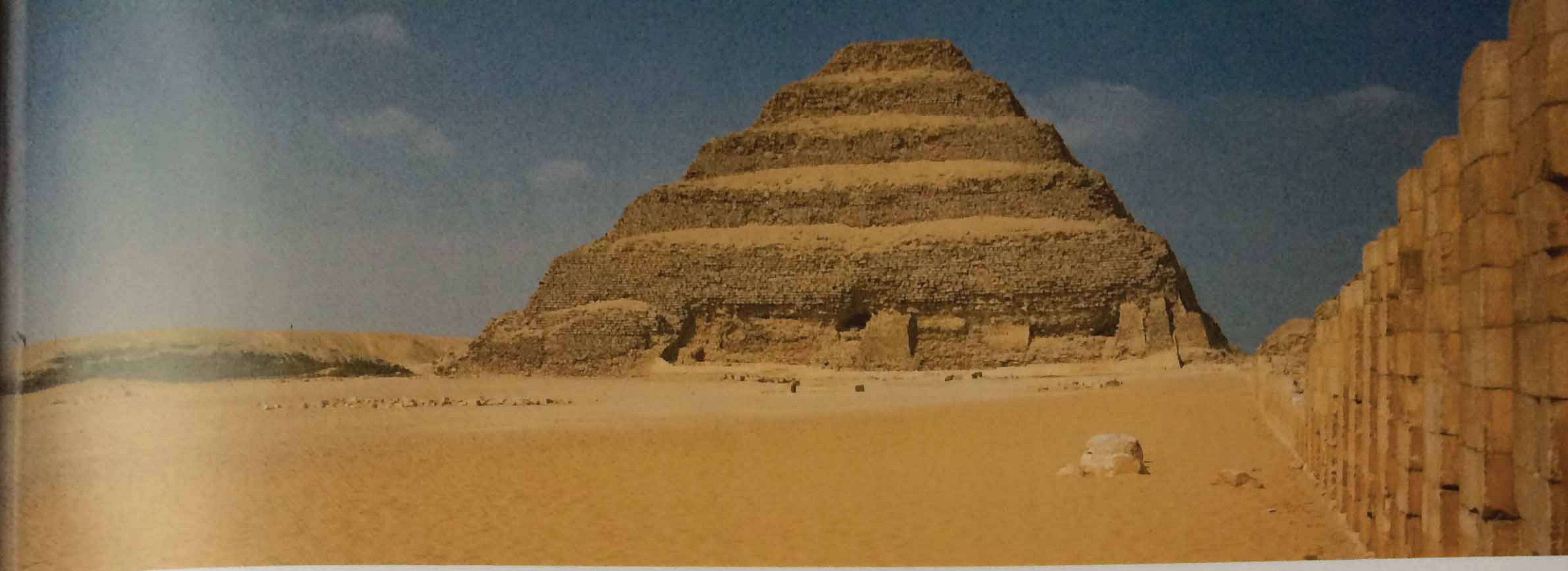
1.20 Obelisk in a quarry, Aswan, Egypt.

surveying and developed the skills to manage large-scale construction projects as they struggled to control the waters that brought both abundance and destruction. As Herodotus notes, the nation of Egypt defined itself by the Nile, and there is no doubt that the engineers of the pyramids learned to survey, to level,

and to organize large work forces on the banks of the river. It has also been speculated that, because the farmers were inactive during flood times, they were available for conscription onto construction work gangs for massive projects like the pyramids.

The Tigris, Euphrates, and Nile rivers also served as the primary transportation arteries for the movement of goods between the various communities that lined them. Even today, in the age of jet travel, by far the cheapest means of moving freight per ton-mile is the river barge. In medieval times it was ten times cheaper to move cargo by boat than by ox-cart. And, because of the Nile, the ancient Egyptians had no use for wheeled vehicles or even paved

roads; the chariot was a foreign import that arrived late to the water-borne Egyptians, who, not surprisingly, developed sophisticated construction techniques for boats of all sizes. In tomb paintings the largest are shown laden with granite obelisks, such as that in Figure 1.20, a cargo of up to 1000 tons.



