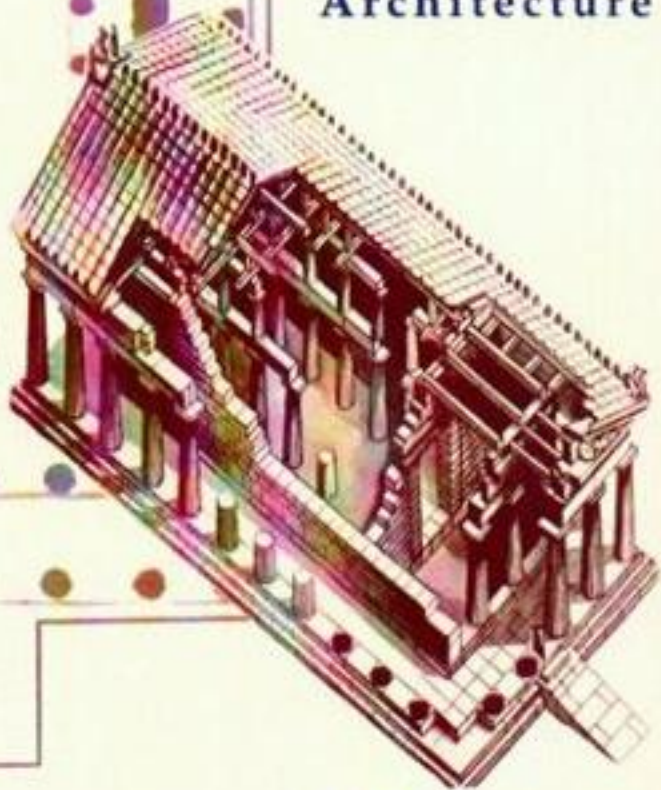


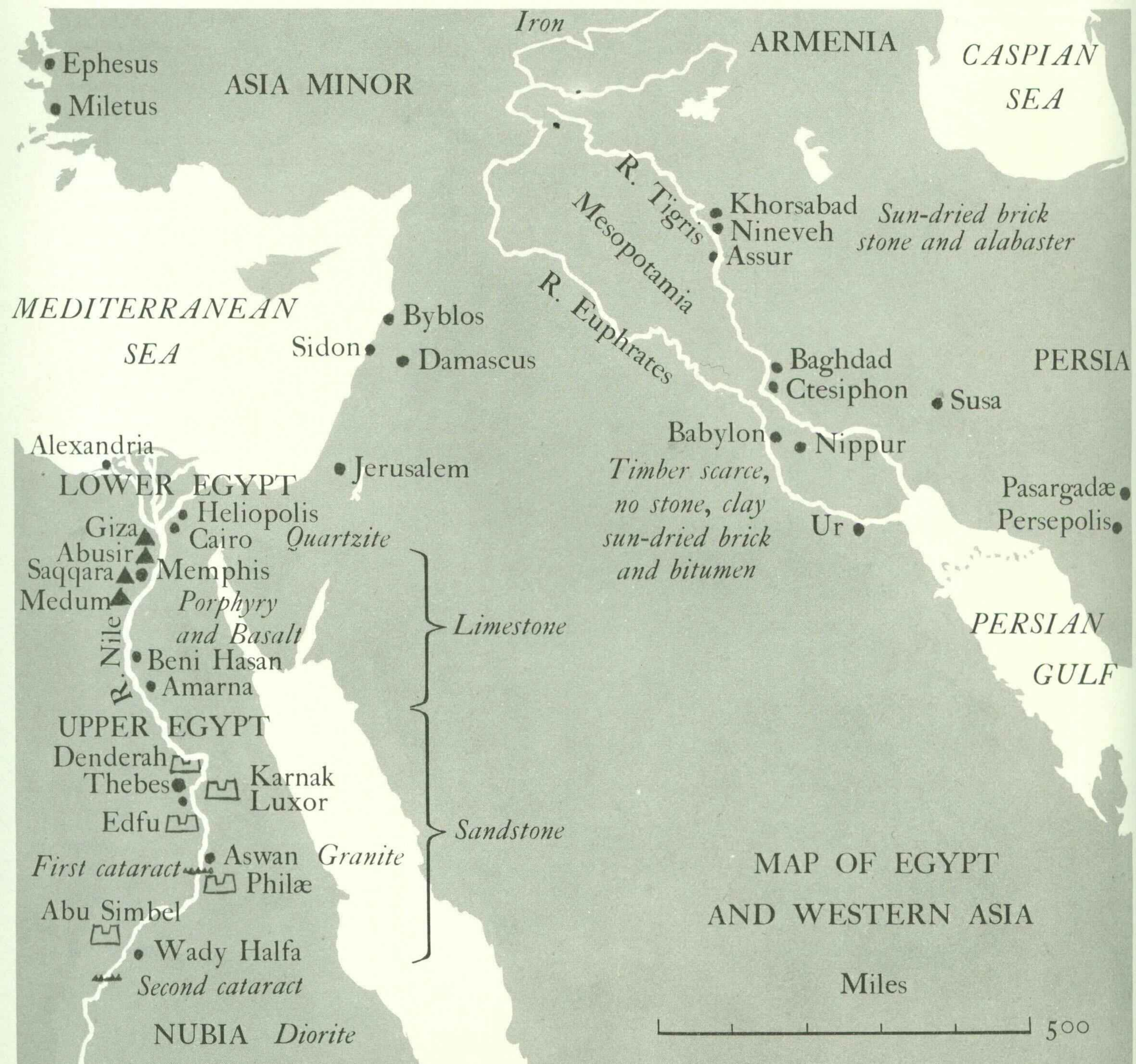
Graphic  
History  
of  
Architecture



JOHN  
MANSBRIDGE

# EGYPT

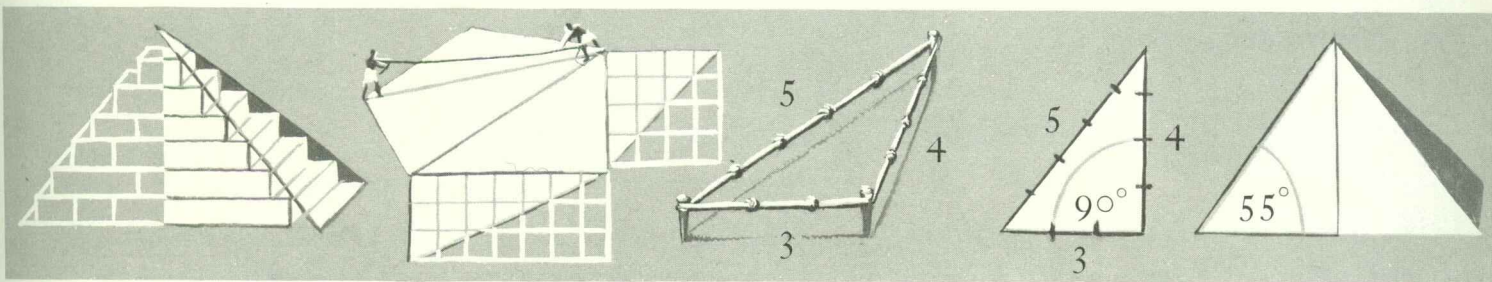
THE ARCHAIC PERIOD		THE OLD KINGDOM				First Intermediate Period	THE MIDDLE KINGDOM		Second Intermediate Period	
Dynasty I	II	III	IV	V	VI		IX	XII		
c.3200 B.C.	2980	2789	2680	2565	2420	2258	2134	1991	1786	1570
Union of Upper and Lower Egypt Capital: Heliopolis		Capital: Memphis The Age of the Pyramids					The Feudal Age Capital: Thebes		Invasion of the Hyksos from Asia	



# INTRODUCTION

THE NEW KINGDOM			THE LATE PERIOD			THE PTOLEMAIC PERIOD
XVIII	XIX	XX	XXI	-	XXXI	
1570	1314	1197	1085	671-663	525	332
The Egyptian Empire in Asia and Nubia Capital: Thebes				Assyrian invasion	Domination of Persia	Egypt a Roman province

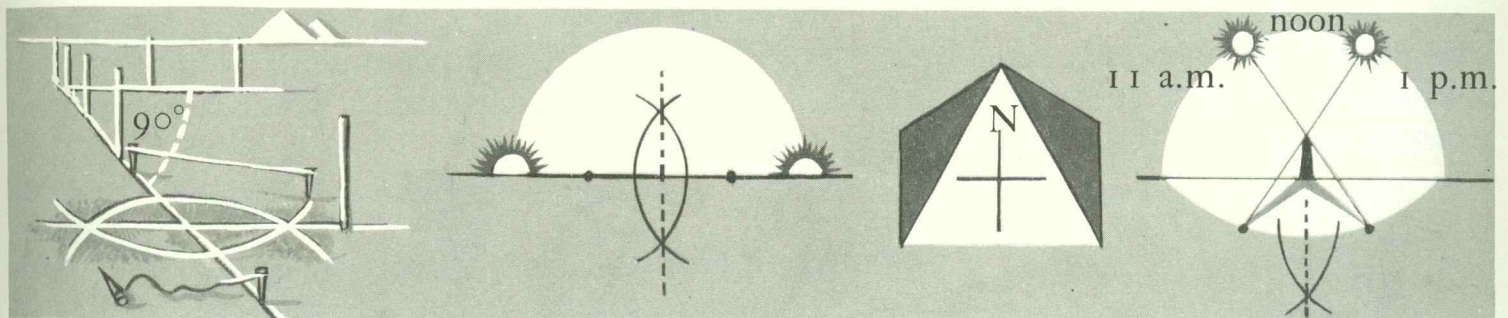
Egypt was a narrow strip of highly productive soil, 8 to 12 miles wide, along the banks of the Nile, about one-fifth of the area of England and Wales. From pre-dynastic times sun-dried mud bricks were used for houses, but these have not survived: timber was scarce and hence arches were built without centering. There was however an abundance of limestone, sandstone and granite. The planning of irrigation canals and fields, necessitated by the annual inundations of the Nile, demanded a system of geometry (Gk land measuring). Believing in a life after death, the Egyptians thought that the body should be preserved in a lasting tomb; this became a geometric construction of great solidity and permanence.



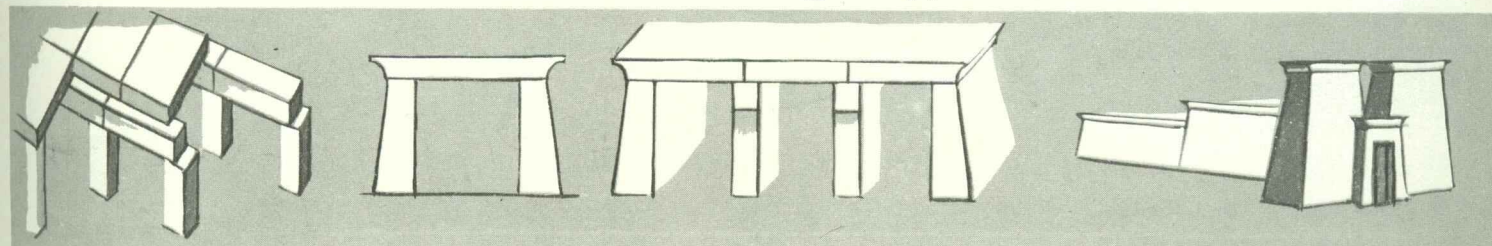
Measurement

The Right Angle

The 'Egyptian Triangle'



Method of orientating the pyramids



Temples constructed with columns, beams and massive, battered external walls

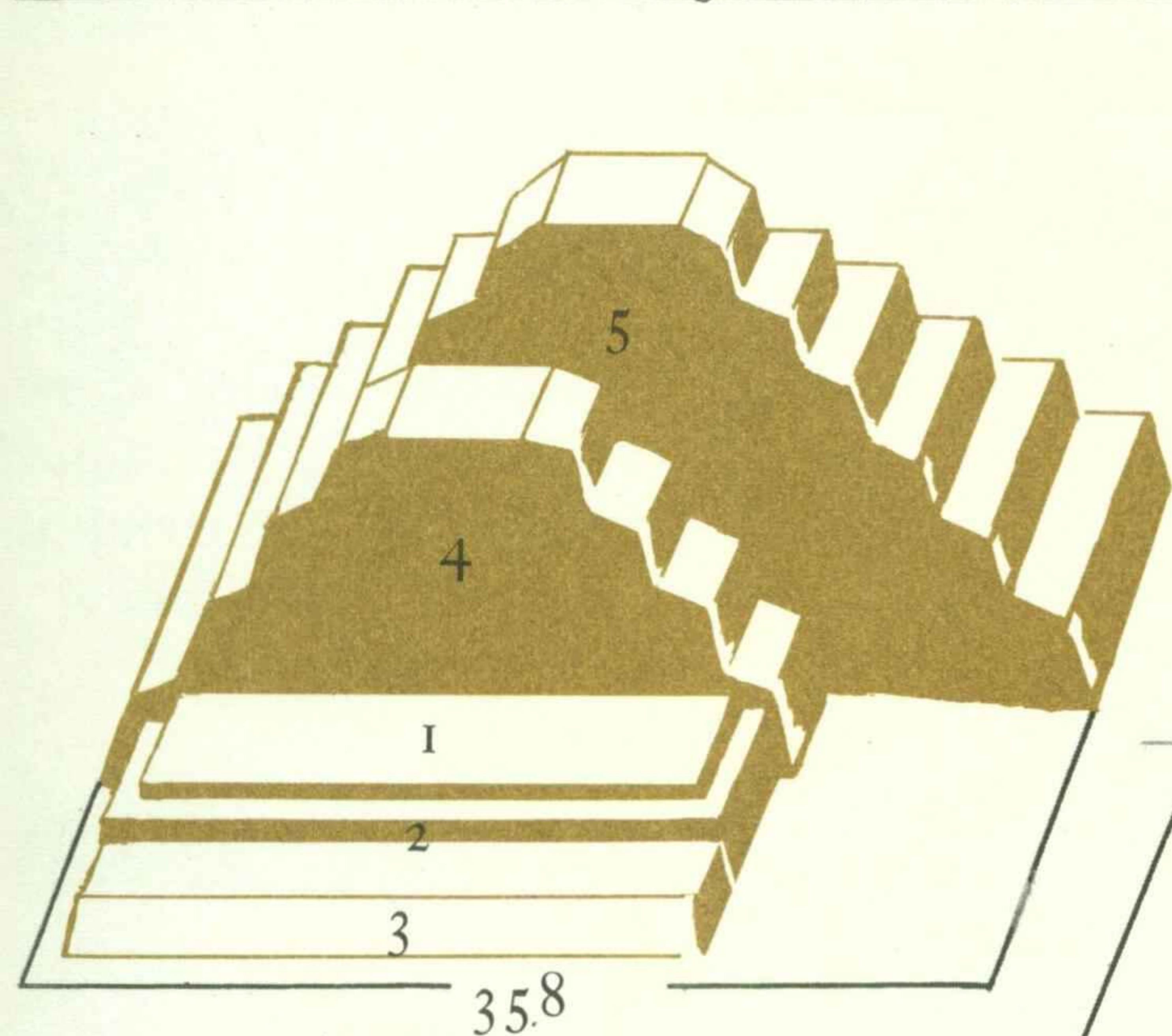
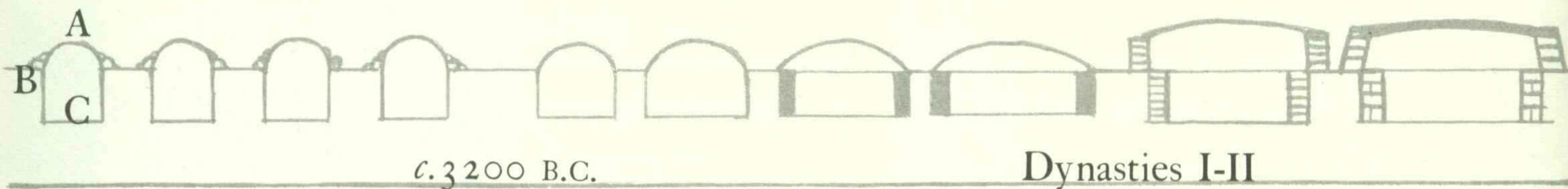
# EGYPT

Pit graves in desert cemeteries:  
sand heap A surrounded by  
circle of stones B over grave C

Pit graves transformed into  
tombs by brick lining and flat  
wooden or arched brick roofs

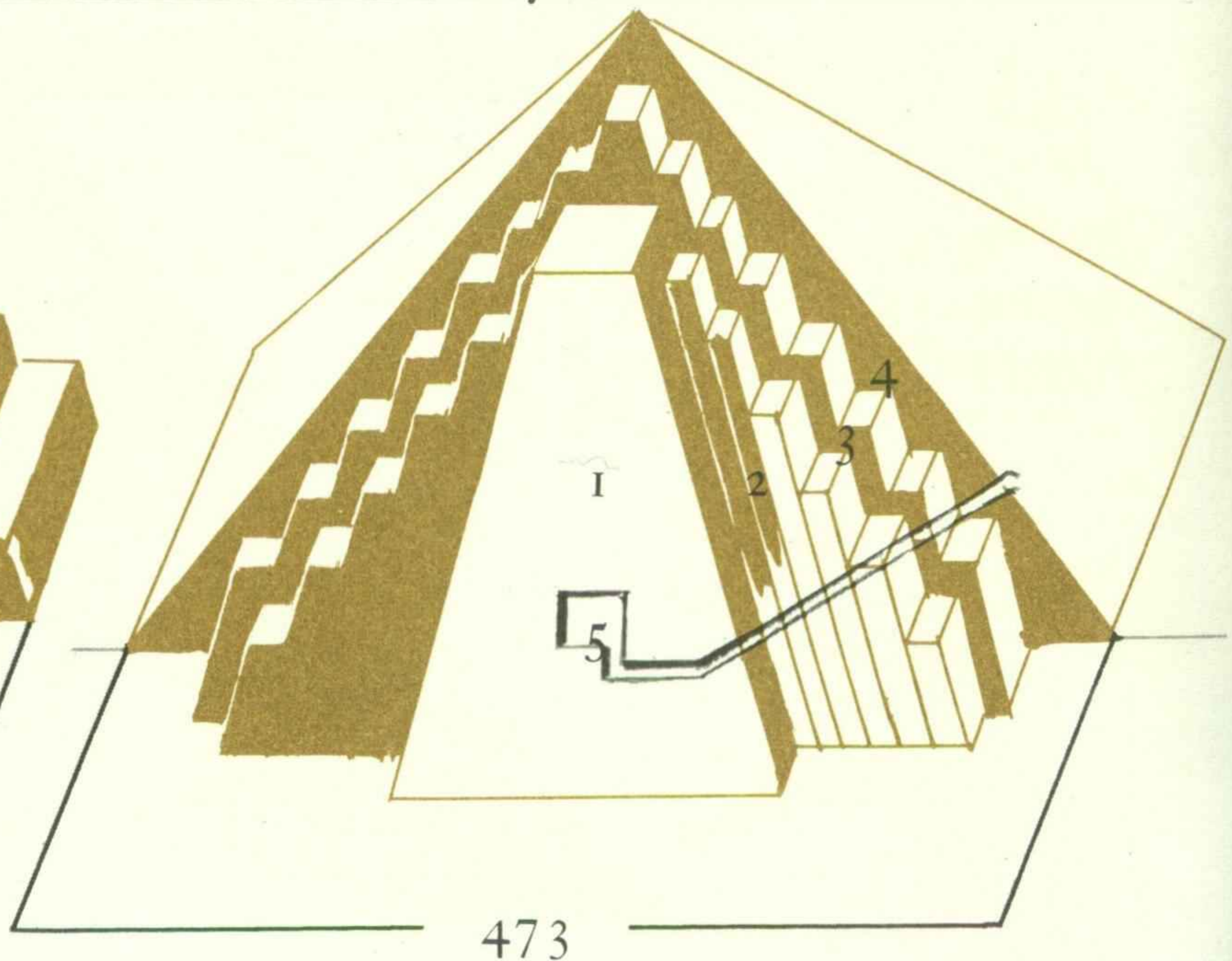
Walls of  
sun-dried  
brick

Beginning  
of *stone*  
masonry



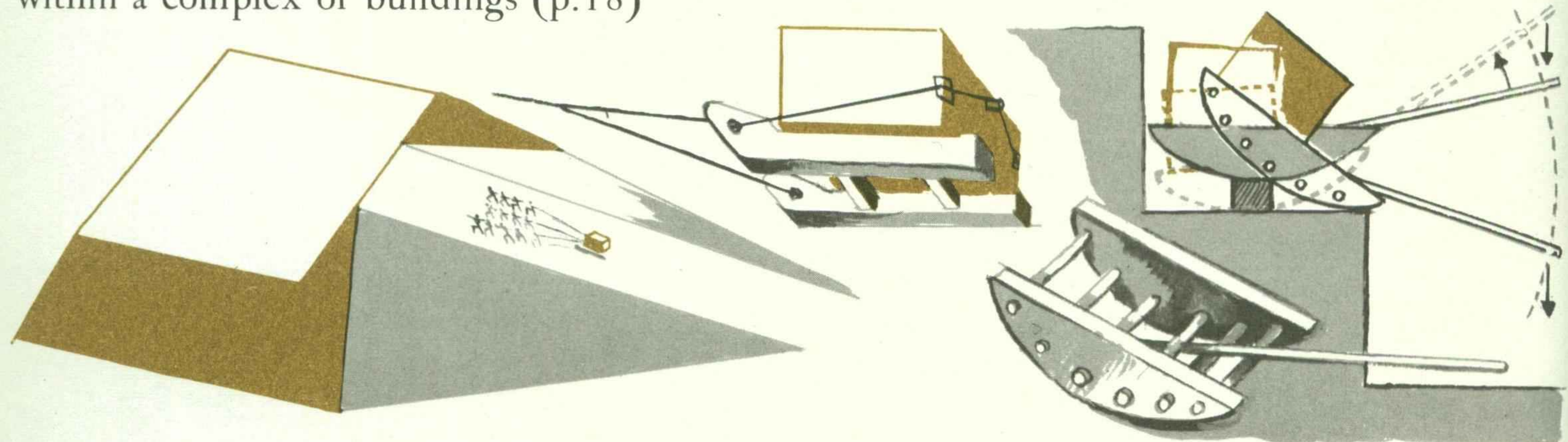
**THE STEP PYRAMID**, Saqqara,  
Dynasty III: Section looking west  
Built by Imhotep, architect to  
King Zoser.

1 Begun as a mastaba-tomb. 2-5 Then  
successively enlarged, in limestone. Set  
within a complex of buildings (p. 18)



**THE PYRAMID OF MEDUM**, Dynasties III-IV  
Section looking west, reconstructed

1 Centre core. 2 Successive layers added, at about  
75°, each of local stone and cased with limestone.  
3 Enlargement of the pyramid. 4 Steps filled in  
with a facing of limestone. 5 The tomb chamber

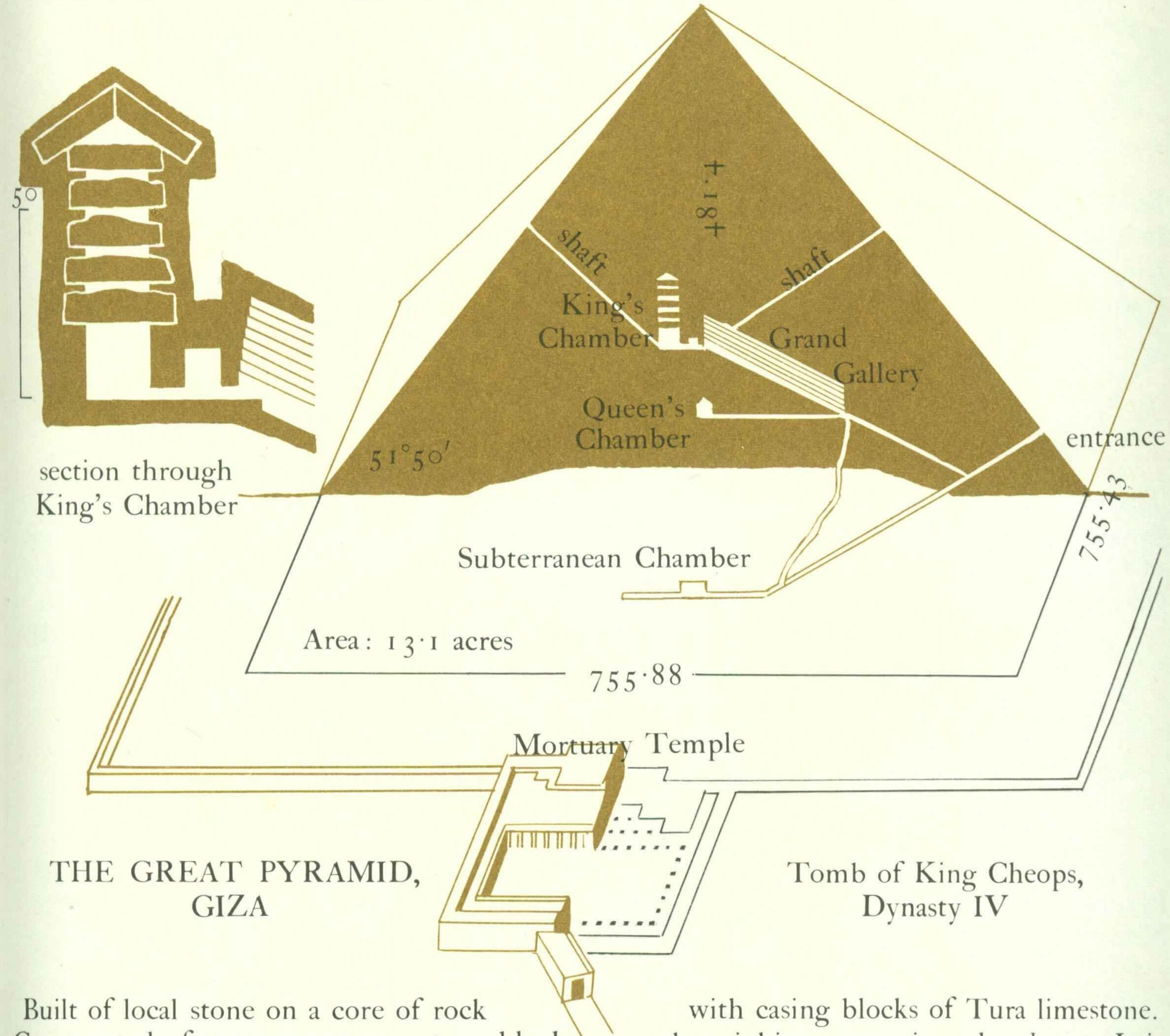
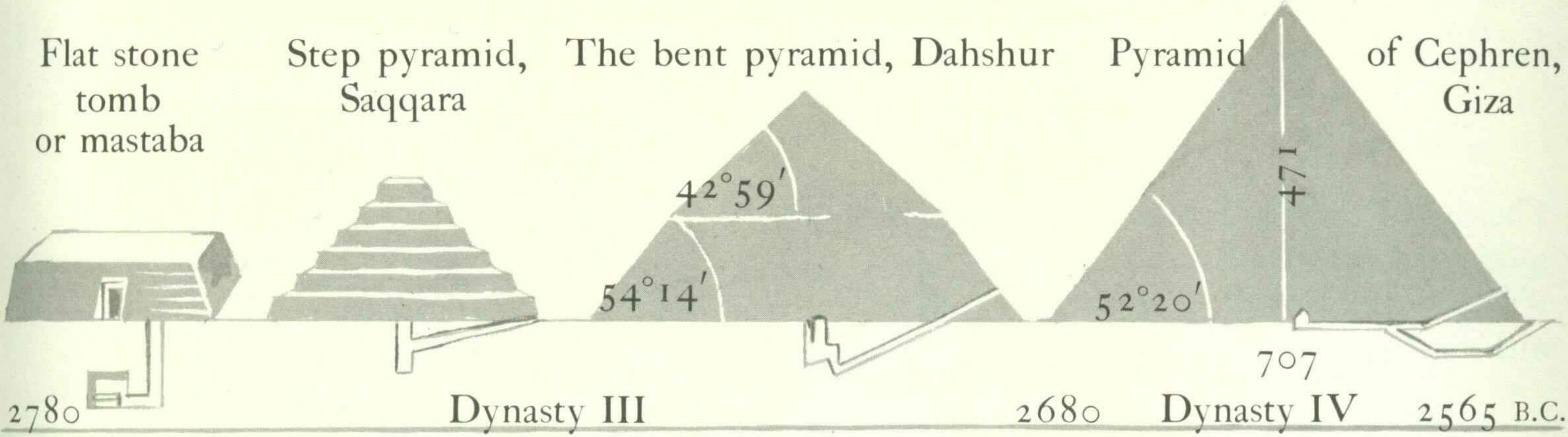


Stones on sledges, pulled up long earth ramps

The Rocker; pulleys were unknown

Suggested methods of hauling and lifting stones

# PYRAMIDS



Built of local stone on a core of rock with casing blocks of Tura limestone. Constructed of some 2,300,000 stone blocks, each weighing approximately  $2\frac{1}{2}$  tons. It is probable that for a period of twenty years 100,000 men were levied annually, during the three months' inundation of the Nile (July to October), for transporting stone. Also about 4,000 permanent skilled masons and attendant labourers were employed

# EGYPT

THE OLD KINGDOM  
Dynasties III-VI, 2780-2258 B.C.  
The Age of the Pyramids

THE MIDDLE KINGDOM  
Dynasties XI-XII, 2134-1786

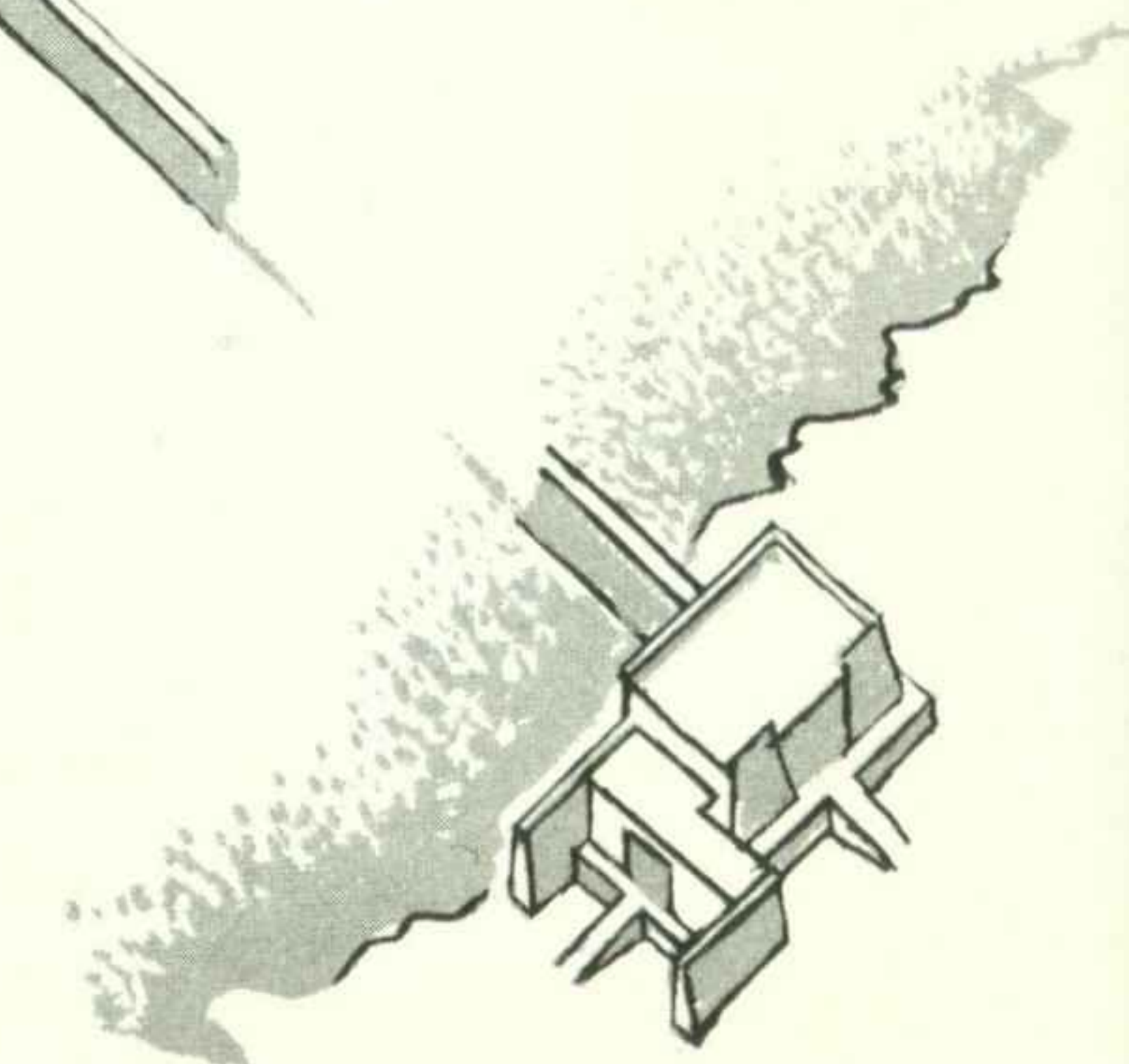
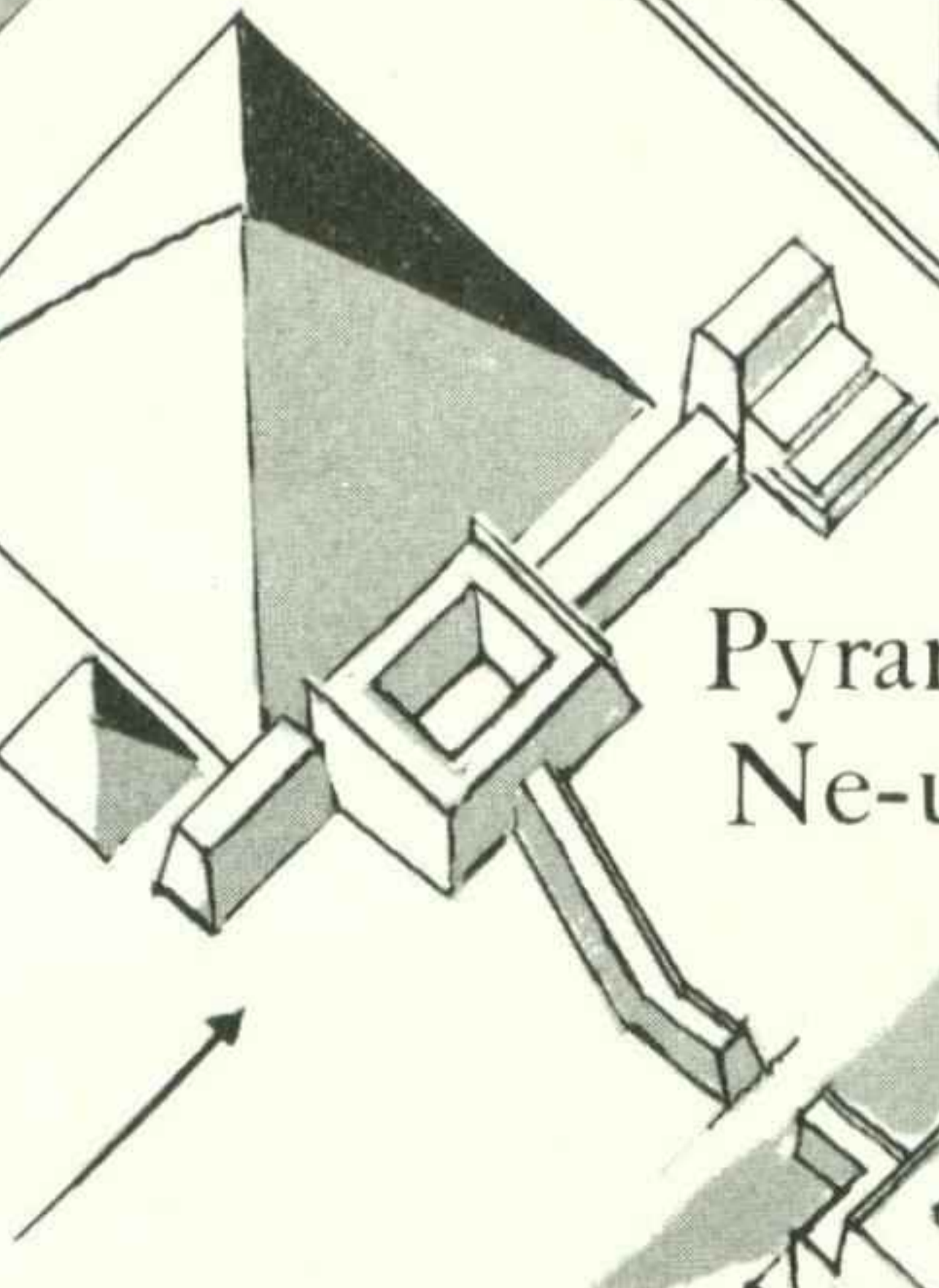
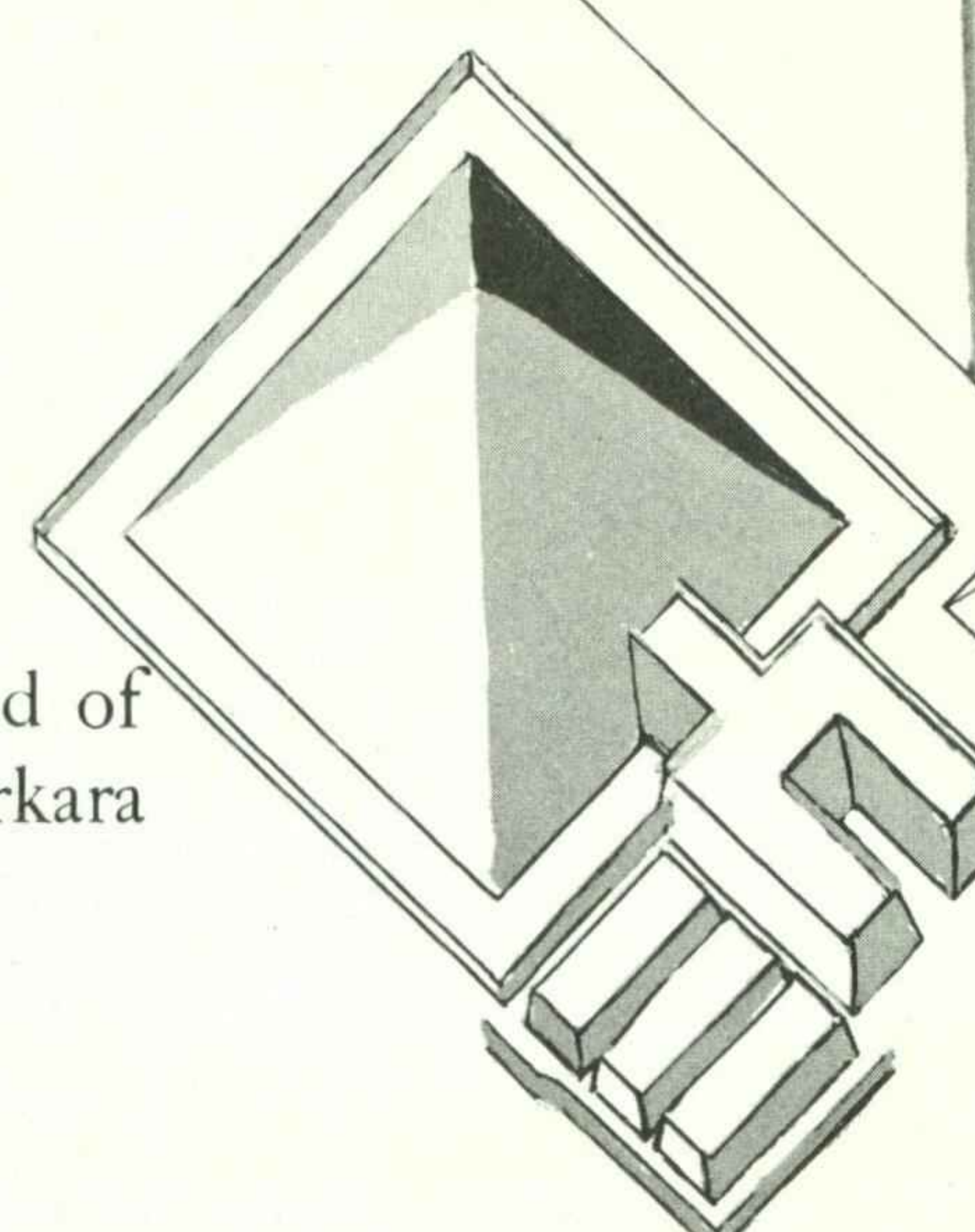
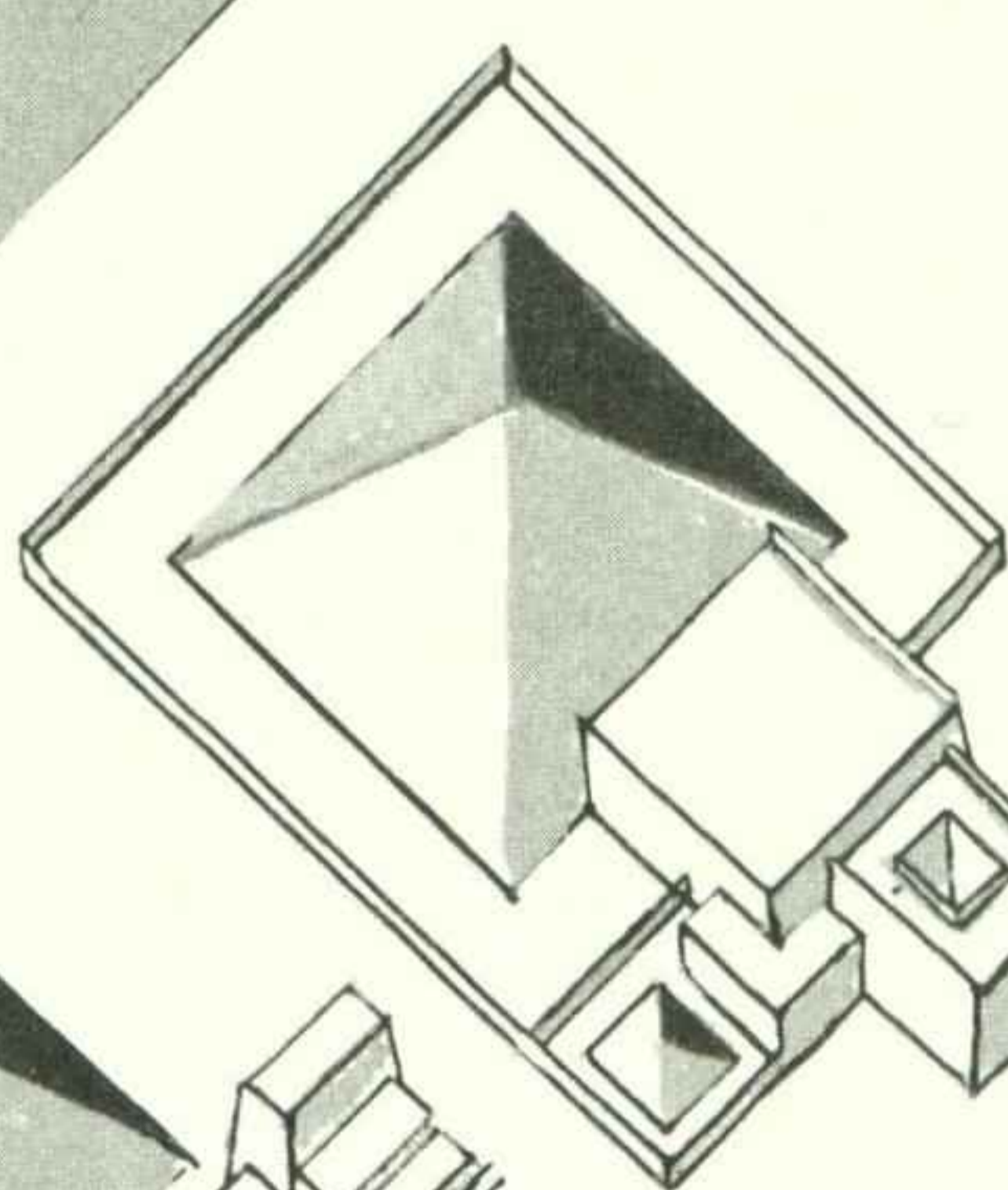
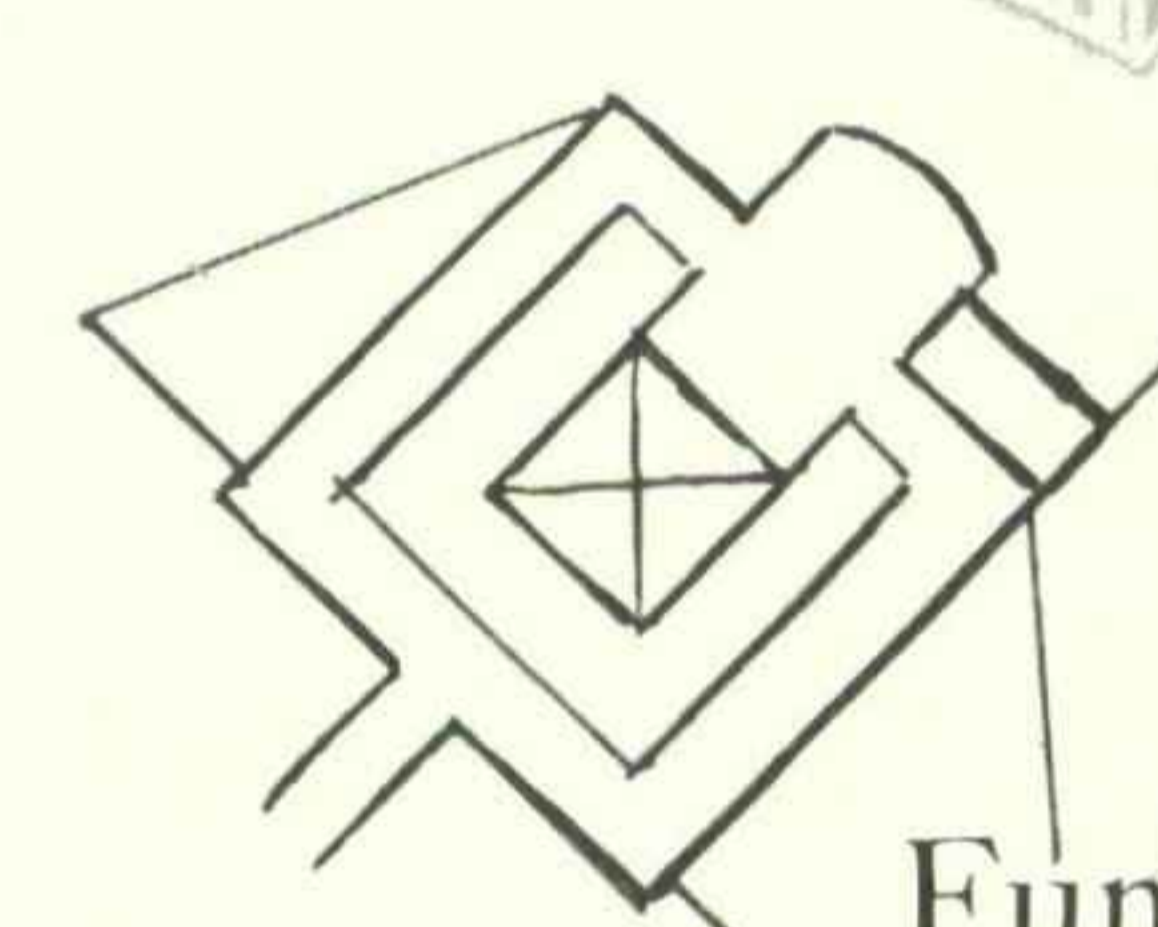
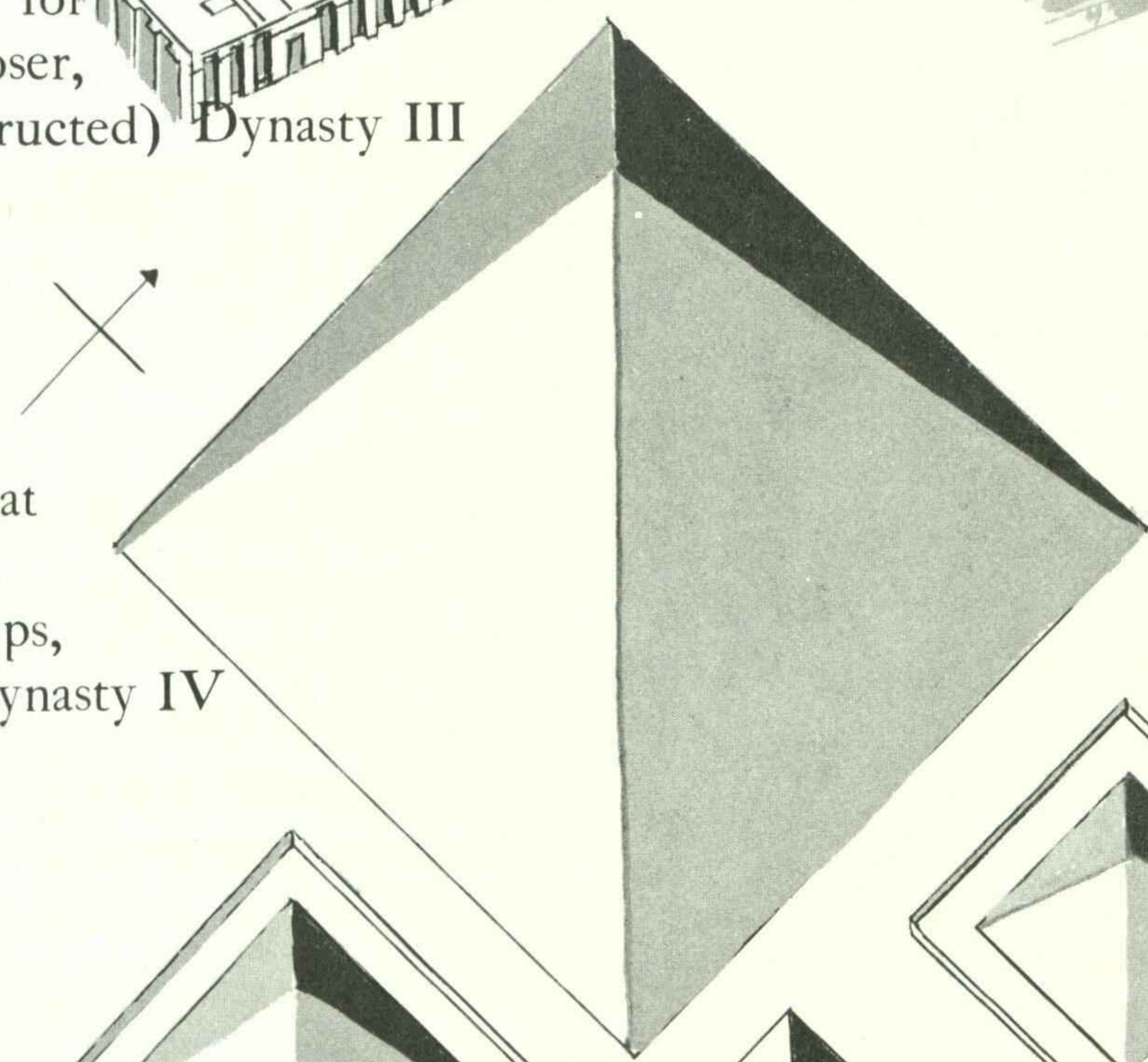
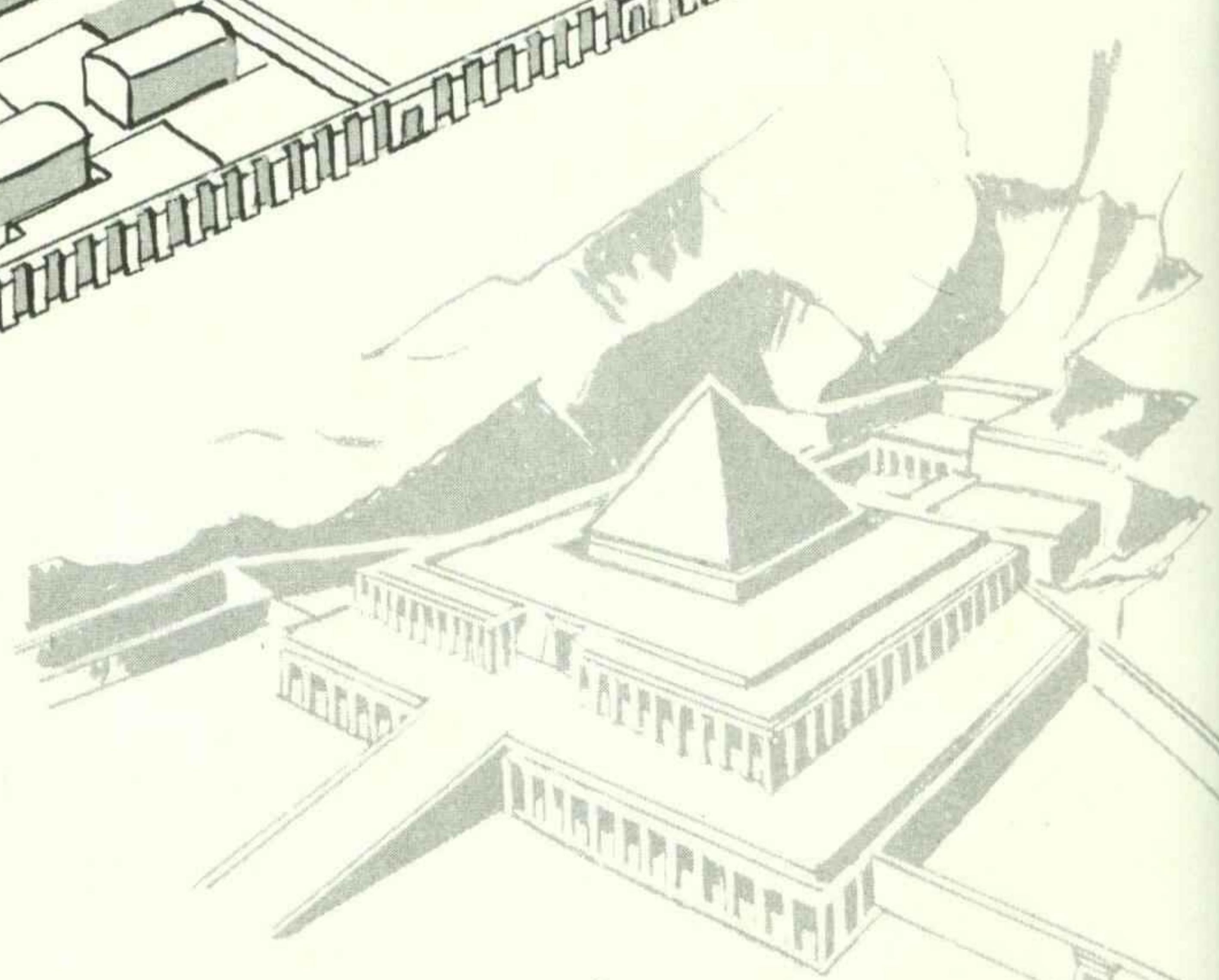
The Step Pyramid, Saqqara, set within a complex of buildings of local stone faced with limestone

Built by Imhotep for King Zoser, (reconstructed) Dynasty III

The great Pyramid of Cheops, Giza, Dynasty IV

Pyramid of Neferirkara

Pyramids of Abu Sir (reconstructed), Dynasty V



Funerary Temple of Mentuhotep I, Deir-el-Bahari (reconstructed), Dynasty XI

Pyramid of Sahura

Pyramid of Ne-user-ra

# COMPARATIVE BUILDINGS & PLANS

## THE NEW KINGDOM

Dynasties XVIII-XX, 1570-1085 B.C.

The Age of the great Temples

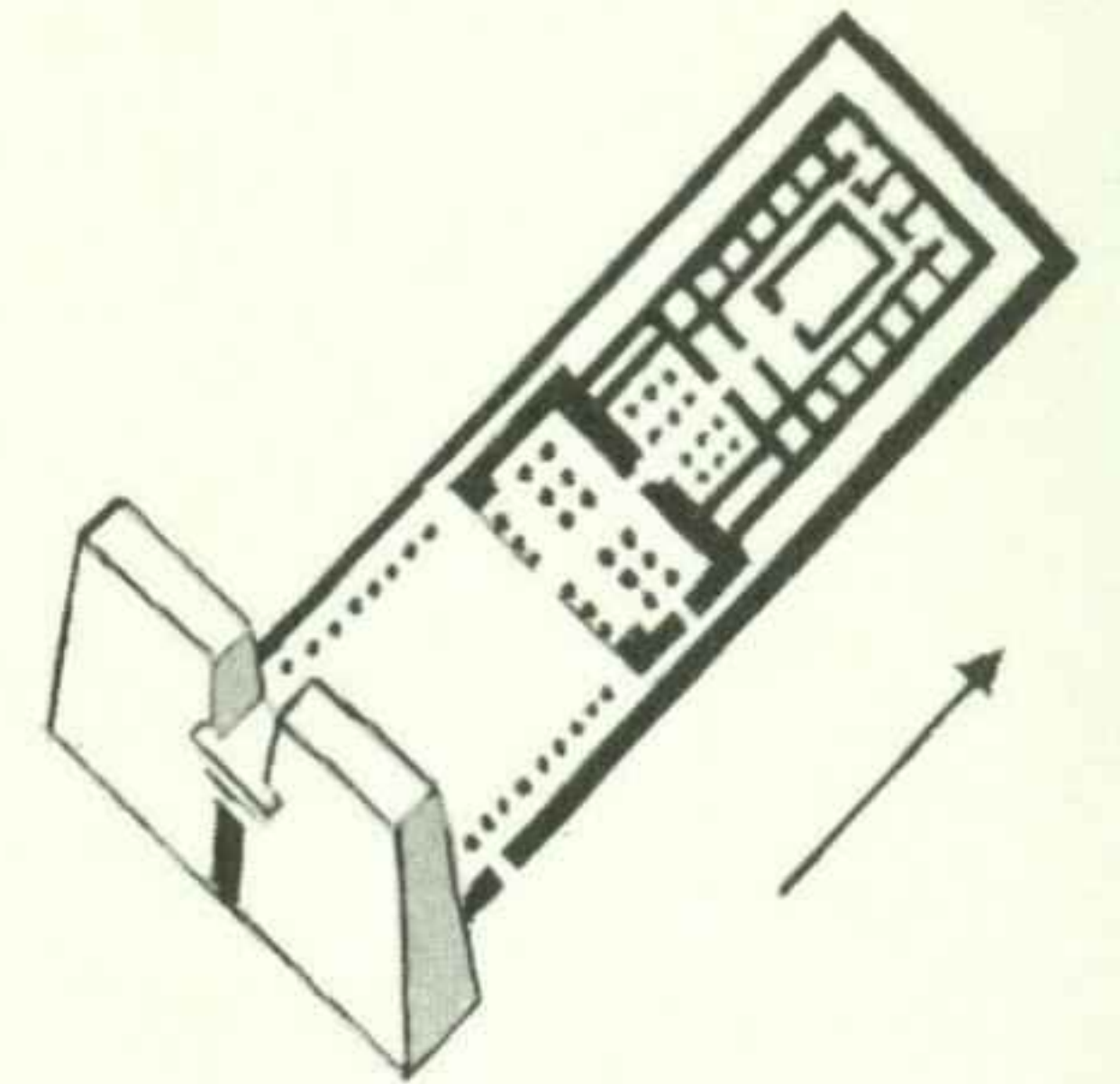
## THE PTOLEMAIC PERIOD

332-30 B.C.

Revival of Temples

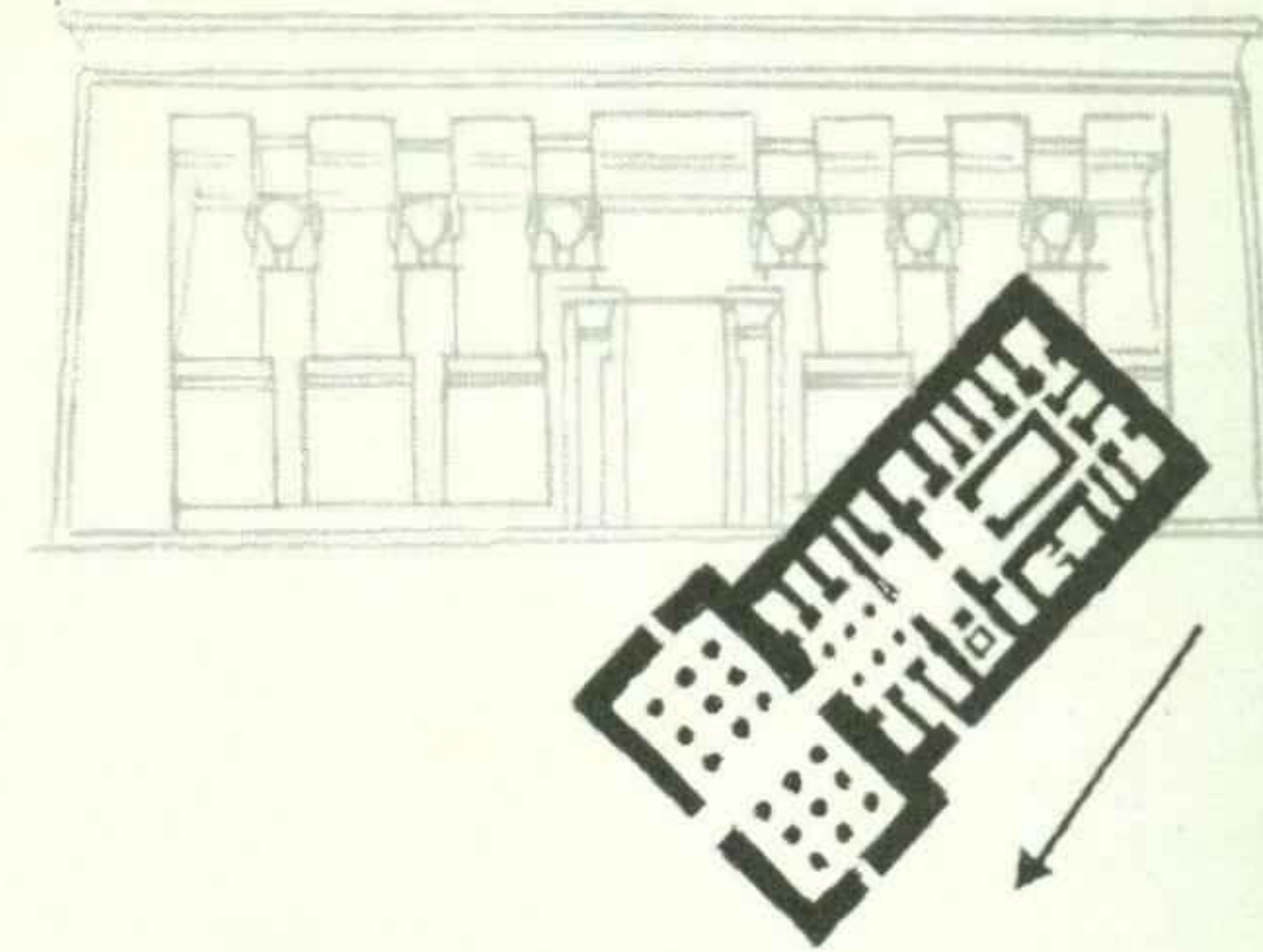
Mortuary Temple of Amon, Deir-el-Bahari (reconstructed), Dynasty XVIII

Designed by Senmut and built for Queen Hatshepsut



The Temple of Horus, Edfu, 237-212 B.C. Begun by Ptolemy III

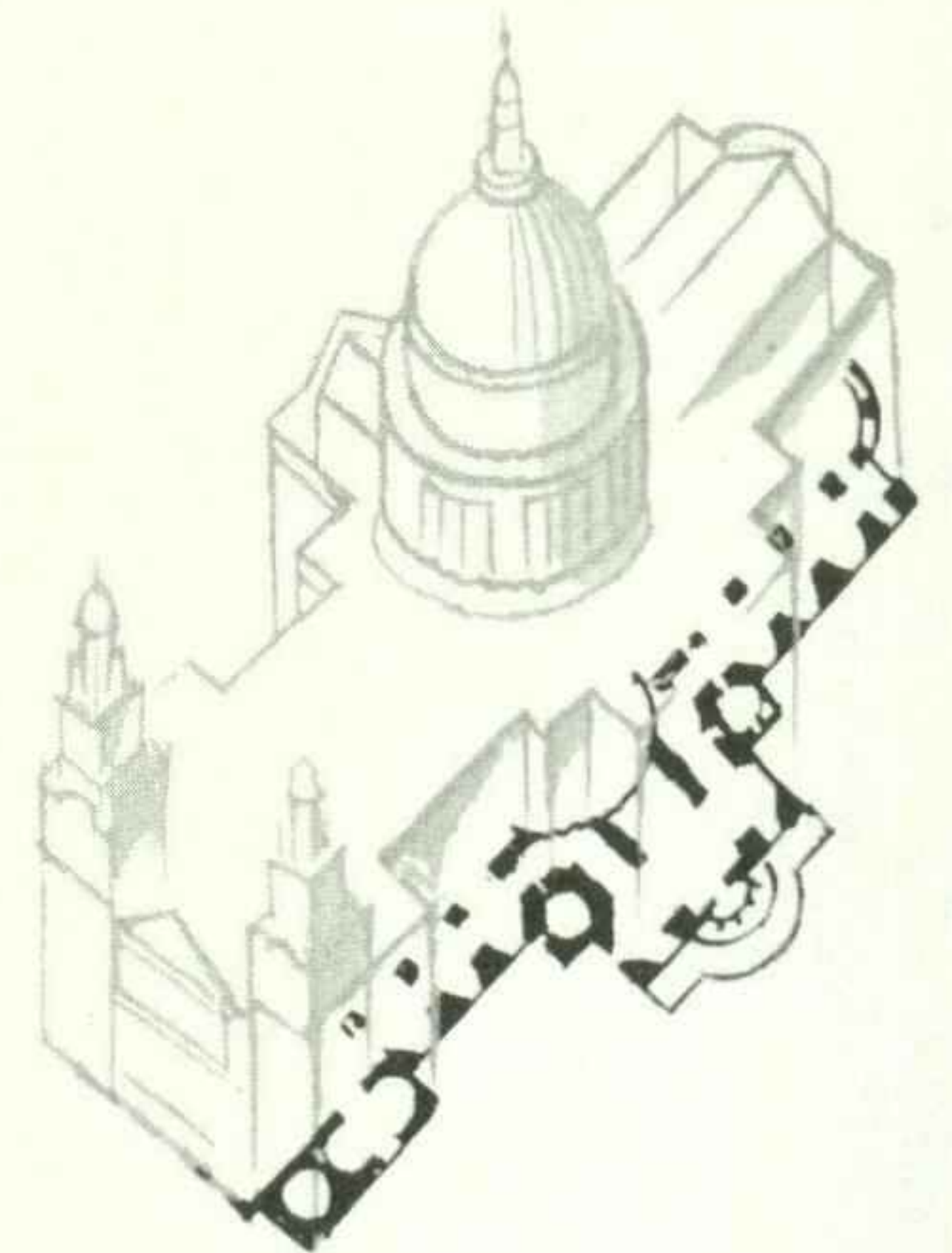
The Great Temple of Amon, Karnak, Dynasties XVIII-XXXI (Foundations Dynasty XI)



The Temple of Hathor, Dendera, 1st cent. B.C.

The Temple of Amon, Luxor, Dynasties XVIII-XIX Begun by Amenhotep III and added to by Rameses II

Temple of Seti I, Abydos, Dynasty XIX

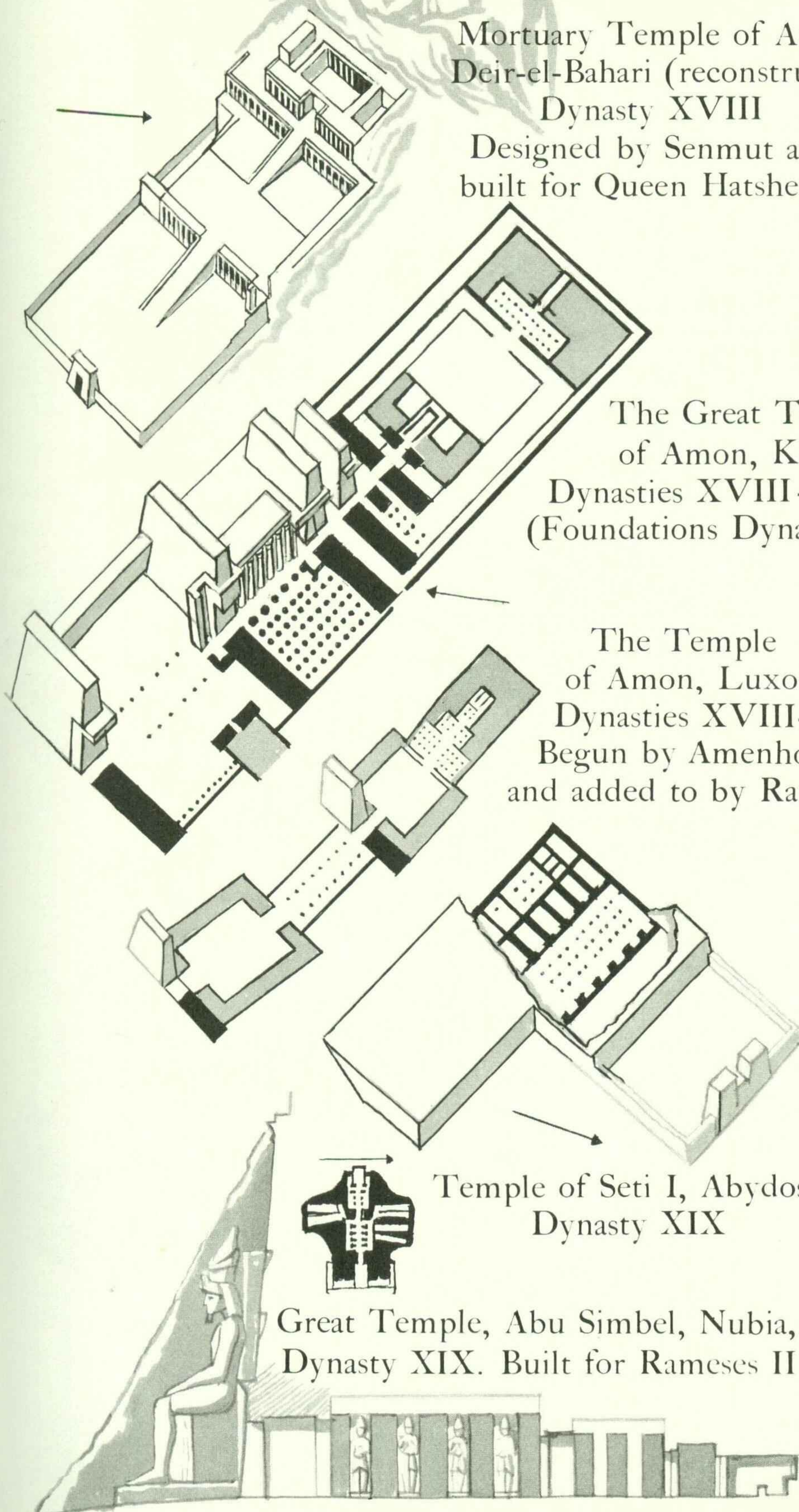


St Paul's, London

Great Temple, Abu Simbel, Nubia, Dynasty XIX. Built for Rameses II

Plans and buildings in black drawn to the same scale

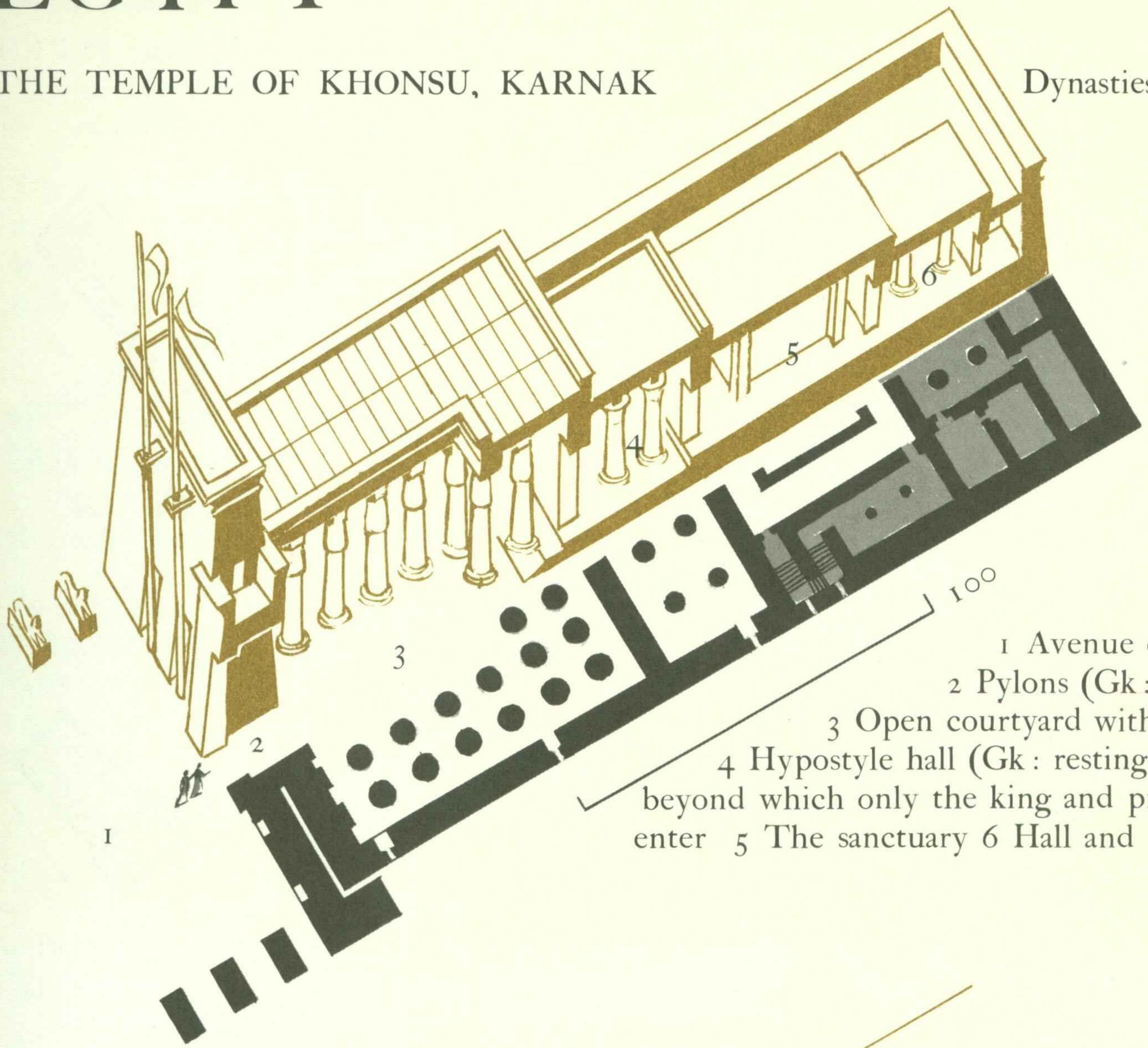
500



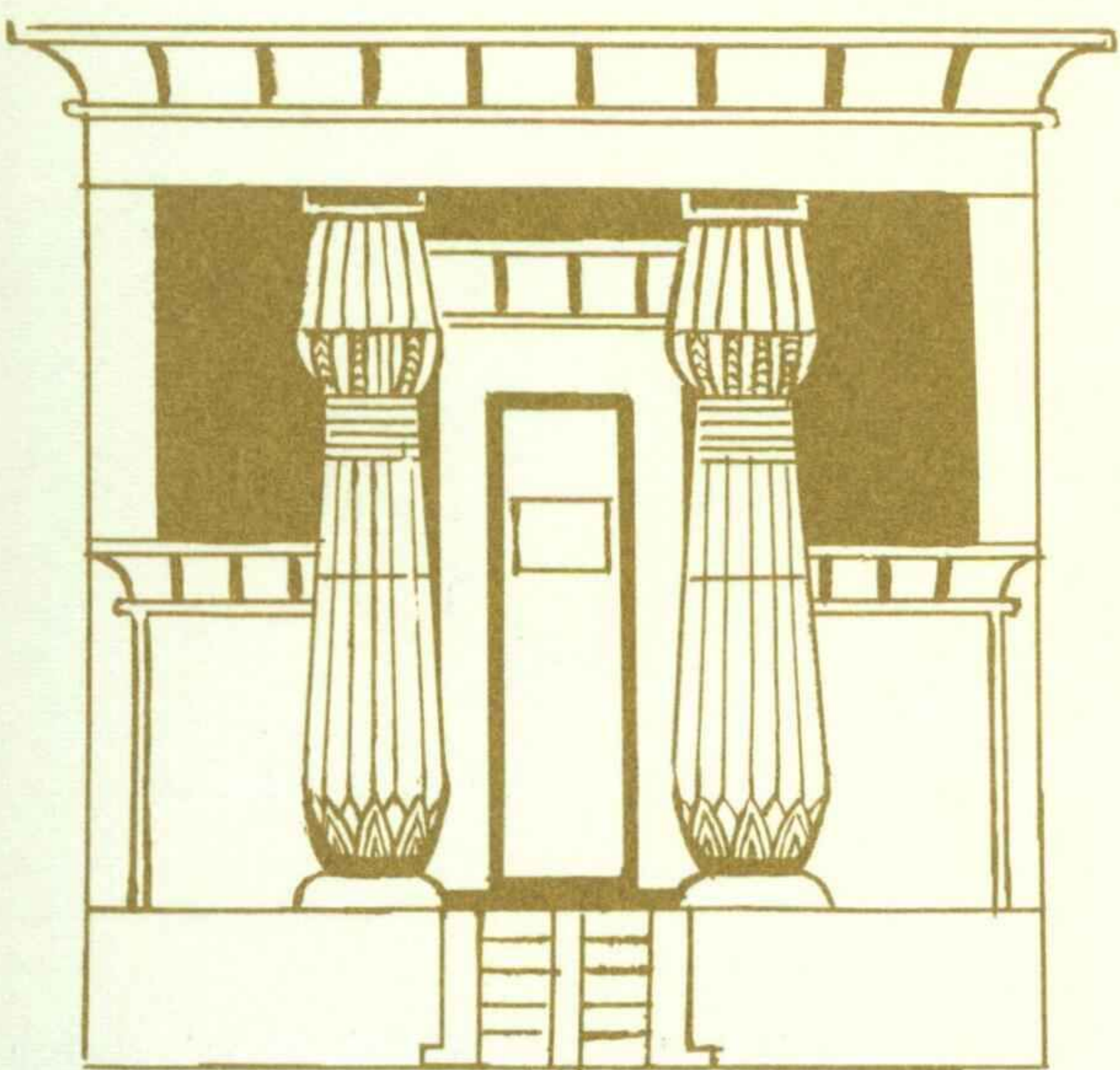
# EGYPT

## THE TEMPLE OF KHONSU, KARNAK

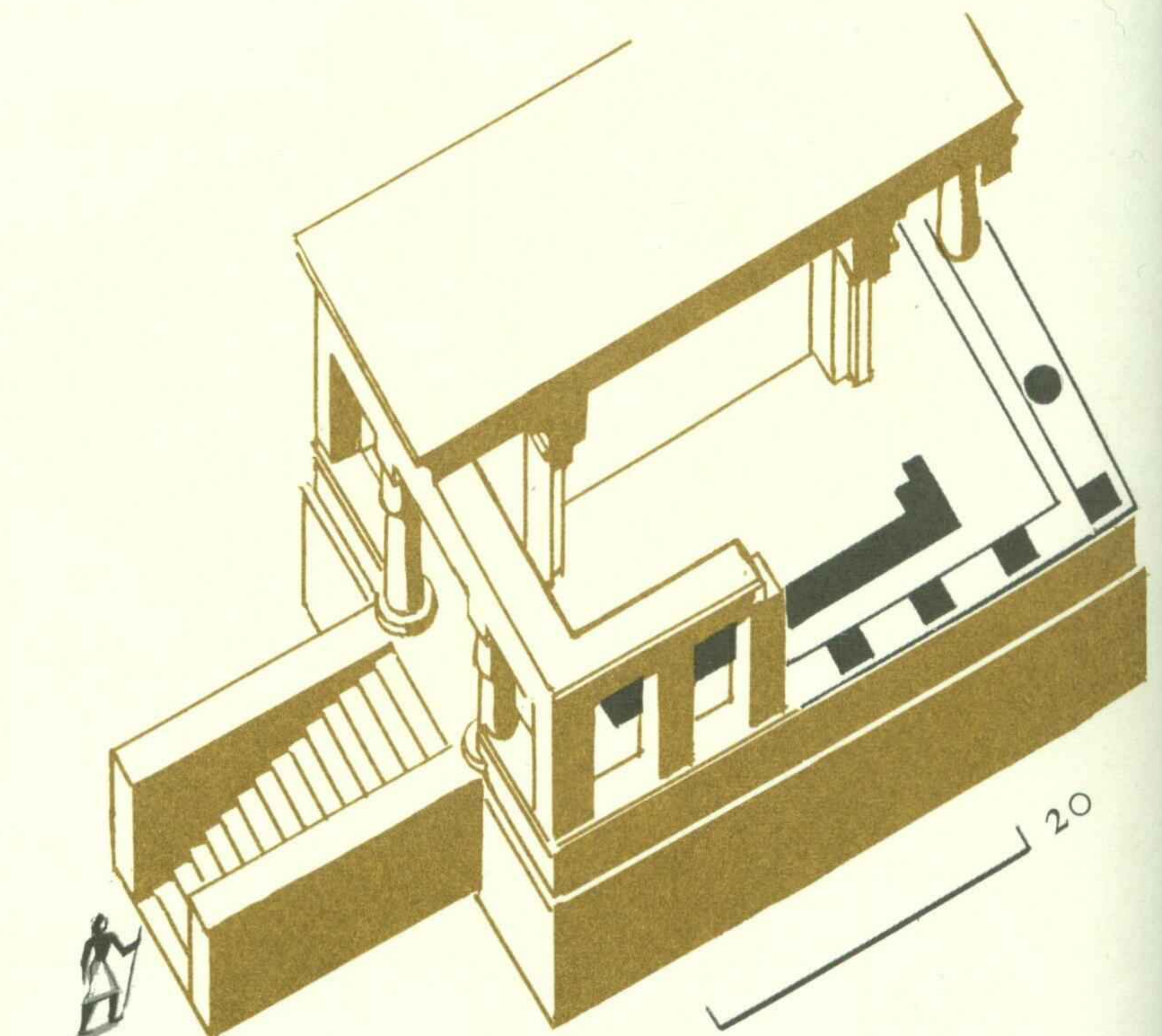
Dynasties XX-XXI



- 1 Avenue of sphinxes
- 2 Pylons (Gk: a gateway)
- 3 Open courtyard with colonnade
- 4 Hypostyle hall (Gk: resting on pillars), beyond which only the king and priests might enter
- 5 The sanctuary
- 6 Hall and store rooms



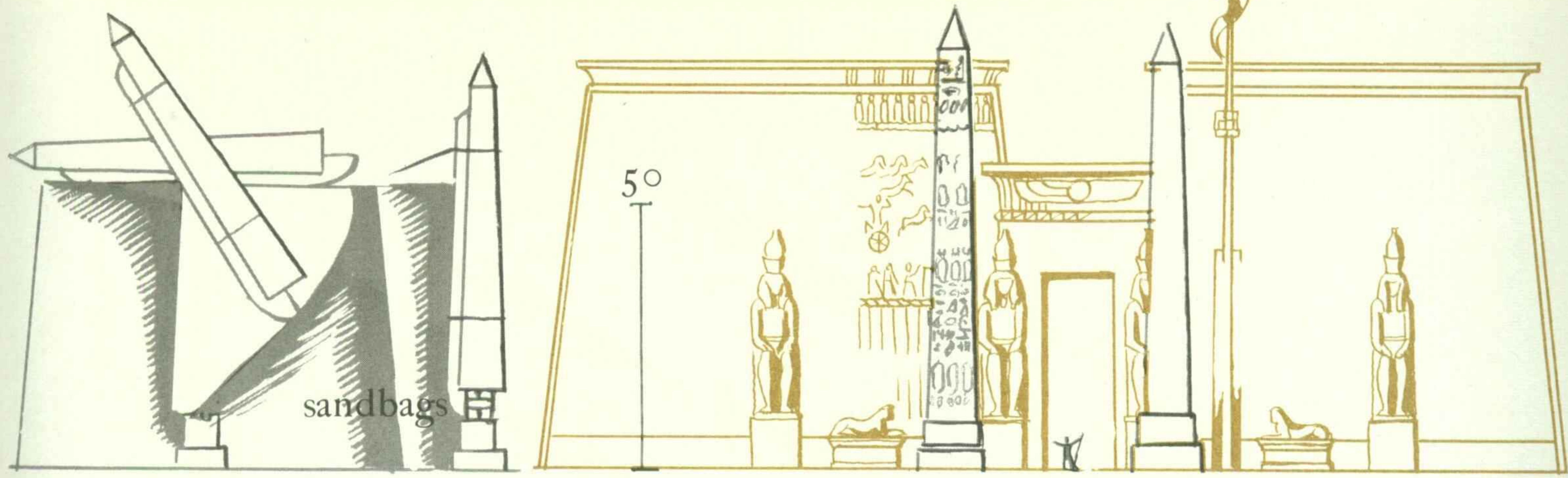
A garden shrine from a painting in a tomb, Thebes, Dynasty XIX



Temple of Amenhotep III, Island of Elephantine, Dynasty XVIII (Destroyed A.D. 1822)



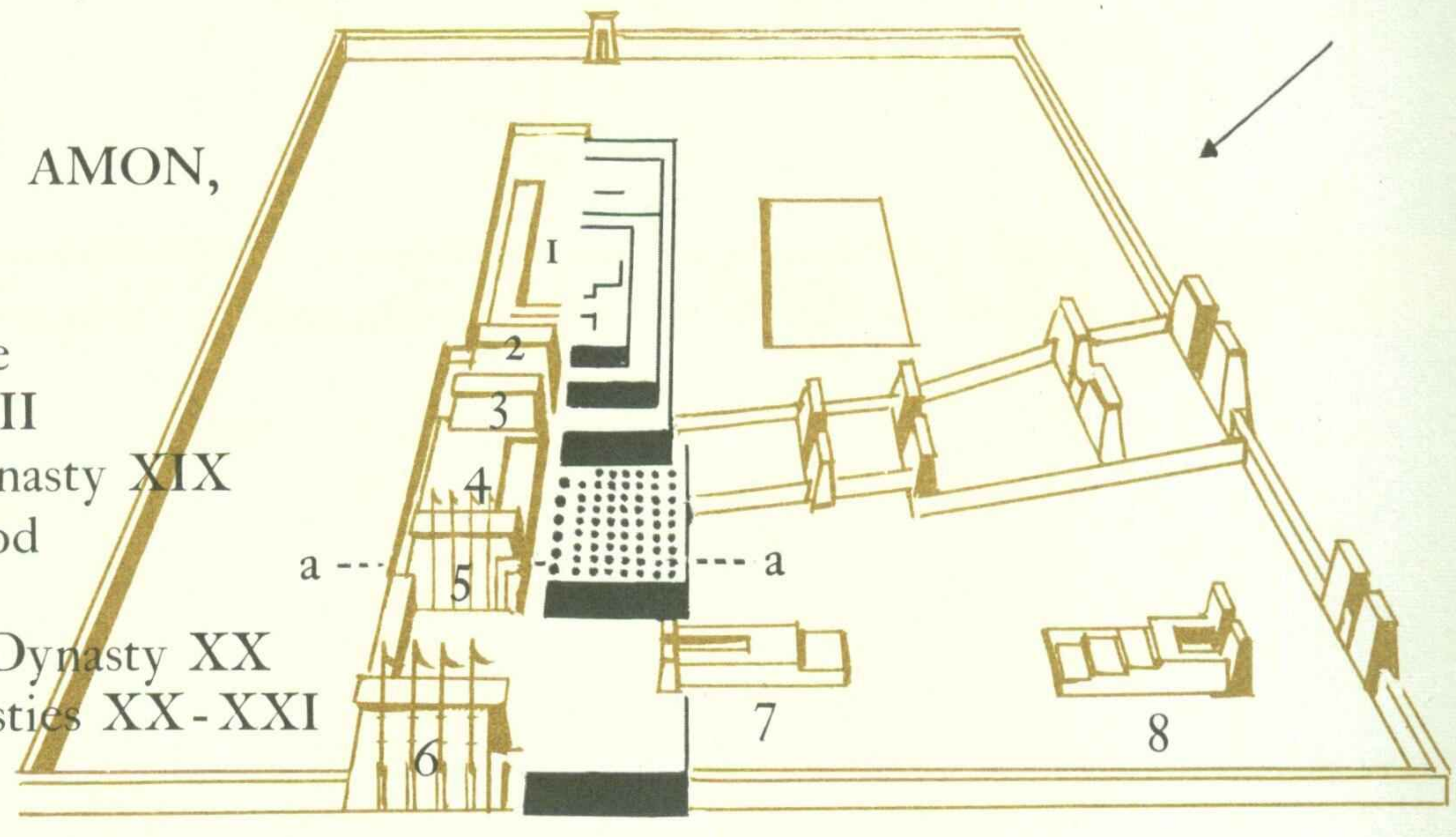
# TEMPLES



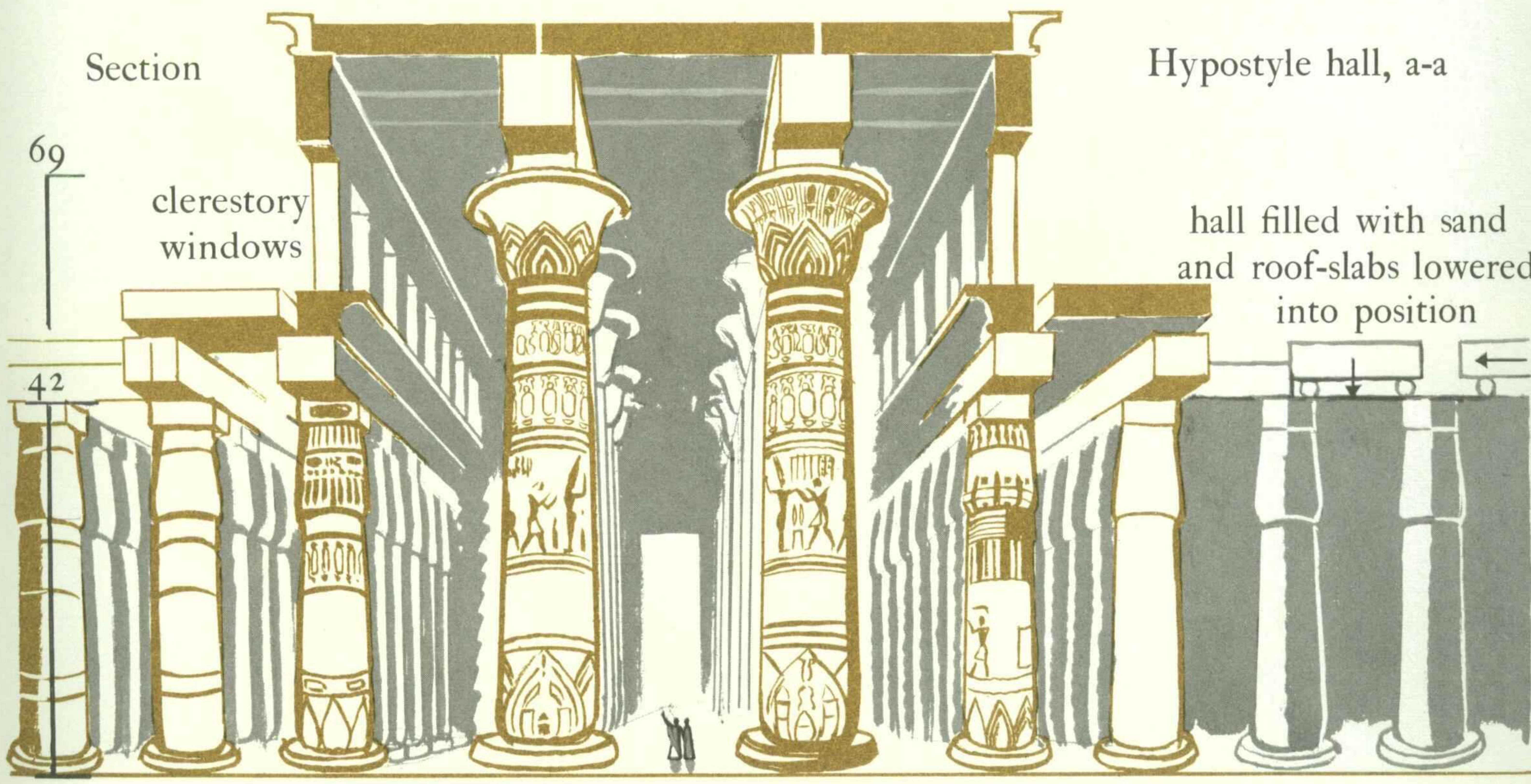
Pylons, Temple of Luxor, Dynasty XIX. Built by Rameses II

## GREAT TEMPLE OF AMON, KARNAK

Built of sandstone  
Begun Dynasty XII  
1-4 Dynasty XVIII 5 Dynasty XIX  
6 Ptolemaic period  
7 Temple of Rameses III, Dynasty XX  
8 Temple of Khonsu, Dynasties XX-XXI



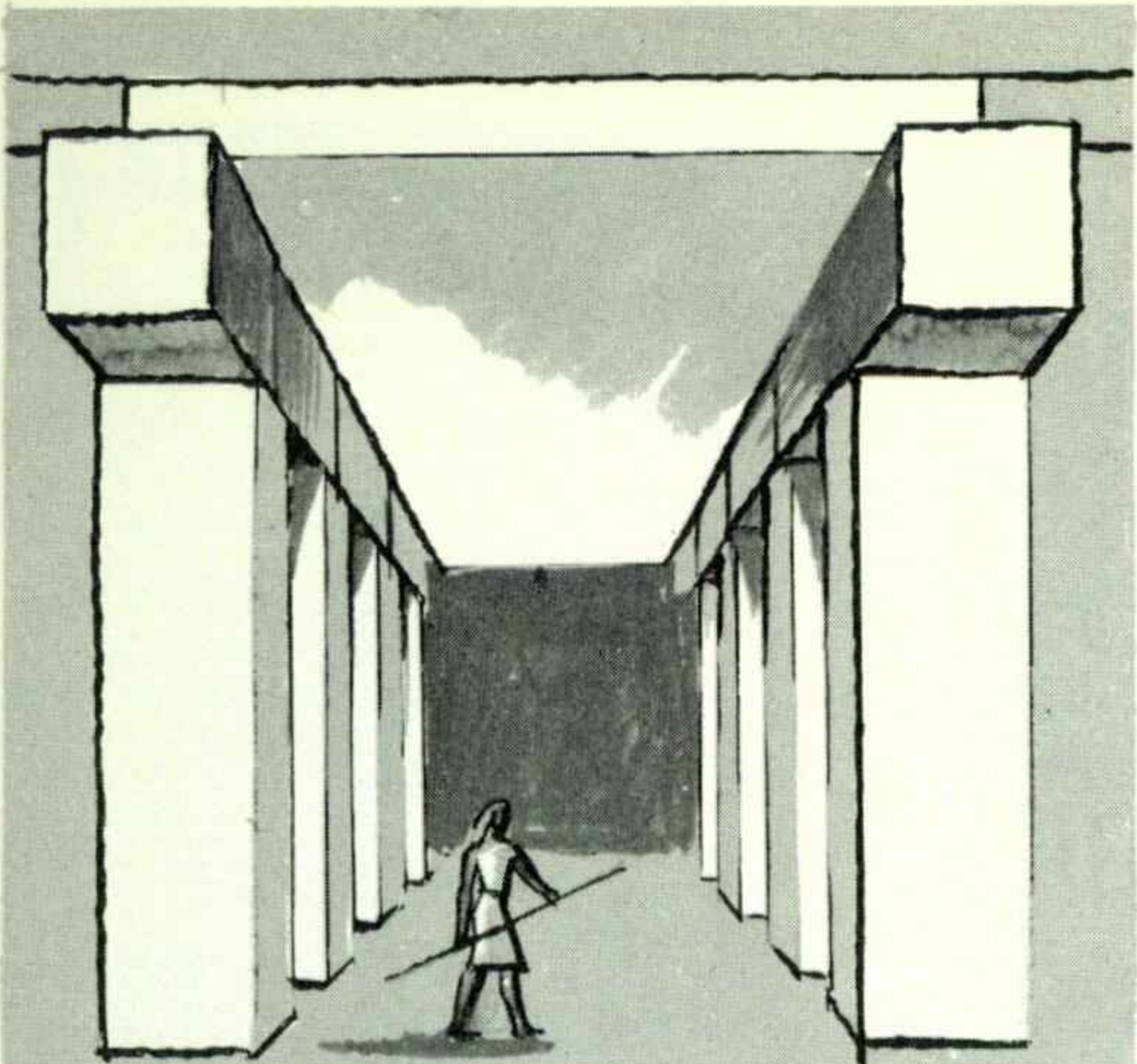
### Section



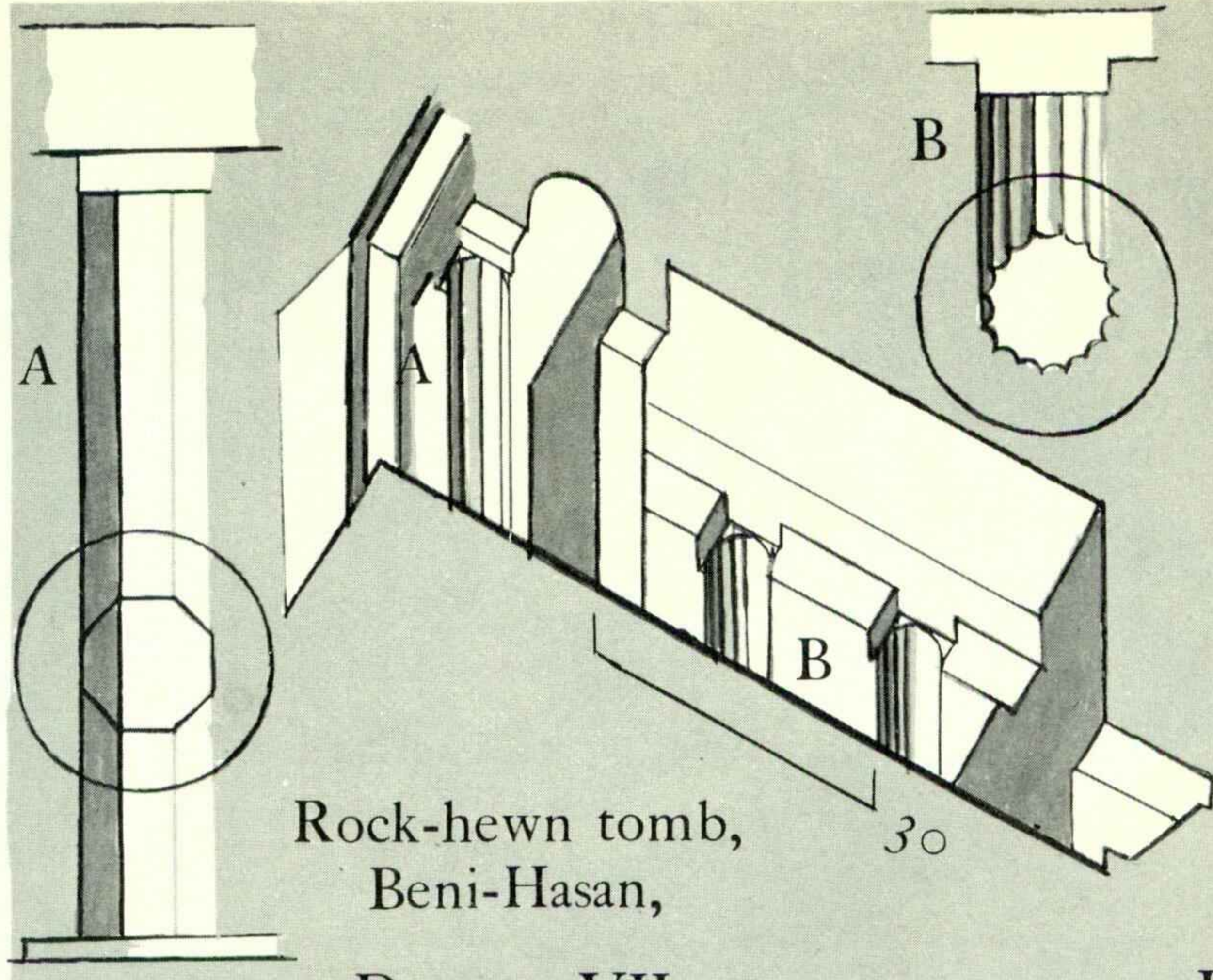
Hypostyle hall, a-a

hall filled with sand and roof-slabs lowered into position

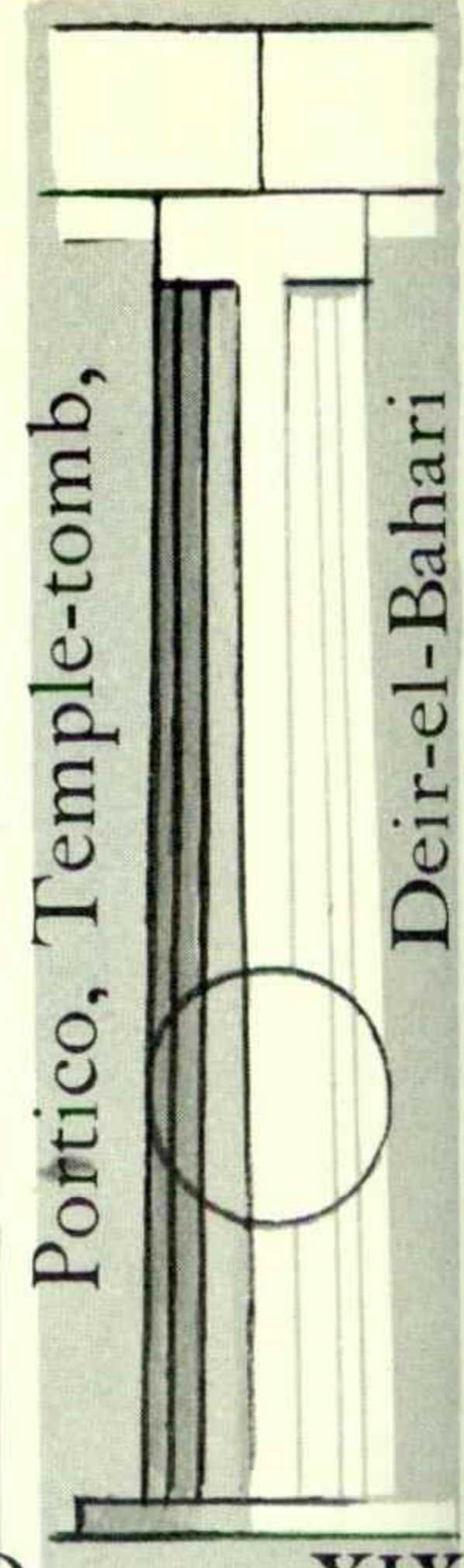
# EGYPT



Valley Temple  
built of granite:  
Pyramid of Cephren, Giza.  
Dynasty IV



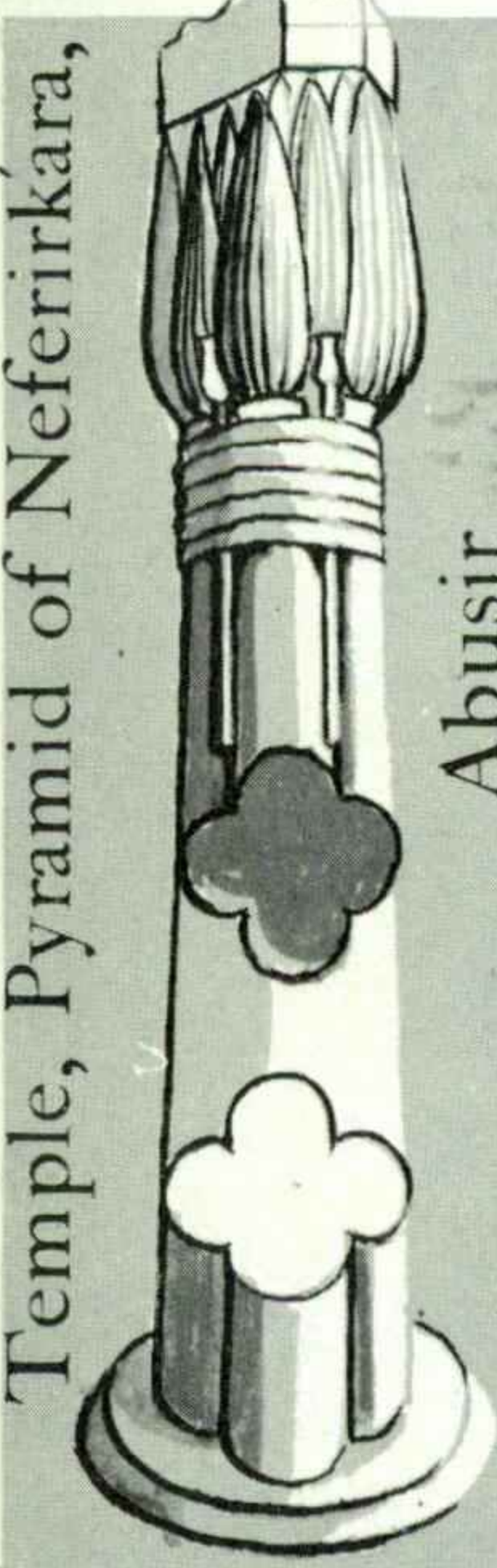
Rock-hewn tomb,  
Beni-Hasan,  
Dynasty VII