1.21 The step pyramid, Saqqara, Egypt, ca. 2630 BCE.

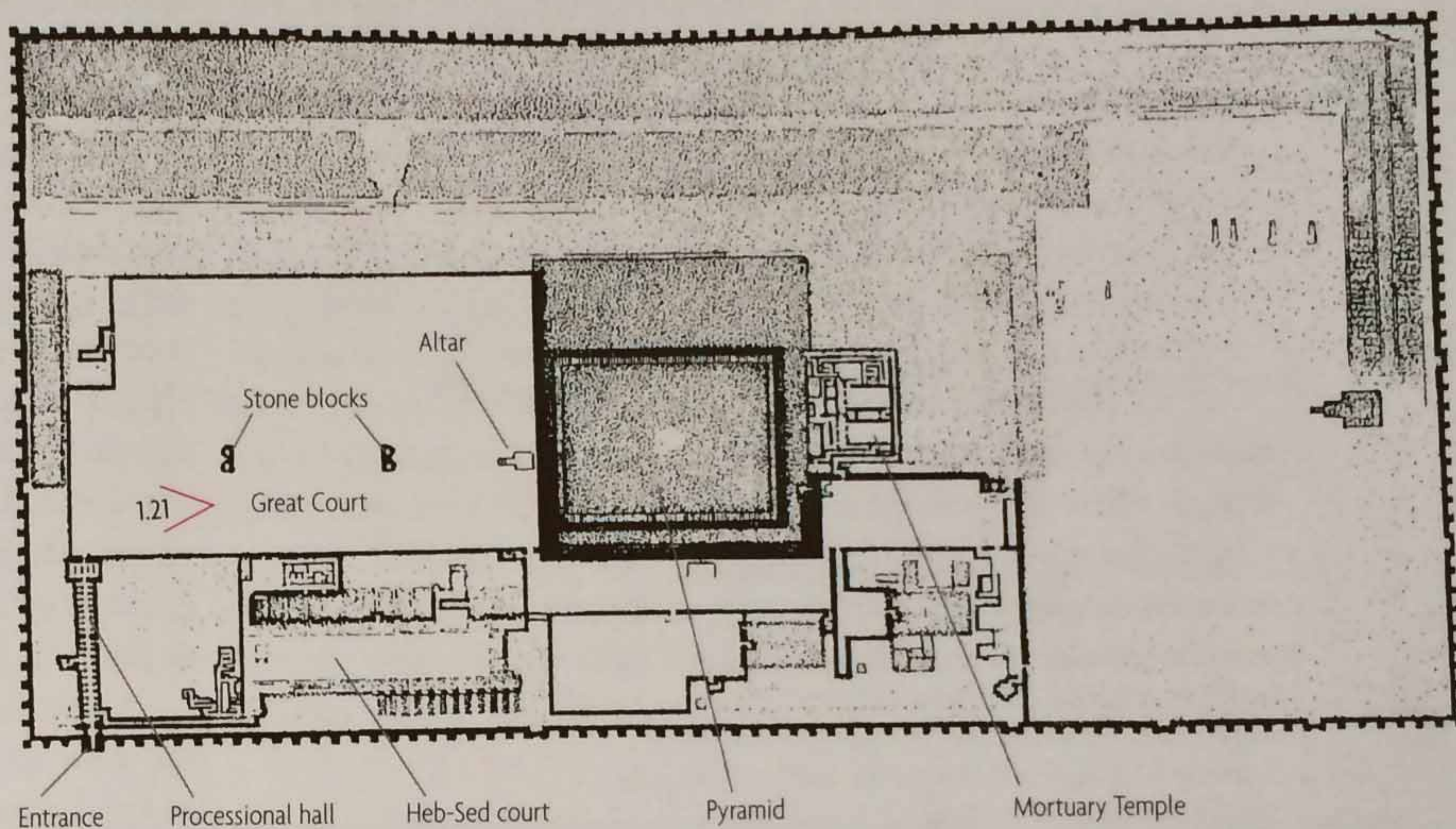
As the first monumental stone construction in Egypt, this tomb set the precedent for later pyramids of the pharaohs. Its architect, Imhotep, was remembered for his genius and later revered as a deity.

1.22a Plan of Djoser's funerary complex, Saqqara, Egypt, ca. 2630 BCE.

The step pyramid is the rectangular element in the center, dominating the Great Court, which is reached through the narrow Processional Hall at the lower left. The Egyptians provided the court's two B-shaped stone blocks so that Djoser's ka could continue to run the ceremonial race between them, symbolizing for eternity the governmental unity of Upper and Lower Egypt.

1.22b Section and plan of the step pyramid, Saqqara, Egypt, ca. 2630 BCE.