Portico, Temple-tomb,  
Deir-el-Bahari  
Dynasty XIX

## COLUMN & BEAM

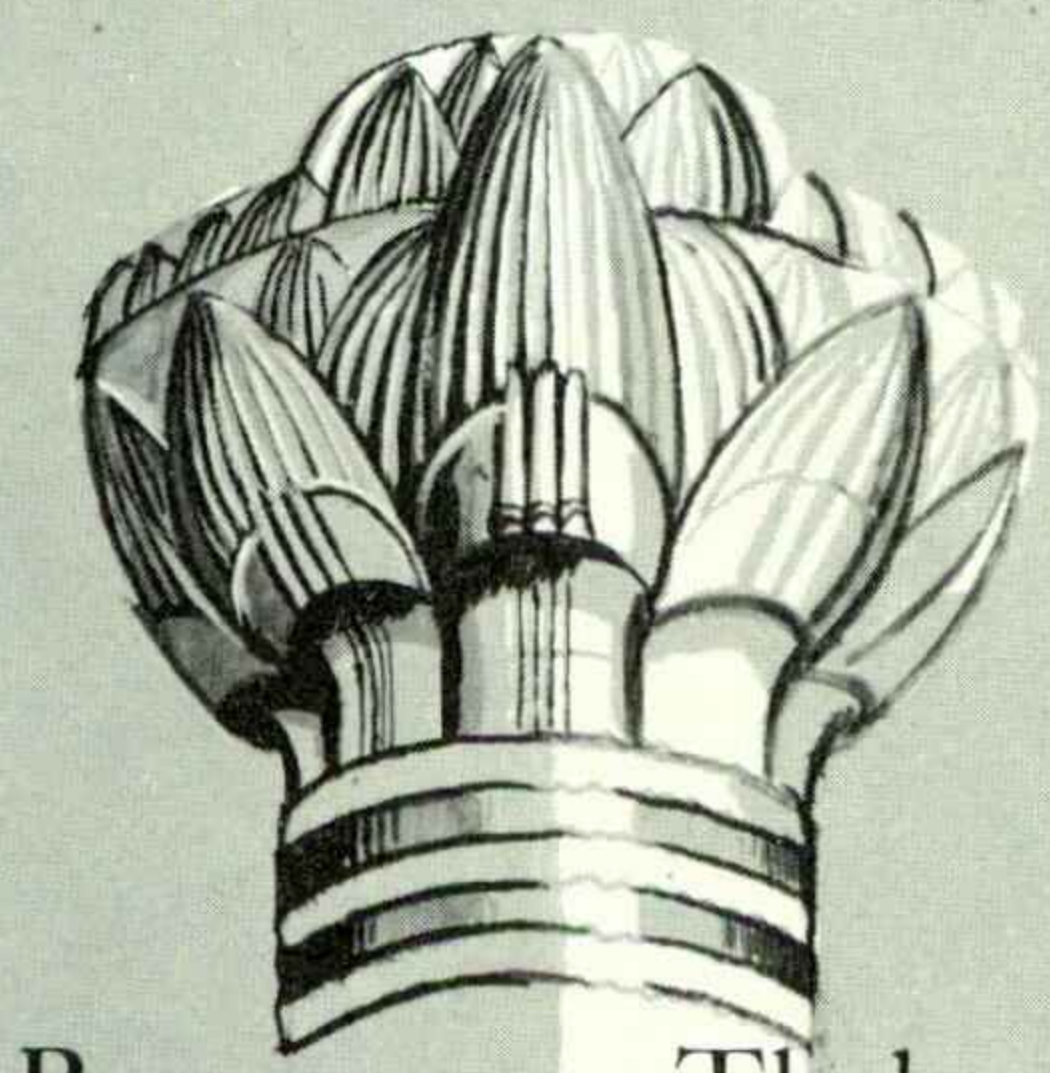
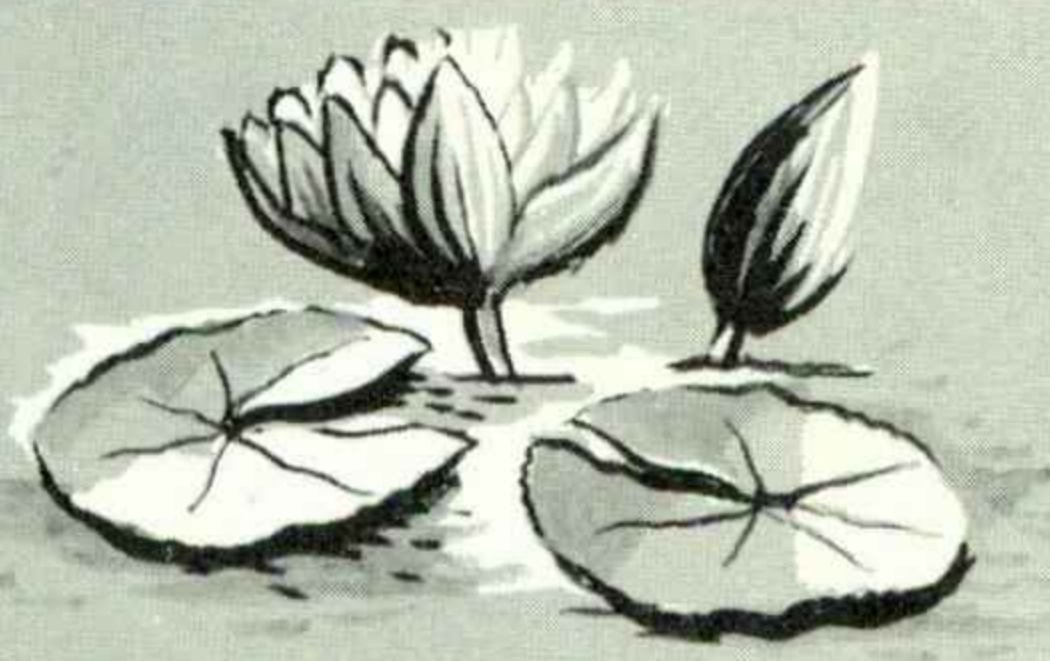
## PROTO-DORIC COLUMNS



Temple, Pyramid of Neferirkara,

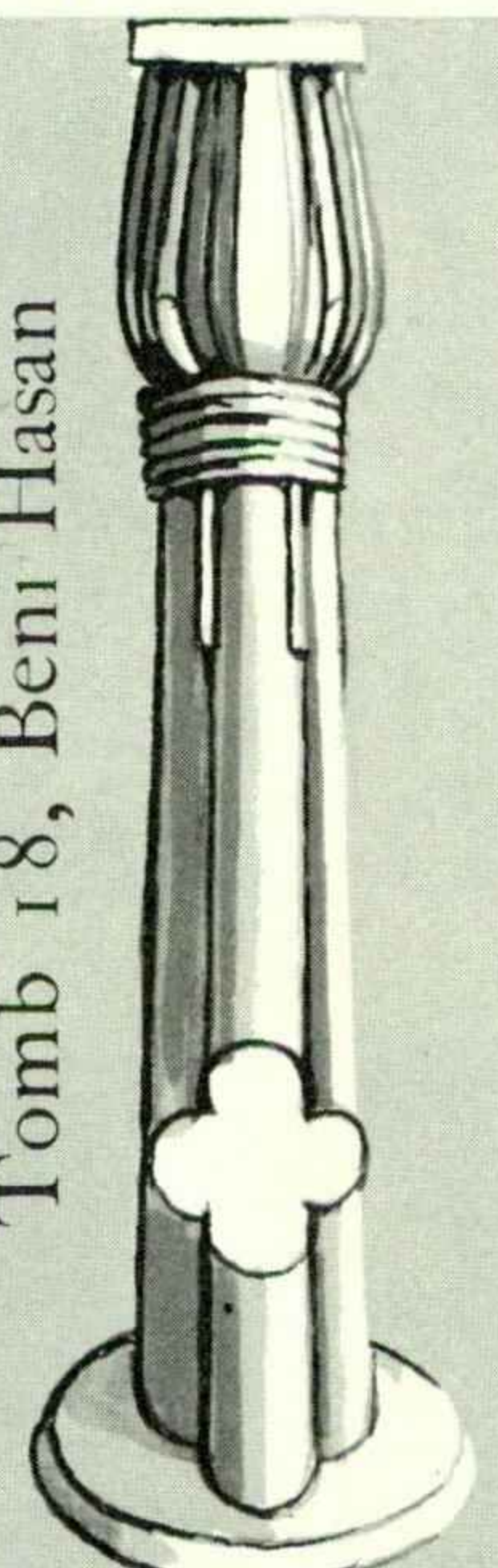
Abusir

Dynasty V



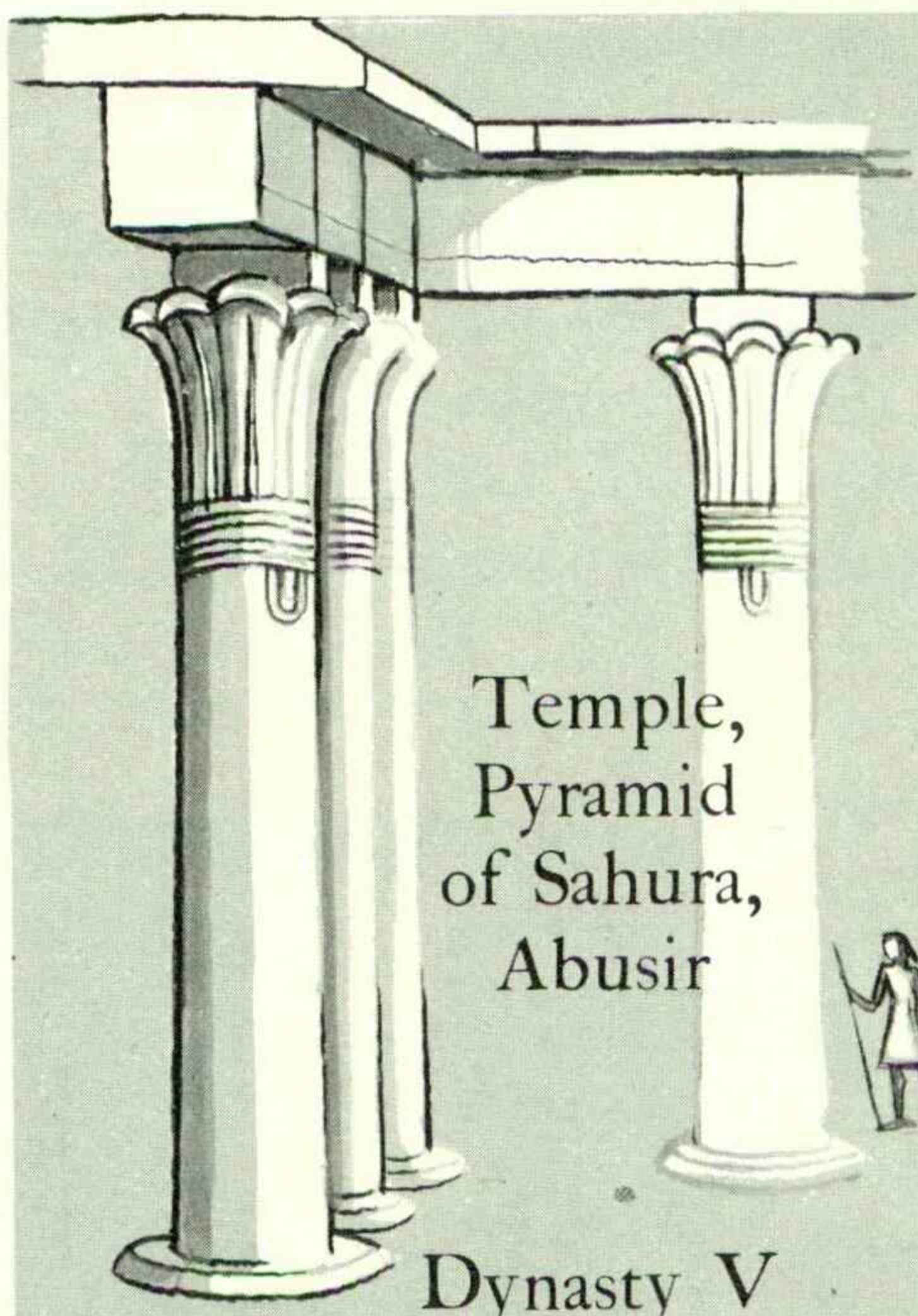
Ramesseum, Thebes

Dynasty XIX



Tomb 18, Beni Hasan

Dynasty XI



Temple,  
Pyramid of Sahura,  
Abusir

Dynasty V

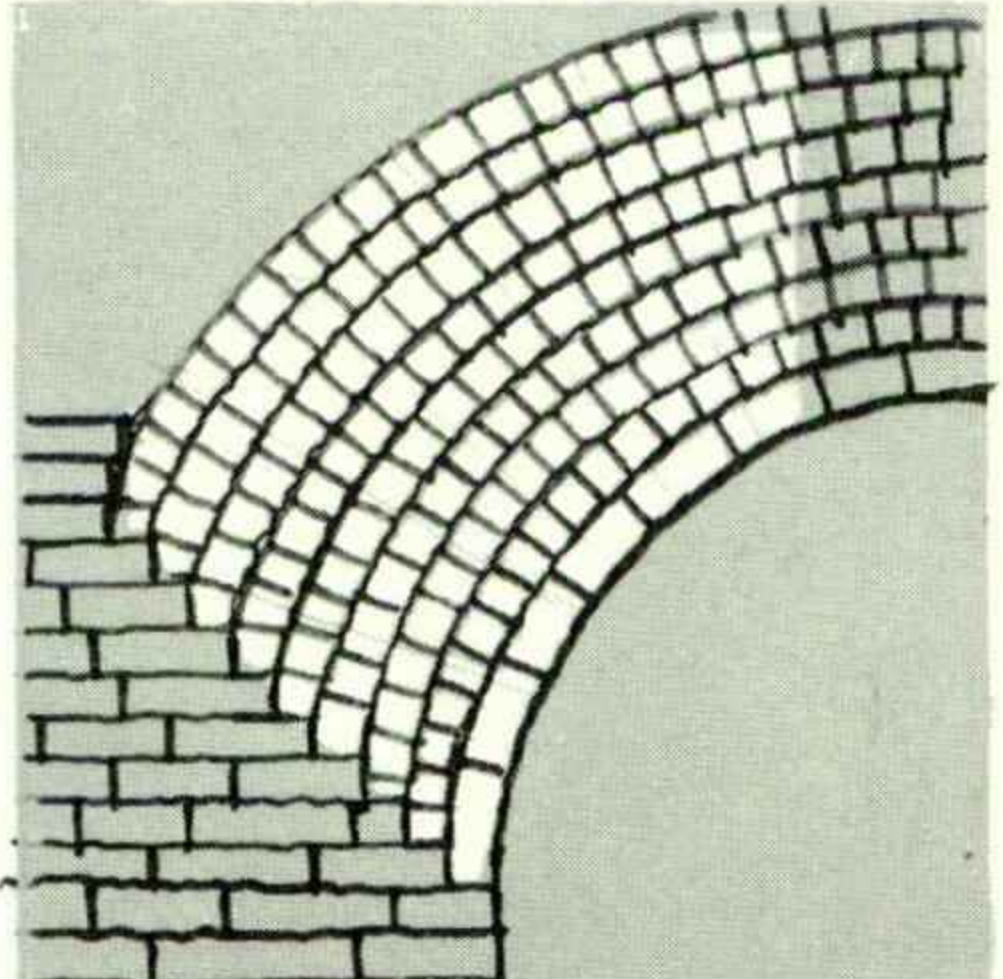
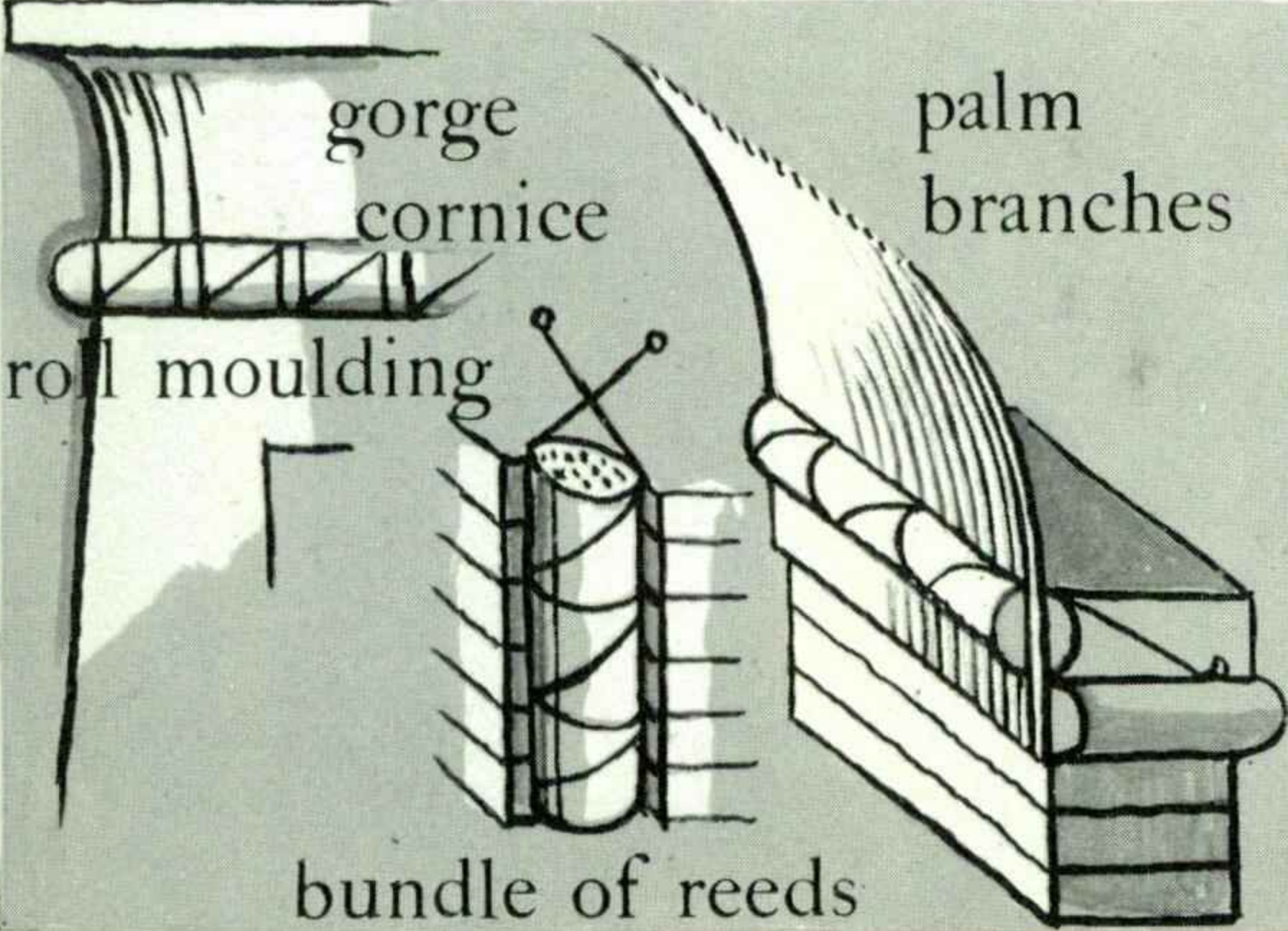


Temple of Isis,  
Philae

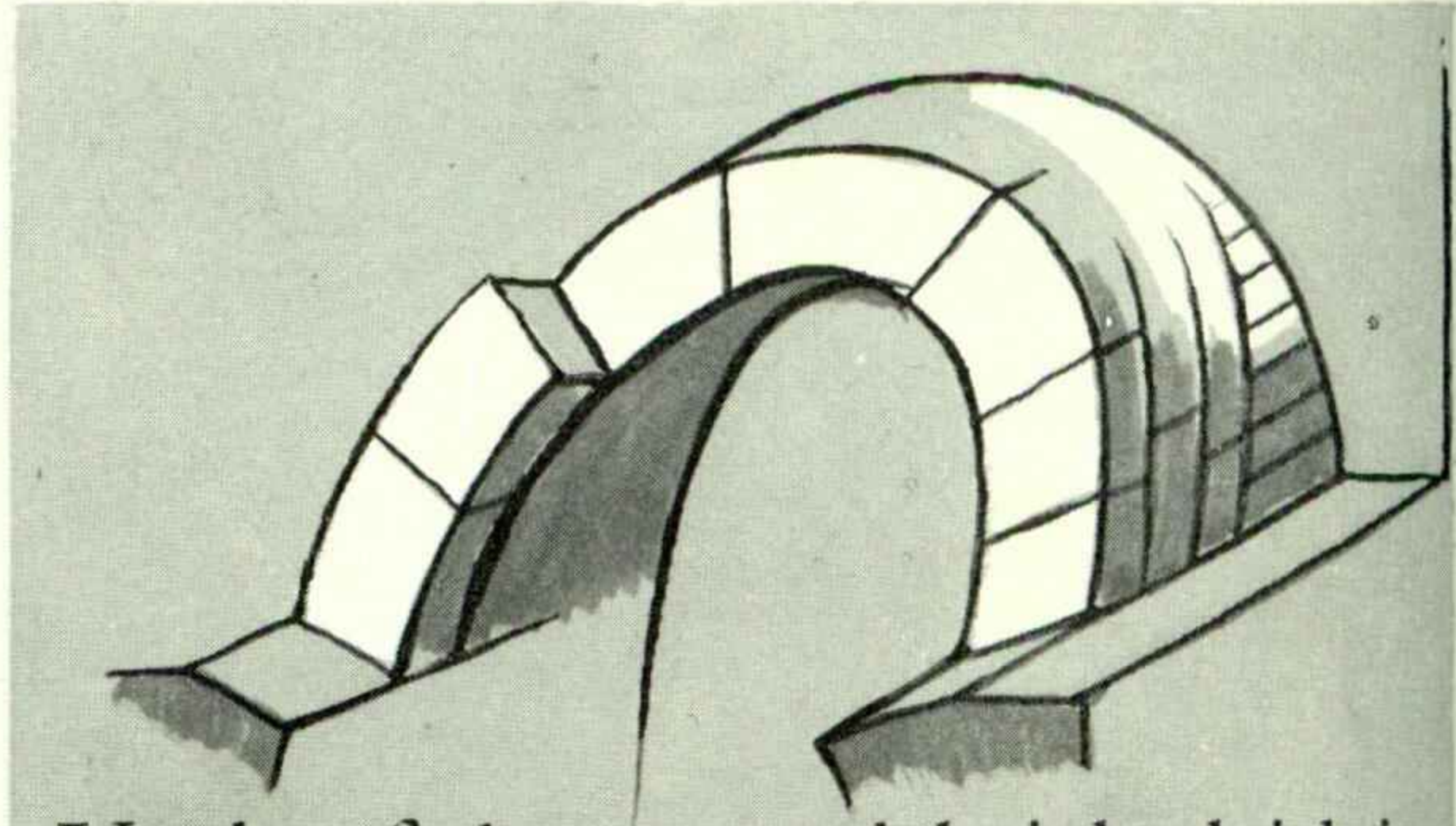
Ptolemaic

## LOTUS COLUMNS

## PALM COLUMNS

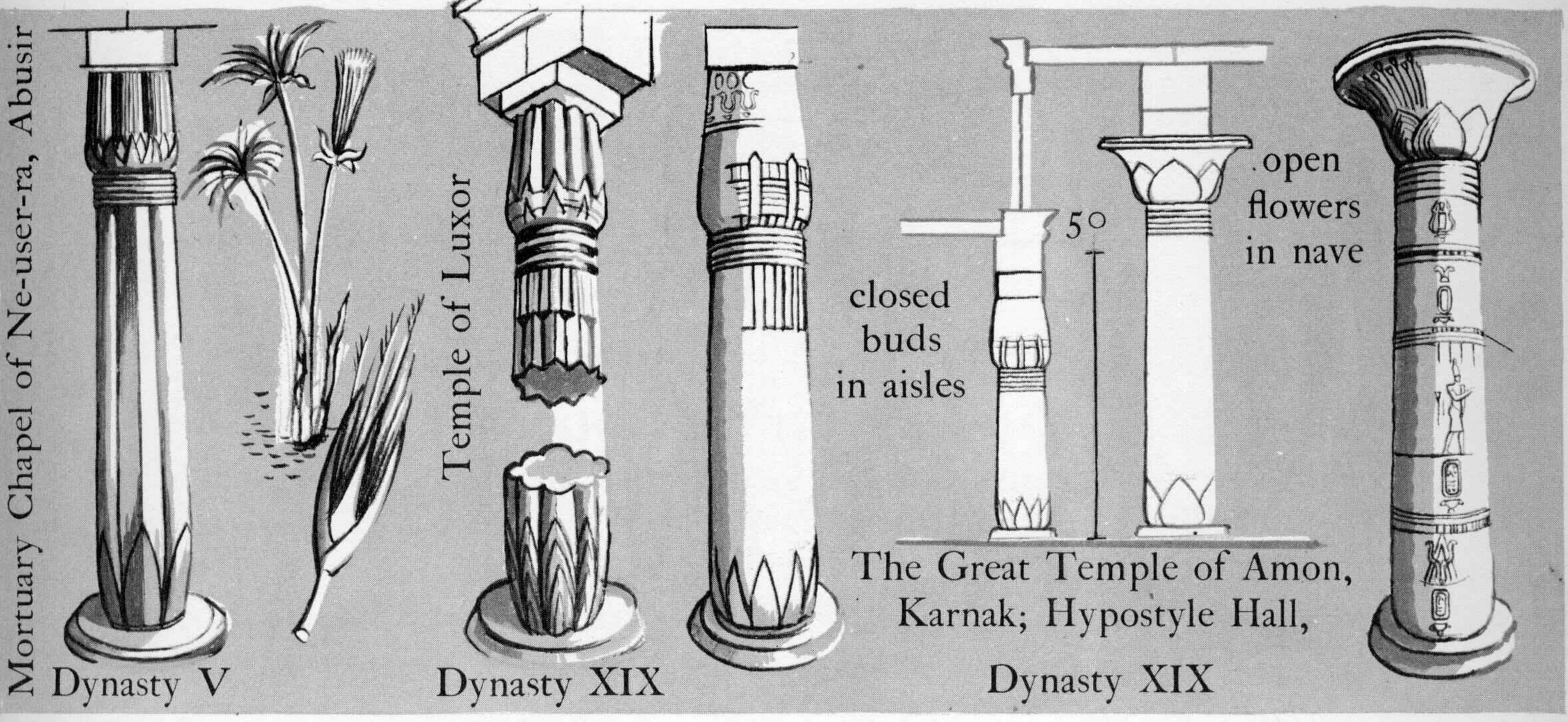


Brick arch,  
el 'Asaseef, Thebes

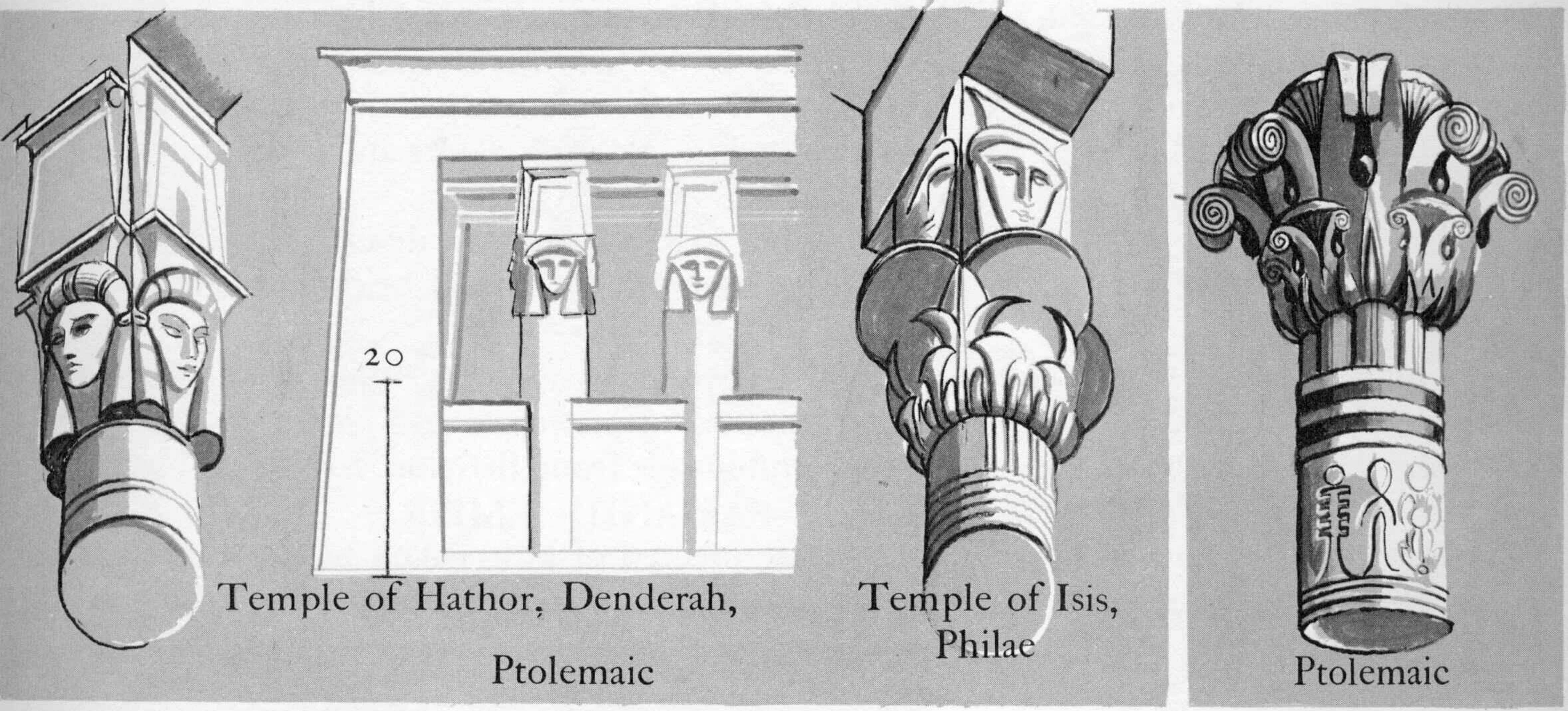


Vault of damp mud bricks laid in  
slanted courses without centering

# COLUMN BEAM & ARCH

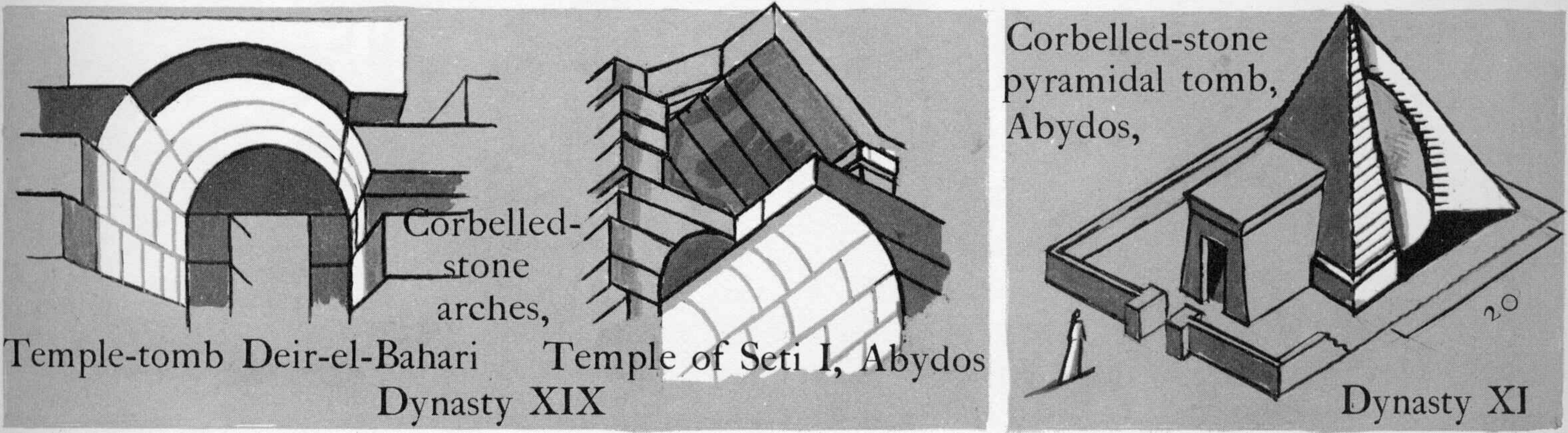


## PAPYRUS COLUMNS

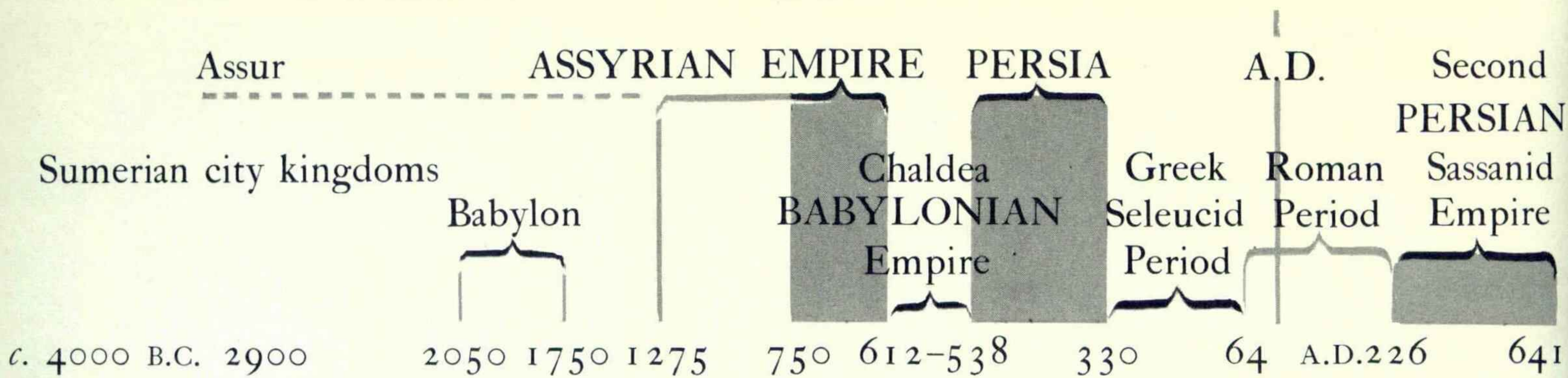


## HATHOR-HEADED COLUMNS

## COMPOSITE



# WESTERN ASIA



## SUMERIAN CITY KINGDOMS

Civilization in Western Asia began with city kingdoms in the rich alluvial plain between the lower Tigris and the Euphrates, an area about that of Wales (Map p. 14). Tower-temples or ziggurats were the centre of city life. There was no stone and little timber but clay was moulded into sun-dried brick. Buildings were faced with kiln-baked bricks, sparingly owing to lack of fuel.

## ASSYRIA

Assyria was set on a high tableland of lime-stone, harder rock & alabaster, but the Assyrians continued to use sun-dried and kiln-baked bricks. Palaces of warrior-kings were built on large platforms of brick 30-50 feet high. Lower courses of walls were faced with slabs of alabaster 9-12 feet high and carved with bas-reliefs or covered with plaster and painted with bright colour. The arch was constructed for gateways, vaults and drains.

## SECOND BABYLONIAN EMPIRE

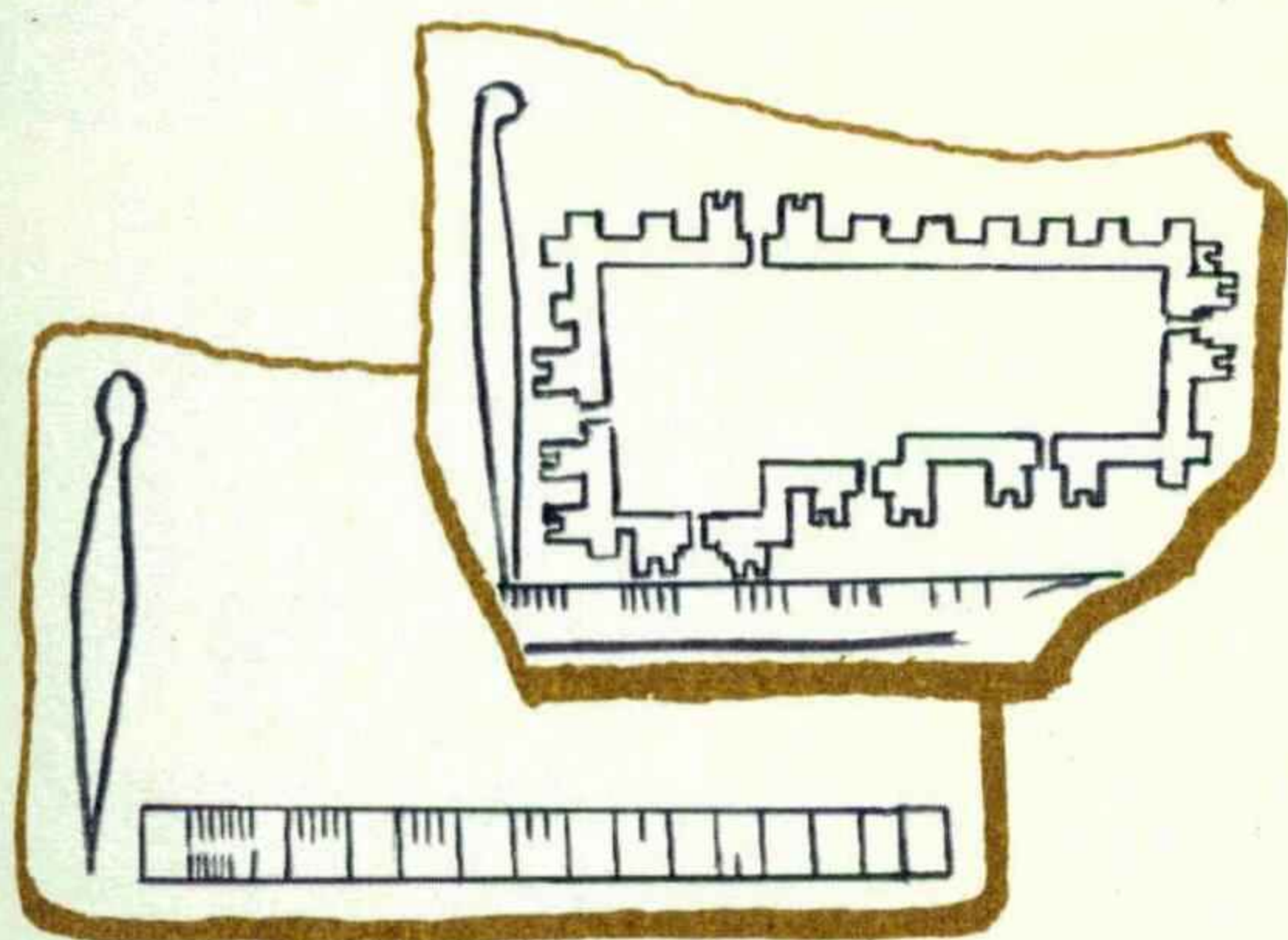
Nebuchadnezzar (604-561 B.C.) rebuilt Babylon to a regular plan described in *The Histories* by Herodotus (484-406 B.C.). Buildings were of kiln-baked brick and bitumen.

## PERSIAN EMPIRE

Palaces were built at the capital city of Susa, at Pasargadae and Persepolis, being constructed of stone which was abundant in Persia; whilst raised platforms and glazed coloured bricks were adapted from the Assyrians; also influences from Babylon, Syria and Egypt.

## SECOND PERSIAN—SASSANID—EMPIRE

The capital city at Ctesiphon. Buildings were erected of kiln-baked brick, vaults and the earliest domes being built over square compartments, developed by the Byzantines.

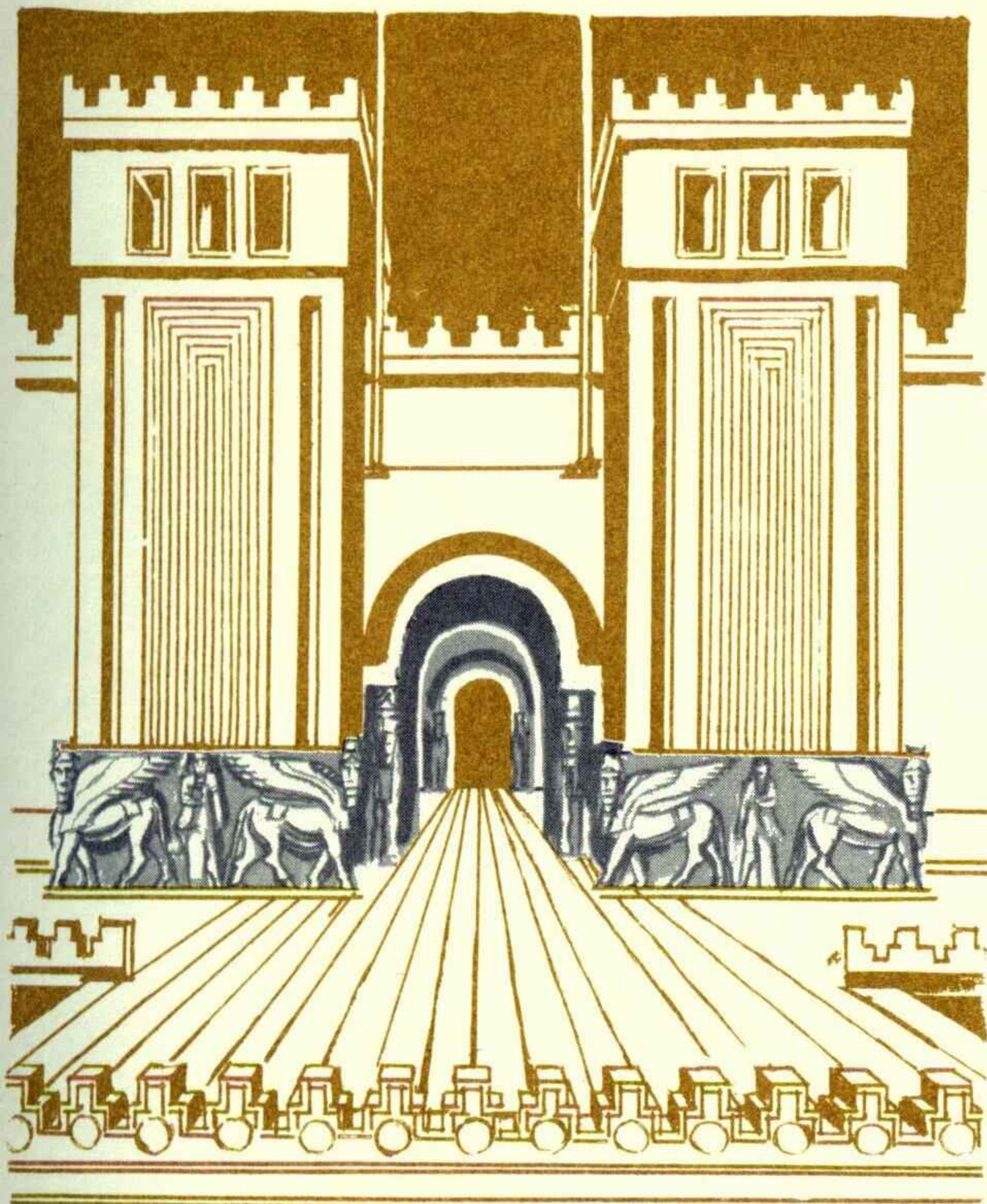


Stilus, scale and plan of King Gudea of Lagash, c. 2350 B.C.

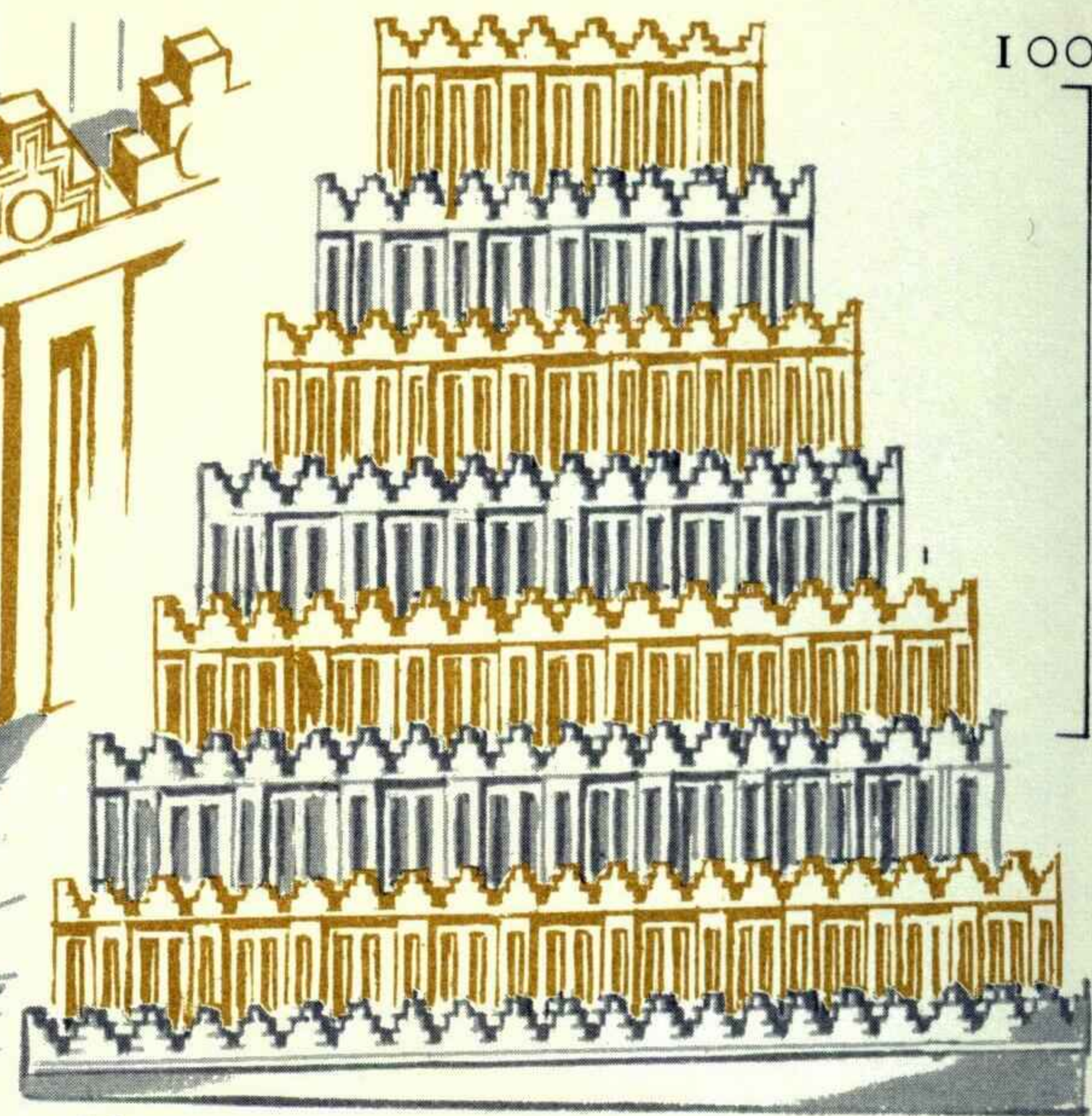
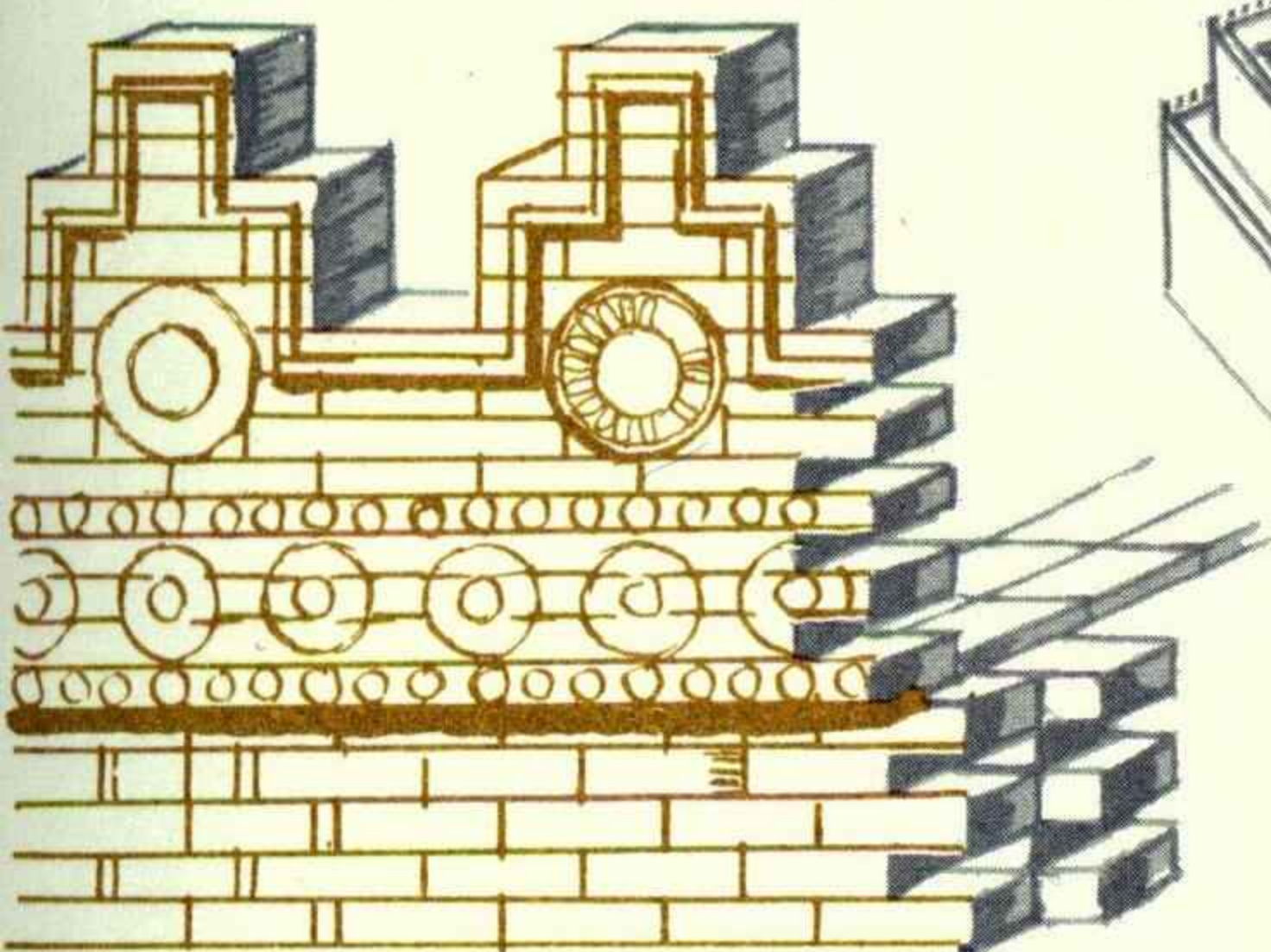


The Ziggurat, Ur (restored), c. 2350 B.C.

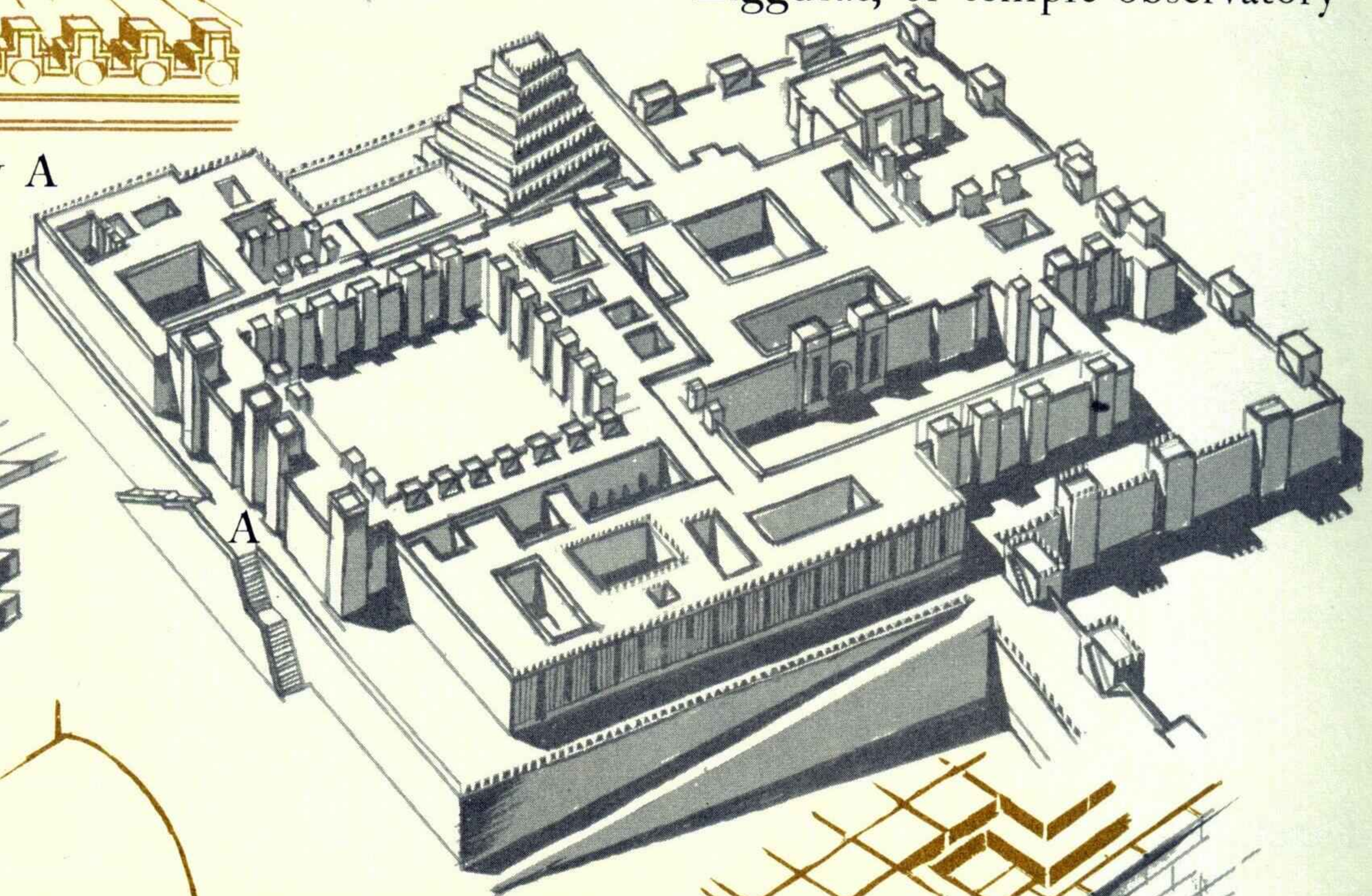
# INTRODUCTION - ASSYRIA



South-east gateway A



Ziggurat, or temple observatory

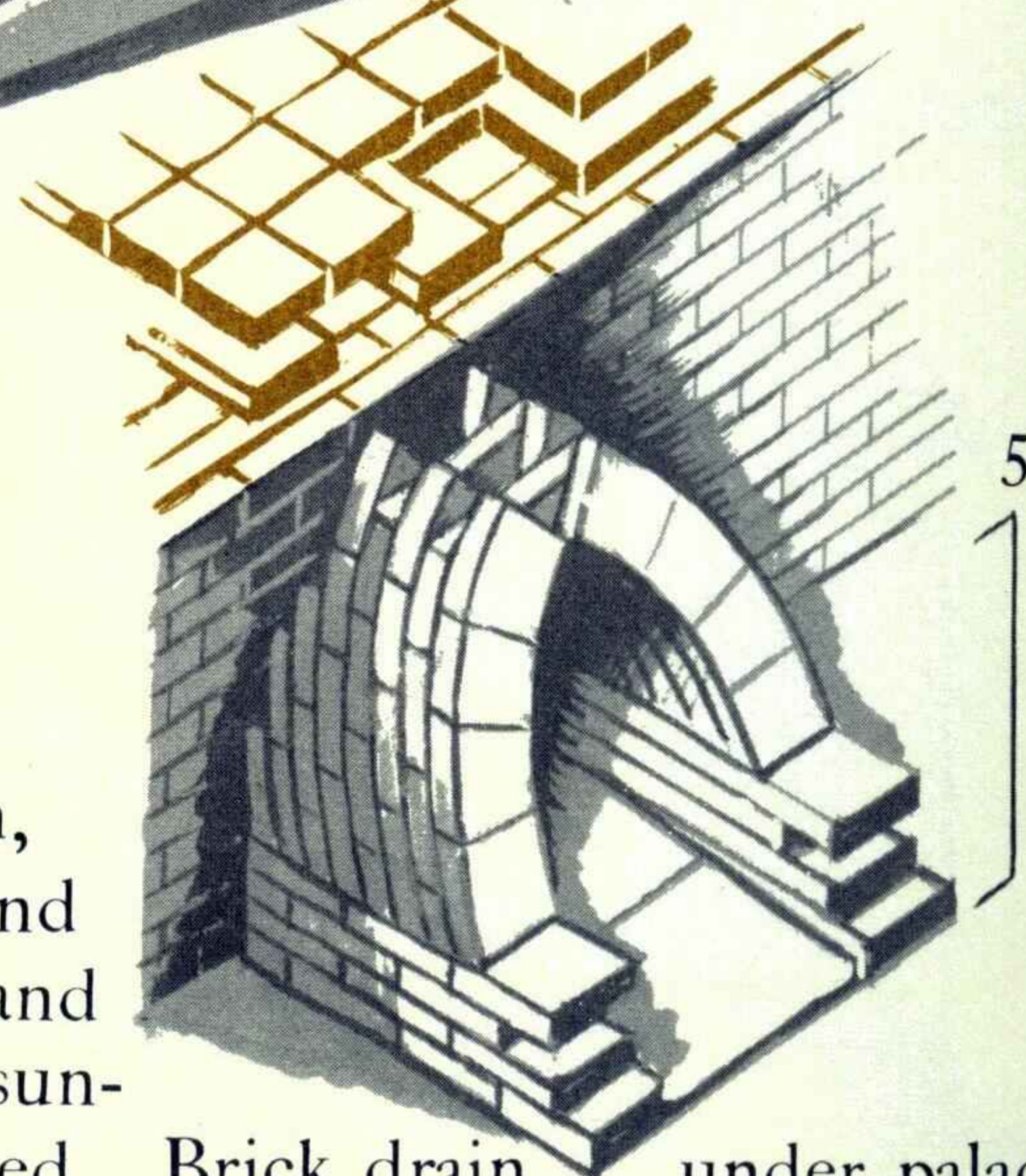


## PALACE OF SARGON II KHORSABAD

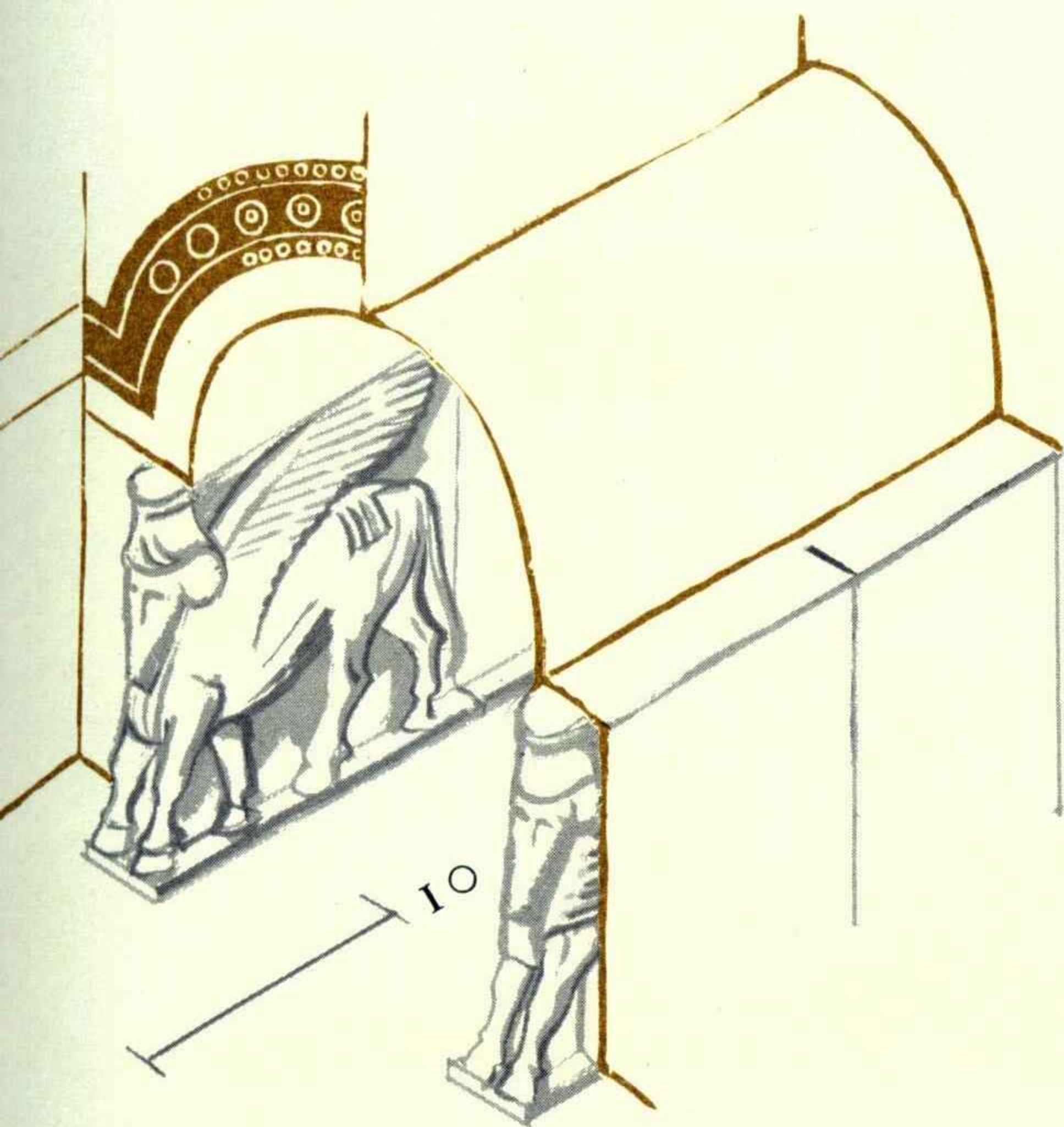
(restored)

772-705 B.C.

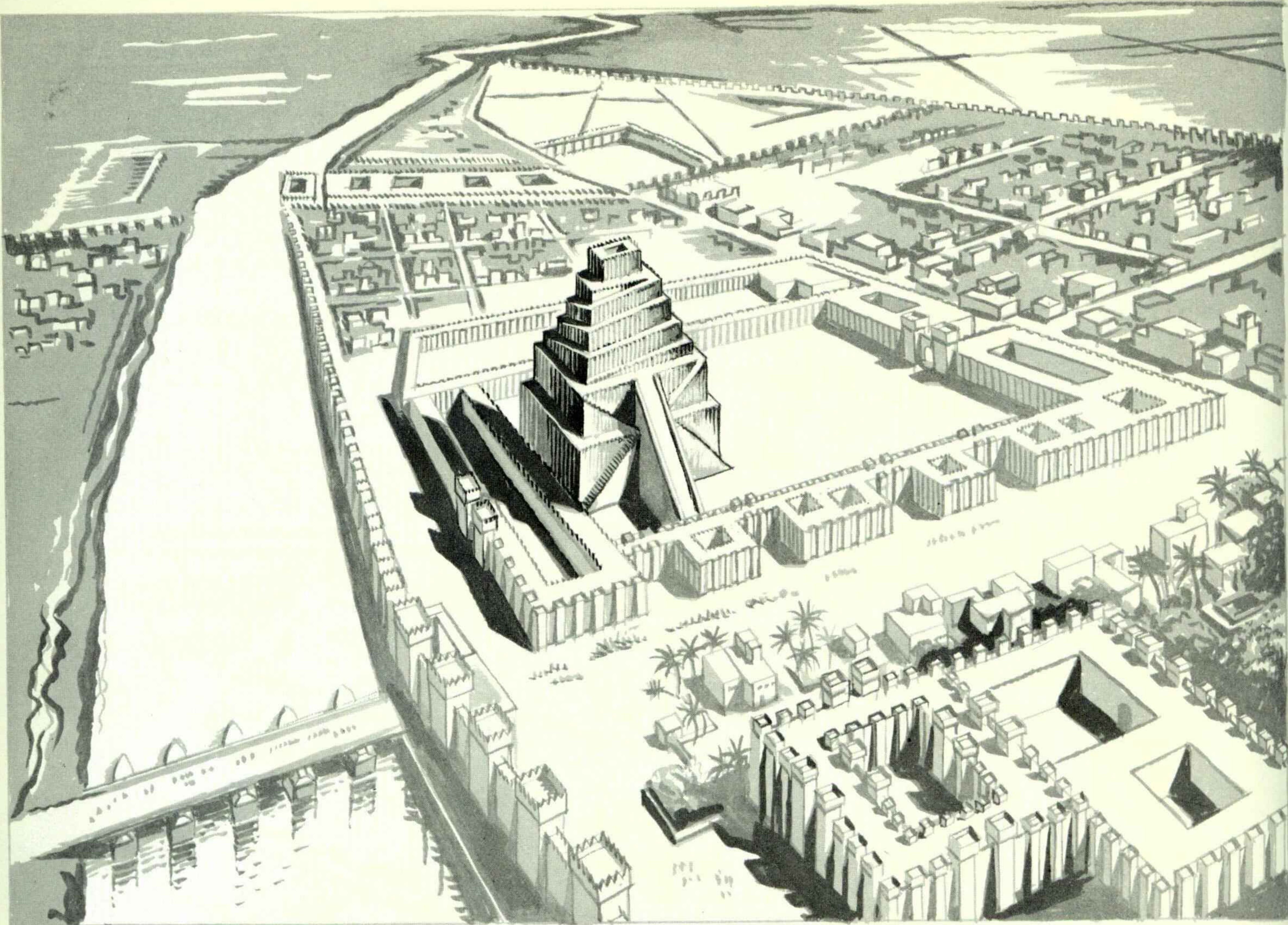
Both the platform, about 50 ft high and 25 acres in extent, and the palace built of sun-dried brick and faced with kiln-baked brick



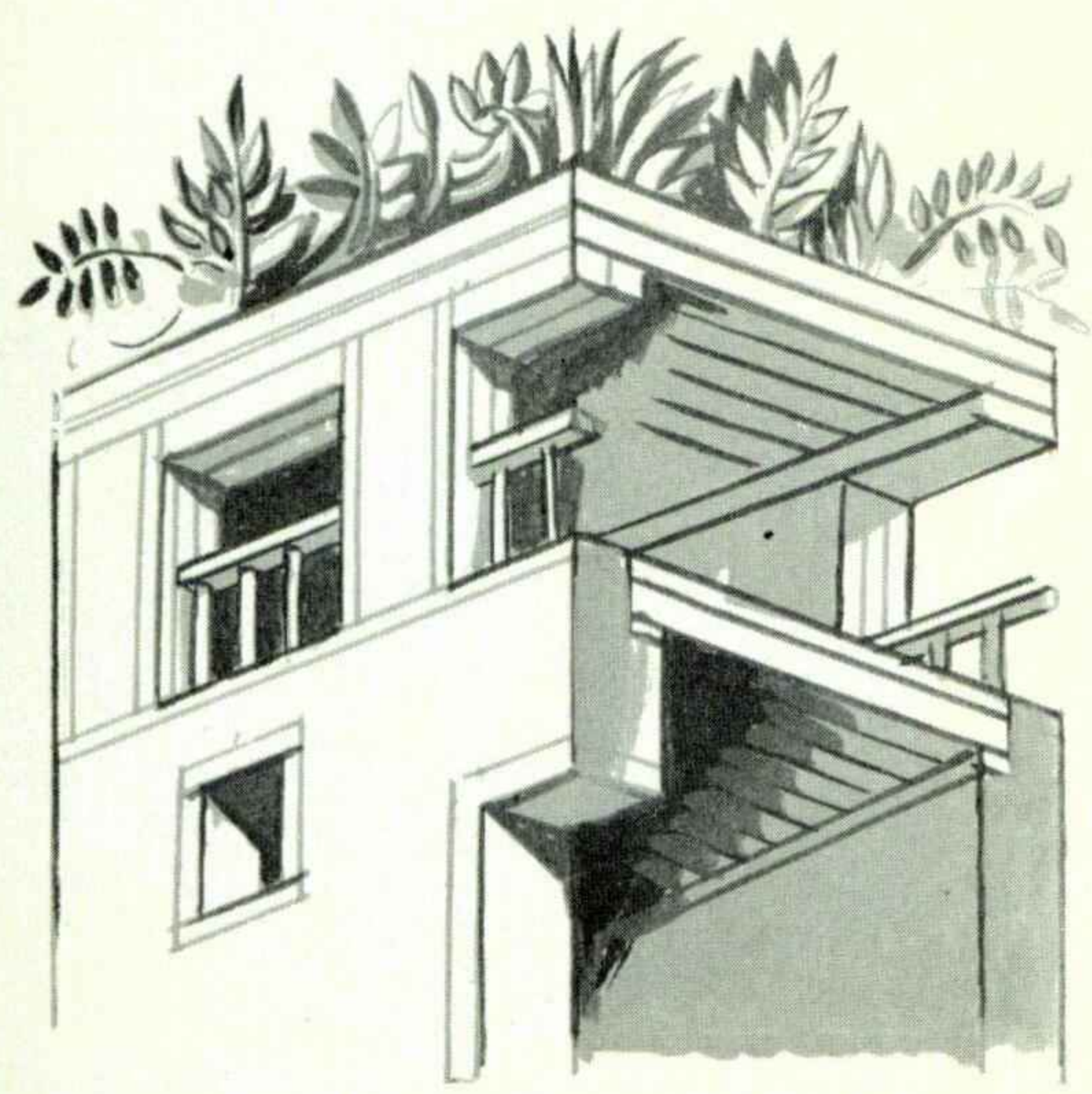
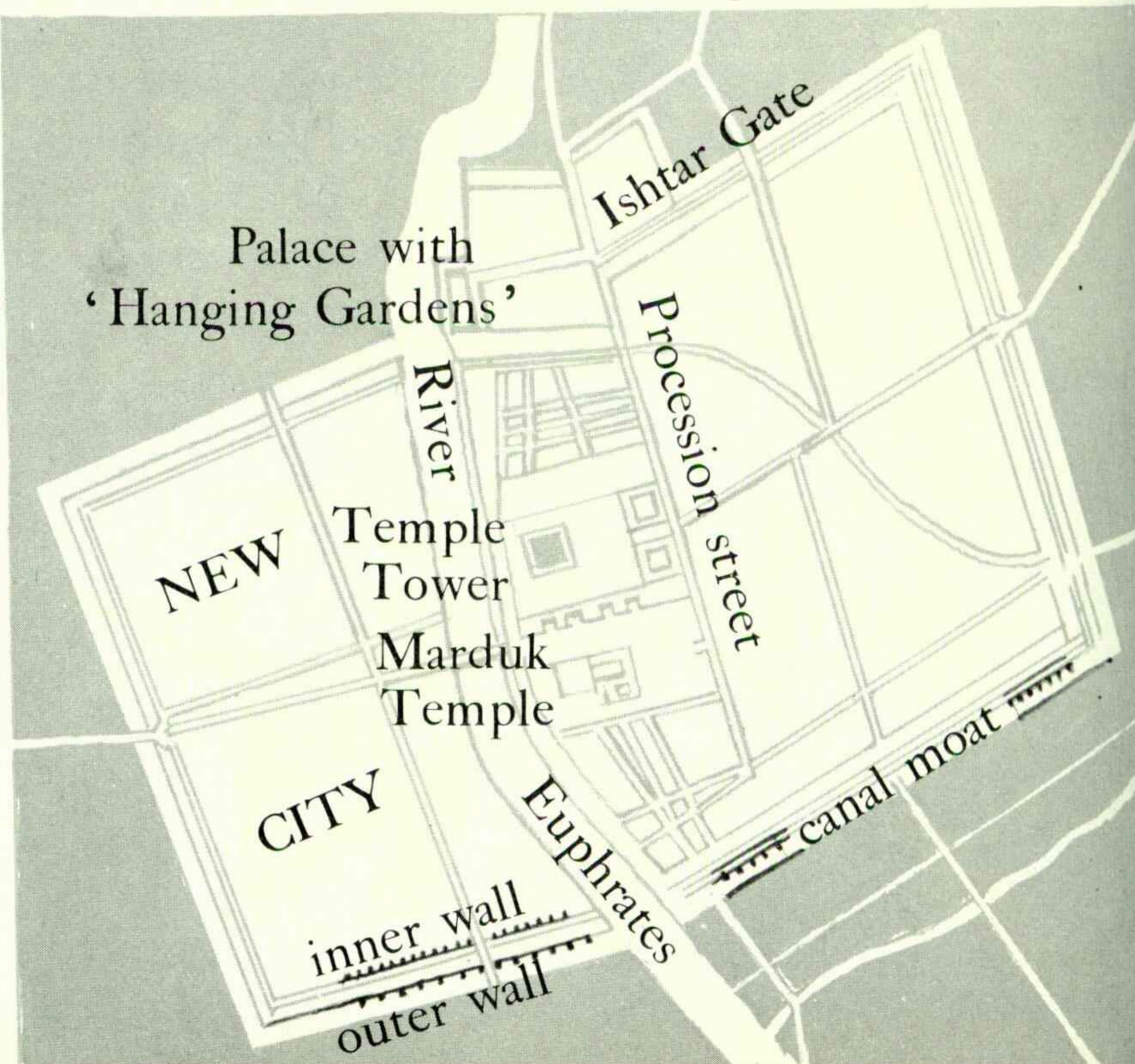
Brick drain under palace built without centering



# WESTERN ASIA BABYLON



THE CITY OF BABYLON  
(reconstructed),  
as rebuilt by Nebuchadnezzar,  
604-561 B.C., during the Second  
Babylonian Empire.  
Described in *The Histories* of Herodotus



House with roof-garden

Hall of 100 columns, Darius

Palace of Xerxes

Palace of Darius

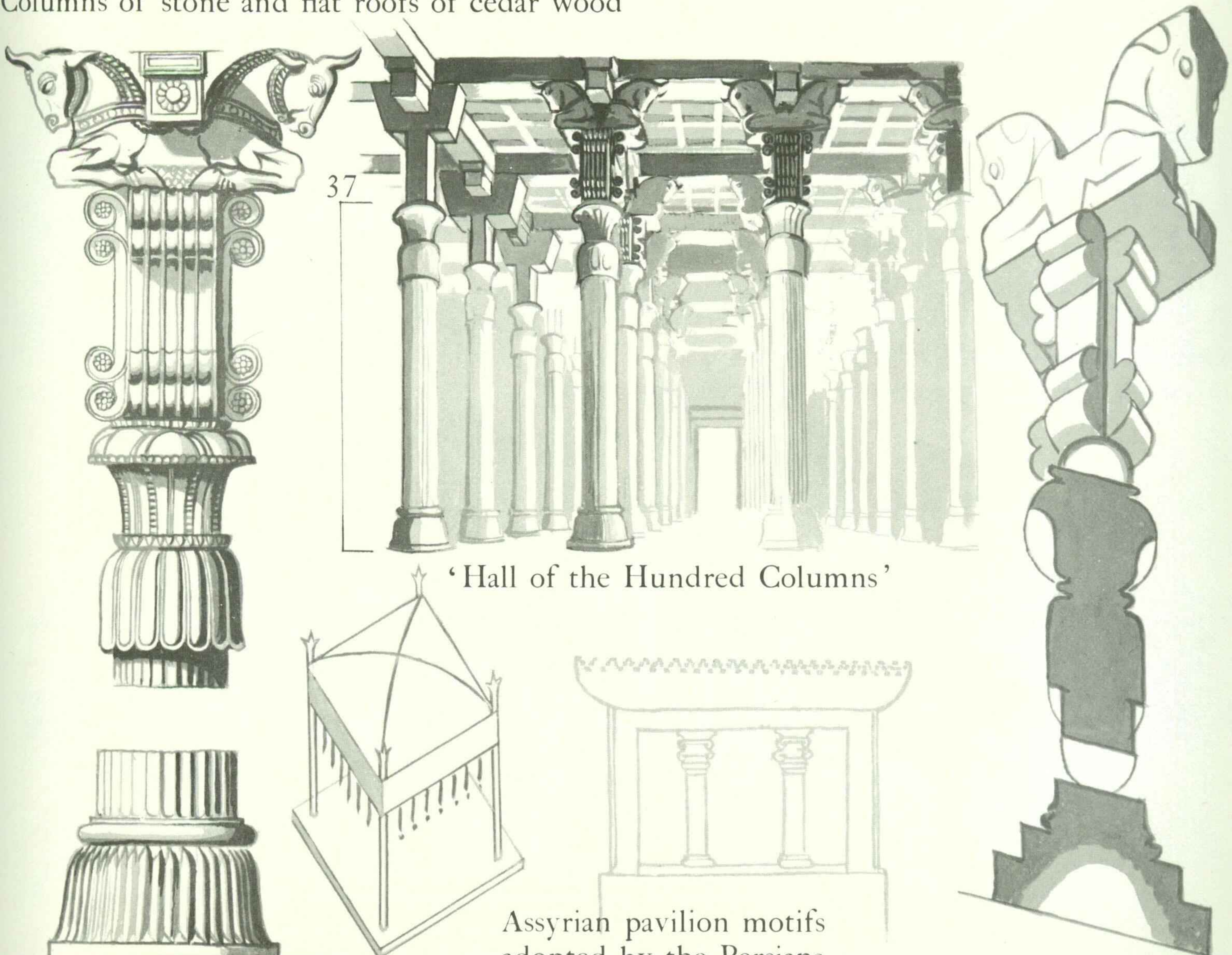
Hypostyle

Hall of Xerxes

Propylae of Xerxes

## THE PALACES OF PERSEPOLIS (reconstructed),

Built by Darius (521-485 B.C.) and Xerxes (485-465 B.C.)  
Built on a platform 1500 ft by 1000 ft in area, and 40 ft above the plain, part solid rock, part large blocks of stone, without mortar, held by metal cramps. Buildings constructed of sun-dried brick and faced with glazed bricks. Columns of stone and flat roofs of cedar wood

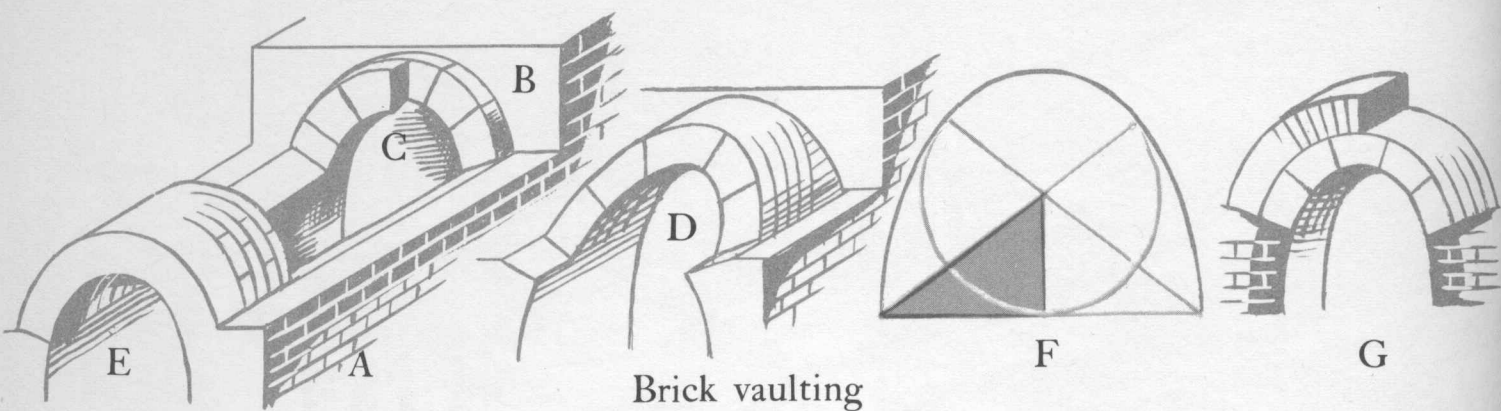


37

'Hall of the Hundred Columns'

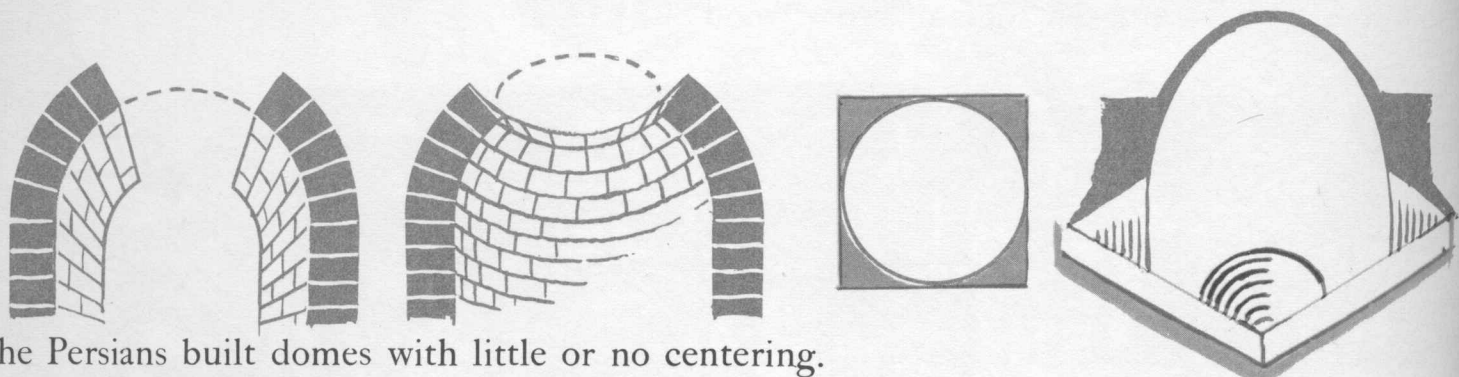
Assyrian pavilion motifs adopted by the Persians

# WESTERN ASIA VAULTS &



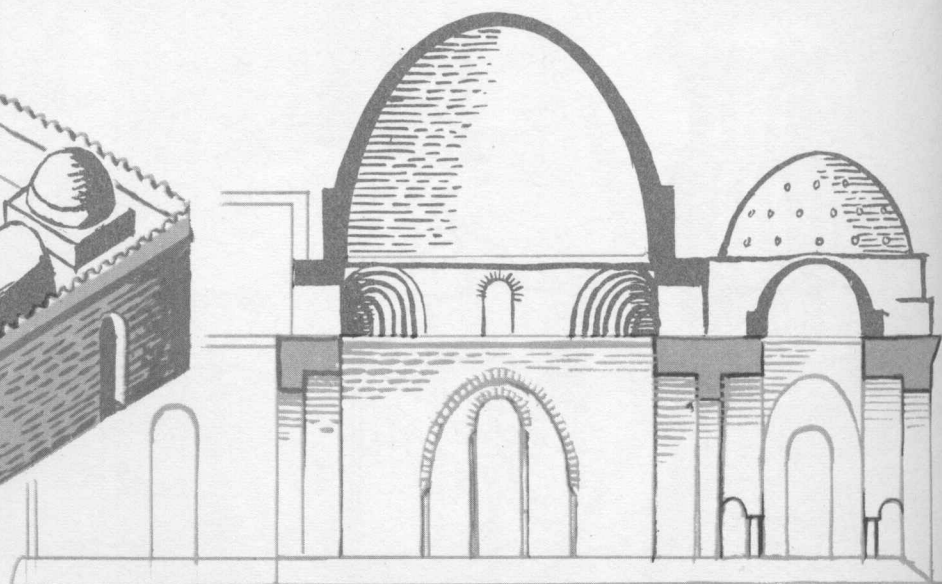
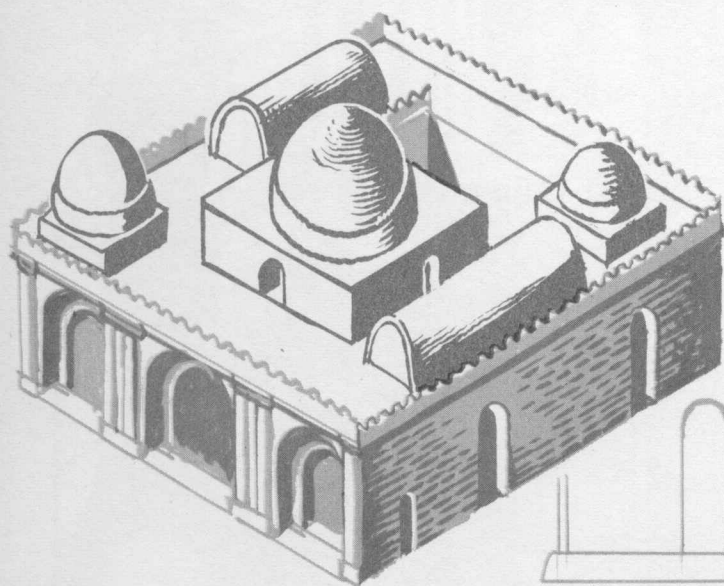
Brick vaulting

Bricks were laid to form a base A; against an end wall B wedge-shaped bricks were fixed with mortar C. To ensure adherence these were often laid in sloping courses D. An arch was constructed with little or no centering to complete the vault E. To facilitate work and to reduce pressure, vaults (and domes) had a high oval profile F. When completed vaults were often re-inforced by a second or more courses of brick G. Sassanid Persian buildings, vaults and domes were constructed of kiln-baked bricks laid with a mortar of lime and sand



The Persians built domes with little or no centering. A dome is an arched construction both vertically & horizontally: each ring of brick or stone once closed in cannot fall if it rests adequately on the ring below

The Persians were the first to erect circular domes on square plans with four angular corbelled semi-domes



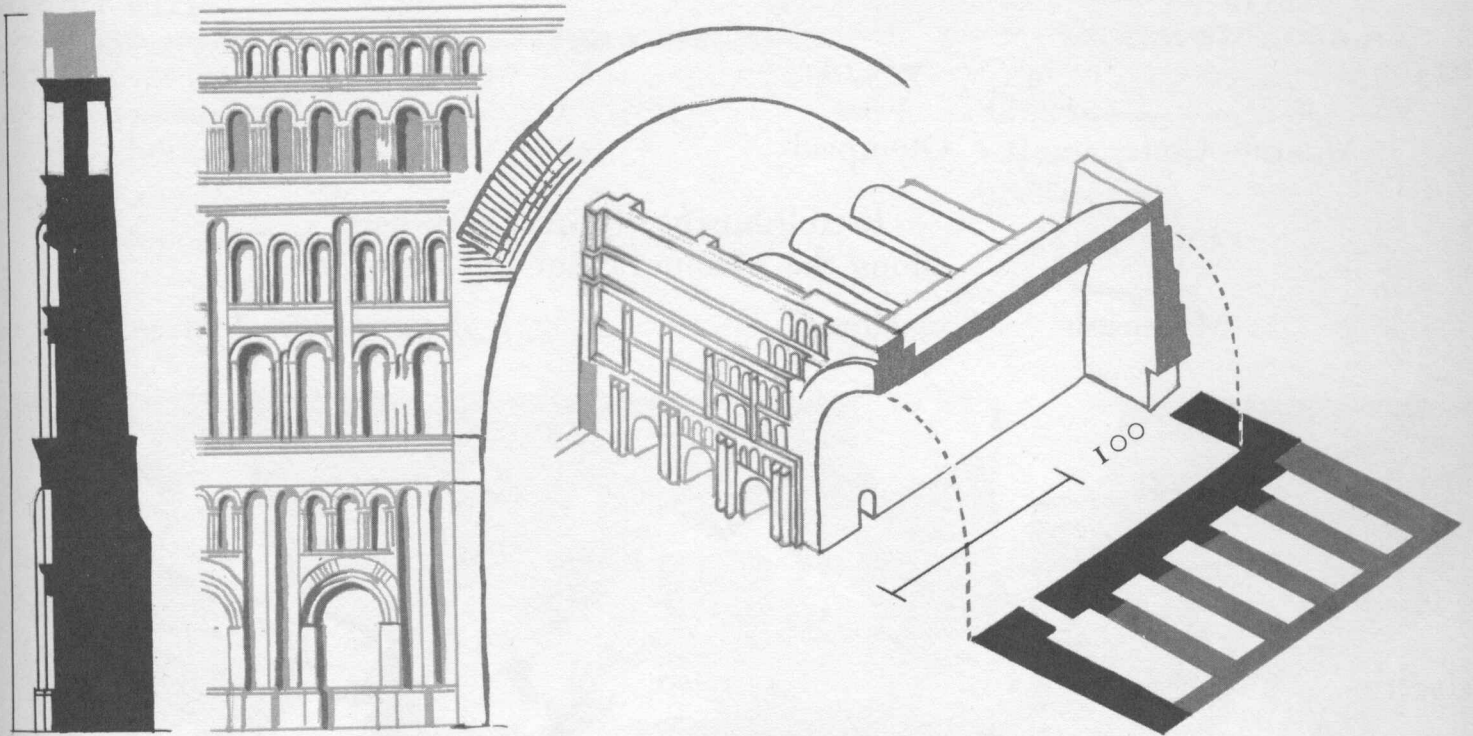
5°

The Palace, Serbistan (exterior restored), c. A.D. 350

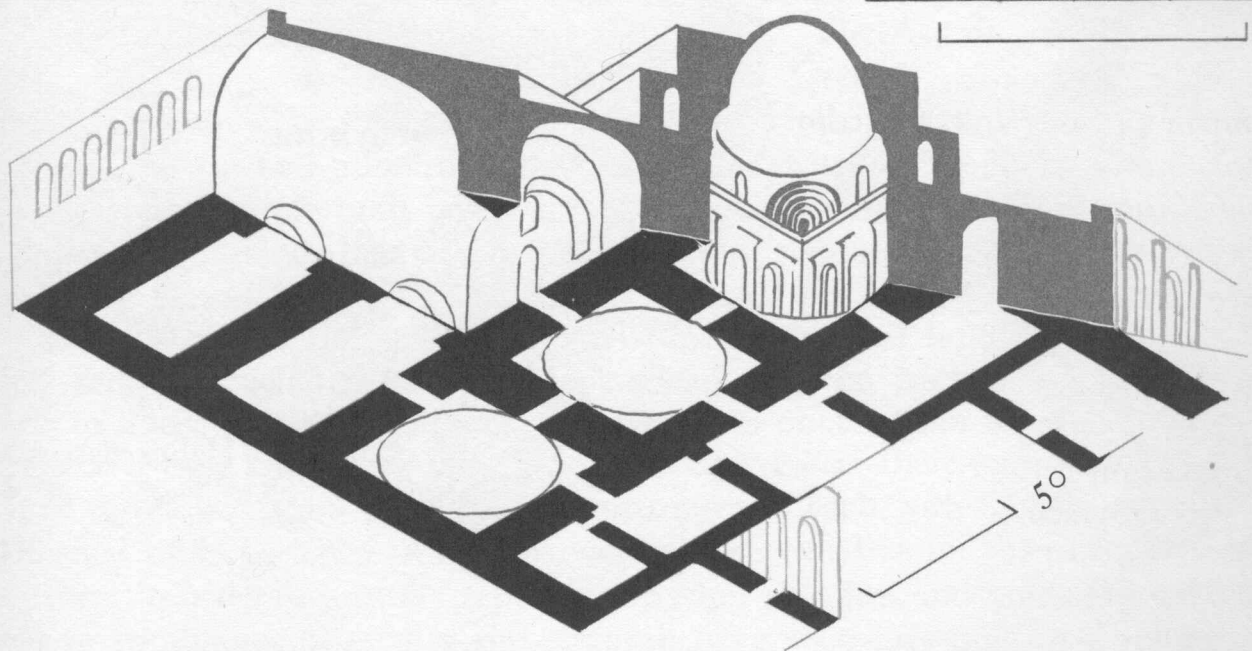
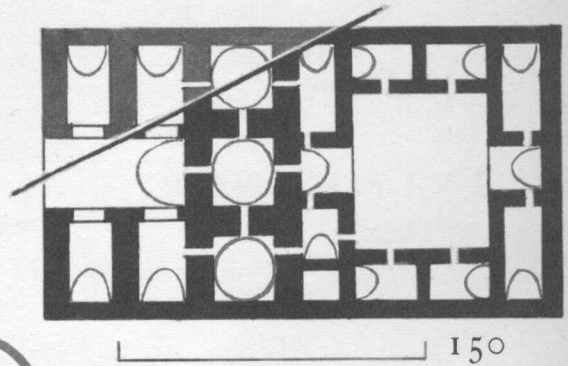
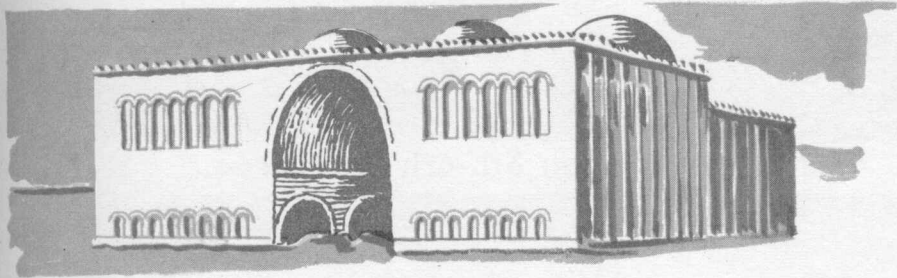


# DOMES - SECOND PERSIAN EMPIRE

112'5



The Palace of Chosroes, Ctesiphon, 6th cent. A.D.

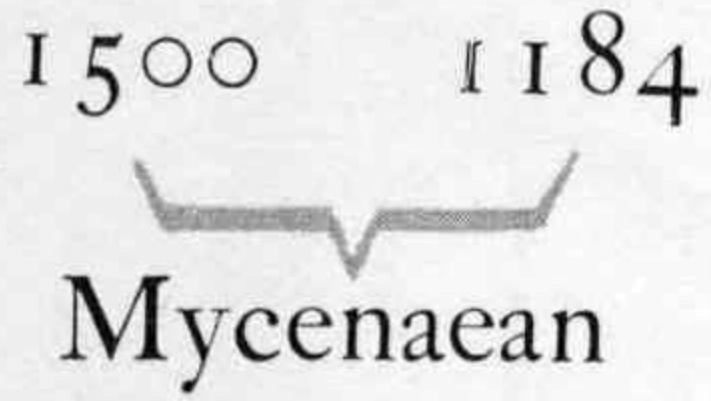
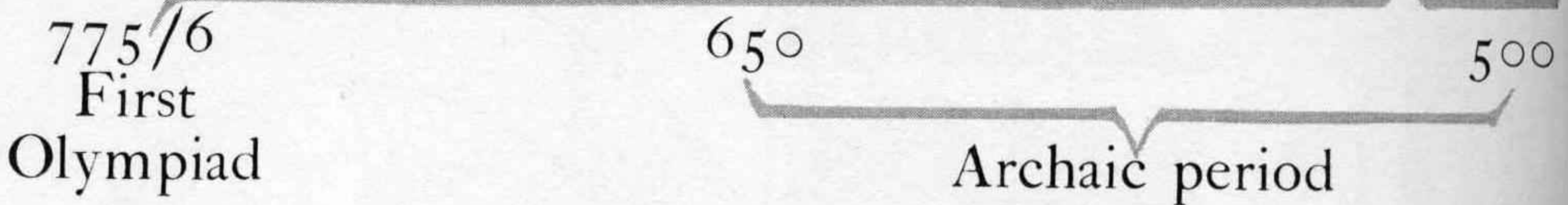
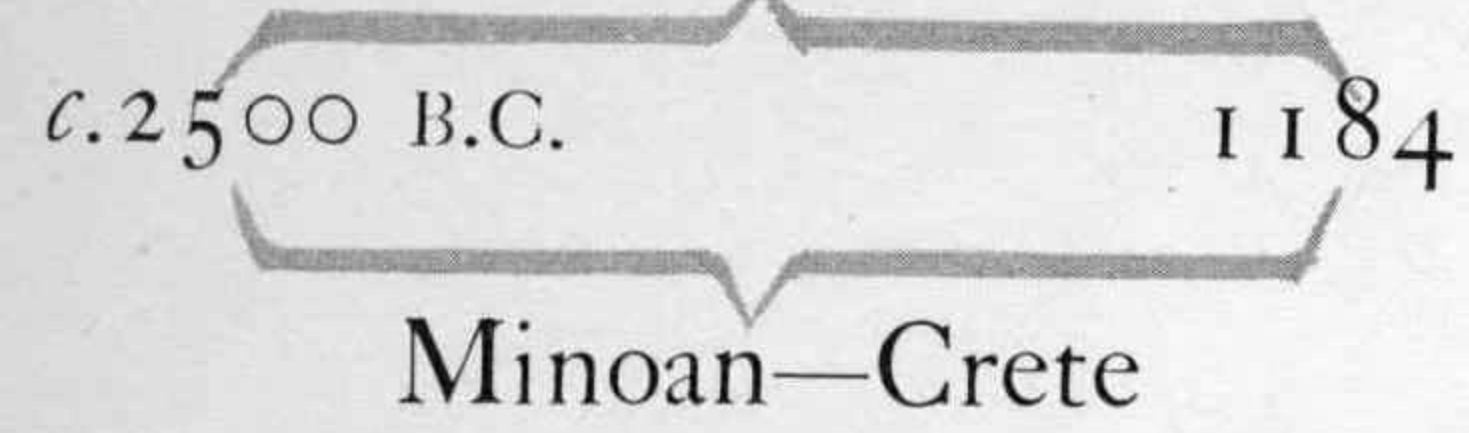


The Palace, Firouzabad (exterior restored), c. A.D. 450

# GREEK

AEGEAN

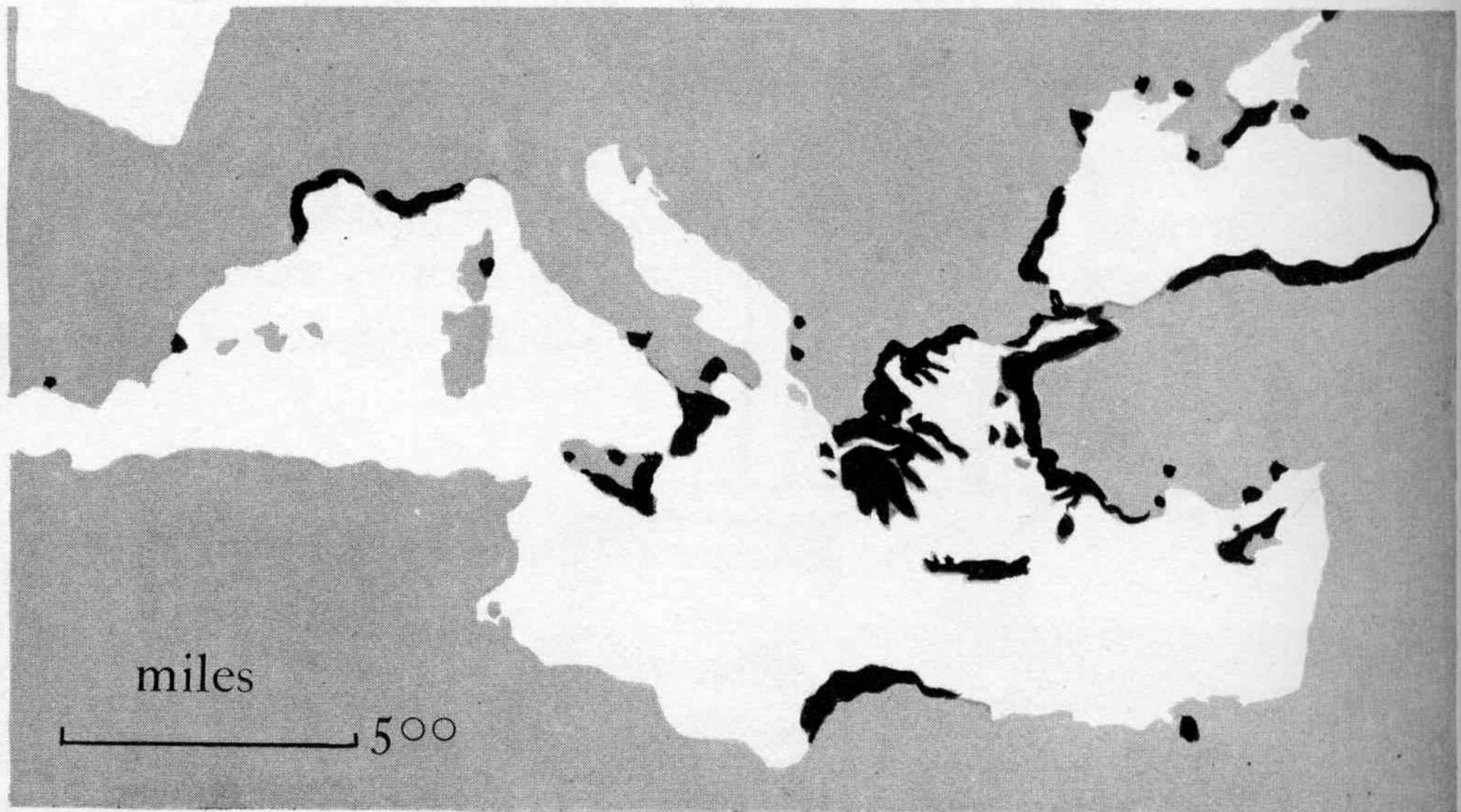
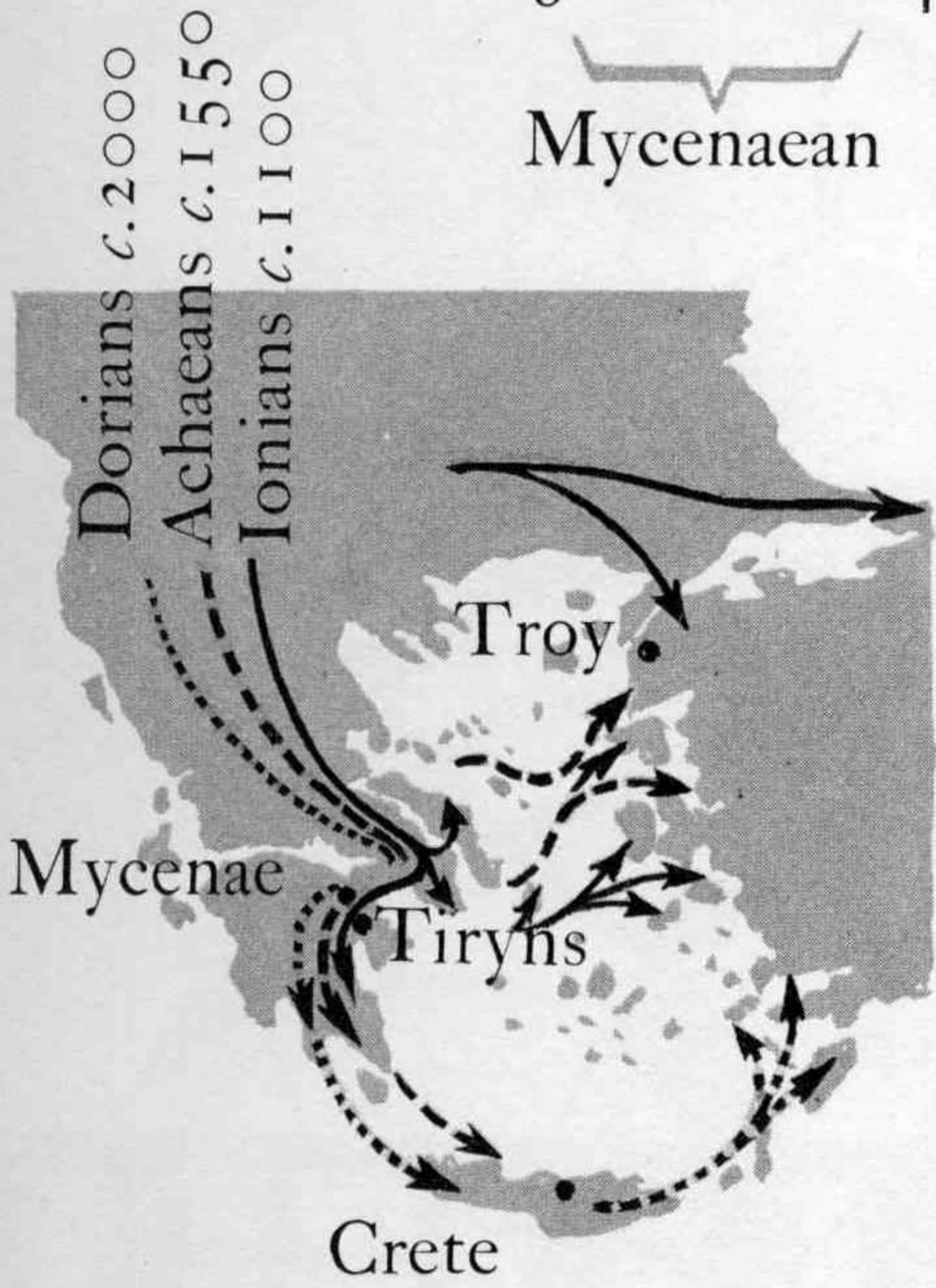
HELLENIC



Establishment of Greek city-states  
along the Mediterranean and Black Sea

c. 835 Homer

c. 582 Pythagoras c. 510



The Greek invasions

Greek colonisation 8th-6th centuries B.C.