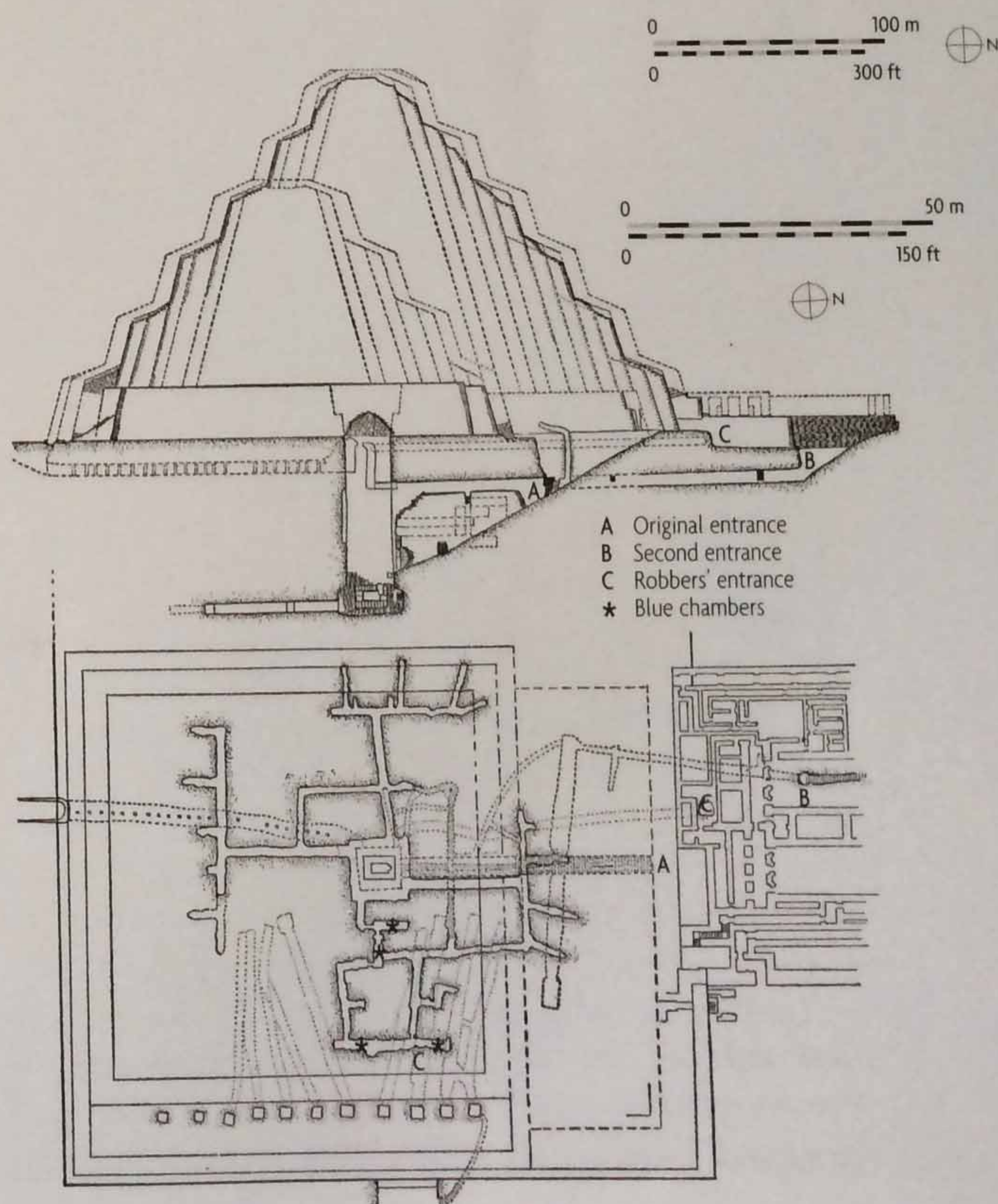
The section drawing shows the successive stages of construction, through which the original mastaba form was enlarged to become a pyramid, with the burial chamber under the center. The plan drawing shows the industry of later tomb robbers who tunneled in to recover treasure buried with Djoser.

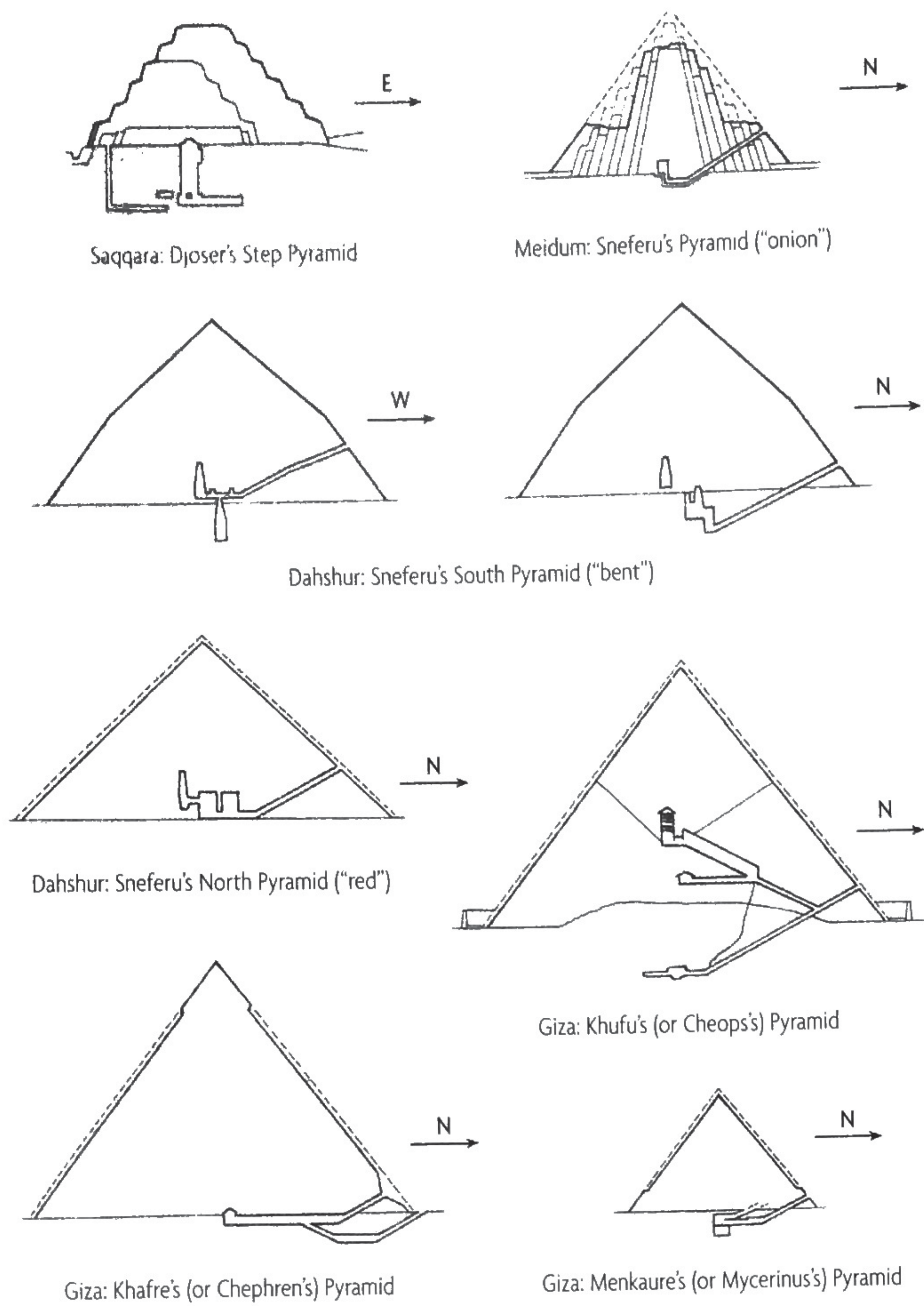


## THE FIRST PYRAMIDS

As the religious ritual prescribed by the priesthood evolved to enhance further the significance of the pharaoh, the mastaba was likewise enlarged, eventually producing the pyramid. At death the pharaoh accompanied the sun god on his daily journey across the sky, so he needed to be lifted skyward. The pyramid, initially an upward-stepping form like the ziggurat, whose peak caught the first rays of morning light, was the emblem of the sun god as worshiped at Heliopolis. The shape also makes symbolic reference to the annual rebirth of nature, for as floods recede, the first signs of plant life appear on small hillocks. Thus the stepped and eventually the true pyramid's form represented both daily and yearly rebirth throughout eternity.