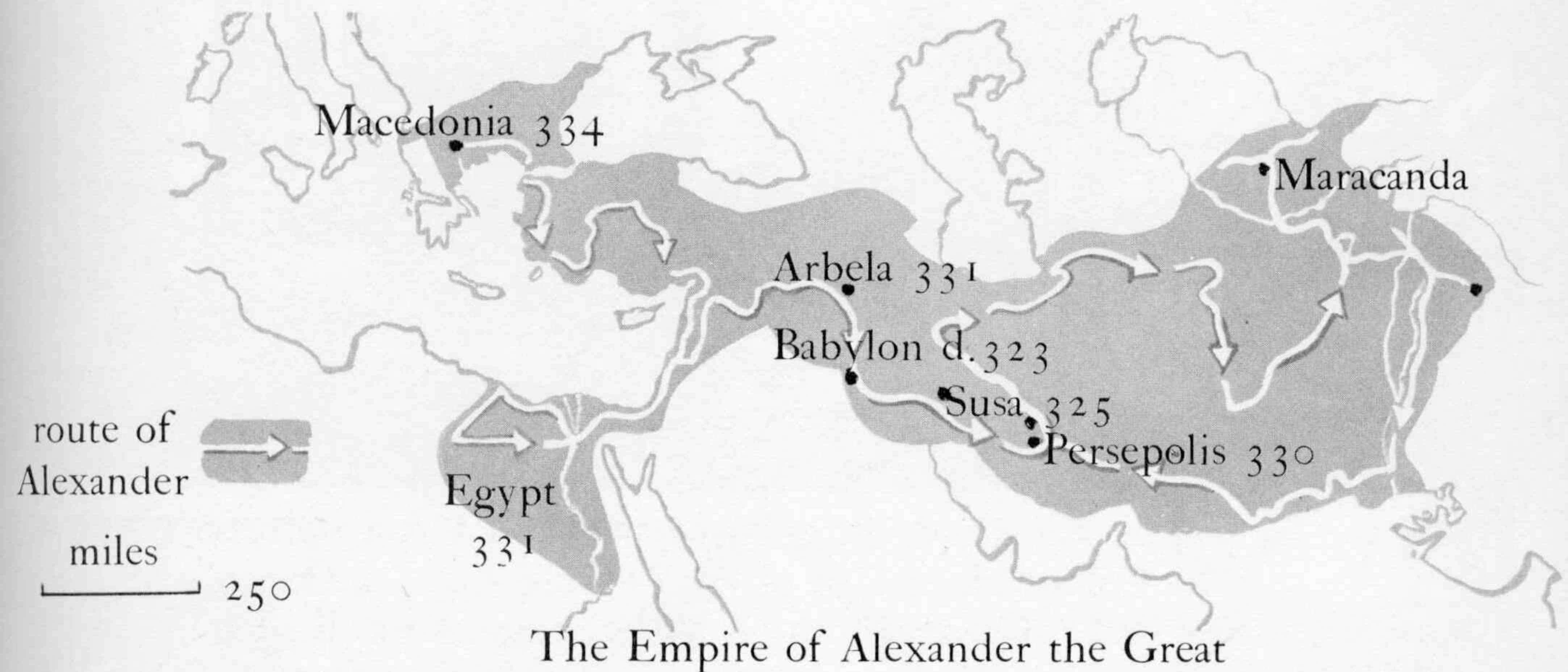


100 miles

# INTRODUCTION

## HELLENISTIC

492-479	444-429	334-323	146	31 B.C.
War with Persia	Ascendancy of Athens	Alexander the Great King of Macedon	Greece a Roman province	
	431 - 404	323		
	Peloponnesian War	Euclid 283		
	429/8	Plato 347		
	384	Aristotle 332		



The Aegean Period. 1 No records survive of the Minoan sea-kings of Crete except remains of palaces, e.g. Cnossus. 2 The Mycenaeans built massive citadels with Cyclopean masonry and domed tholos tombs on the mainland. The Aegean civilization fell before the Homeric Greeks.

The Hellenic Period. The Greeks called themselves Hellenes (Hellas was called Graecia by the Romans). They formed numerous small city states in which primitive houses surrounded a citadel and later a temple built on an acropolis or upper city. National unity was achieved by pan-Hellenic festivals held at Olympia, Delphi, Argos and Corinth every few years.

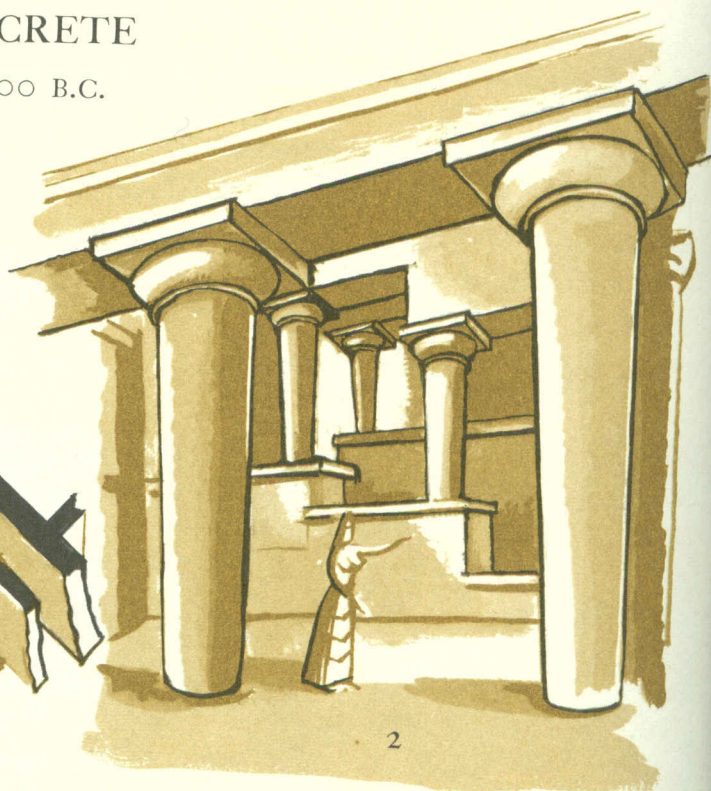
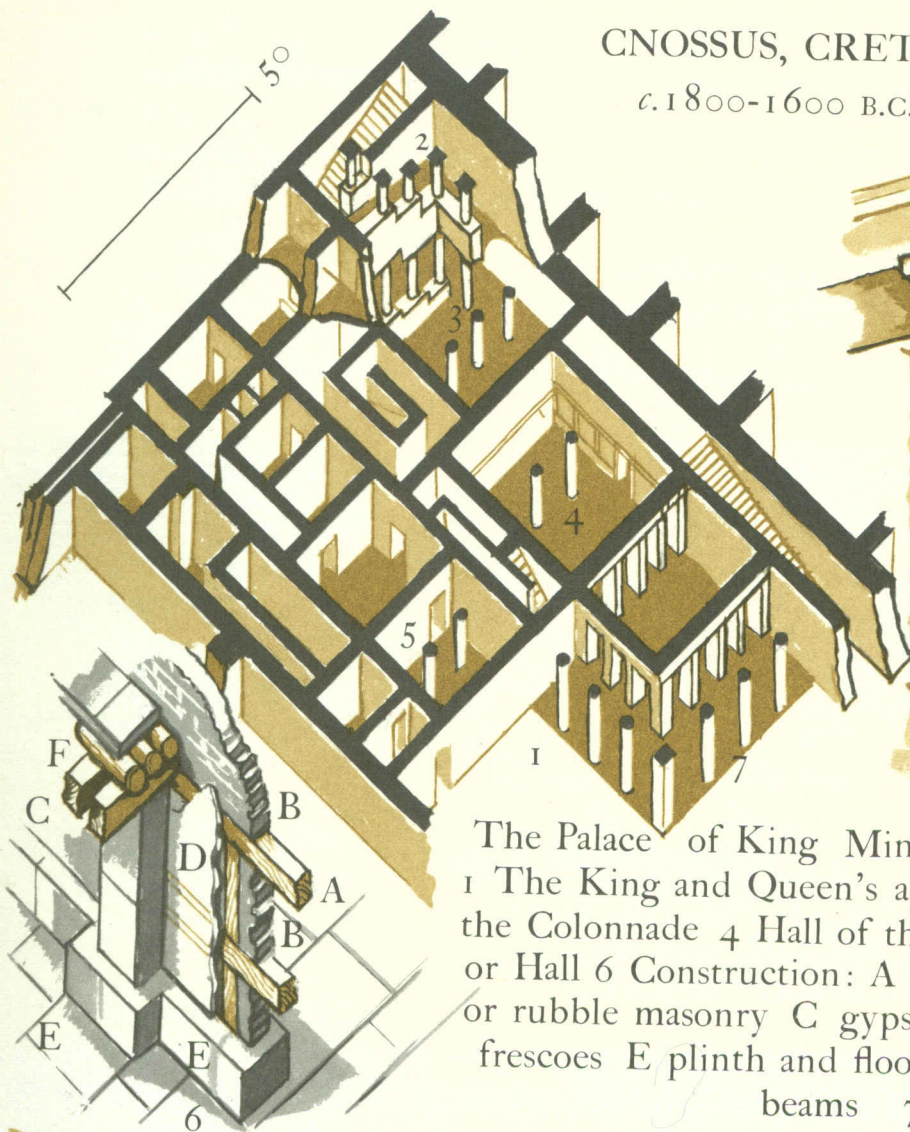
The Hellenistic Period began with the Empire created by Alexander the Great when many new cities were founded with monumental buildings.

The Greek temple developed from the Mycenaean megaron built of sun-dried brick, stone and timber to house a deity and to be looked at from outside, not to contain a congregation within. The arch was known to the Greeks, but they based their temples on the column & beam. These developed from the 6th-4th centuries B.C., each with its own ratios of proportions established by experience. Columns were often placed closer than necessary to support the entablature in order to create a repetitive rhythm of solids and voids. Optical refinements displaying an appearance of vitality and strength have been measured in a number of them. Many architects wrote treatises about their buildings, cited by Vitruvius (1st cent. B.C.) who classified their plans and proportions.

# GREEK

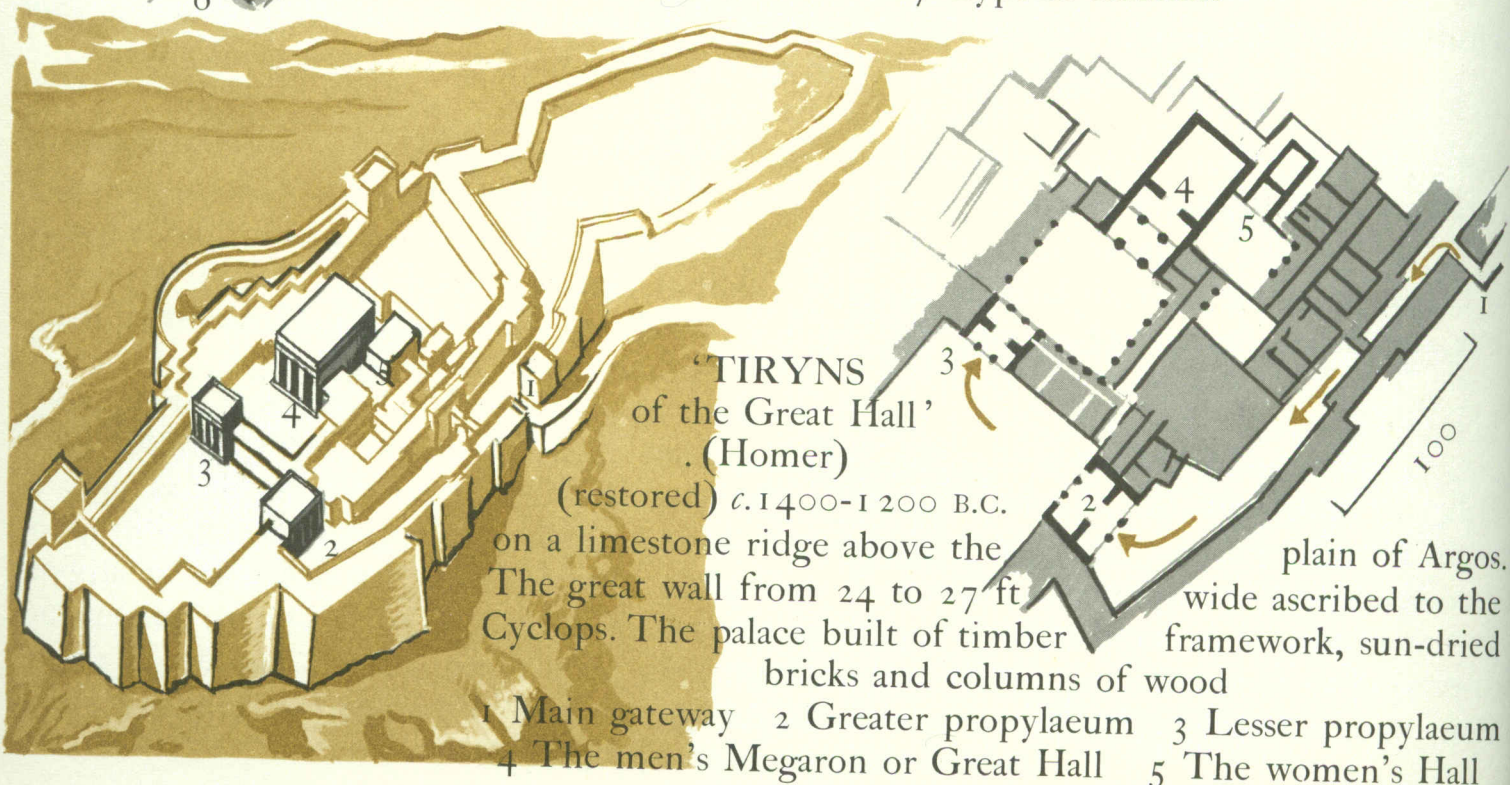
## CNOSSUS, CRETE

c. 1800-1600 B.C.



The Palace of King Minos (restored), c. 1800-1600 B.C.

1 The King and Queen's apartments 2 Great staircase 3 Hall of the Colonnade 4 Hall of the Double Axes 5 Queen's Megaron or Hall 6 Construction: A timber framework B sun-dried brick or rubble masonry C gypsum slabs or D plaster painted with frescoes E plinth and floor of gypsum or limestone F ceiling beams 7 Cypress columns



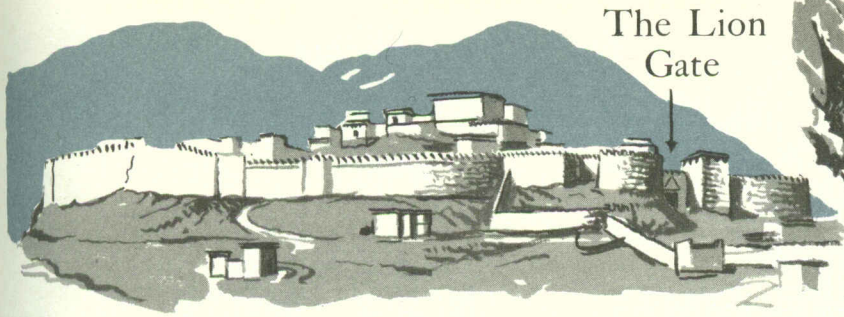
## TIRYNS of the Great Hall (Homer)

(restored) c. 1400-1200 B.C.

on a limestone ridge above the plain of Argos. The great wall from 24 to 27 ft wide ascribed to the Cyclops. The palace built of timber framework, sun-dried bricks and columns of wood

1 Main gateway 2 Greater propylaeum 3 Lesser propylaeum 4 The men's Megaron or Great Hall 5 The women's Hall

# THE AEGEAN

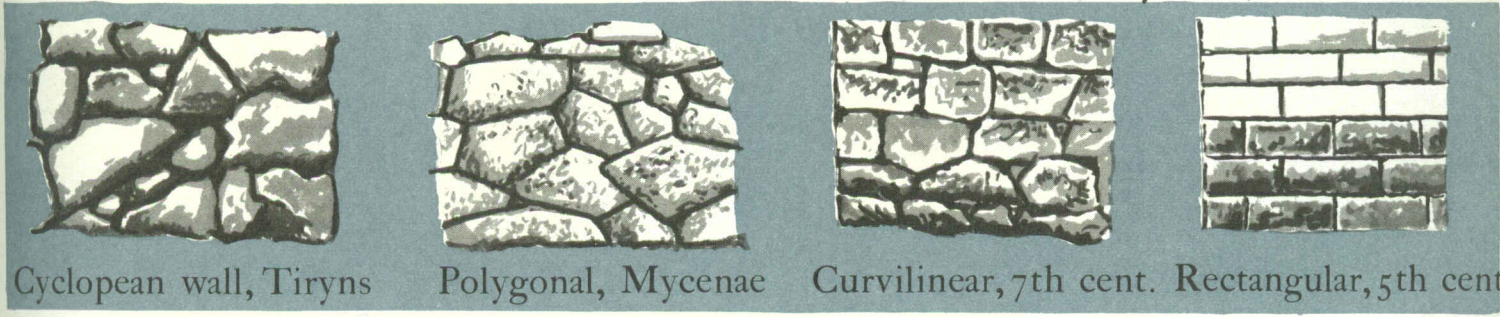


The Lion Gate



Lion Gate, Mycenae, c.1200 B.C.

MYCENAE (restored), c.1350 B.C.  
 The citadel palace of Agamemnon, Cyclopean walls of boulders weighing 5 to 6 tons were eased into alignment on pebbles

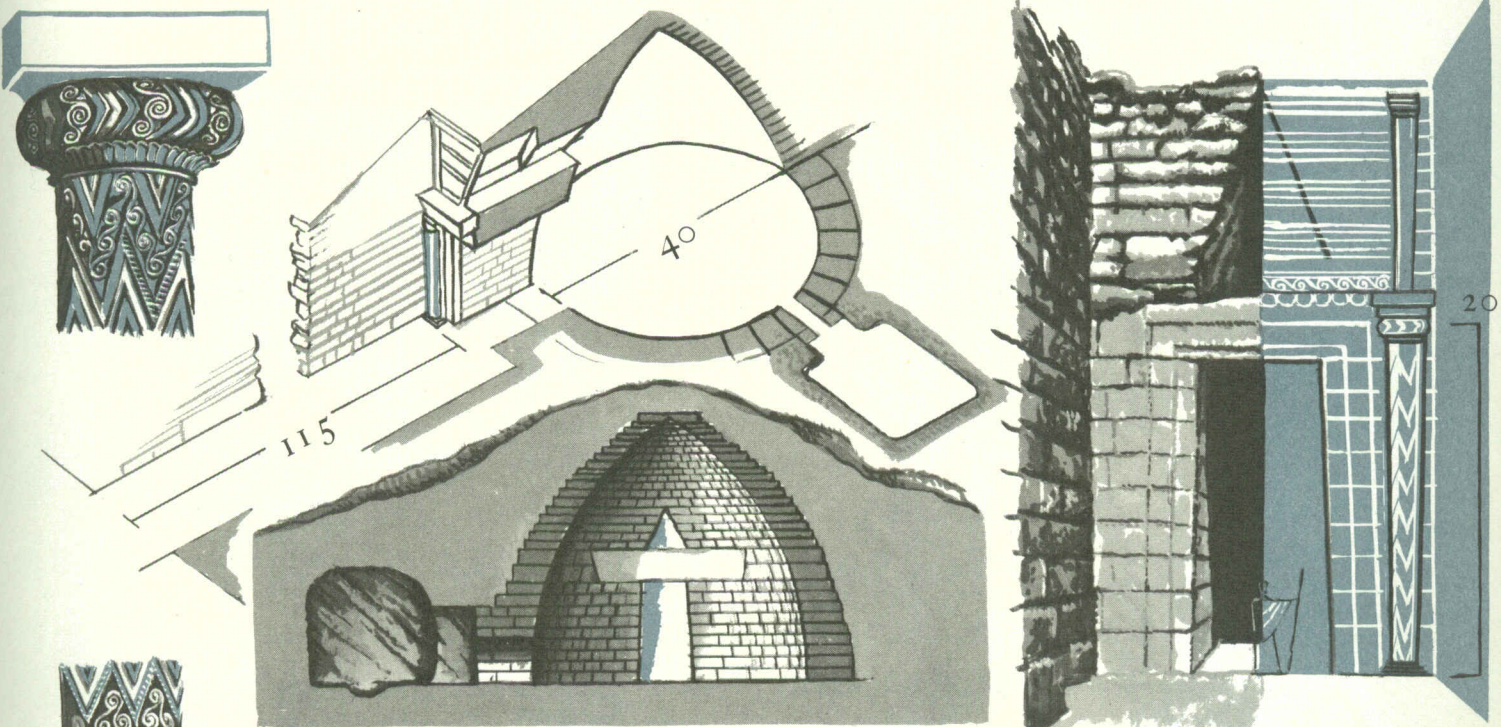


Cyclopean wall, Tiryns

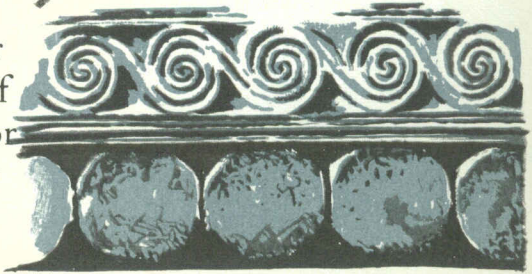
Polygonal, Mycenae

Curvilinear, 7th cent.

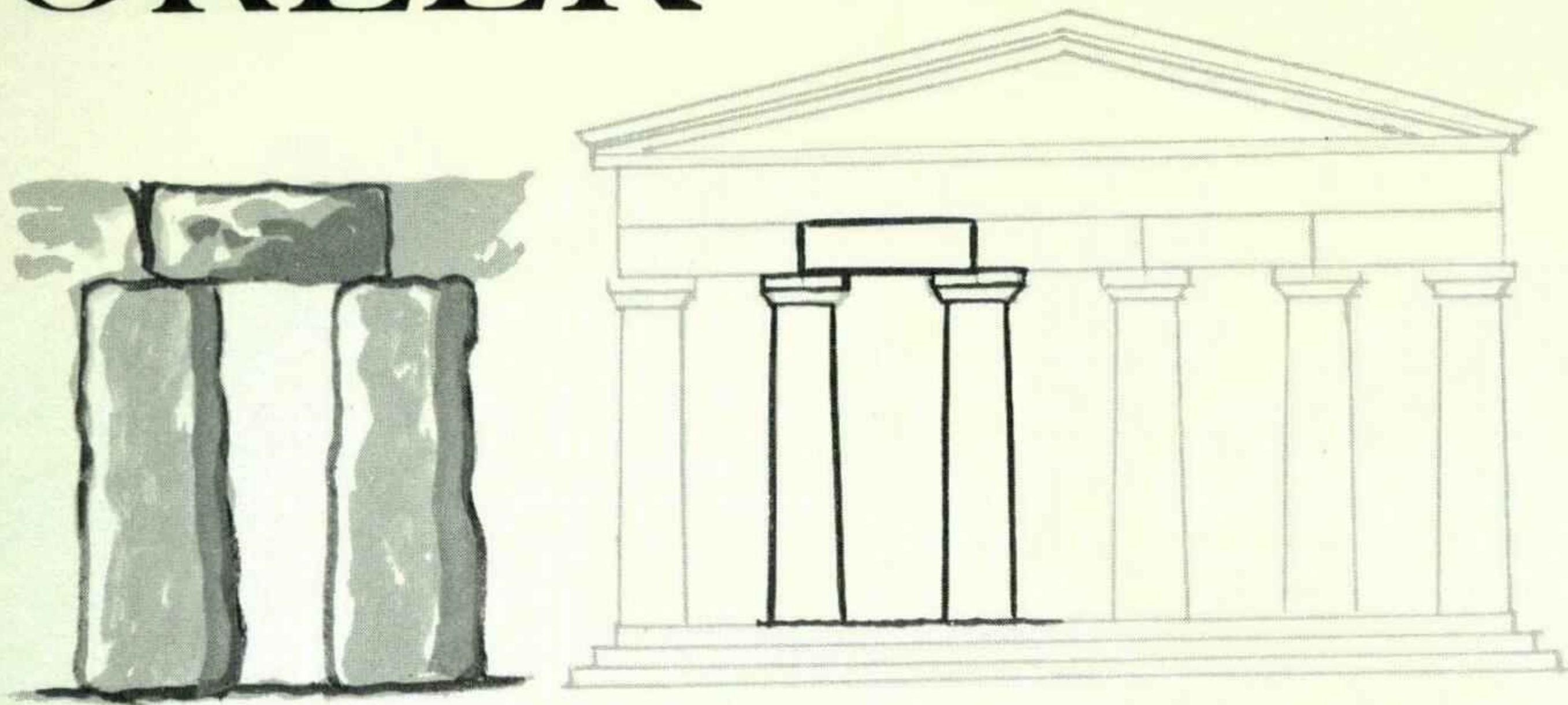
Rectangular, 5th cent.



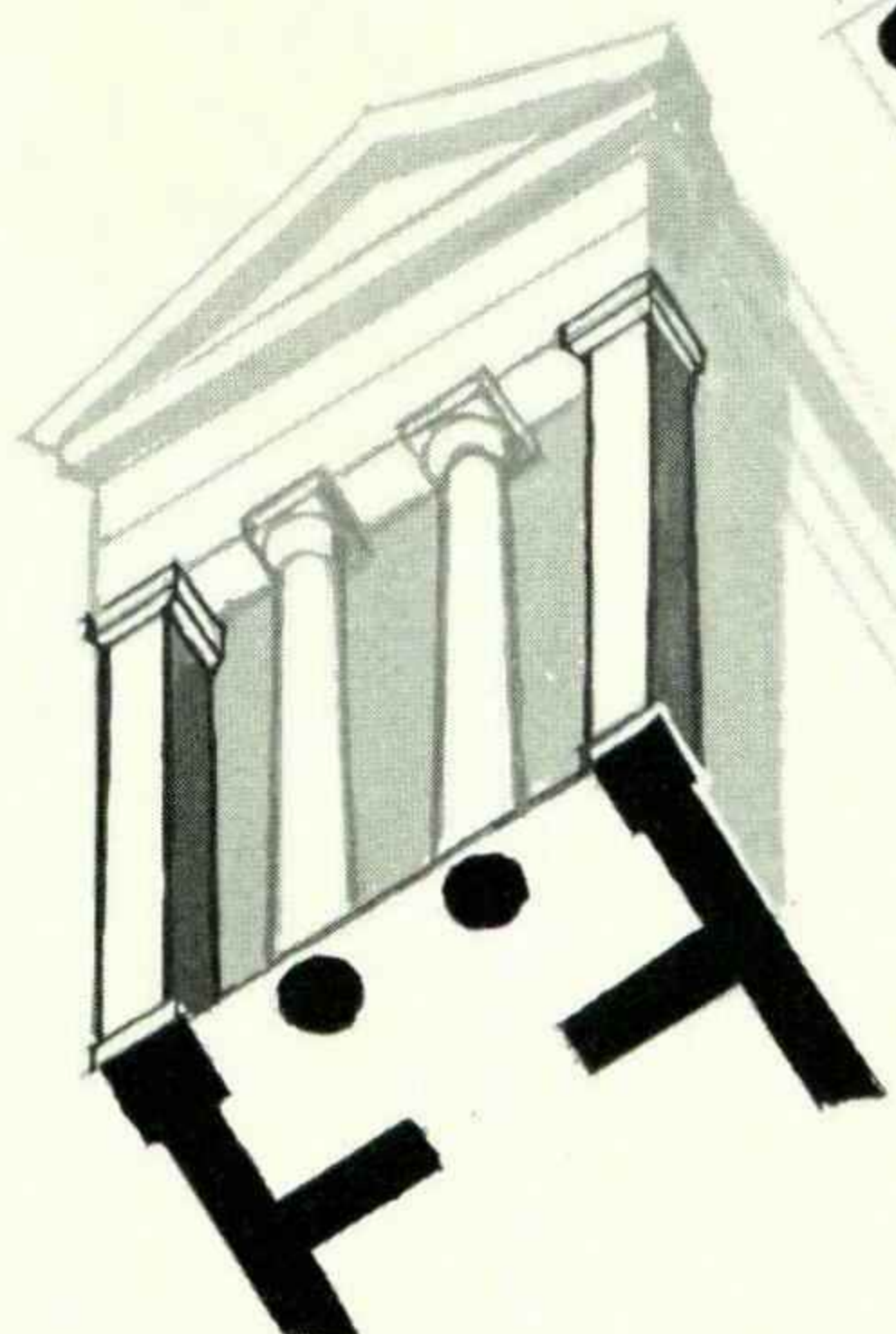
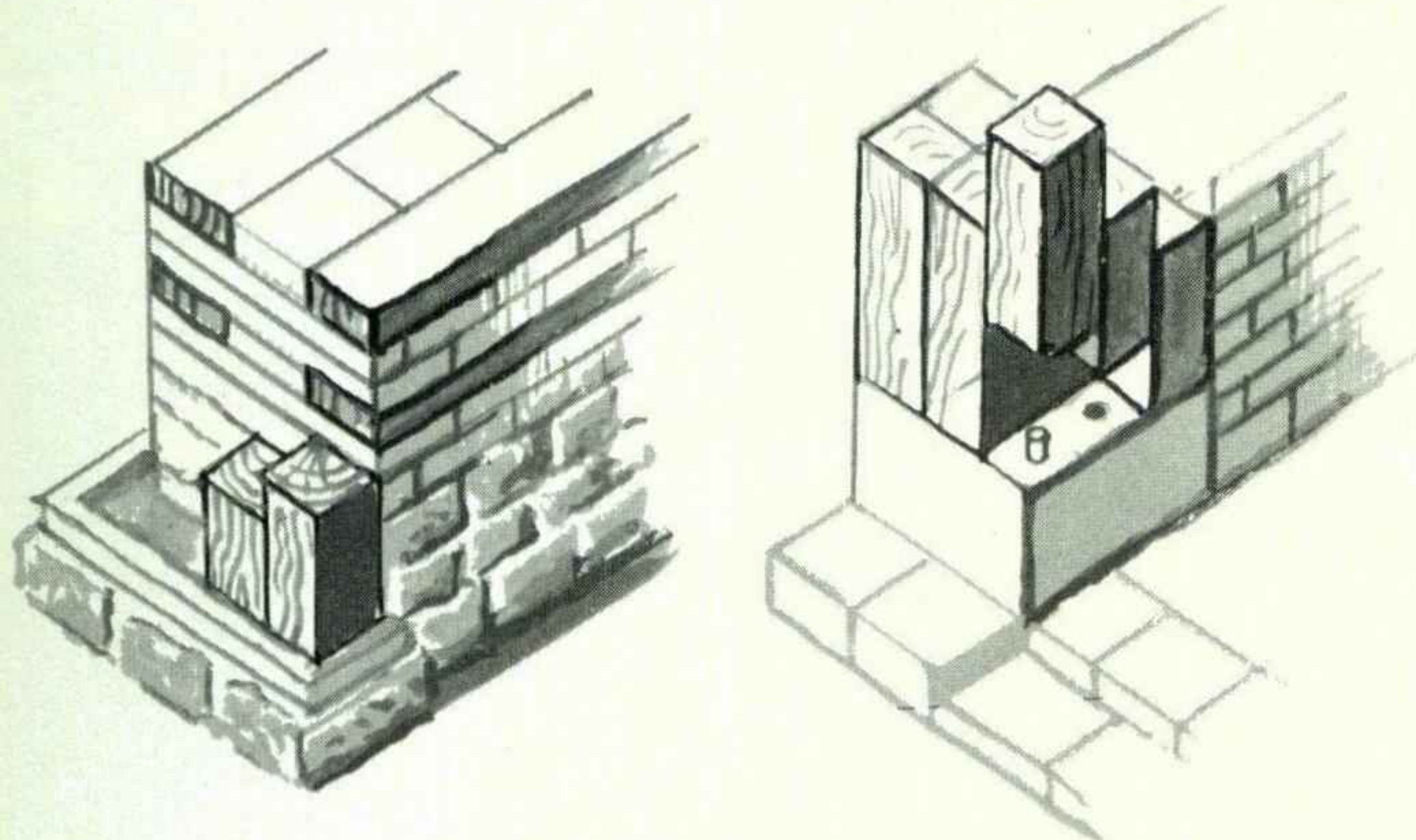
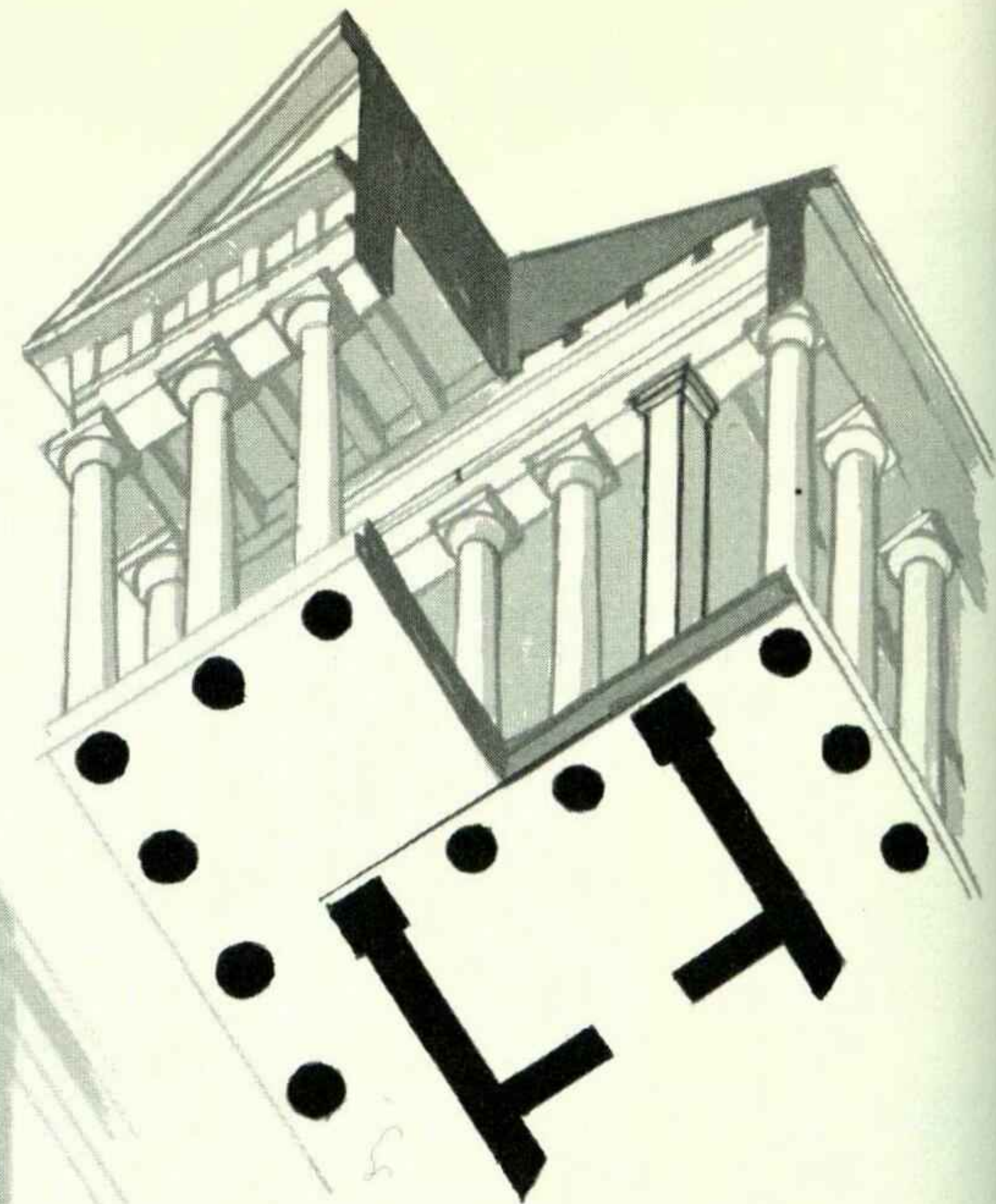
MYCENAE, The Treasury of Atreus, 1330-1300 B.C. One of some 40 beehive or tholos tombs on the Greek mainland. Built of horizontal overlapping courses of lime-stone or corbelling without centering. The door-way flanked by 2 green sandstone half-columns with a relieving triangle above



# GREEK

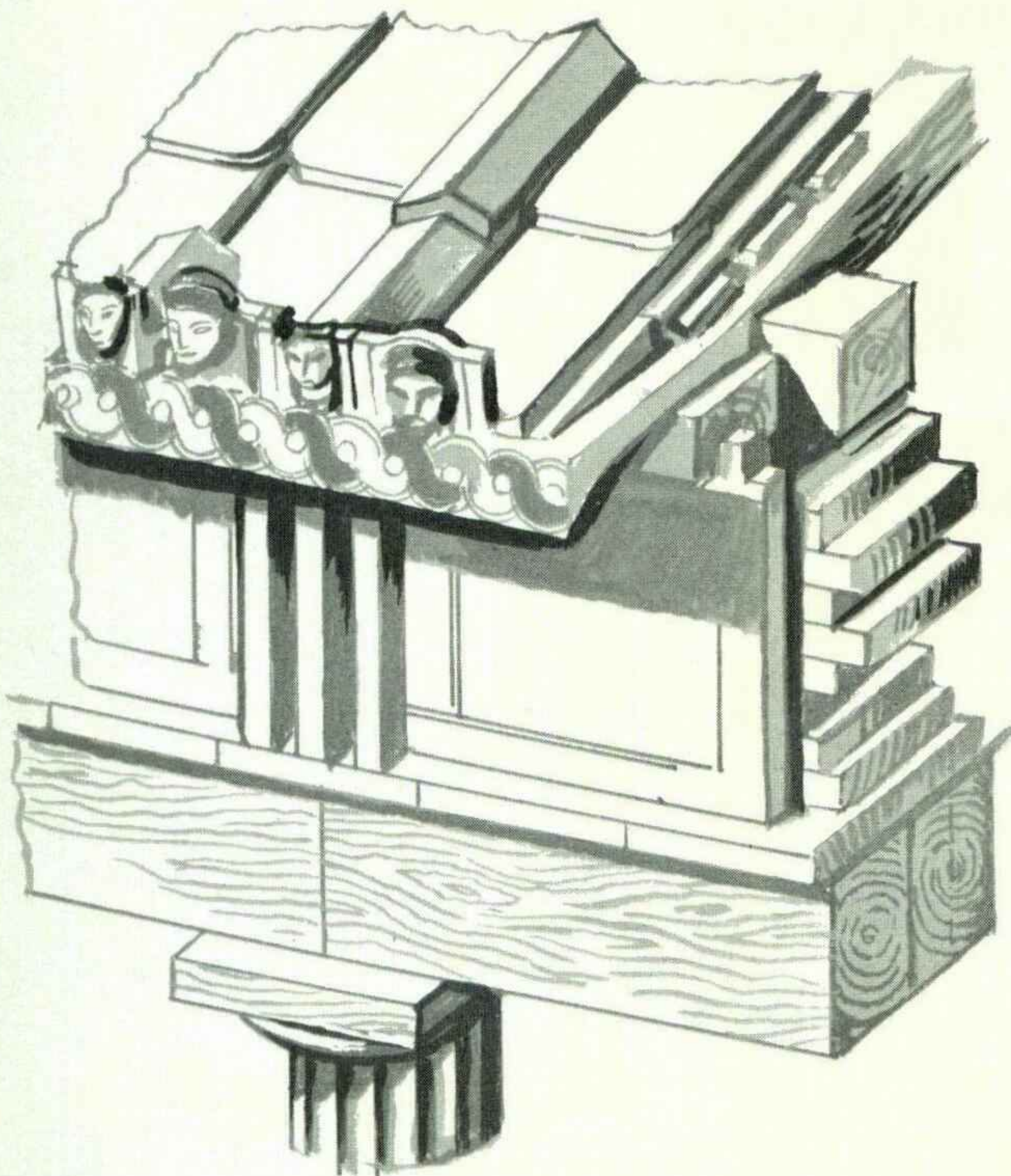


COLUMN AND BEAM

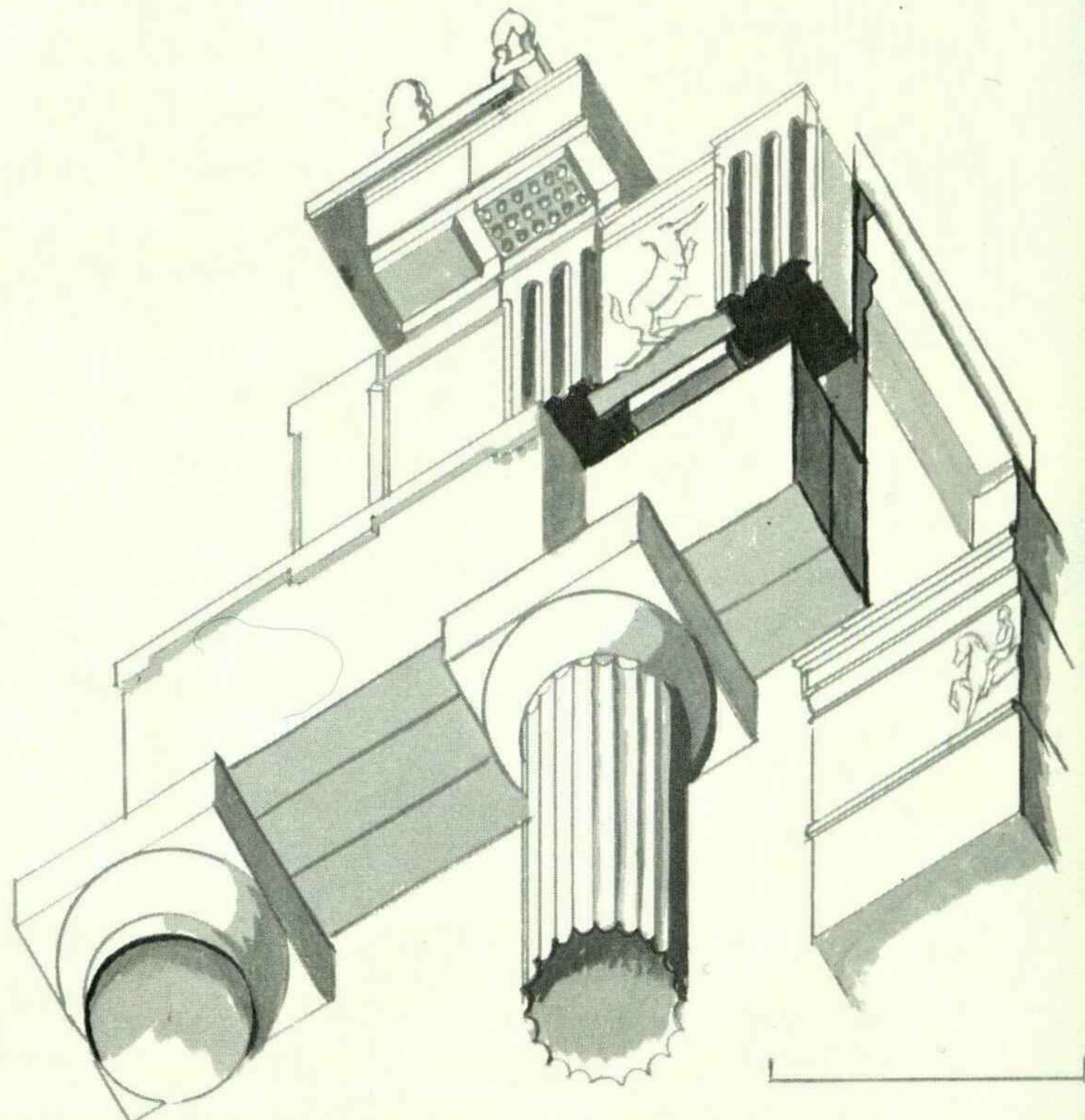


Stone beams of great span are liable to fracture, therefore columns were placed close together

TIMBER TO STONE ANTAE OR PILASTERS

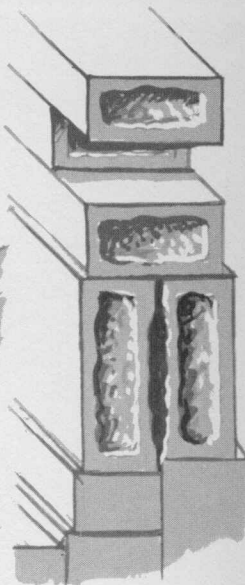
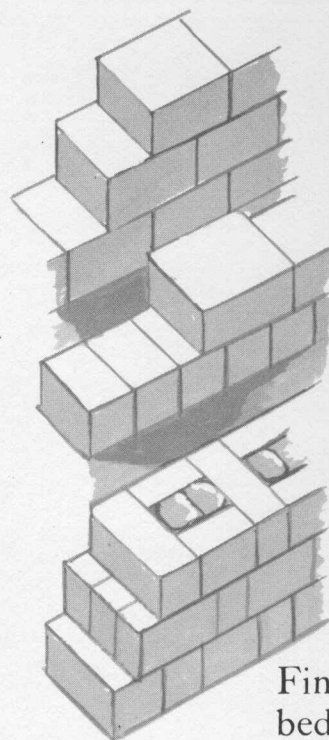
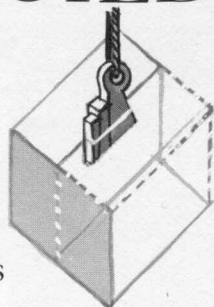
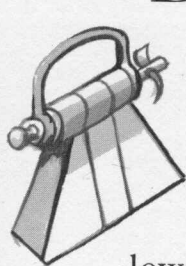
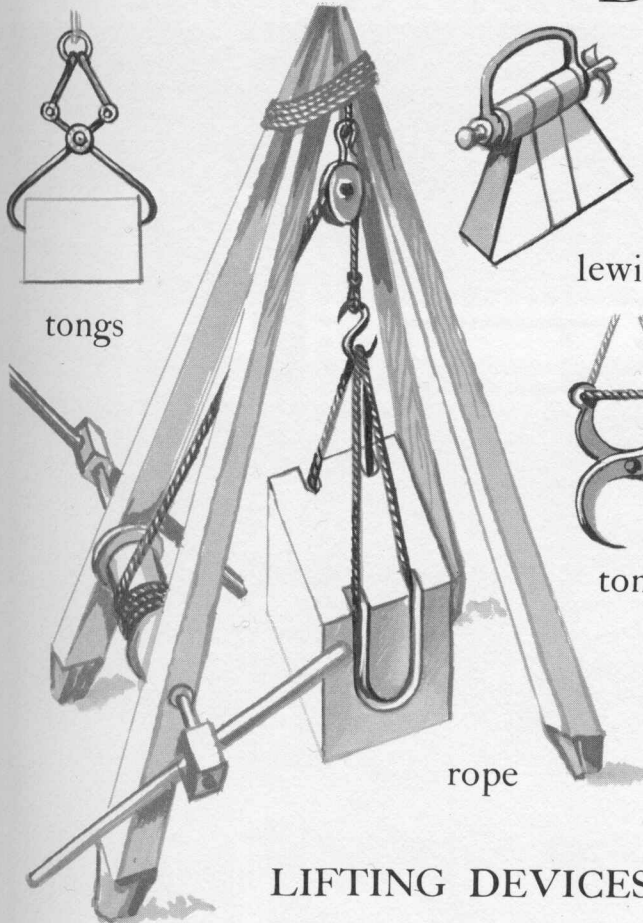
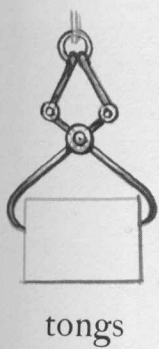


TIMBER construction, c.620 B.C.  
Doric temple of Apollo, Thermum.  
Wooden entablature and columns



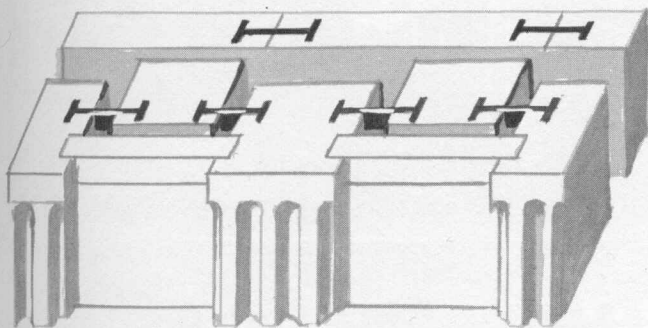
MARBLE construction, c.477-438 B.C.  
The Parthenon, Athens

# BUILDING METHODS

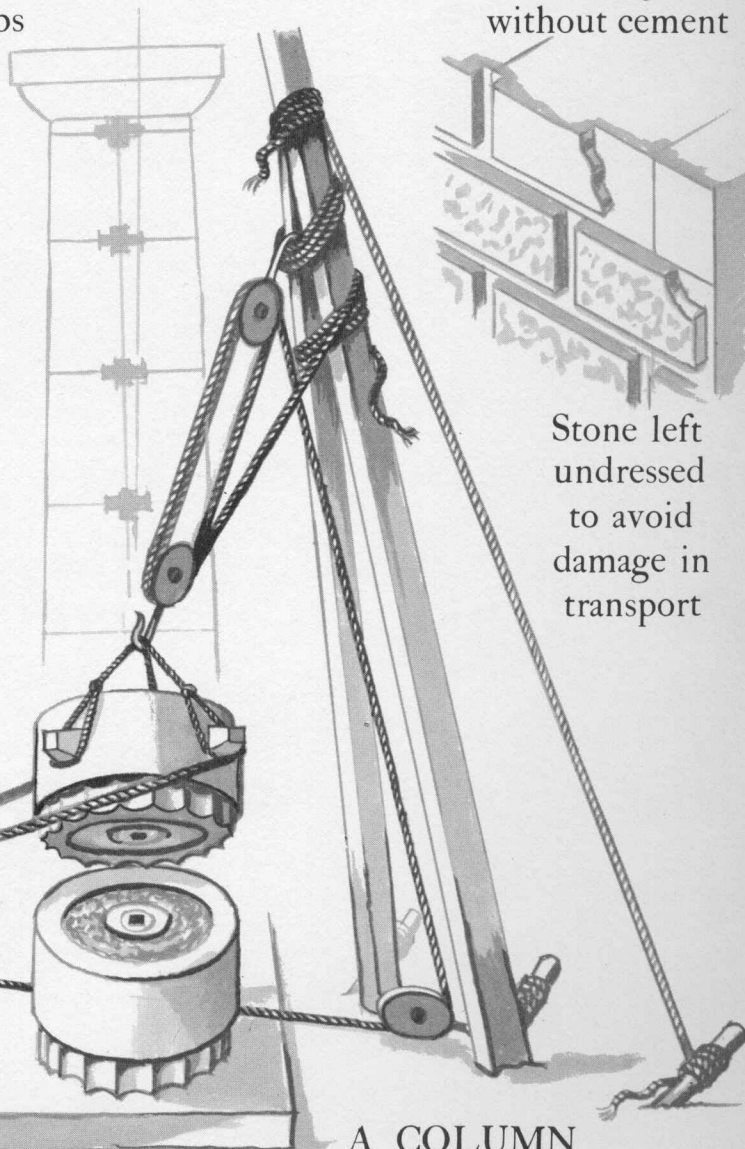


**MASONRY**  
Fine squared ashlar bedded and jointed without cement

## LIFTING DEVICES



METAL CRAMPS set in molten lead

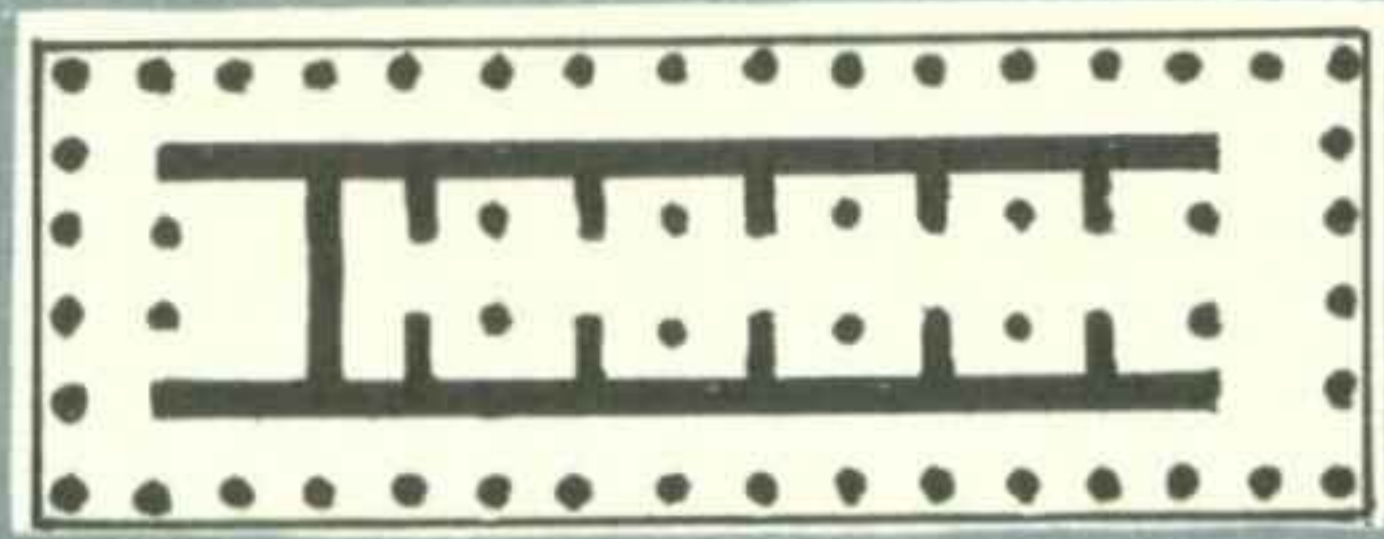
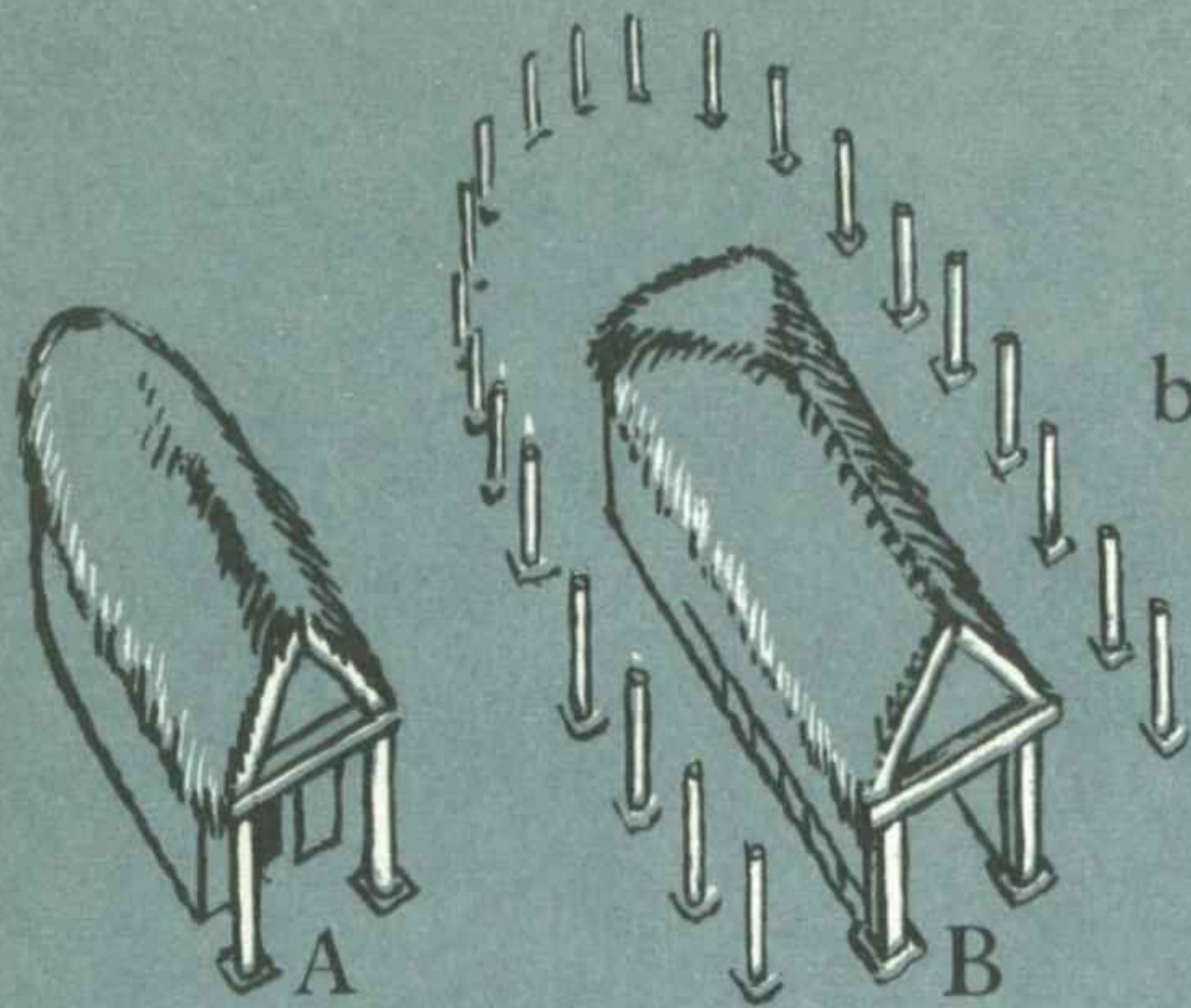