Imhotep, architect to the Third-Dynasty pharaoh Djoser (2630–2611 BCE), is credited with designing the first pyramid, for Djoser's funerary complex at Saqqara, outside Memphis (Fig. 1.21). This was also Egypt's first monumental construction in stone, no small factor in its survival through 4600 years. The complex is a large rectangle in plan, covering thirty-five acres, surrounded by a wall thirty-three feet high and a mile long (Figs. 1.22a,b). There is only





1.23 Sections through pyramids at Saqqara, Meidum, Dahsur, and Giza, Egypt, ca. 2550–2460 BCE.

These drawings indicate the relative sizes of the major pyramids from the Third and Fourth dynasties. That of Cheops remains the largest pile of stones ever assembled, and, among the pyramids, it also has the most complex array of interior passages and chambers.

one entrance, a small door in the southeast corner that leads into a narrow colonnaded processional hall. At the end of the hall, one enters the main courtyard dominated by Djoser's stepped pyramid, which rises 197 feet above its 397-by-358-foot base. Begun as a mastaba, the pyramid was built up in several stages to attain its present shape, a mass rising in six steps. The exterior of the pyramid was faced with dressed limestone, while the courtyards and surrounding buildings are thought to be representations of Djoser's earthly palace in Memphis, rebuilt here to last for eternity. The appearance and typical details of the original materials are imitated in stone: reed-bundle and papyrus-stalk columns, log ceilings, even a stone hinge for an immobile stone door. North of the pyramid is the mortuary temple in which the pre-burial ritual was performed. A statue of Djoser looking outward sits in a small chamber, with a small aperture cut in the wall in front of the statue's stone eyes being the only access to the outside world.

Djoser's complex includes areas for the practice of rituals that are not completely understood today, but that were apparently important symbols of the bond between Upper and Lower Egypt. The great court was the scene of

the Heb-Sed race, run annually by the pharaoh to ensure fertility of the fields. The course consisted of four circuits of the court in each direction, clockwise for half of the kingdom and counterclockwise for the other half. Djoser had two burial chambers to symbolize his power and paternity over Upper and Lower Egypt. One chamber, located beneath the pyramid, contained his mummy in an alabaster coffin. The access passage was blocked by a stone plug six feet in diameter and weighing six tons, but this was inadequate protection against robbers, who nonetheless gained access to the tomb in antiquity. In 1928 excavators discovered the second chamber in the south side of the perimeter wall. Although it too had been plundered, the chamber originally contained the embalmed internal organs of the pharaoh, emblematic of his fertility and his protection of Lower Egypt. Grave robbers did not steal the handsome blue **faïence** wall decorations, which are now all that remains of the interior. These tiles are set into horizontal and vertical stone members to represent rush matting between wooden slats attached to larger wooden supports. On one wall is a relief carving depicting Djoser running the Heb-Sed race. Wearing the white crown of Upper Egypt, Djoser is portrayed in the manner peculiar to Egyptian art, with head, legs, and feet shown in profile and the torso shown frontally. In this one view Egyptian artists captured the essential features of the human body with great exactitude, even though the pose is not a "realistic" or natural one.

From its beginnings at Saqqara, the evolution of what we now think of as the "true" pyramid proceeds through at least three major projects before its culmination in the Fourth-Dynasty tombs at Giza, outside Cairo (Fig. 1.23). All three of these developmental pyramids were built or modified for one of the first pharaohs of the Fourth Dynasty, Sneferu (2575–2551 BCE), whose cult remained active for over 2000 years after his death. At Meidum, six miles south of Saqqara, Sneferu added an outer layer to the pyramid that may have been begun for Huni, the last pharaoh of the Third Dynasty. It began with a stepped core of seven stages, which was transformed into a true pyramid with the addition of two overbuildings. As the third and final outer casing of limestone was being installed, there is evidence that the upper portions of the work collapsed because the pyramid's stonework was insufficiently supported, given the relatively steep angle of inclination ( $51^{\circ} 50' 35''$ ). Had it been completed as planned, the pyramid would have reached nearly 302 feet in height. As it stands, with its stepped core rising above the rubble, it has been given the descriptive name of an "onion" pyramid. Entrance was through a sloping corridor opening off the north side, descending below ground, and then rising a short distance vertically to the burial chamber at the center of the pyramid's base. Corbeled construction in the vault of this chamber marks the first time this technique was employed in stone by the Egyptians, although it had been used earlier in brick.

The collapse of the Meidum pyramid had an impact on another of Sneferu's pyramids under construction at the same time at Dahshur, about twenty-eight miles south of Meidum. There, a partially finished structure was transformed to create the so-called "bent" pyramid that began with a 616-foot-square base and sides inclined at  $54^{\circ} 27' 44''$ . Observing the collapse at Meidum, the builders at Dahshur changed to a lower inclination angle of  $41^{\circ} 22'$  when the pyramid was half-built. Eventually reaching a height of 344 feet, the bent pyramid gains added stability from its firm limestone foundation and core, large stone casing blocks that are slightly inclined to the center, and the reduced angle of inclination. These stabilizing design features were incorporated from the beginning in the third pyramid of Sneferu, the north or "red" pyramid, also at Dahshur. (The color name derives from oxidation of the limestone used for its core, exposed after stone scavengers removed the white limestone casing.) From a base 722 feet square, the north pyramid rises at a constant  $43^{\circ} 22'$  angle to its apex 344 feet above the ground. Its profile is thus relatively low, a testimony to the conservative attitudes of its designers.

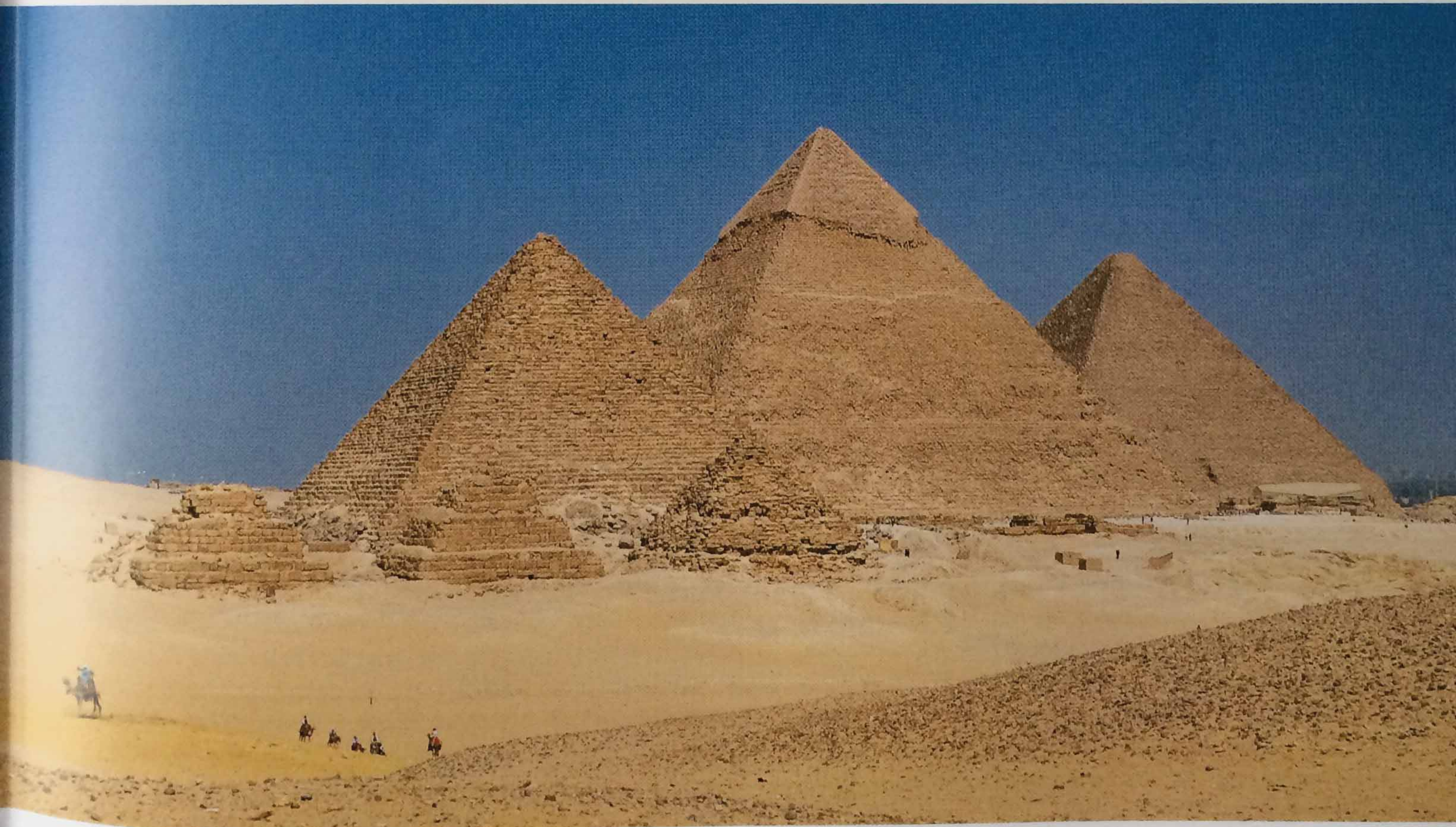
#### FOURTH-DYNASTY PYRAMIDS AT GIZA

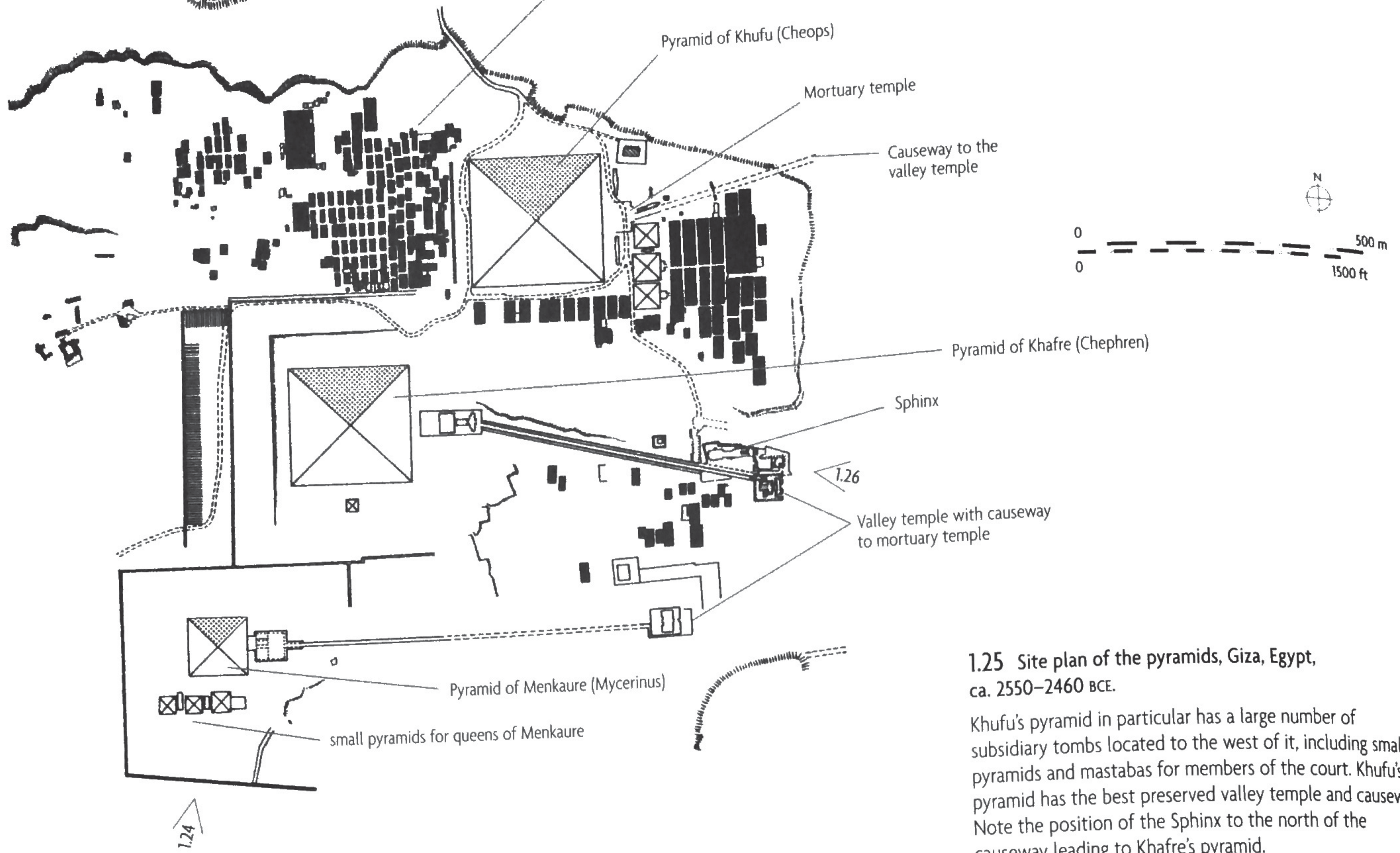
The trio of large pyramids at Giza (2550–2460 BCE) are the work of Sneferu's descendants, the Fourth-Dynasty pharaohs known as Khufu, Khafre, and Menkaure (or Cheops, Chephren, and Mycerinus in Greek transliteration) (Figs. 1.24–1.25). The largest pyramid, that of Khufu, who reigned 2551–2528 BCE, was built first and planned from the start to be a true pyramid of unprecedented proportions. The 755-by-755-foot base covers over thirteen acres; the sides rise at an angle of  $51^{\circ} 50' 40''$  to an apex at 481 feet. Most of the stone in the pyramid is limestone, although the large pharaoh's chamber in the center is made of granite. Nothing built in stone before or since has rivaled the Great Pyramid of Khufu for sheer size.