Stone left undressed to avoid damage in transport

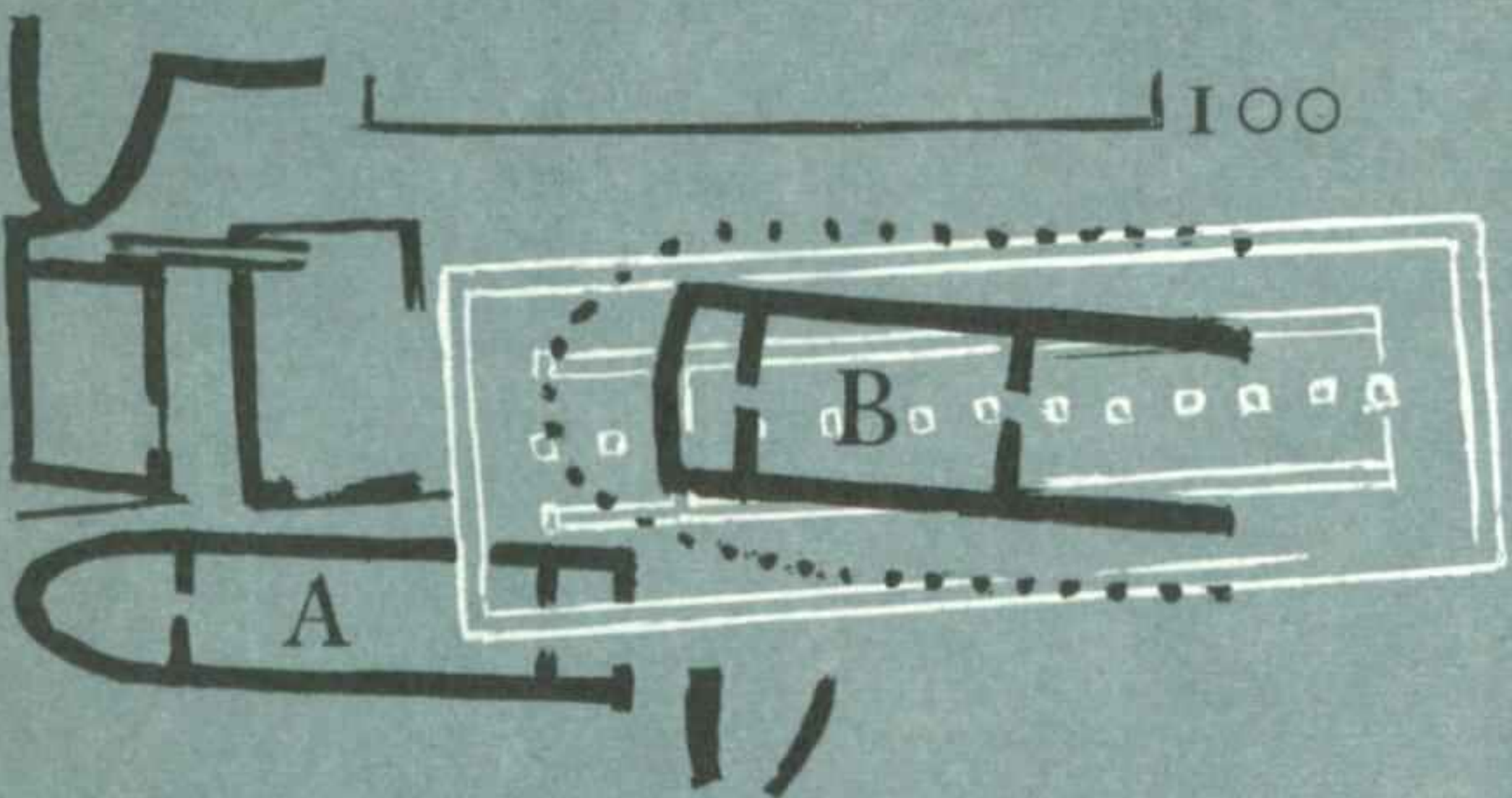
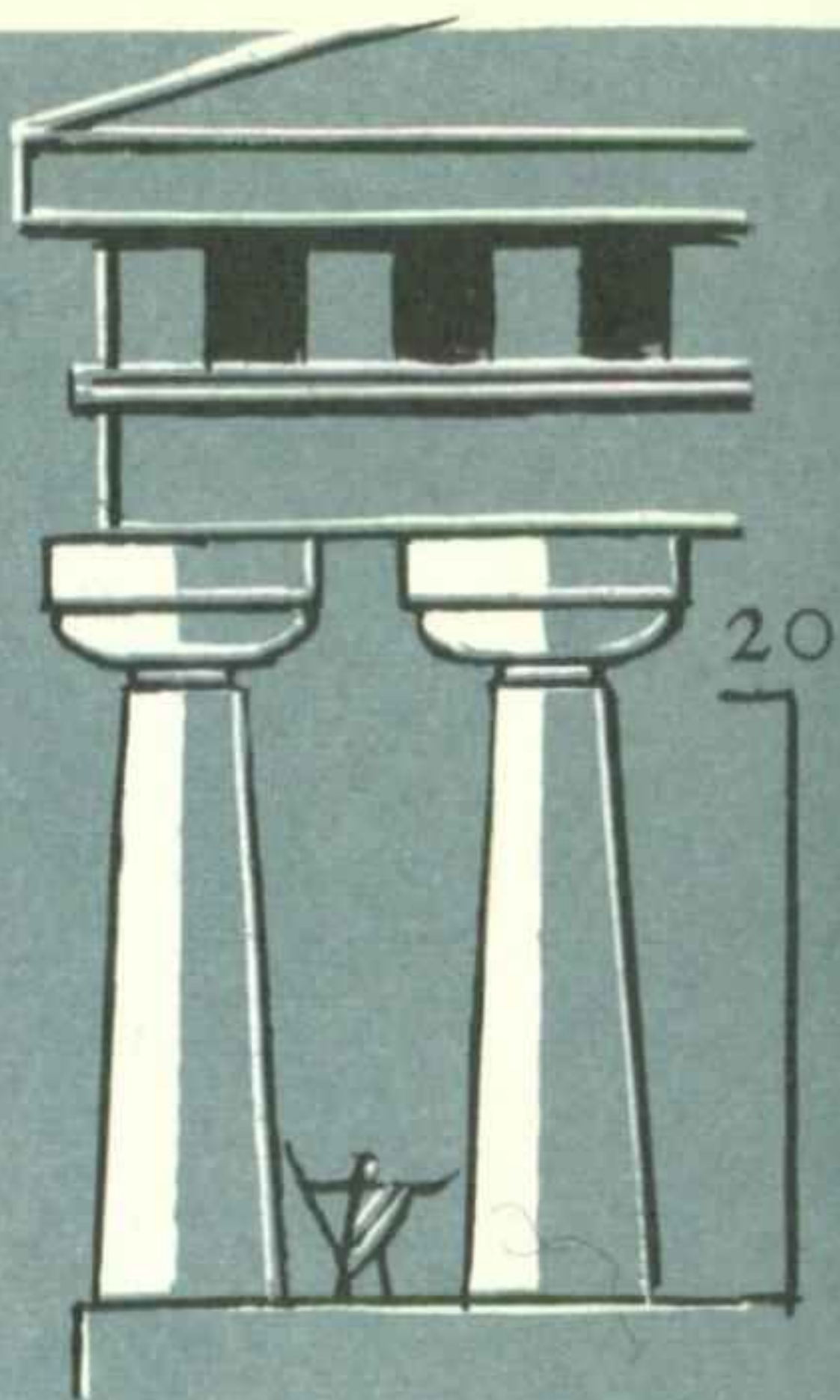
## ERECTION OF

## A COLUMN

# GREEK



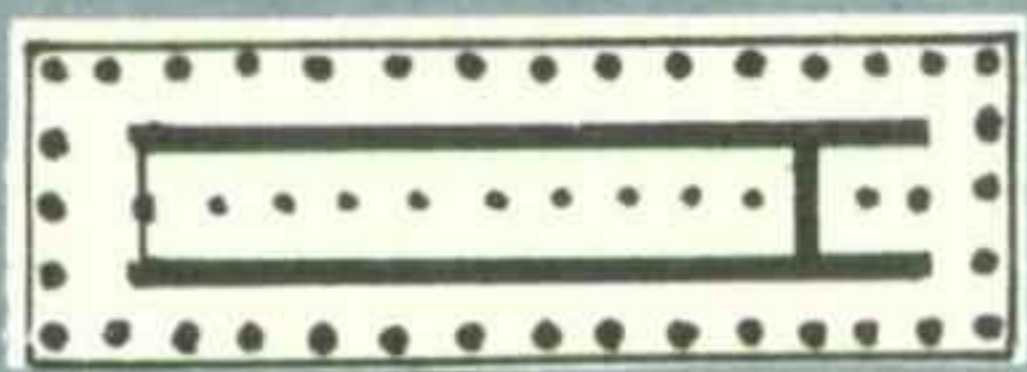
The Heraeum, Olympia, c.649 B.C.  
Walls sun-dried brick. Stone replaced wood columns as they decayed. Gable roof with terracotta tiles



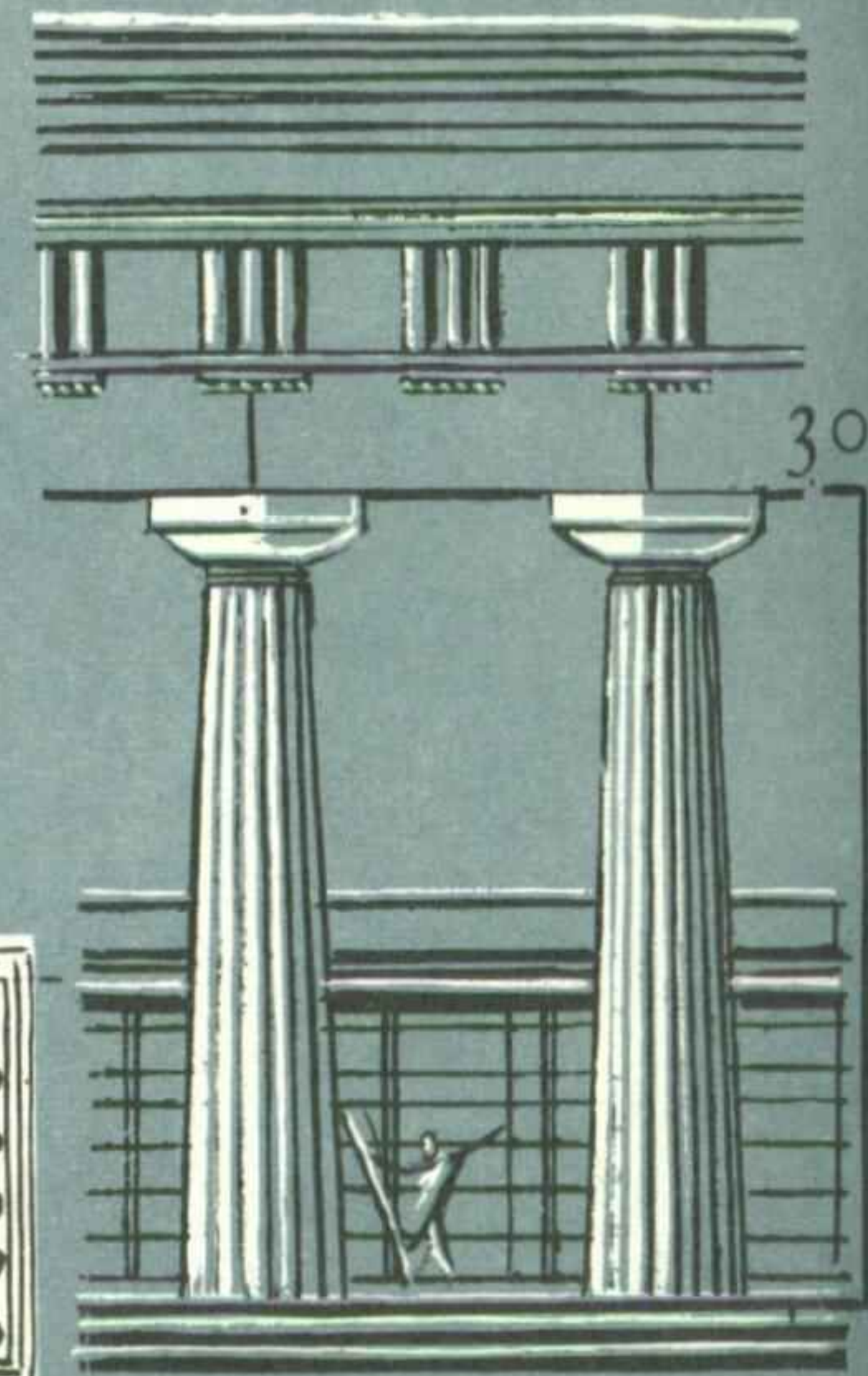
Sanctuary of Thermum, Aetolia

Megaron A, c.2000-1500 B.C.  
Small stones carry walls of wood and clay, roof thatched with reeds

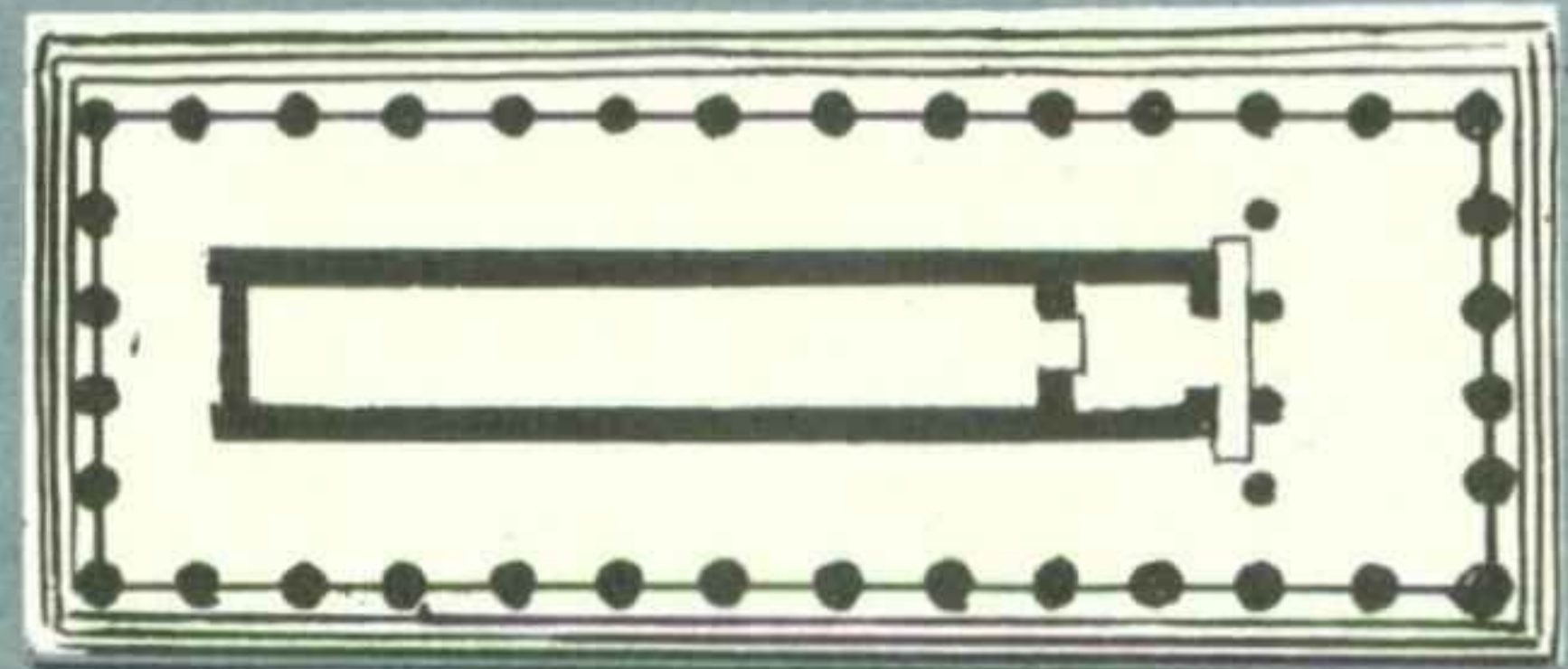
Megaron B, c.1000-800 B.C.  
House or Temple. 18 posts formed the first known Greek peripteral temple scheme



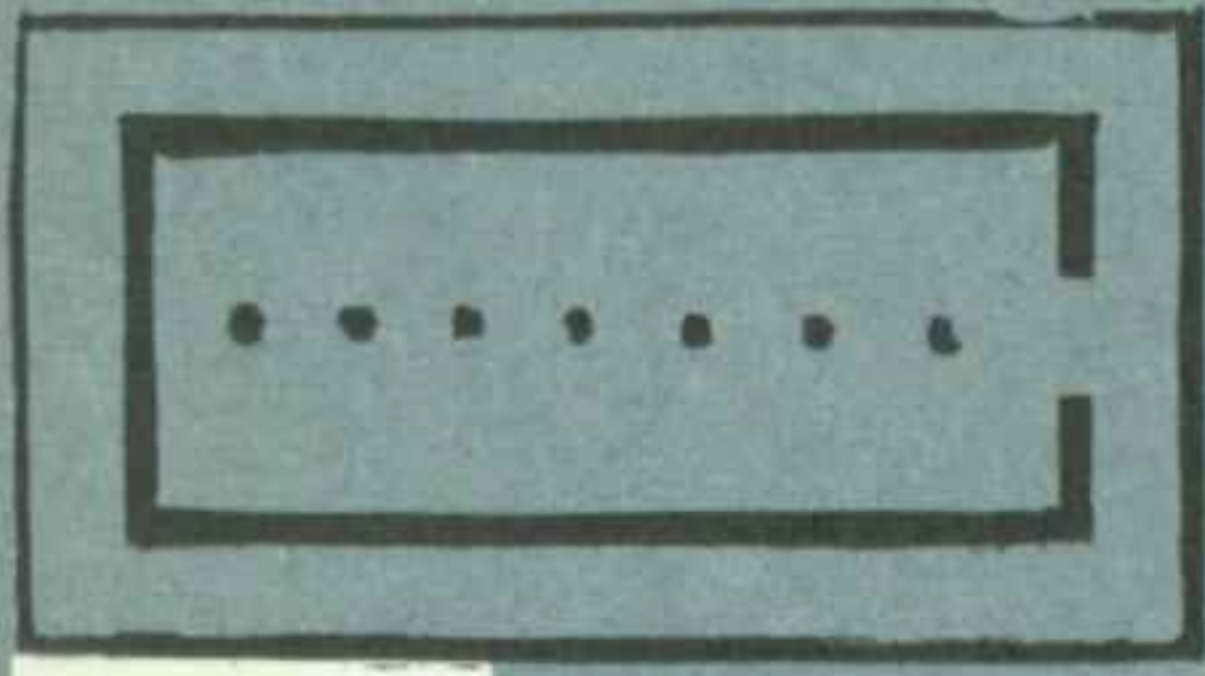
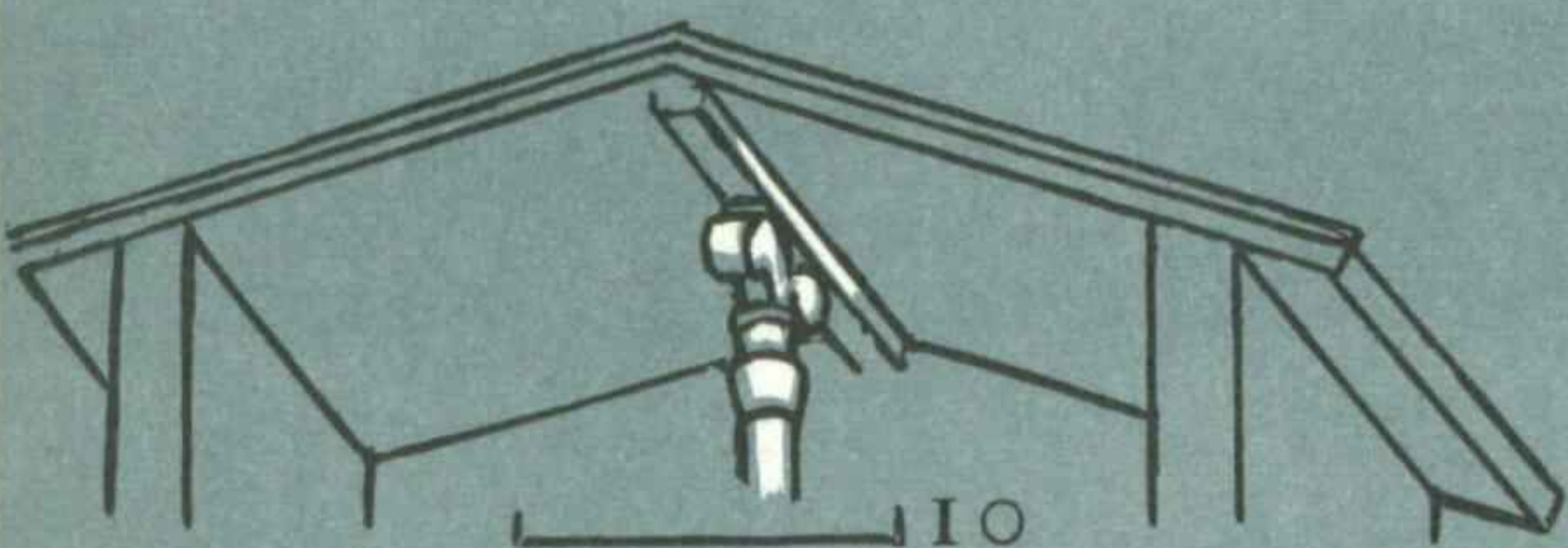
Temple of Apollo, Syracuse, c.575 B.C.  
Monolithic stone columns



The Temple of Apollo, c.600 B.C., built over Megaron B. Columns and entablature of wood

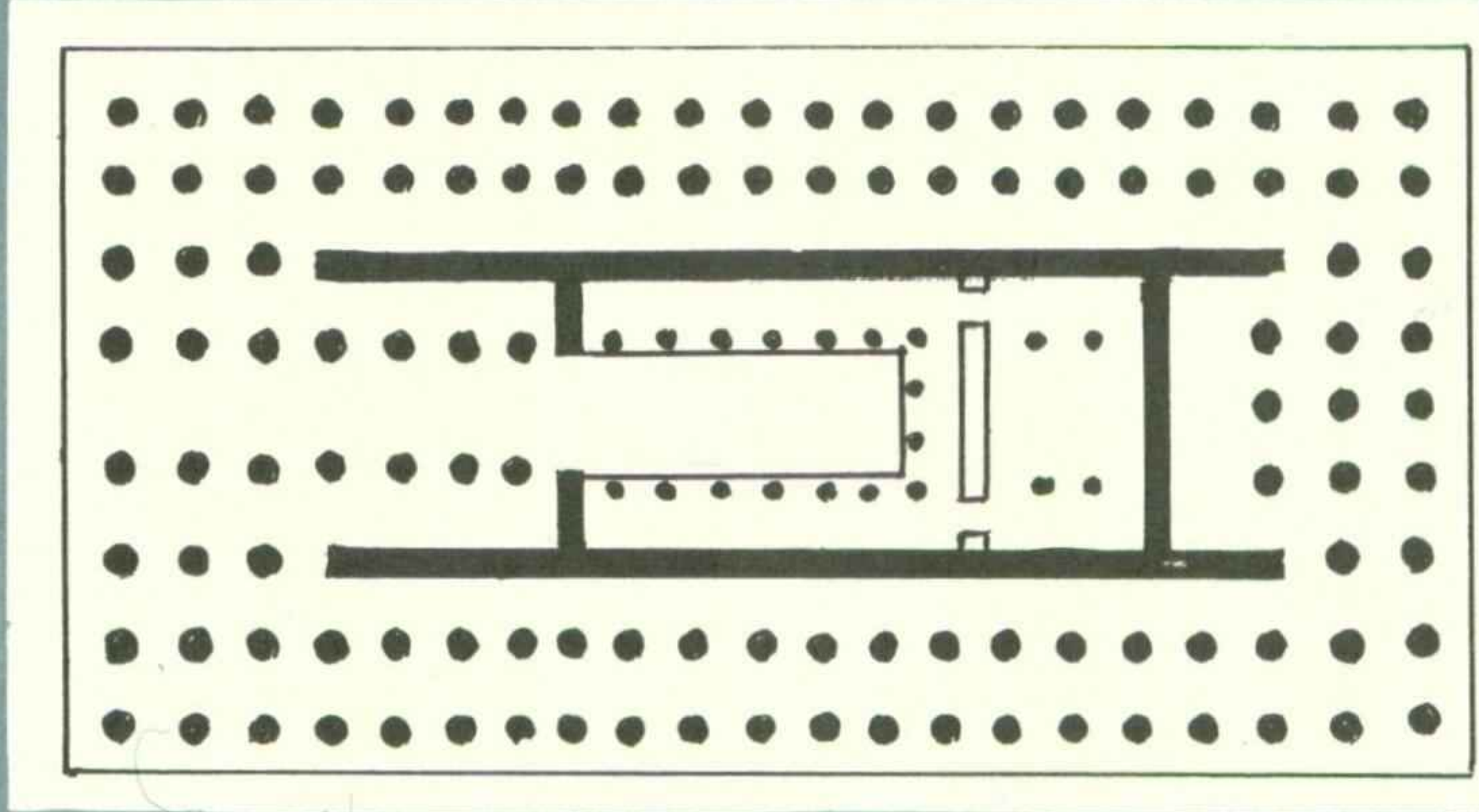


Temple F, Selinus, c.560 B.C.  
Stone screens join the columns



Temple of Neandria, Asia Minor, c.7th century B.C.

Built of sandstone, roof gabled with tiles, 7 stone columns have 'Aeolic' capitals, i.e. Asiatic-Ionic motifs.

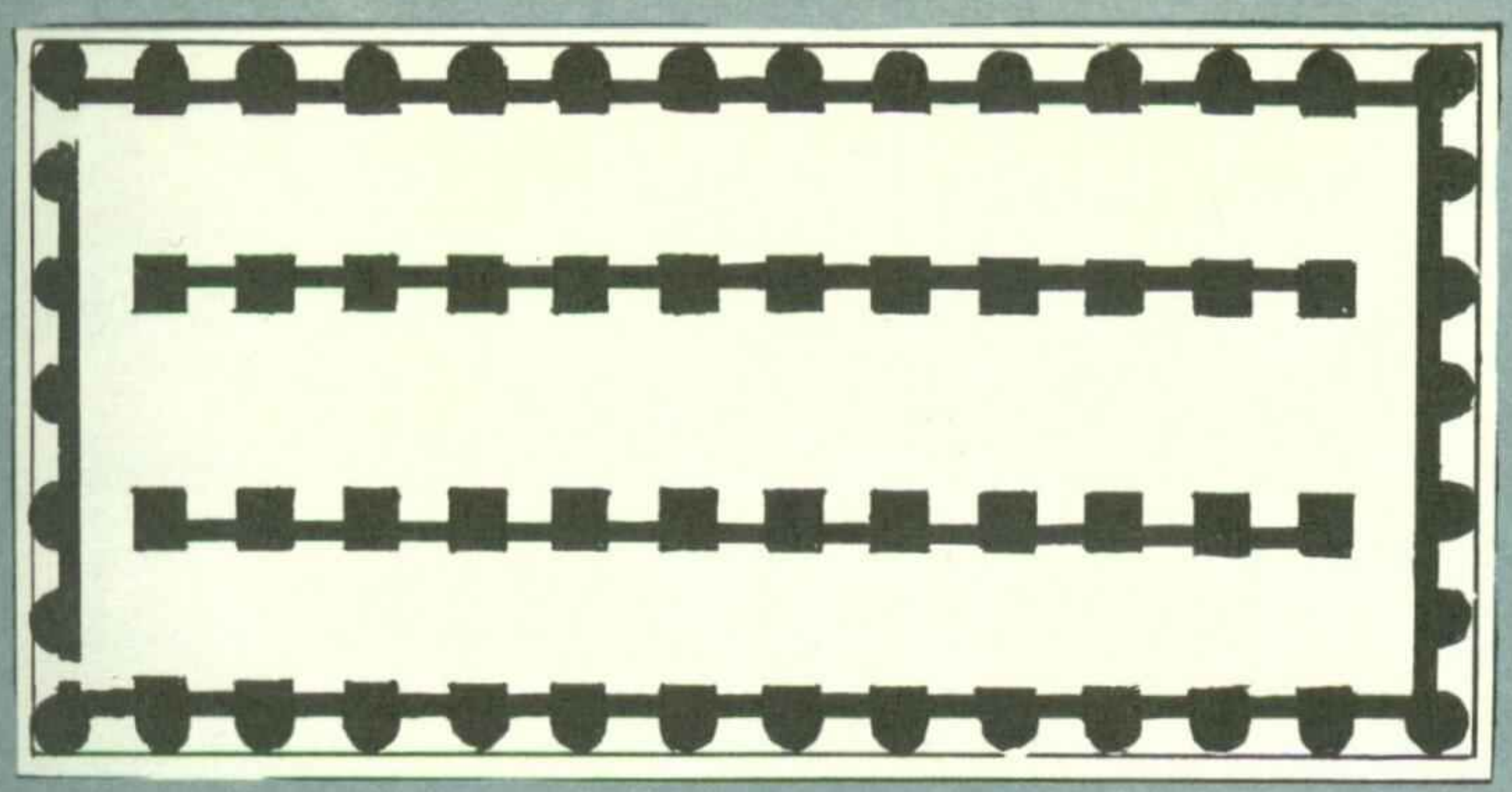


Archaic Temple of Artemis, Ephesus, c.560 B.C. Burnt down and rebuilt, 356 B.C. Designed by Chersiphron of Cnossus and his son Metagenes who wrote a work on the temple, now lost, cited by Vitruvius. Appearance conjectural, columns of marble, walls of limestone faced with marble



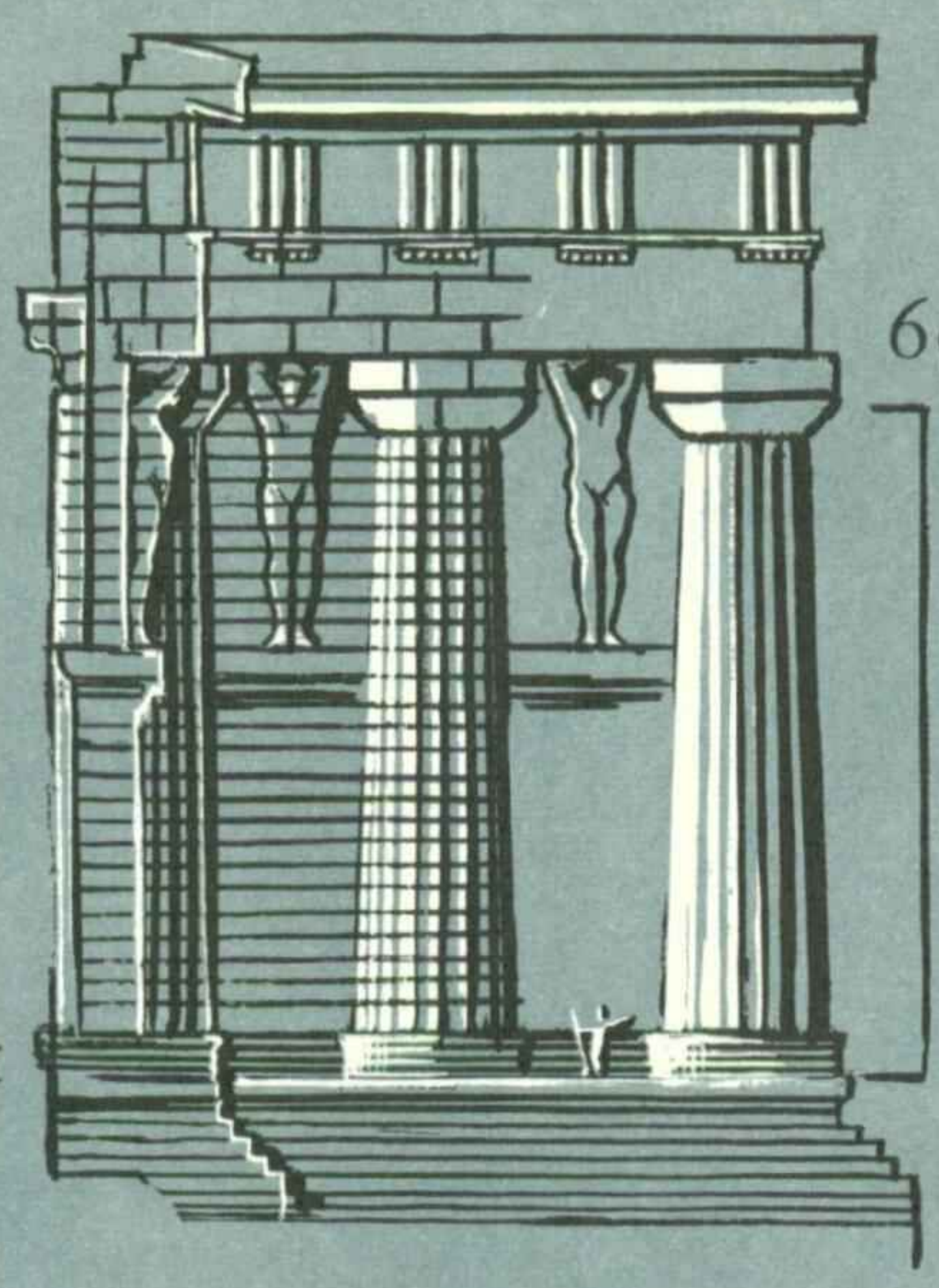


# PLANS, DORIC & IONIC TEMPLES



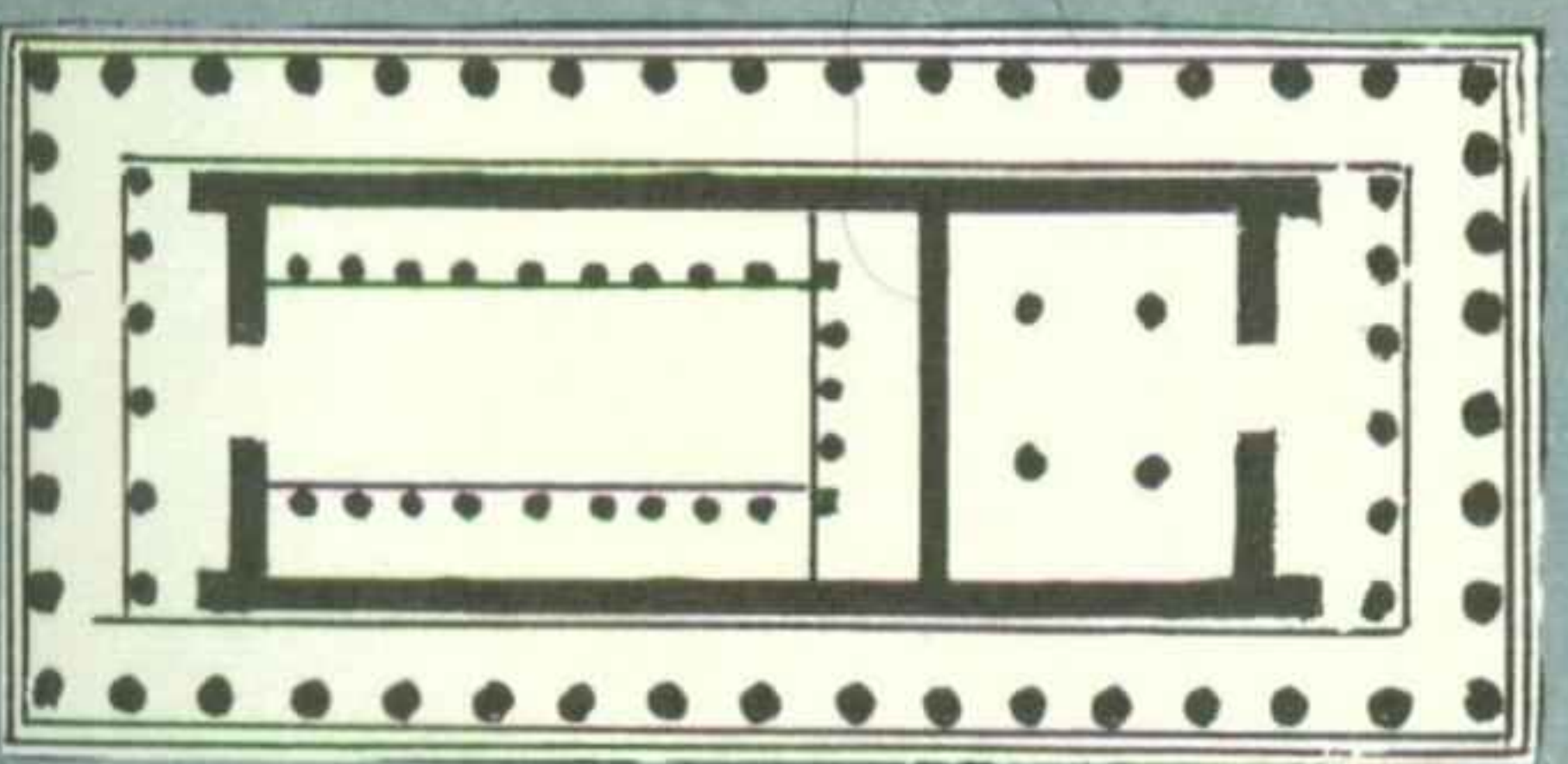
Temple of Zeus Olympius, Agrigentum, c.480 B.C.

Built of coarse stone faced with marble dust cement; position of figures conjectural



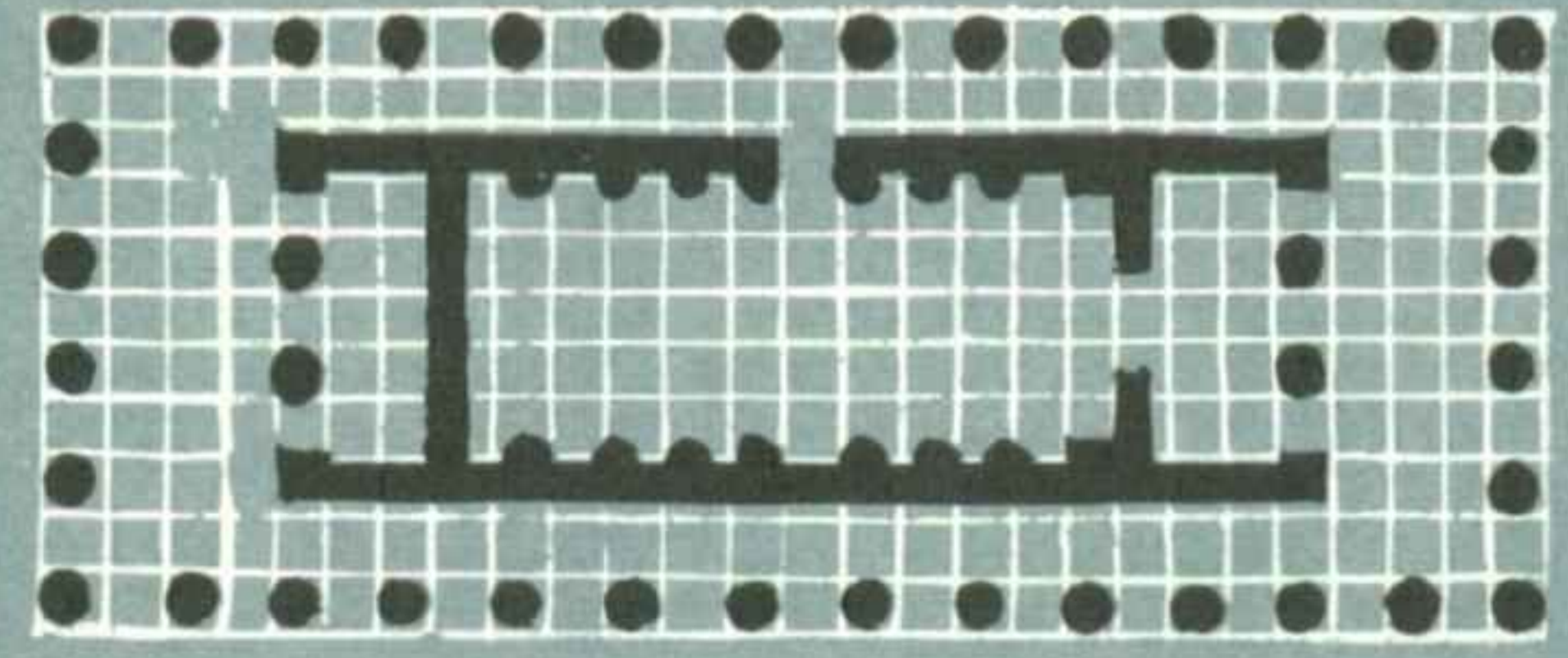
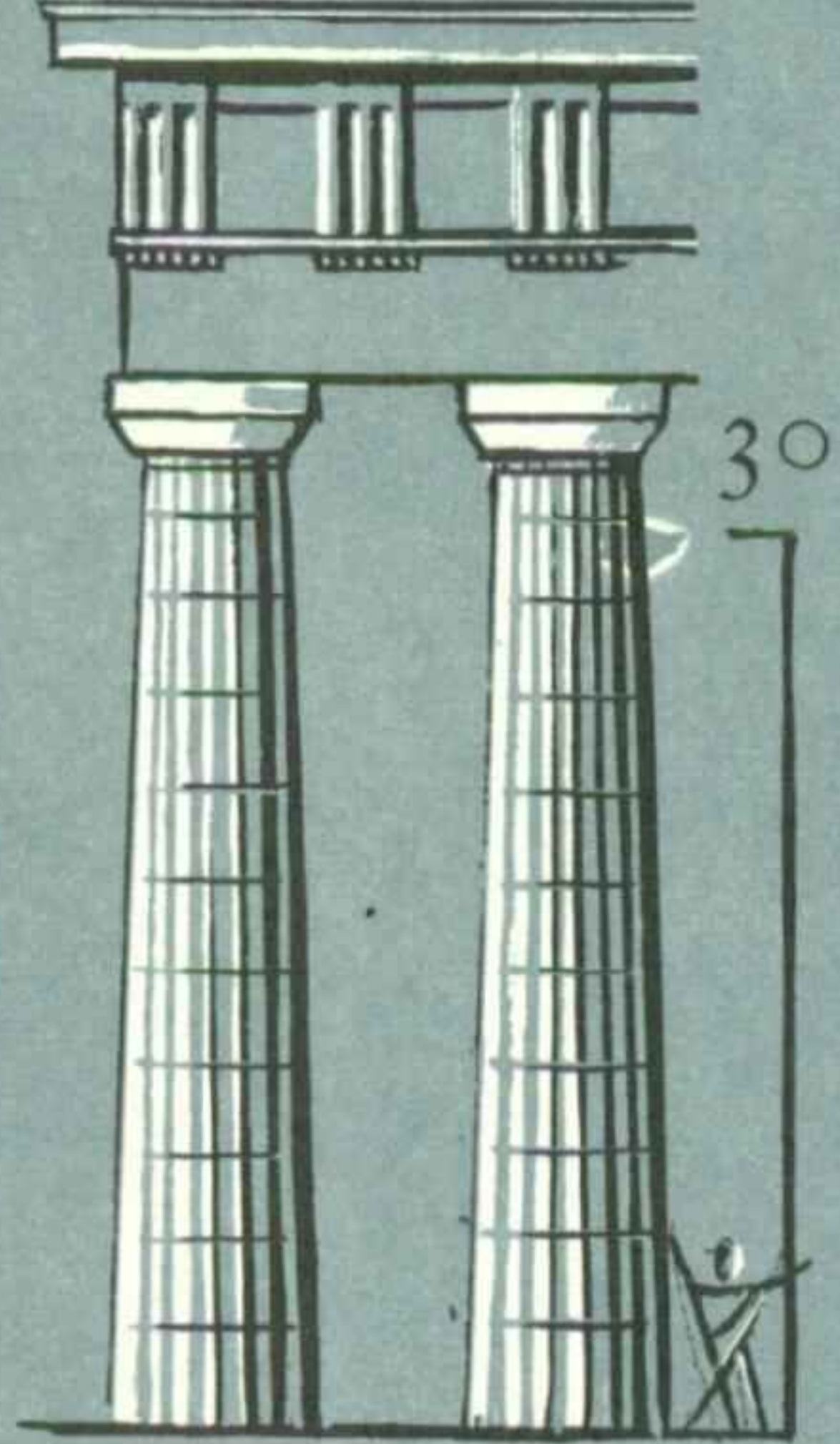
Plans drawn in black to the same scale  
 60  
 100

Temple of Aphaia, Aegina, c.490 B.C.



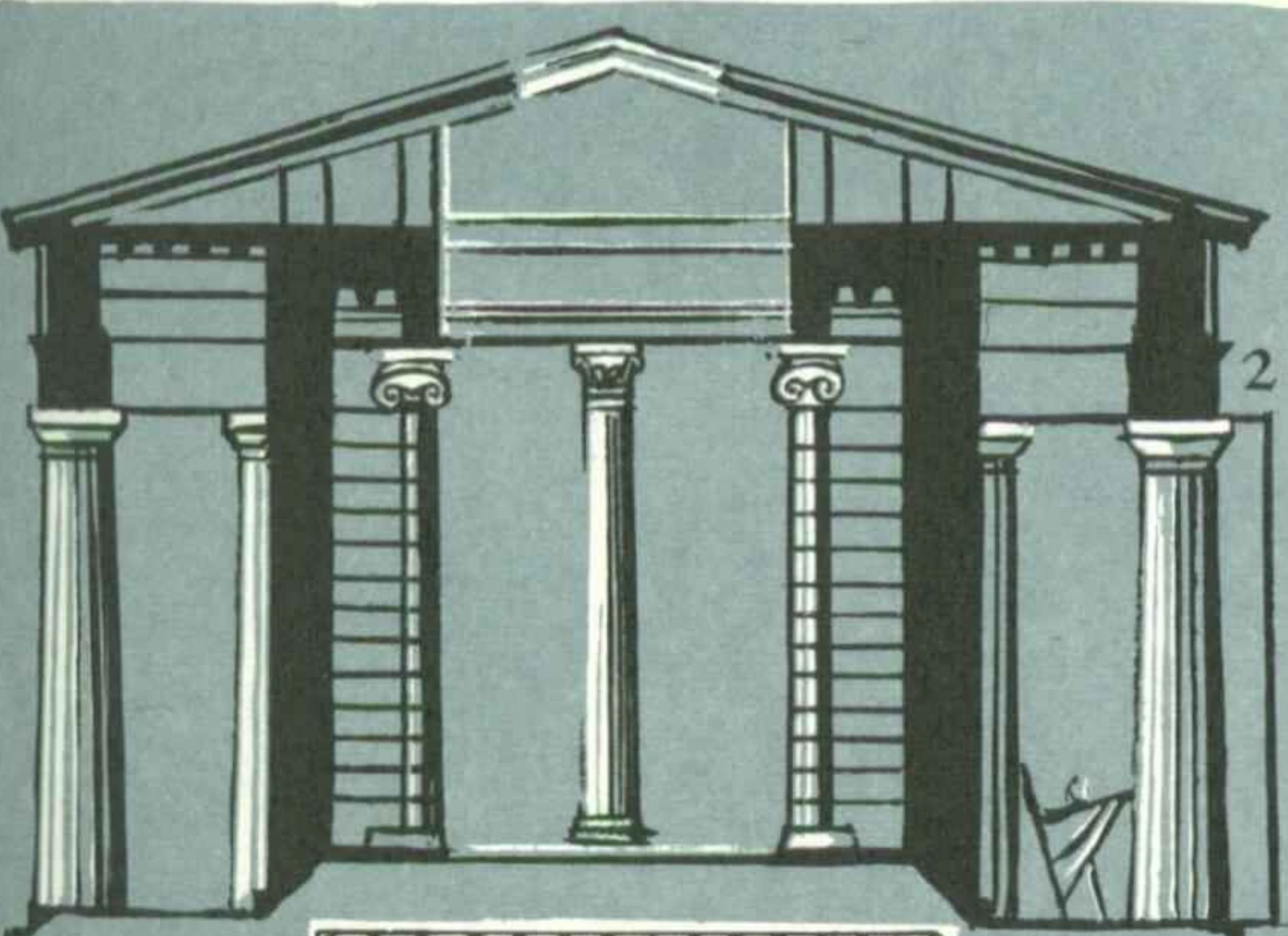
The Parthenon, Athens, 447-432 B.C.

Ictinus and Callicrates architects, Pheidias master sculptor; built of white marble



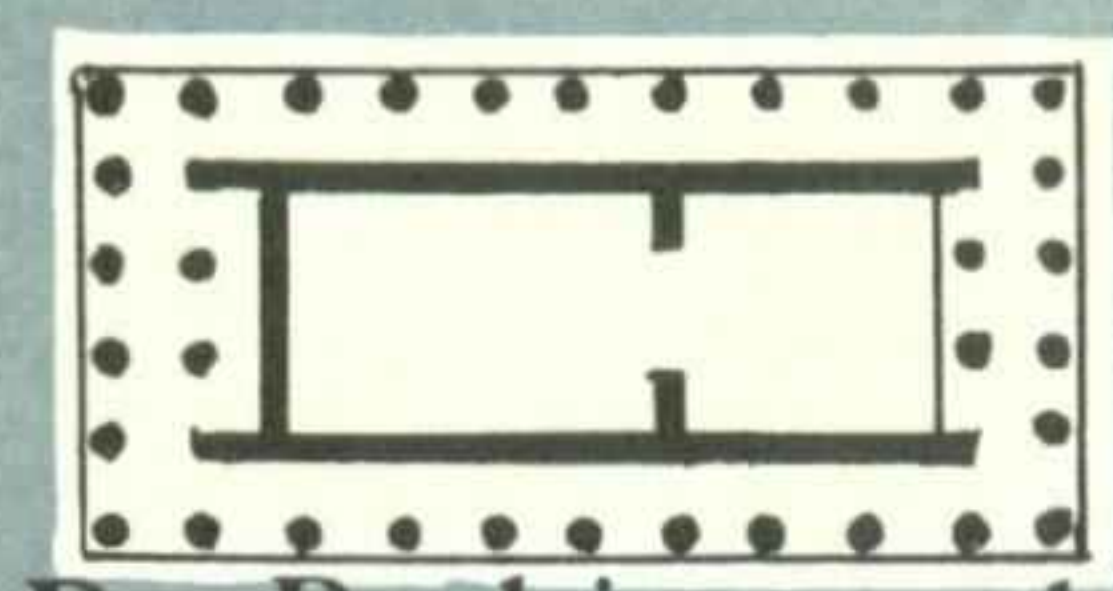
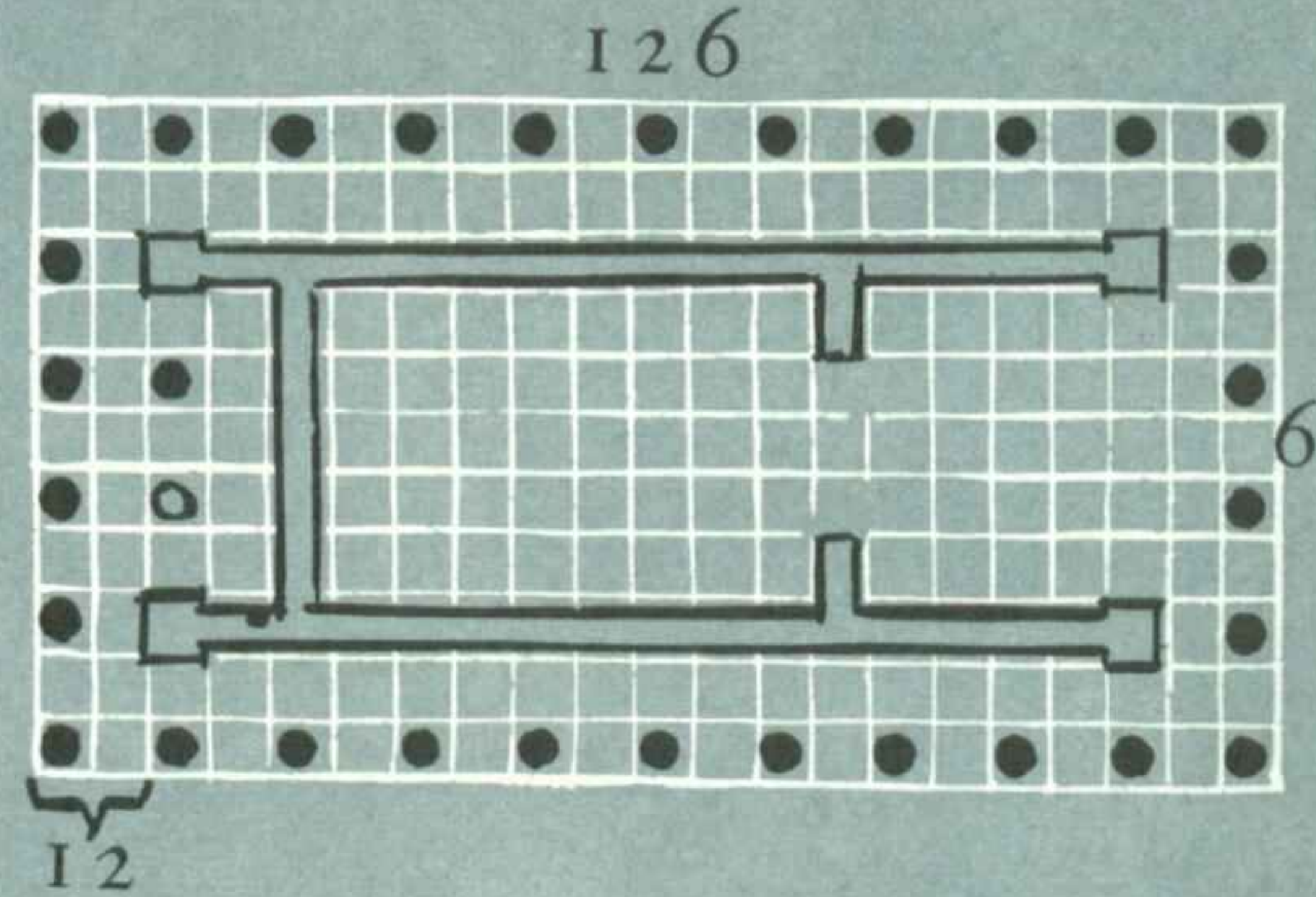
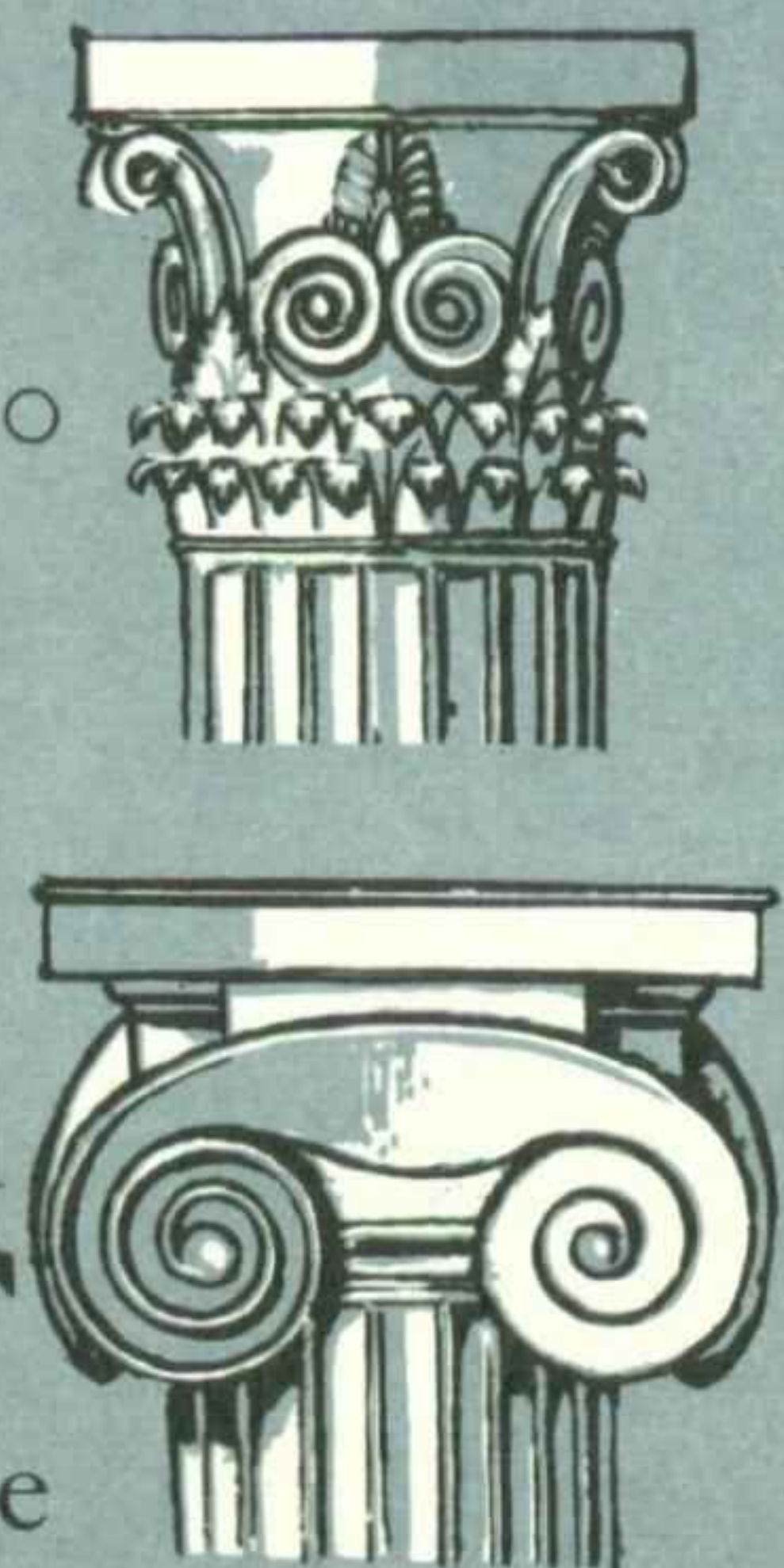
The Doric Temple of Athena Alea, Tegea, c.353 B.C.

Designed by the sculptor Scopas, the interior had 14 Corinthian engaged columns



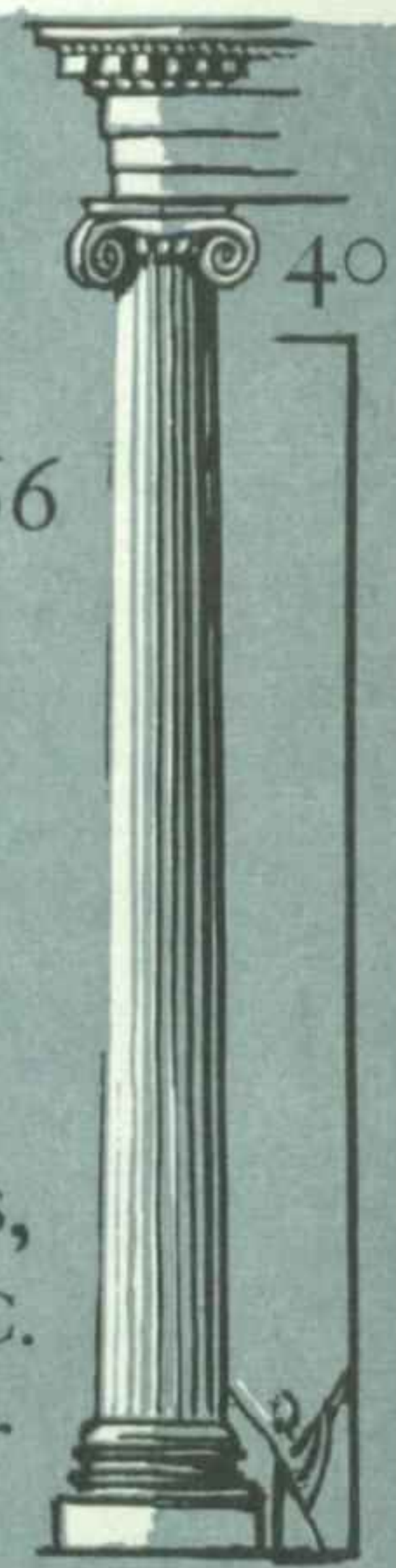
Doric temple of Apollo Epicurius, Bassae, c.430 B.C.

By Ictinus, architect of the Parthenon, Athens. The Corinthian order used for the first time. Built of fine-grained, brittle grey limestone; details in marble, roof of thin marble slabs.



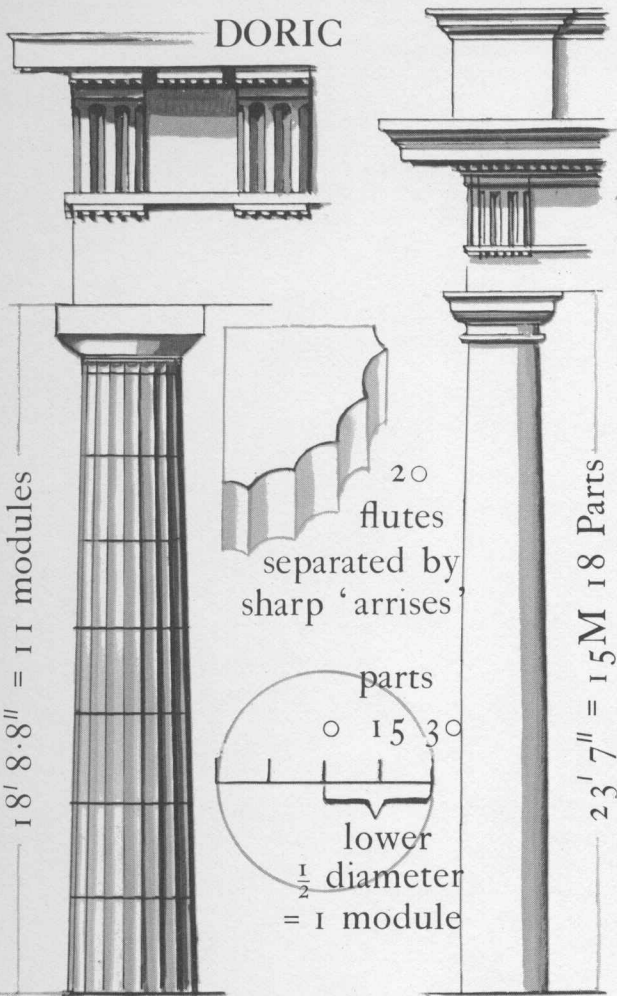
Ionic temple of Athena Polias, Priene, c.334 B.C.

By Pythios, architect and sculptor of the Mausoleum, Halicarnassus, who wrote a book on the temple, since lost. All the measurements are in multiples of the Ionic foot, i.e. 11.587 inches.



# GREEK & ROMAN

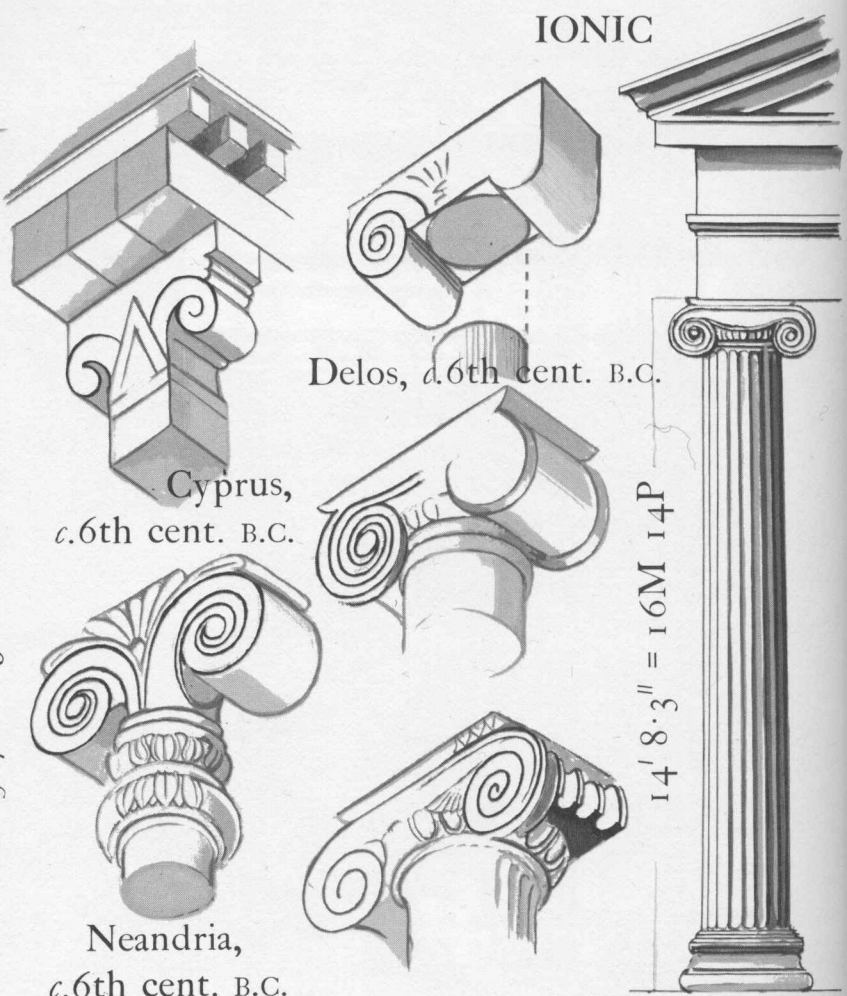
DORIC



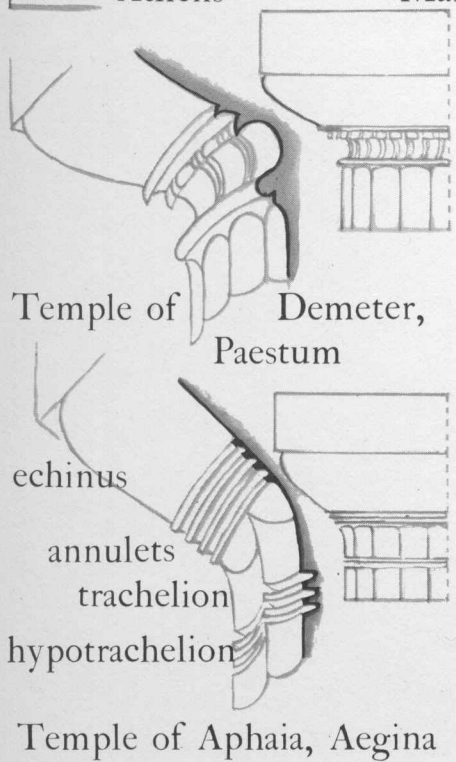
Greek  
The Theseion,  
Athens

Roman  
Theatre of  
Marcellus, Rome

IONIC

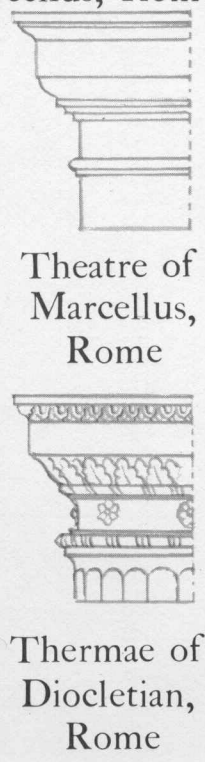


Greek  
Temple on the  
Ilissus, Athens



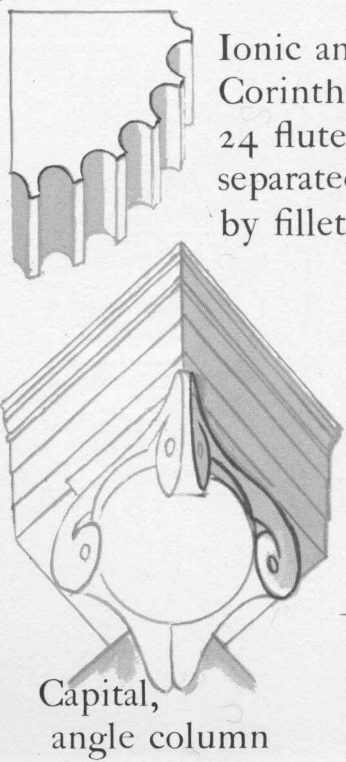
Temple of  
Demeter,  
Paestum

Temple of Aphaia, Aegina



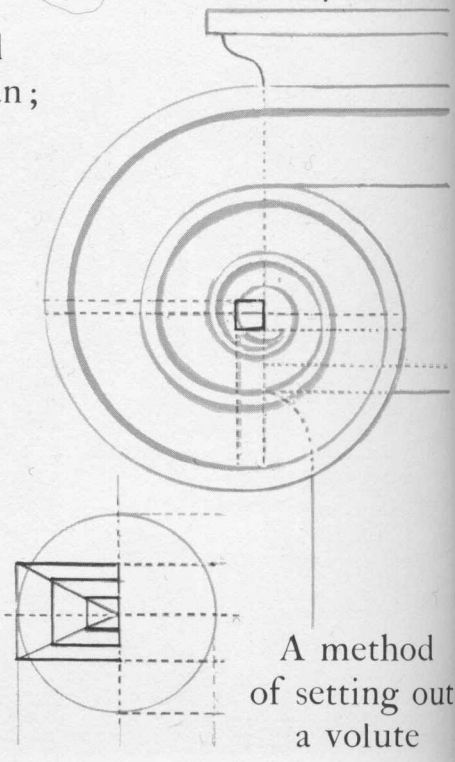
Theatre of  
Marcellus,  
Rome

Thermae of  
Diocletian,  
Rome



Ionic and  
Corinthian;  
24 flutes  
separated  
by fillets

Capital,  
angle column



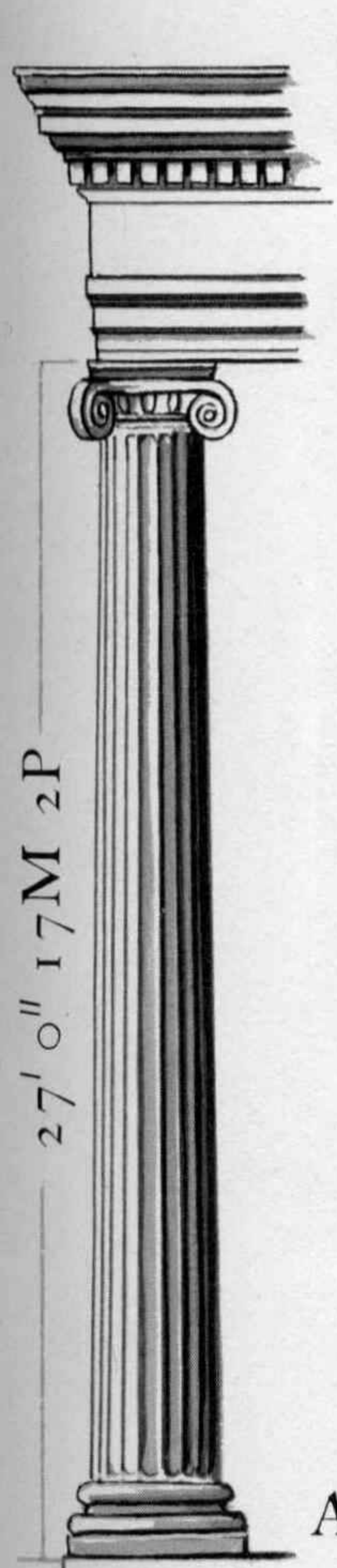
A method  
of setting out  
a volute

# THE FIVE ORDERS

## CORINTHIAN

## COMPOSITE

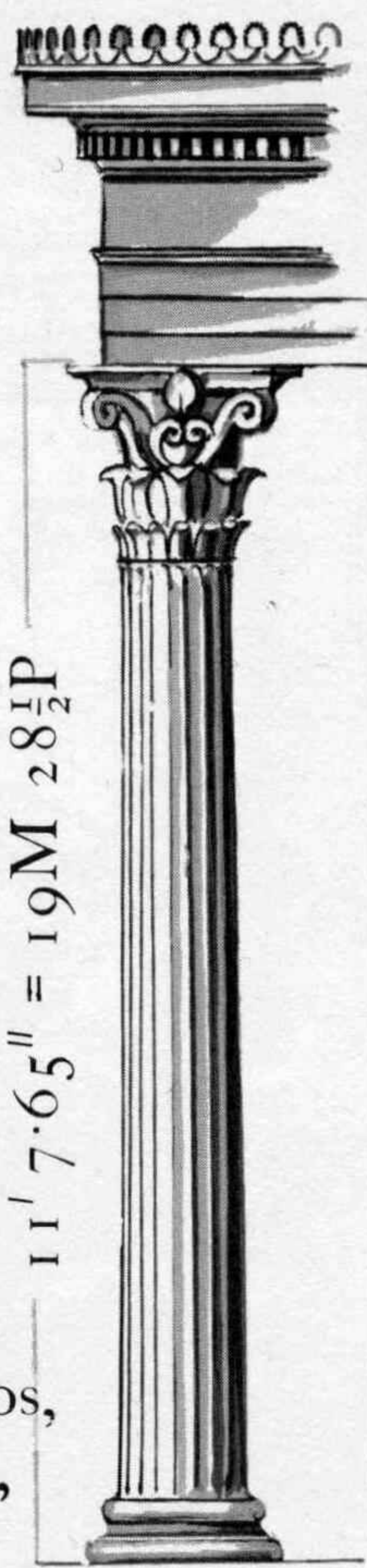
## TUSCAN



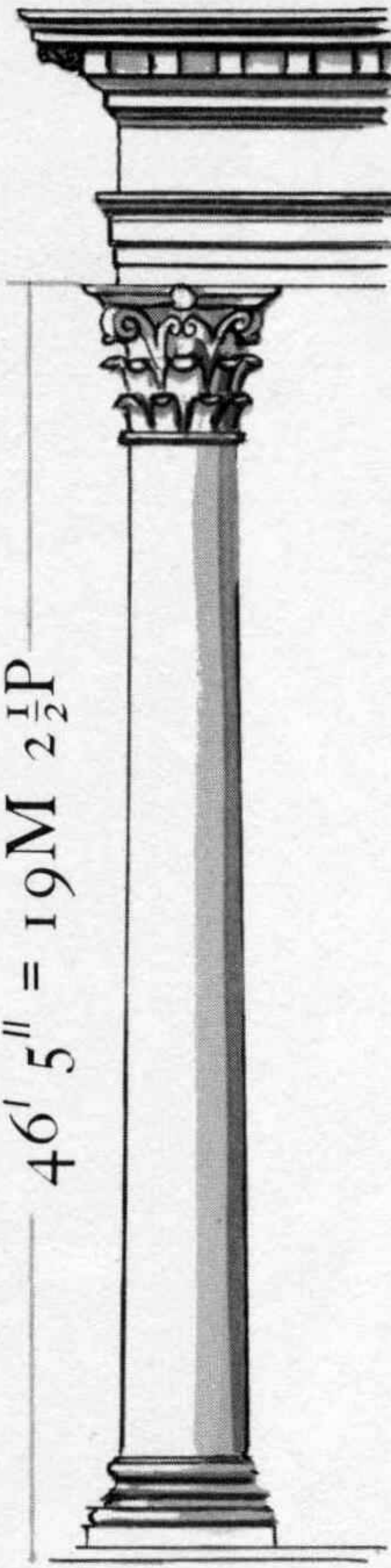
Egypt, Dynasty XIX



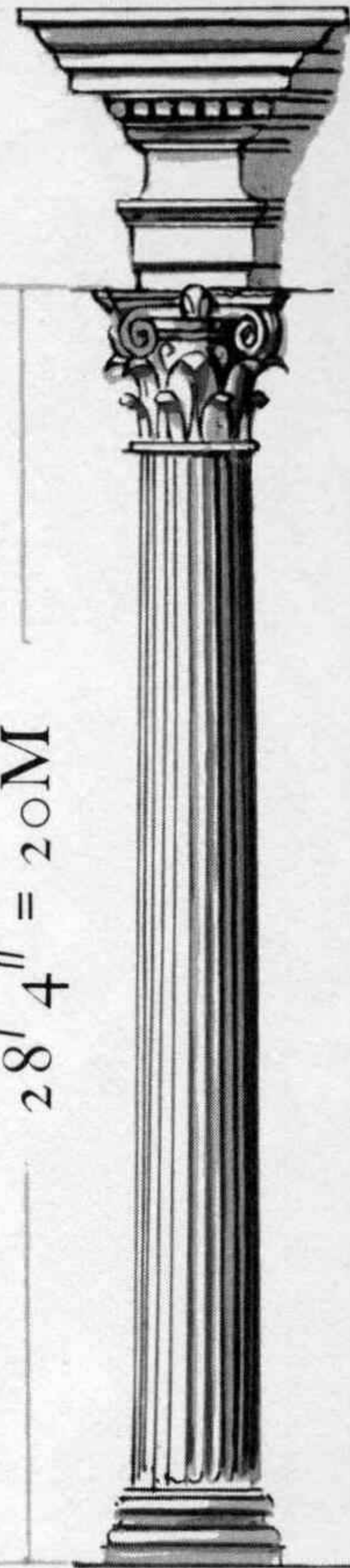
Tower of the Winds, Athens, c. 334 B.C.  
The Tholos, Epidaurus, c. 360 B.C.



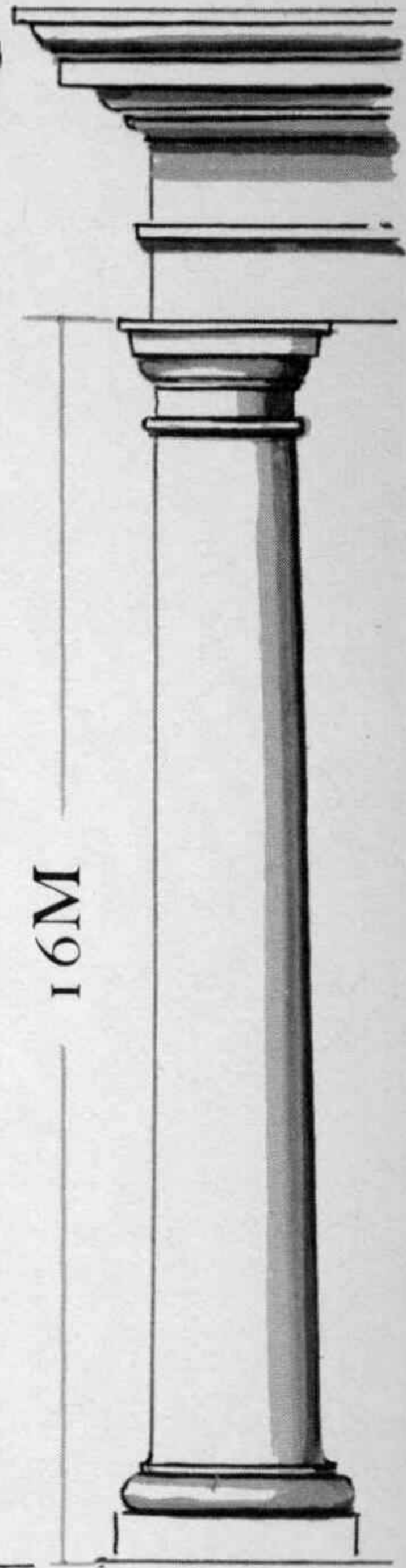
11' 7.65" = 19M 28 1/2 P



46' 5" = 19M 2 1/2 P



28' 4" = 20M



16M

Roman

Greek

Roman

Roman

Roman

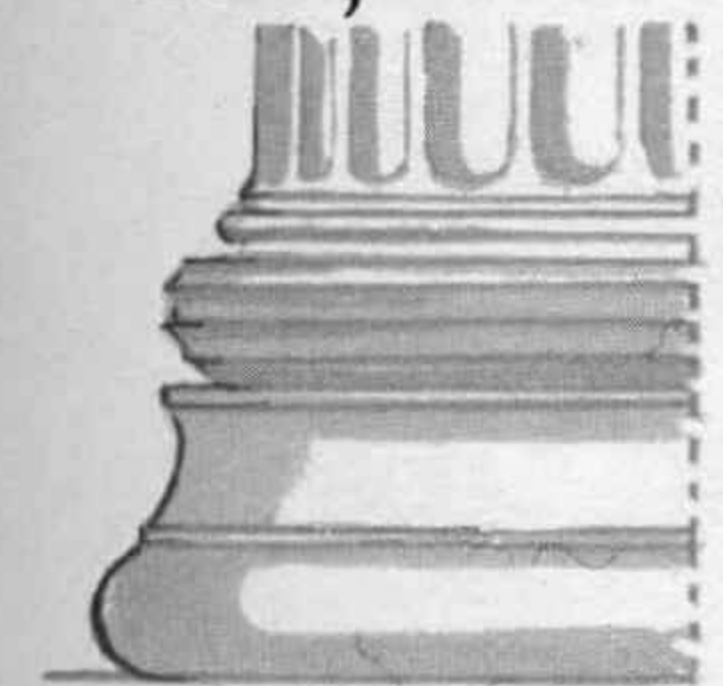
Temple Fortuna Virilis, Rome

Choragic Monument, Athens

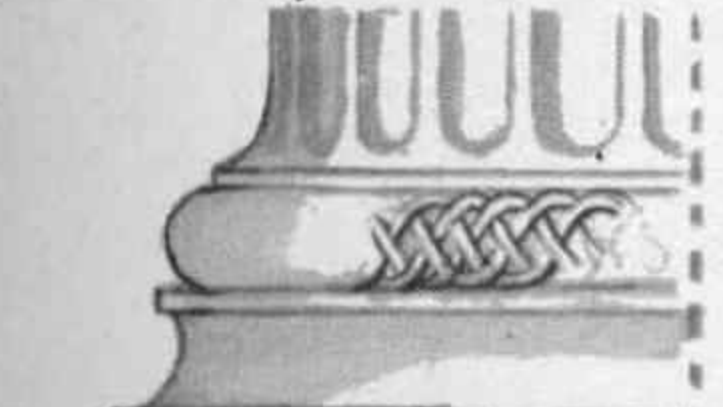
The Pantheon, Rome

Arch of Severus, Rome

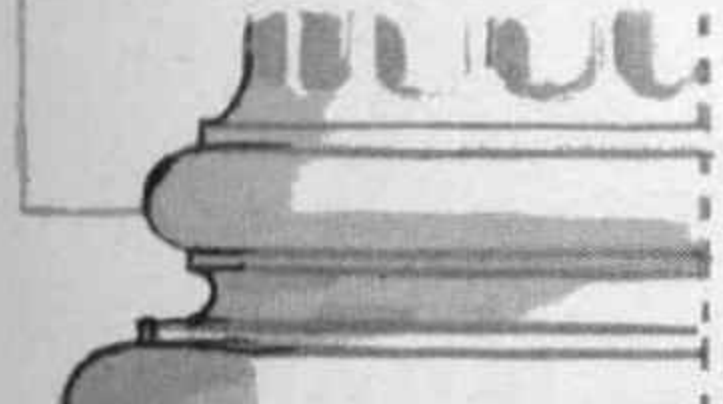
Vitruvius (IV, 7)



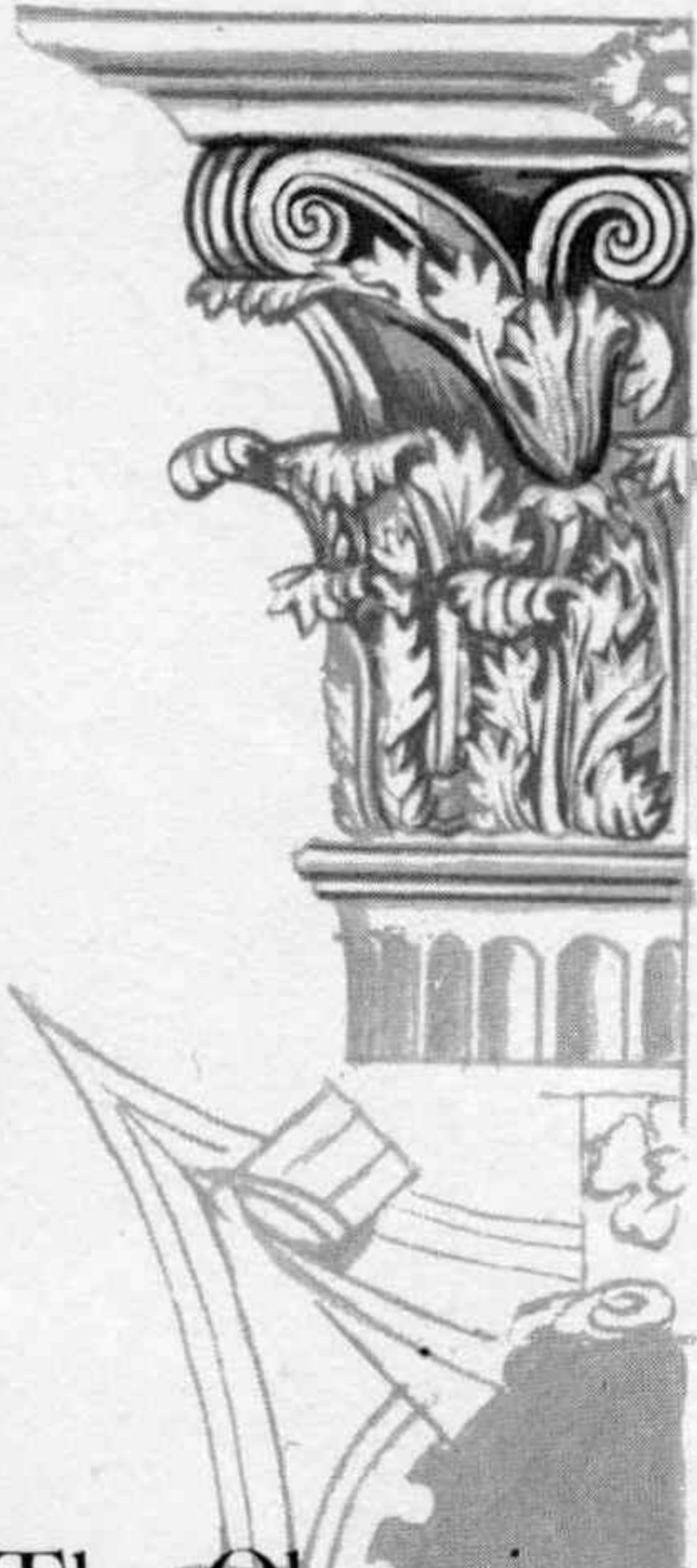
Ilissus, Athens



Erechtheum, Athens



Temple Fortuna Virilis, Rome



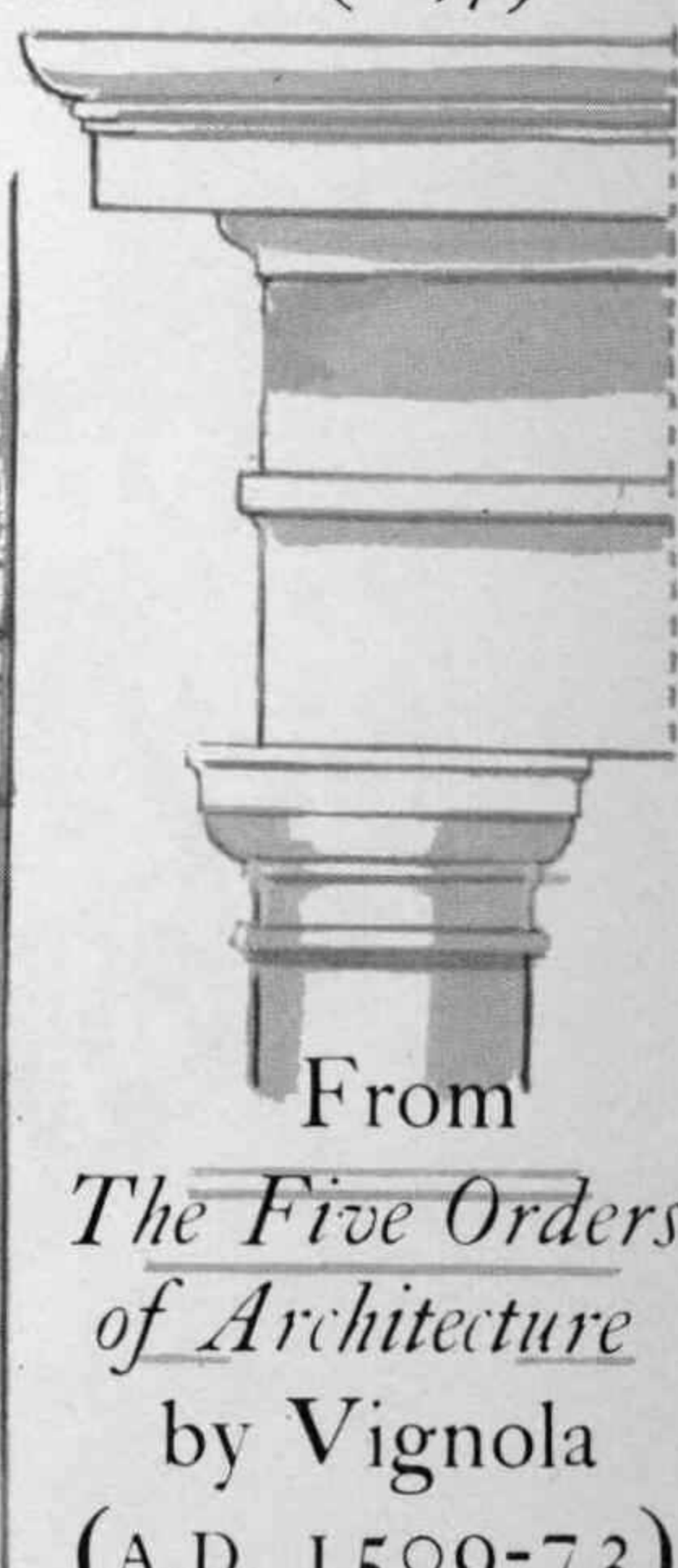
The Olympieum, Athens, c. 174 B.C.  
Capitals taken to Rome, 86 B.C.



Temple of Castor and Pollux, Rome, A.D. 16

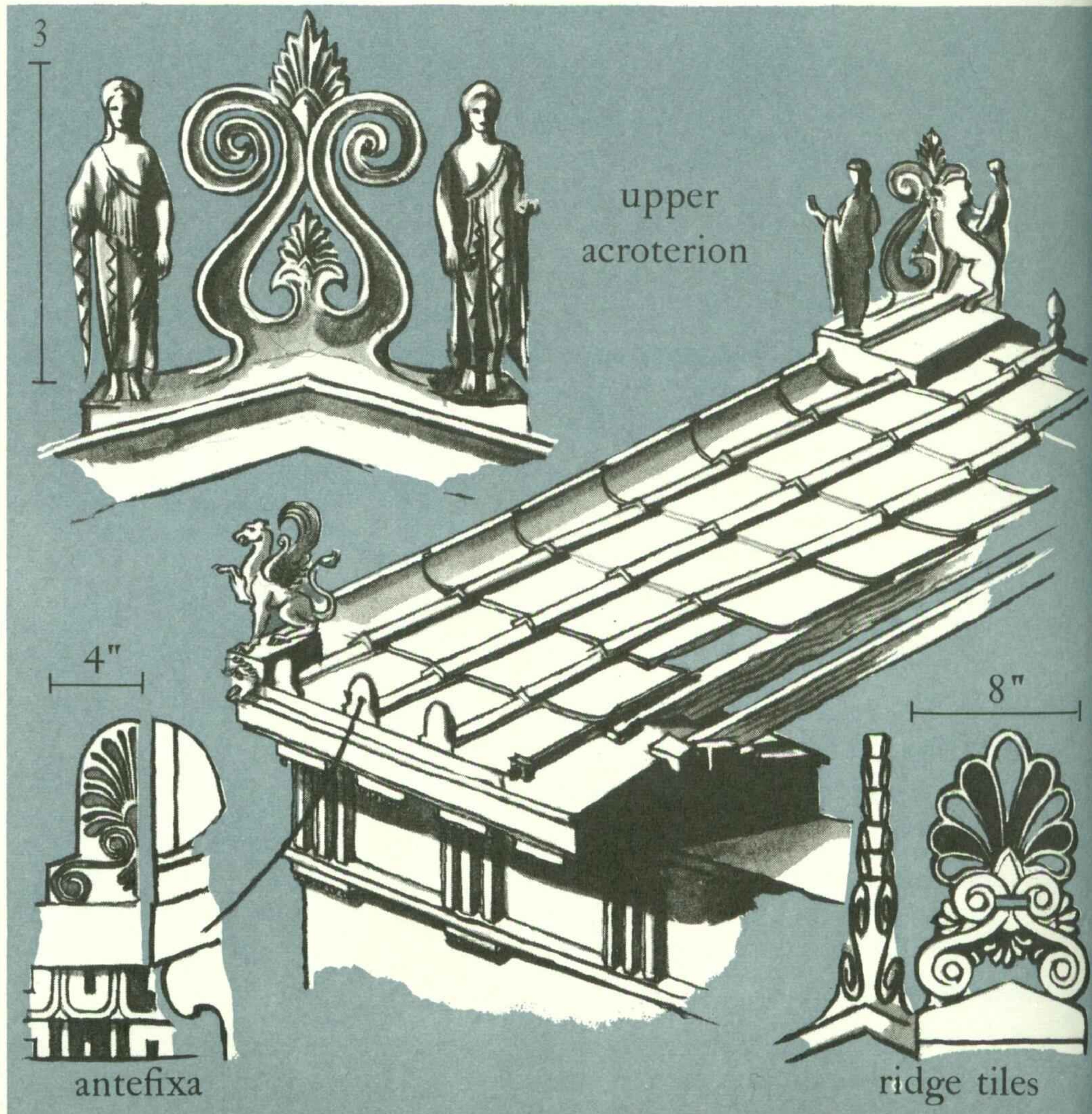
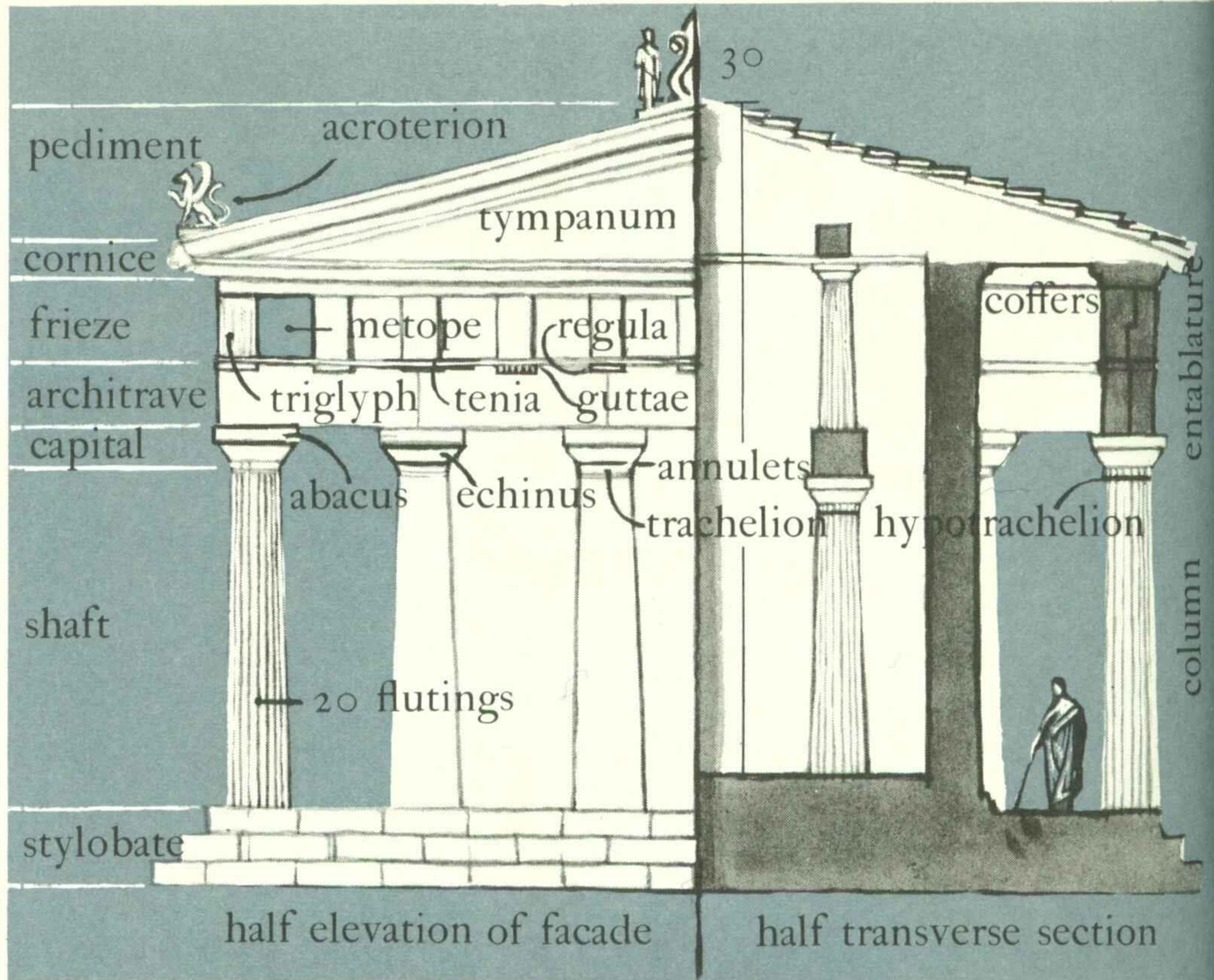
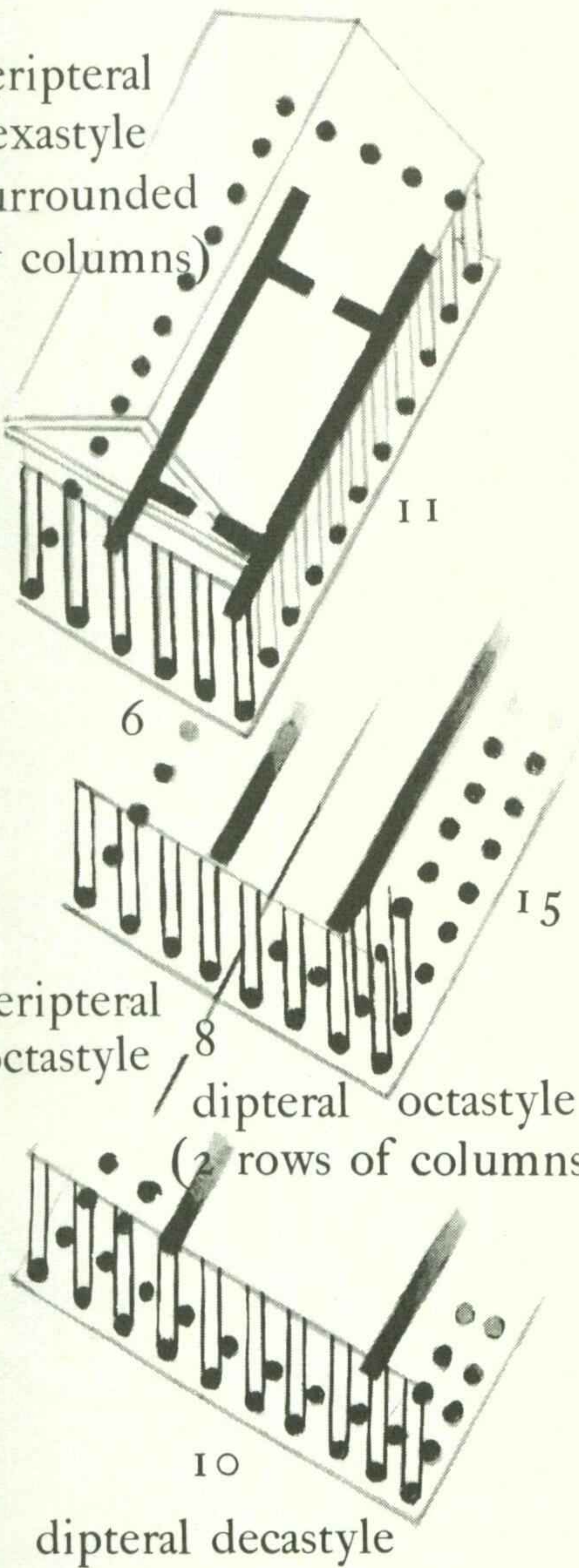
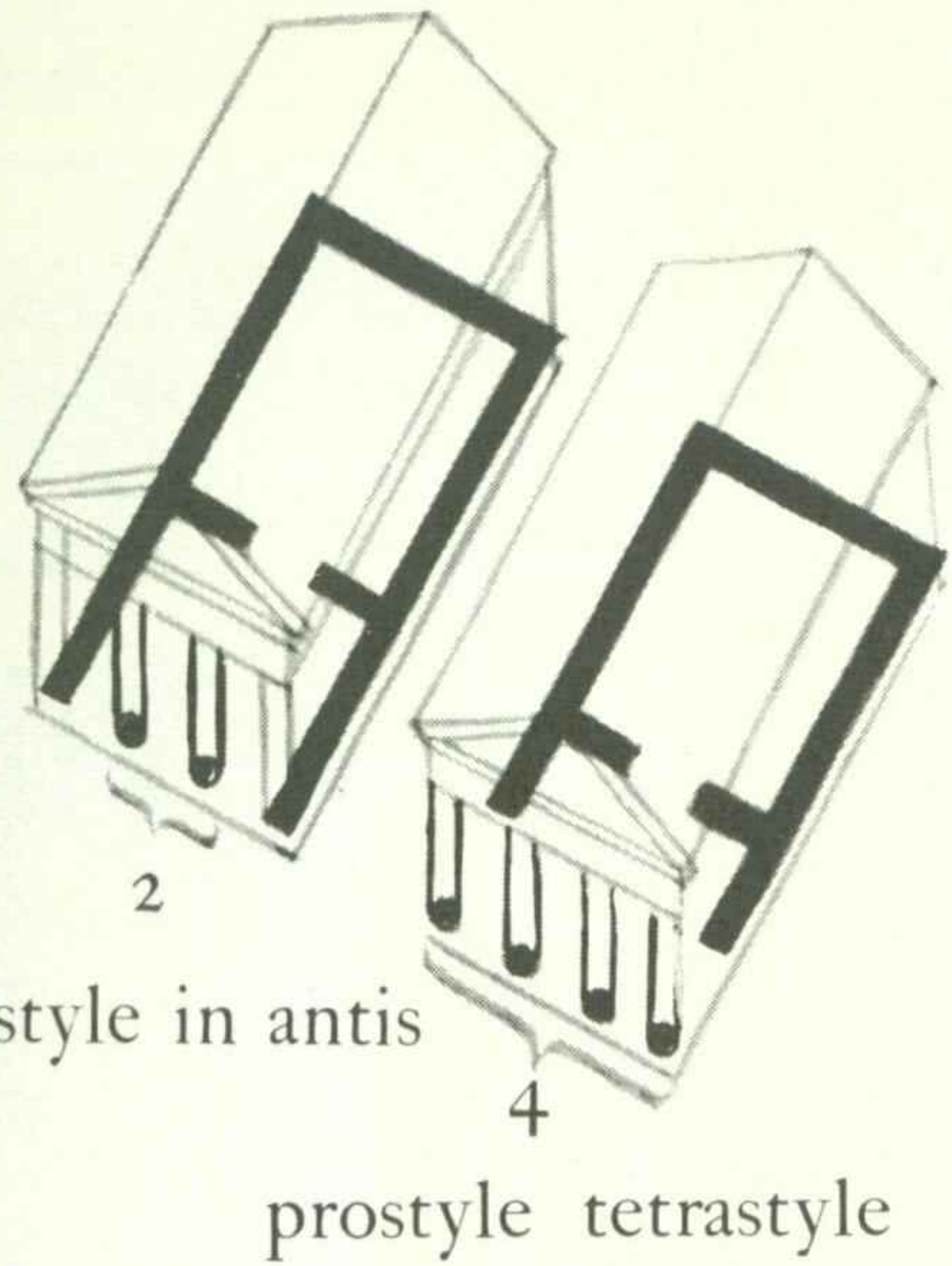


Arch of Titus, Rome, A.D. 81



From *The Five Orders of Architecture* by Vignola (A.D. 1509-73)

# GREEK

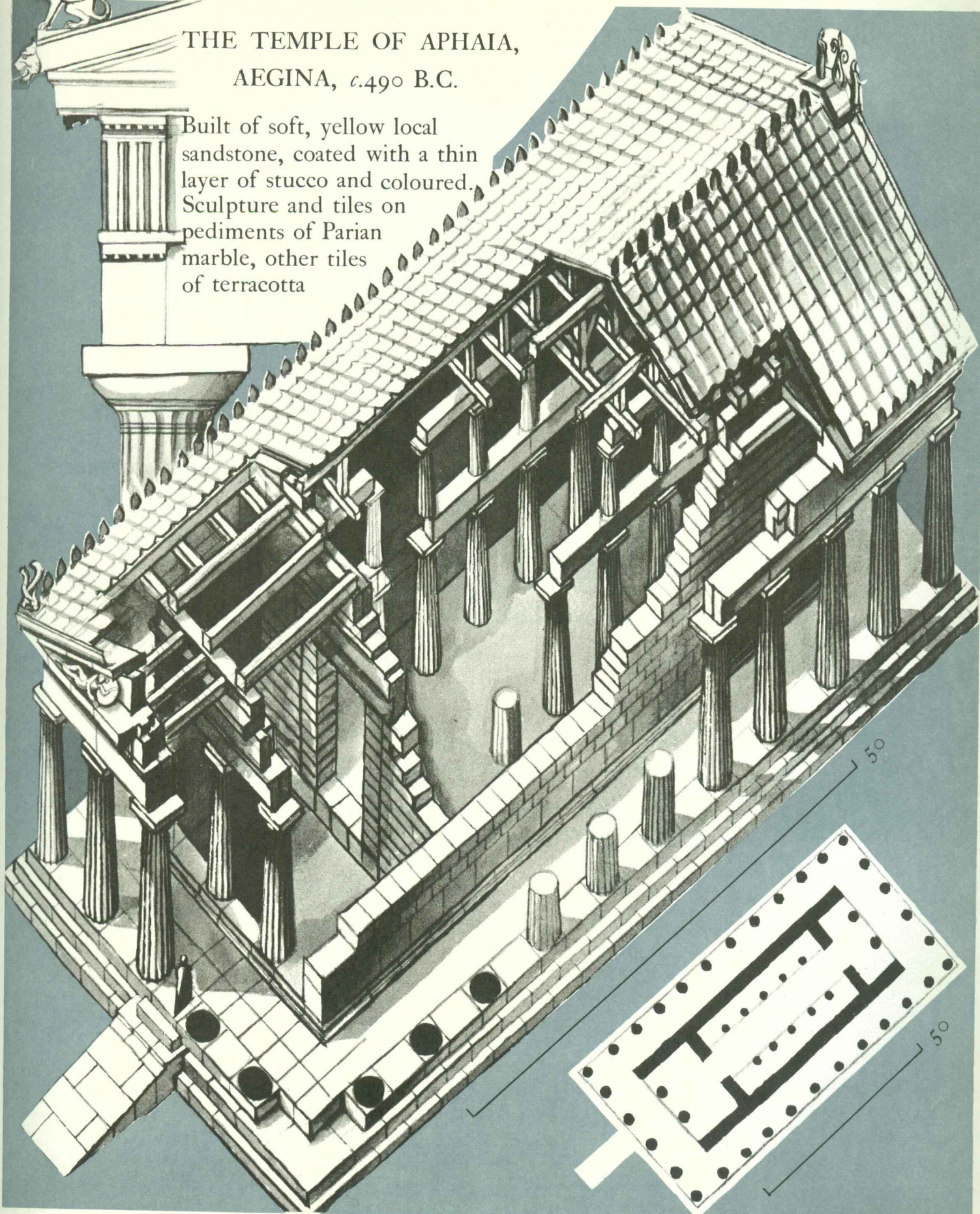


Classification of columnan arrangement according to Vitruvius (I 11, 2)

# THE DORIC TEMPLE

THE TEMPLE OF APHAIA,  
AEGINA, c.490 B.C.