Khufu's pyramid is not completely solid, however. Three burial chambers are built within it, one excavated out of foundation bedrock and the other two constructed as the stone mountain was erected. Although these were once thought to represent changes made in design as work progressed, they are now interpreted as deliberate accommodations. The roughly finished lowest chamber is thought to represent the underworld. The middle chamber, the so-called Queen's Chamber, probably contained an over-life-sized statue of Khufu and served as his spirit chamber, or serdab. The top, or King's Chamber, beautifully constructed of red granite, contains a granite sarcophagus in which Khufu was in fact buried. To transfer the tremendous weight of the pyramid around the ceiling of the King's

1.24 Pyramids, Giza, Egypt, ca. 2550–2460 BCE.

Khufu's pyramid is the farthest back, to the right of Khafre's pyramid (distinguished by the remnant of outer casing stones at its peak). In front of Khafre's pyramid is that of Menkaure, while three much smaller pyramids in the foreground belonged to queens of Menkaure.





1.25 Site plan of the pyramids, Giza, Egypt, ca. 2550–2460 BCE.

Khufu's pyramid in particular has a large number of subsidiary tombs located to the west of it, including smaller pyramids and mastabas for members of the court. Khufu's pyramid has the best preserved valley temple and causeway. Note the position of the Sphinx to the north of the causeway leading to Khafre's pyramid.

Chamber, eleven pairs of granite beams were set as a gabled brace or saddle roof extending into the mass of the pyramid above the chamber. Five massive sets of horizontal granite slabs form relieving chambers stacked between the saddle roof and the flat ceiling of the crypt as a means of reducing weight and pressure from above. The corbeled gallery leading to this chamber is also a construction marvel, rising twenty-six feet in height, a splendid contrast to a four-foot-high ascending passage to which it connects.

Both the King's and Queen's chambers have pairs of small shafts angling upward through the mass of the pyramid that may have been intended for ventilation. Their particular orientation implies connection to the pole star (north side) and Orion (south side), although the precise function and symbolic meaning of these ventilation shafts remain unclear.

Next in sequence of construction (and only slightly smaller in size) is the pyramid of Khafre, a son of Khufu, who reigned 2520–2494 BCE. Khafre's pyramid is 705 feet square at the base and rises at an angle of  $53^{\circ} 20'$  to an ultimate elevation of 471 feet. In many photographs of the Giza pyramids, this one seems the tallest of the three, but this is only because it stands on higher ground than that of Khufu. Khafre's monument is readily distinguished by the substantial fragment of the original smooth limestone casing that survives at the apex. On the inside there is a single tomb chamber in the center of the pyramid at the base level. A passageway in the north side provides access to the room, which, like all the tomb chambers in pyramids, was pillaged in ancient times.

The smallest of the Giza trio of major pyramids belonged to Menkaure, a son of Khafre who reigned 2490–2472 BCE. Containing less than one-tenth of the amount of stone of Khufu's pyramid, Menkaure's tomb seems to have been erected hurriedly and with less care than those of his predecessors. We know that it was not finished before Menkaure died. Its dimensions—335 by 343 feet at the base, a slope of  $51^{\circ} 20' 25''$ , and 213 feet high—maintain the general proportions established by the neighboring tombs. Menkaure's successor, Shepseskaf, the last pharaoh in the Fourth Dynasty, chose not to have a pyramid burial, and although pyramids continued to be built by later rulers, the quality and scale of the Giza trio were never exceeded.

Associated with each of the pyramids were ancillary temples that are now largely ruins. Alongside the Nile was a lower or valley temple, where the boat bearing the pharaoh's body would land to disembark its royal cargo. The valley temple may have been the place where the process of mummification took place, although the evidence is not entirely clear on this point. A causeway connected this valley temple to the upper or mortuary temple at the base of the pyramid itself. Here the corpse would receive a final ritual cleansing prior to entombment.

Of all the Giza valley temples, the lower temple of Khafre remains in the best state of preservation. Essentially square in plan, with thick limestone walls encased in red granite, its central hall is an inverted T-shape. Red granite piers supported a roof with a clerestory; the windows were set so that sunlight coming through them illuminated the twenty-three statues of the pharaoh placed