Built of soft, yellow local sandstone, coated with a thin layer of stucco and coloured. Sculpture and tiles on pediments of Parian marble, other tiles of terracotta



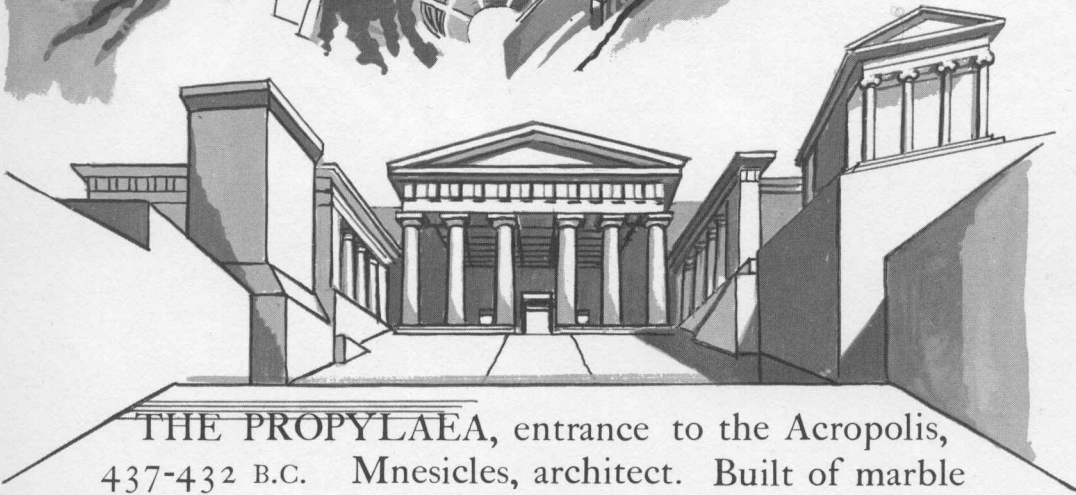
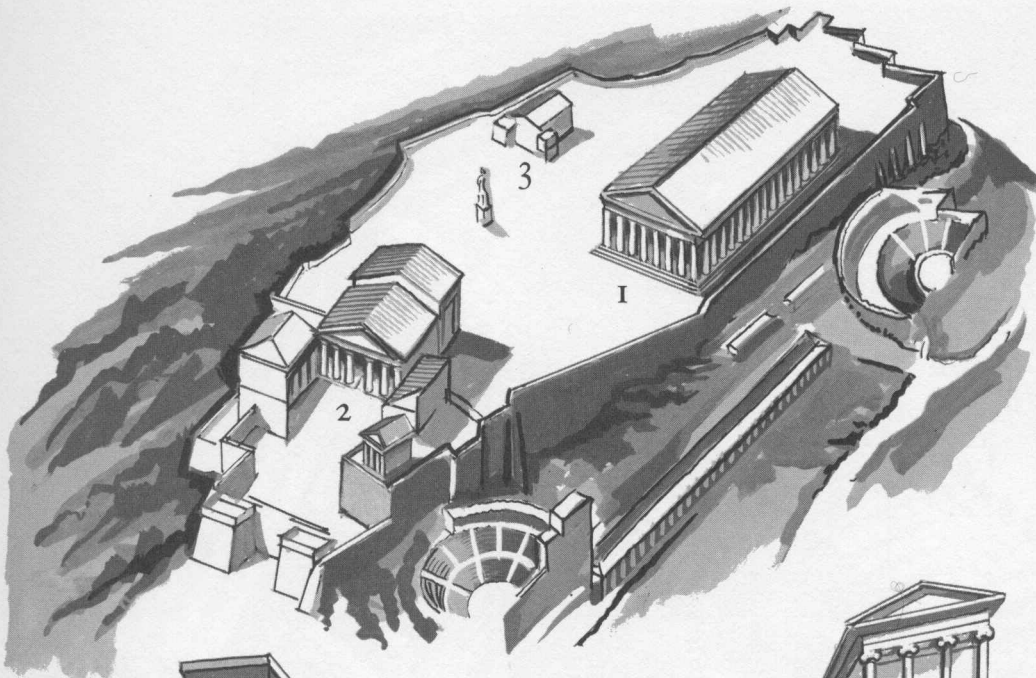
# GREEK

# ATHENS,

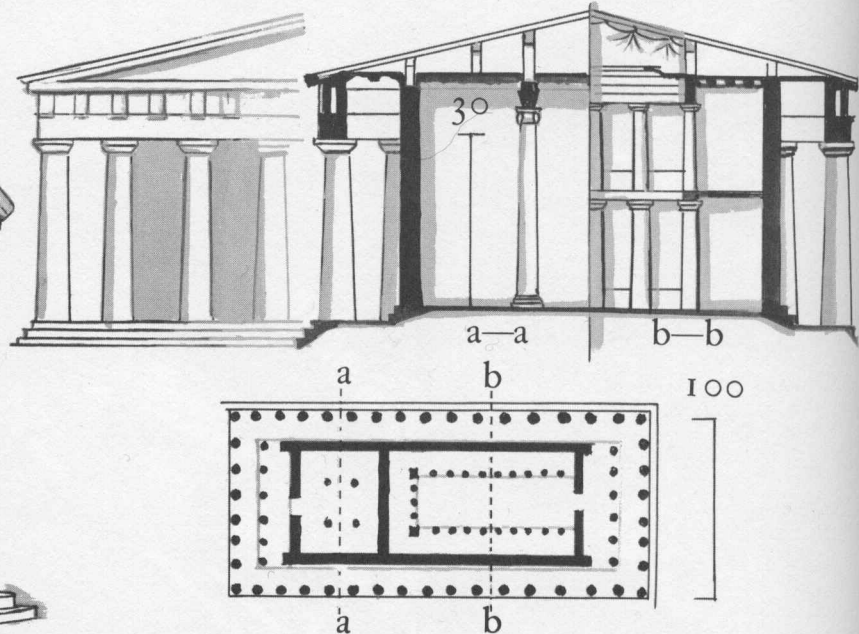
Between the Greeks' defeat of the Persians in 479 B.C. and the Peloponnesian War (431-404 B.C.)

Athens rose to her zenith; under the leadership of Pericles buildings were erected on the Acropolis:

- 1 The Parthenon
- 2 The Propylaea
- 3 The Erechtheum (restored)

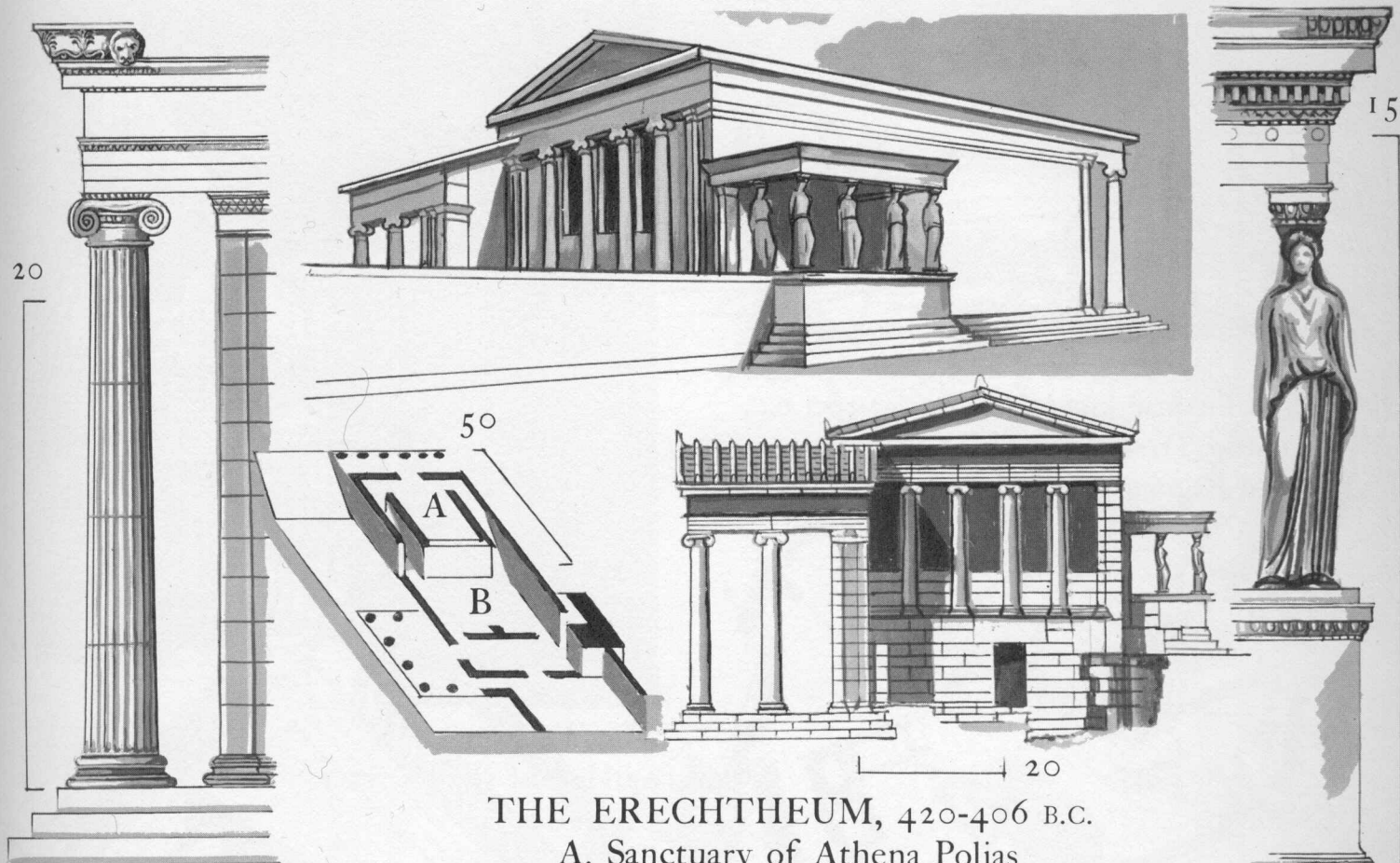


THE PROPYLAEA, entrance to the Acropolis, 437-432 B.C. Mnesicles, architect. Built of marble



THE PARTHENON, 447-432 B.C. Doric temple dedicated to Athena. Ictinus and Callicrates, architects; Phidias, master sculptor. Optical refinements p. 38

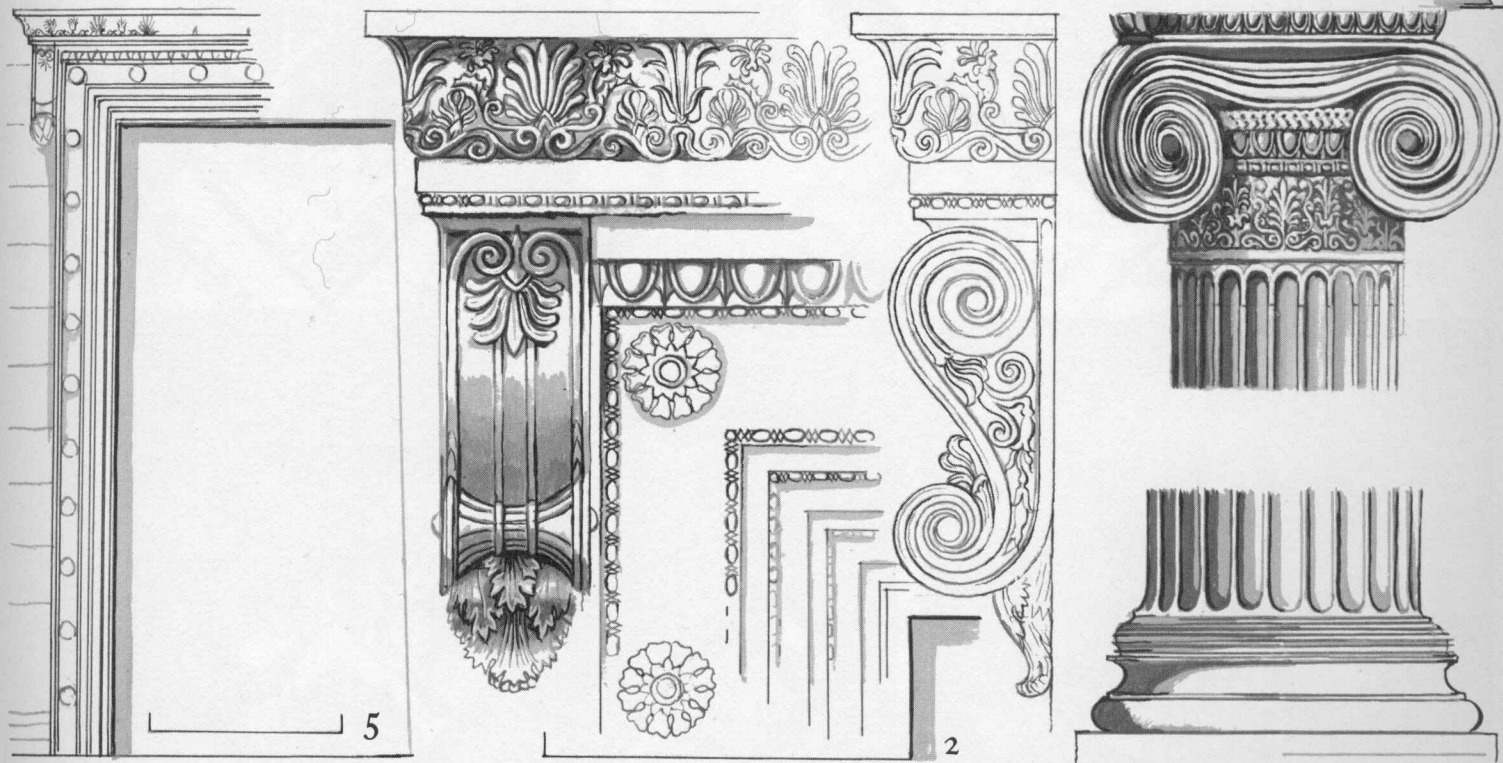
# BUILDINGS ON THE ACROPOLIS



THE ERECHTHEUM, 420-406 B.C.

A. Sanctuary of Athena Polias

B. Sanctuaries of Erechtheus and Poseidon

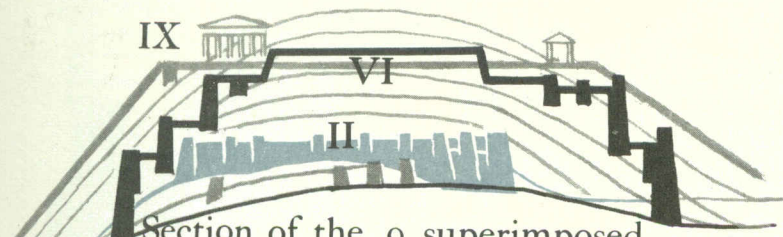


Possible architect Mnesicles. The caryatids and column capitals may have been designed by Callimachus, inventor of the Corinthian capital. Built on 4 levels, irregular in plan to preserve places sacred to Athens; built of white marble

# GREEK

# CITY

## AEGEAN

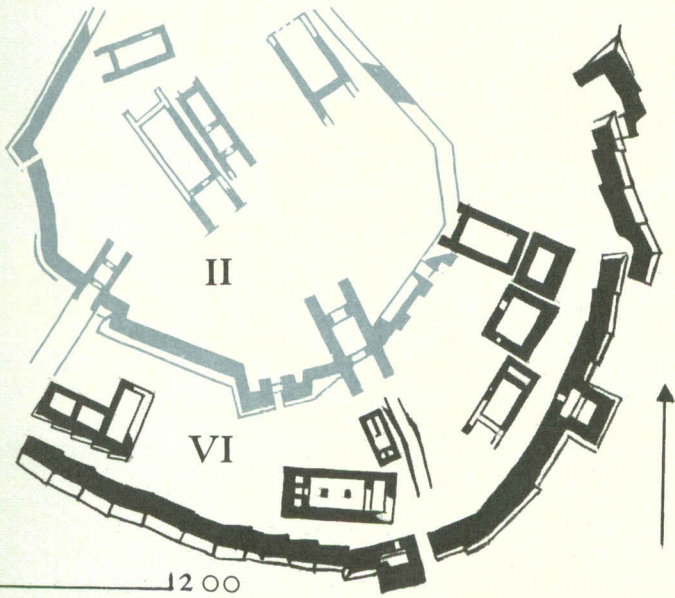


Section of the 9 superimposed 'cities' of TROY

II Prehistoric citadel, c.2600-2300 B.C.

VI Homeric Troy, 1900 B.C.; sacked c.1200 B.C.

IX The Roman acropolis, c.30 B.C.-A.D. 14.



Plan of selected buildings, Troy

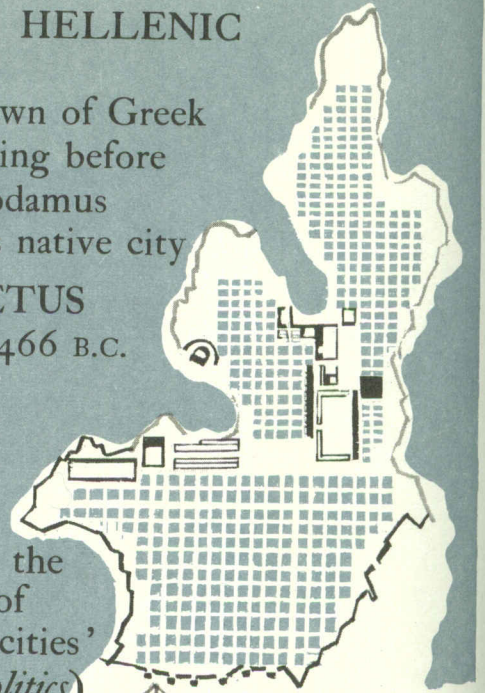
II Prehistoric citadel VI Homeric Troy

## HELLENIC

Little is known of Greek city planning before Hippodamus laid out his native city

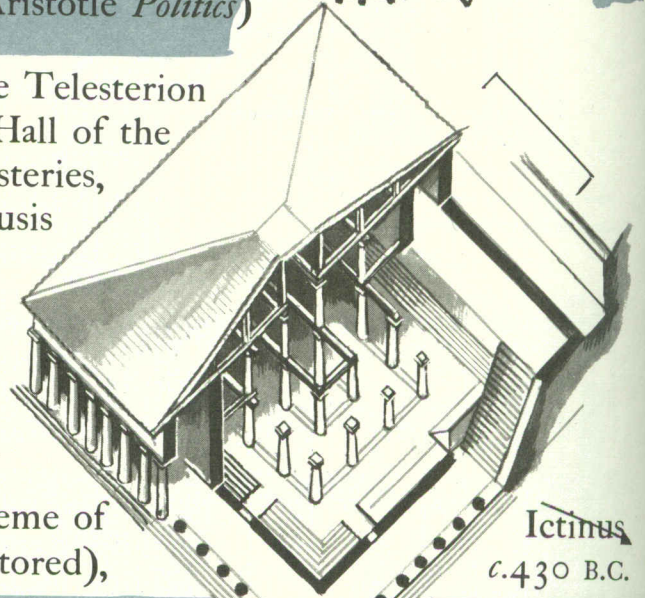
### MILETUS

c.479 or 466 B.C.



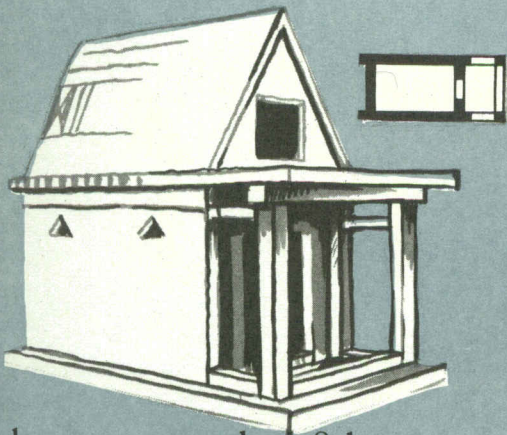
and 'discovered the method of dividing up cities' (Aristotle *Politics*)

The Telesterion or Hall of the Mysteries, Eleusis



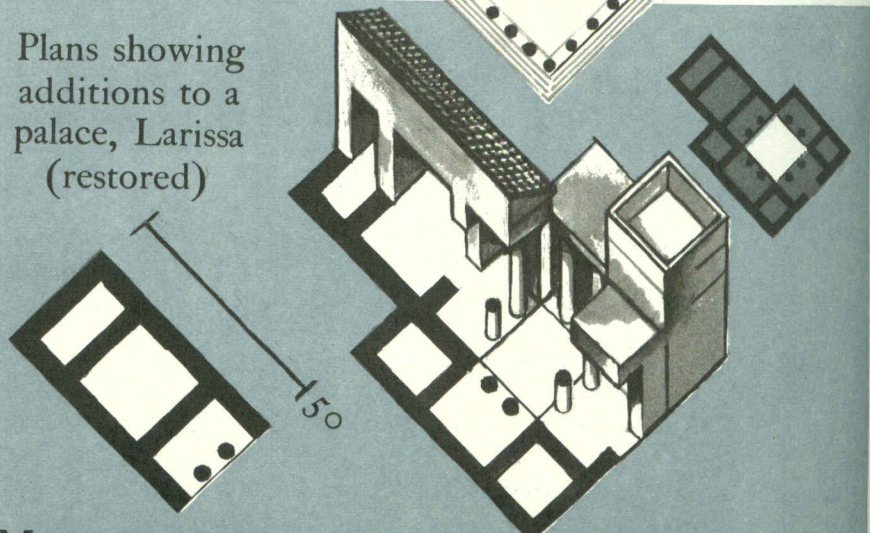
Scheme of (restored),

Ictinus c.430 B.C.



A house or temple, c.8th cent. B.C. after a terracotta model from Argive Heraeum

Plans showing additions to a palace, Larissa (restored)



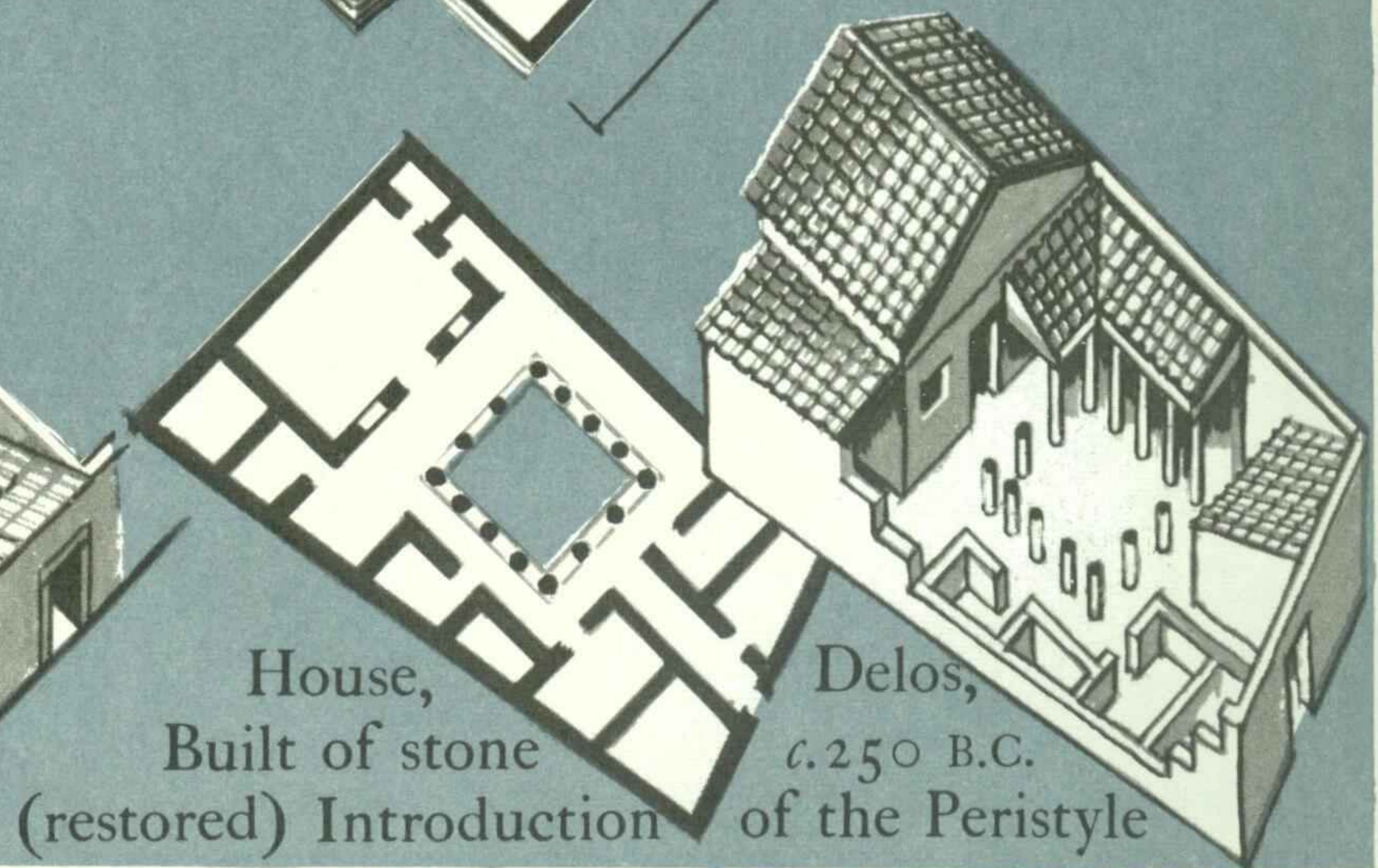
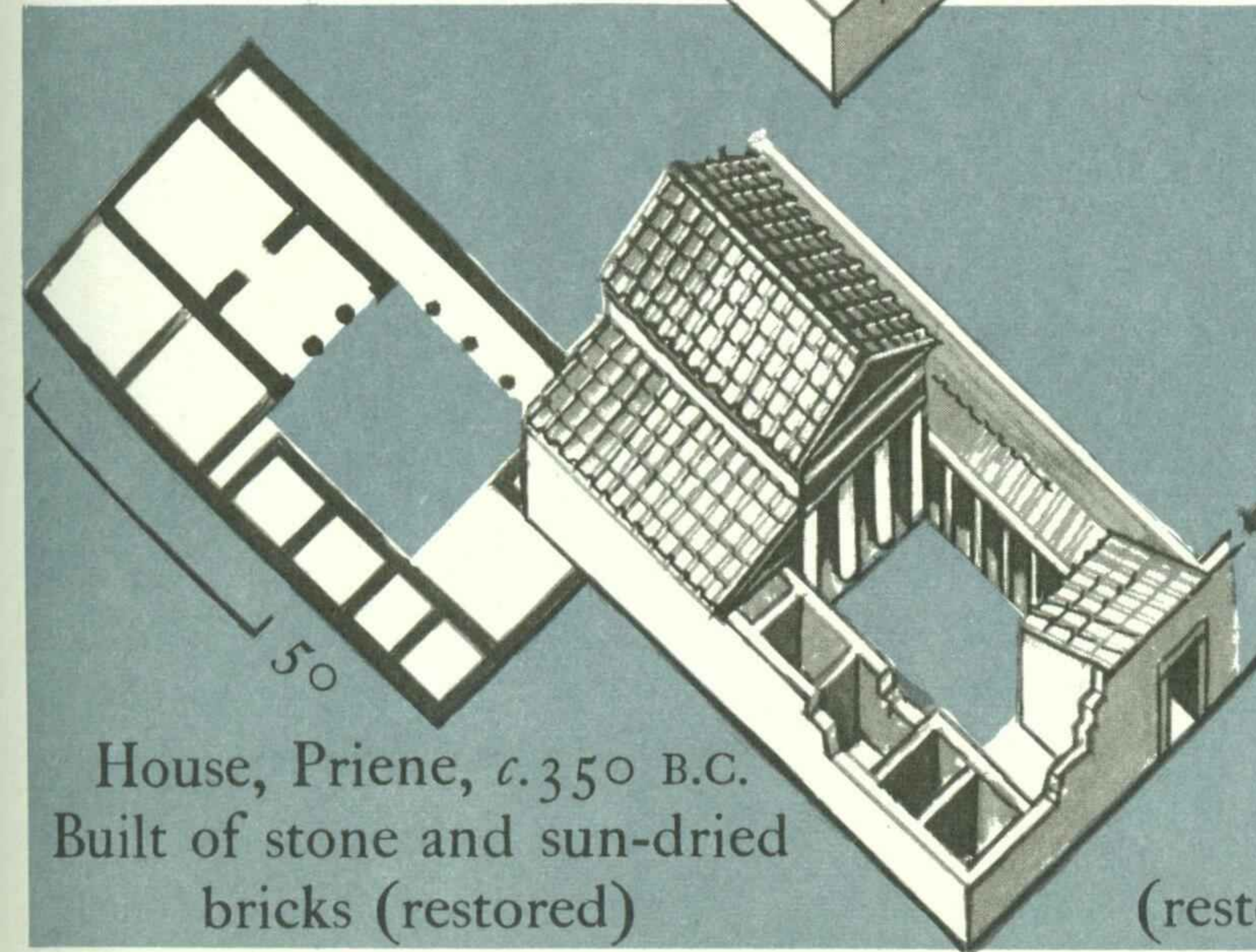
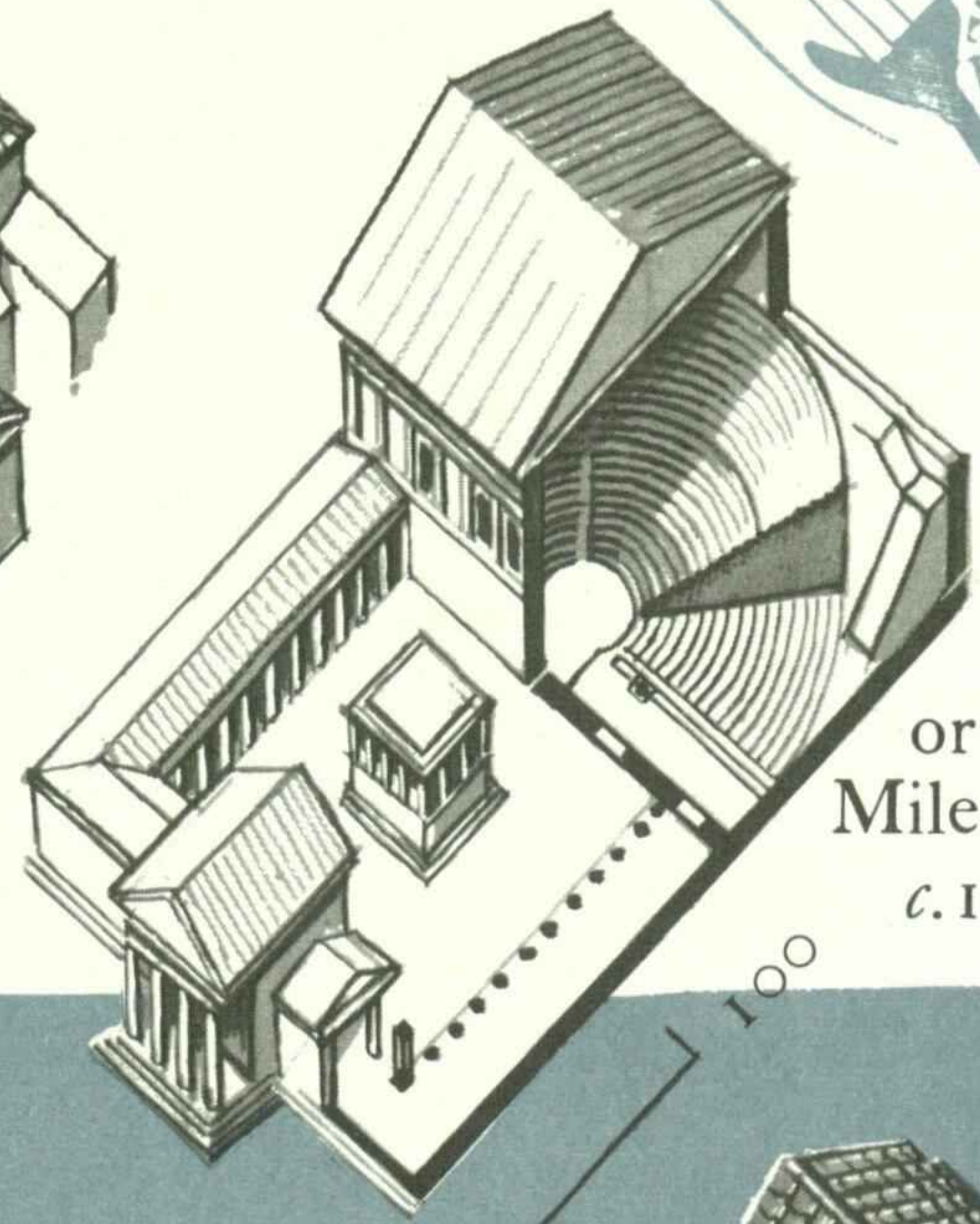
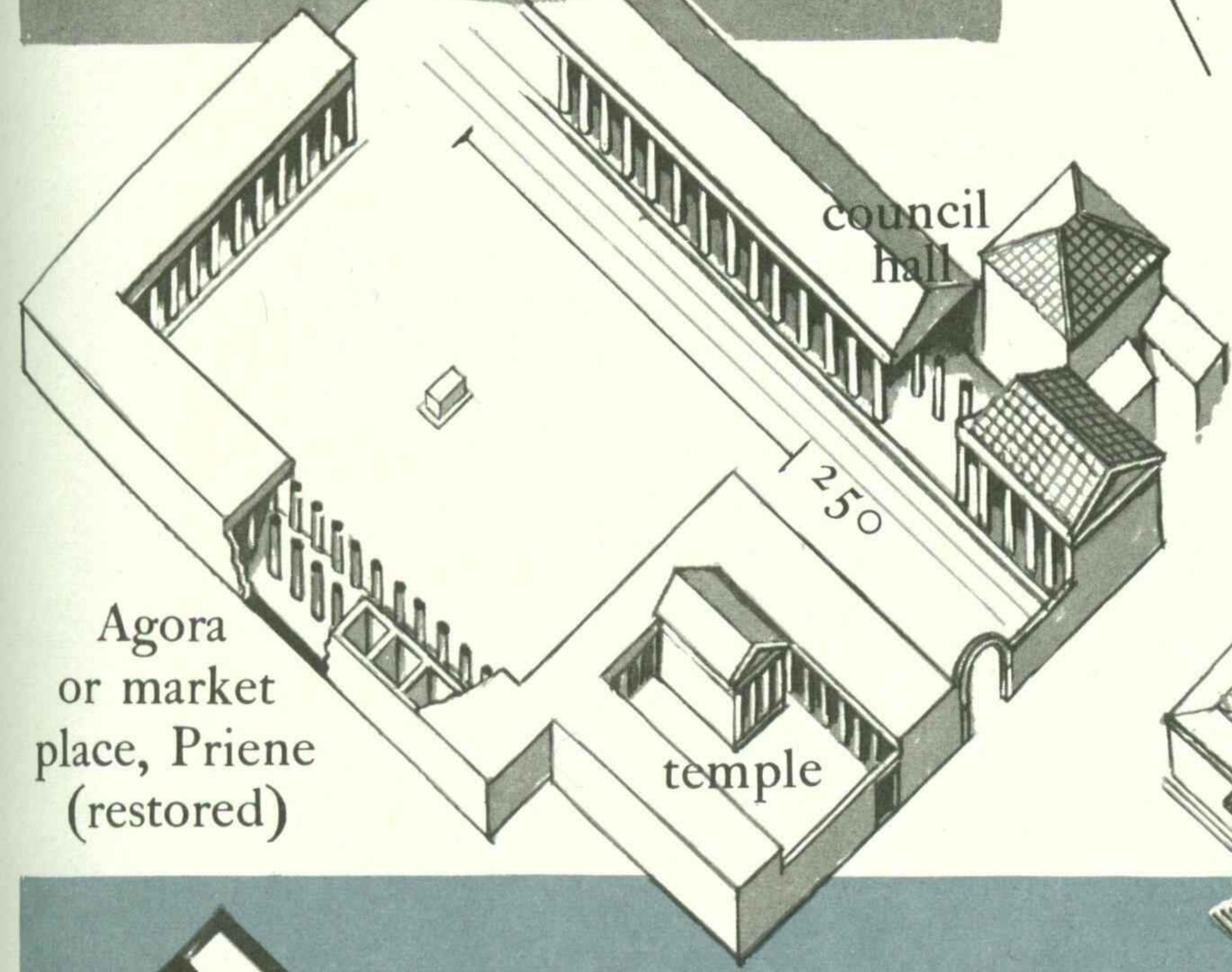
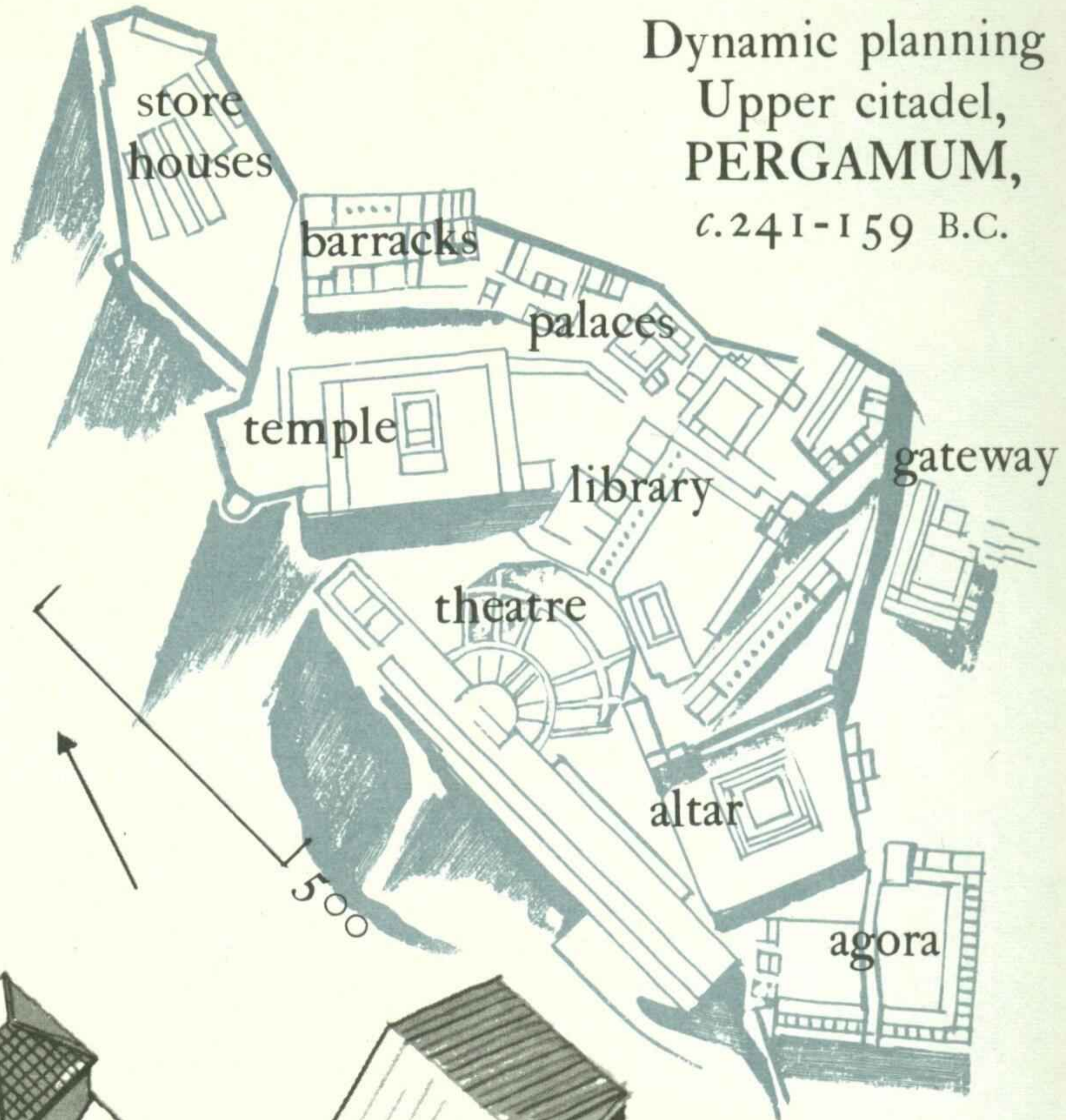
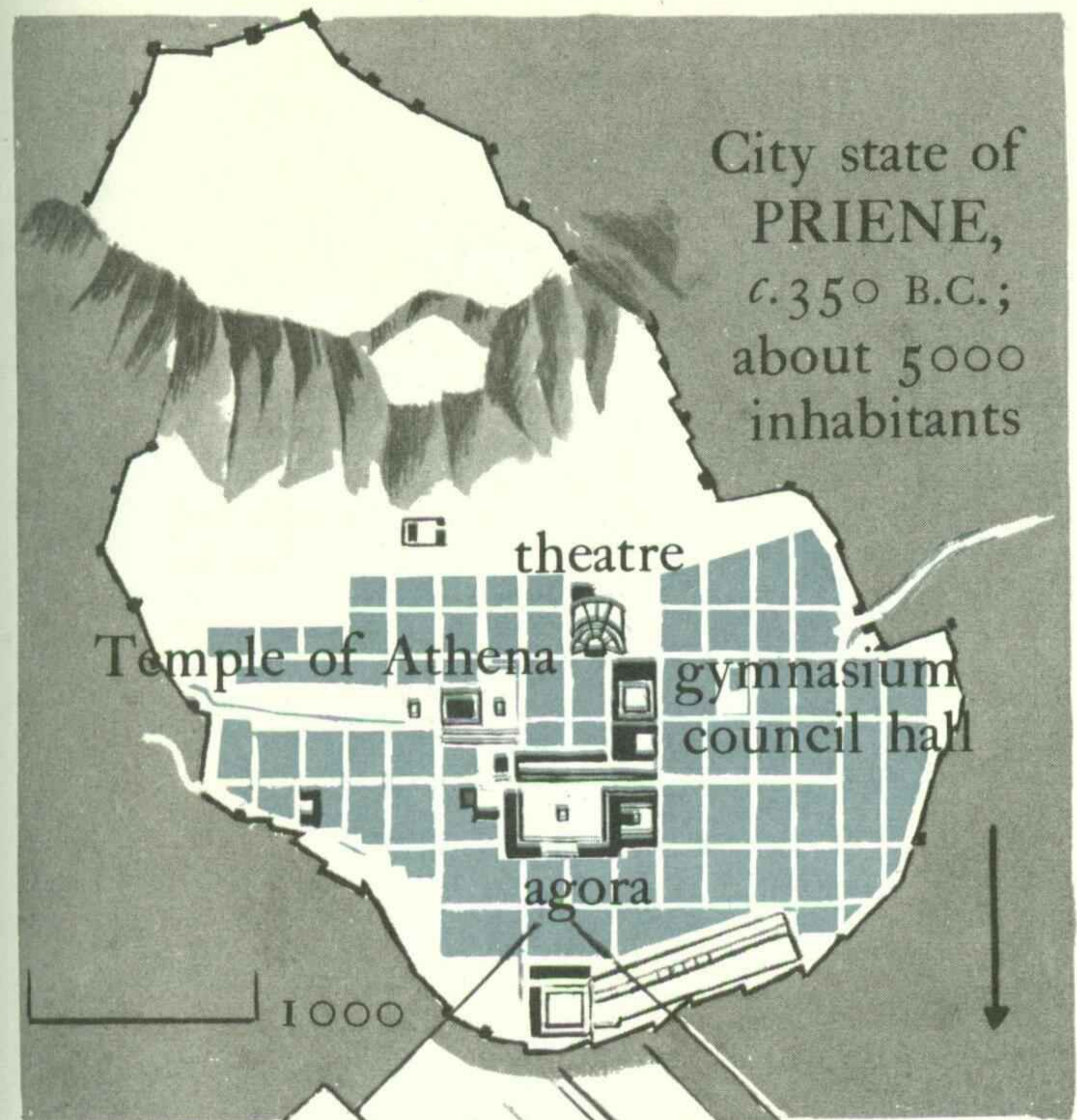
Megaron, c.500 B.C.

Peristyle, c.450 B.C.



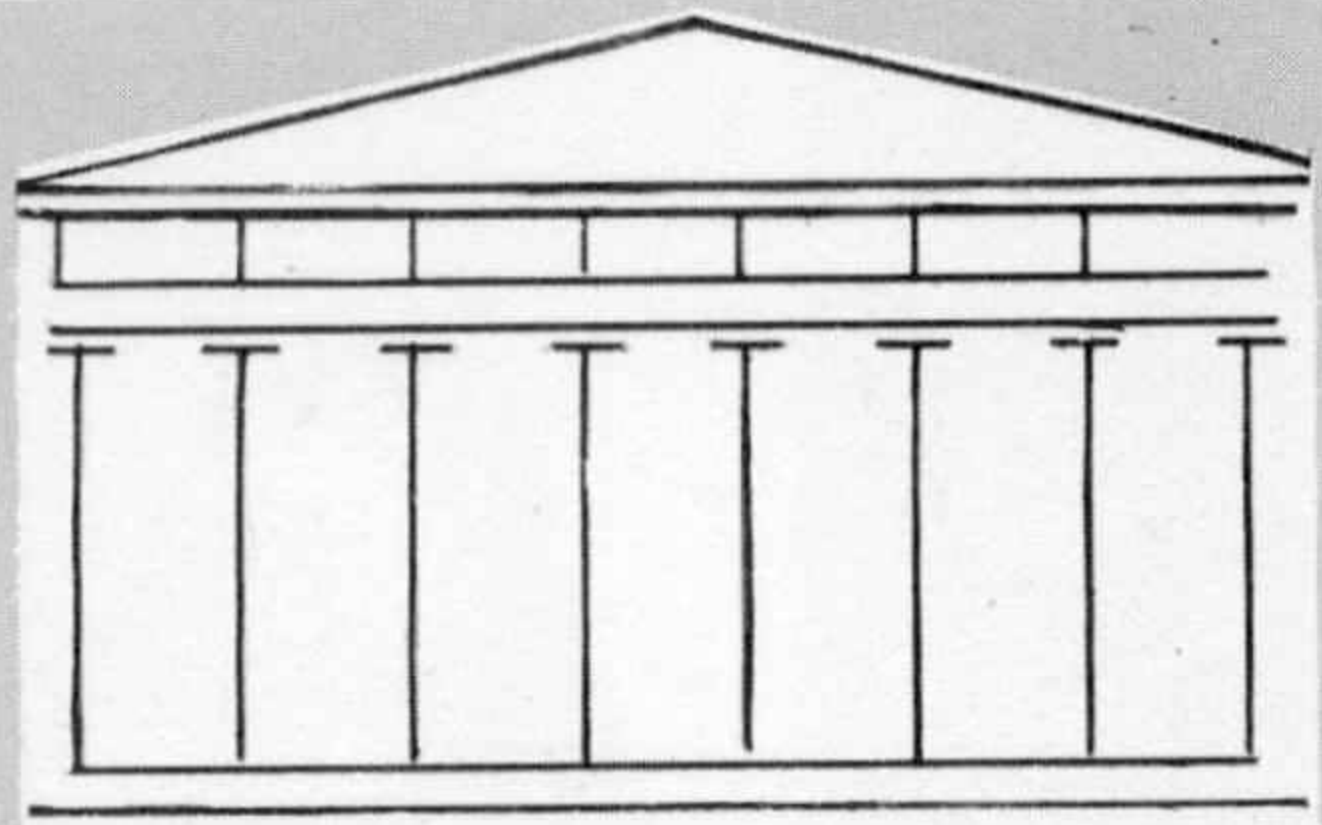
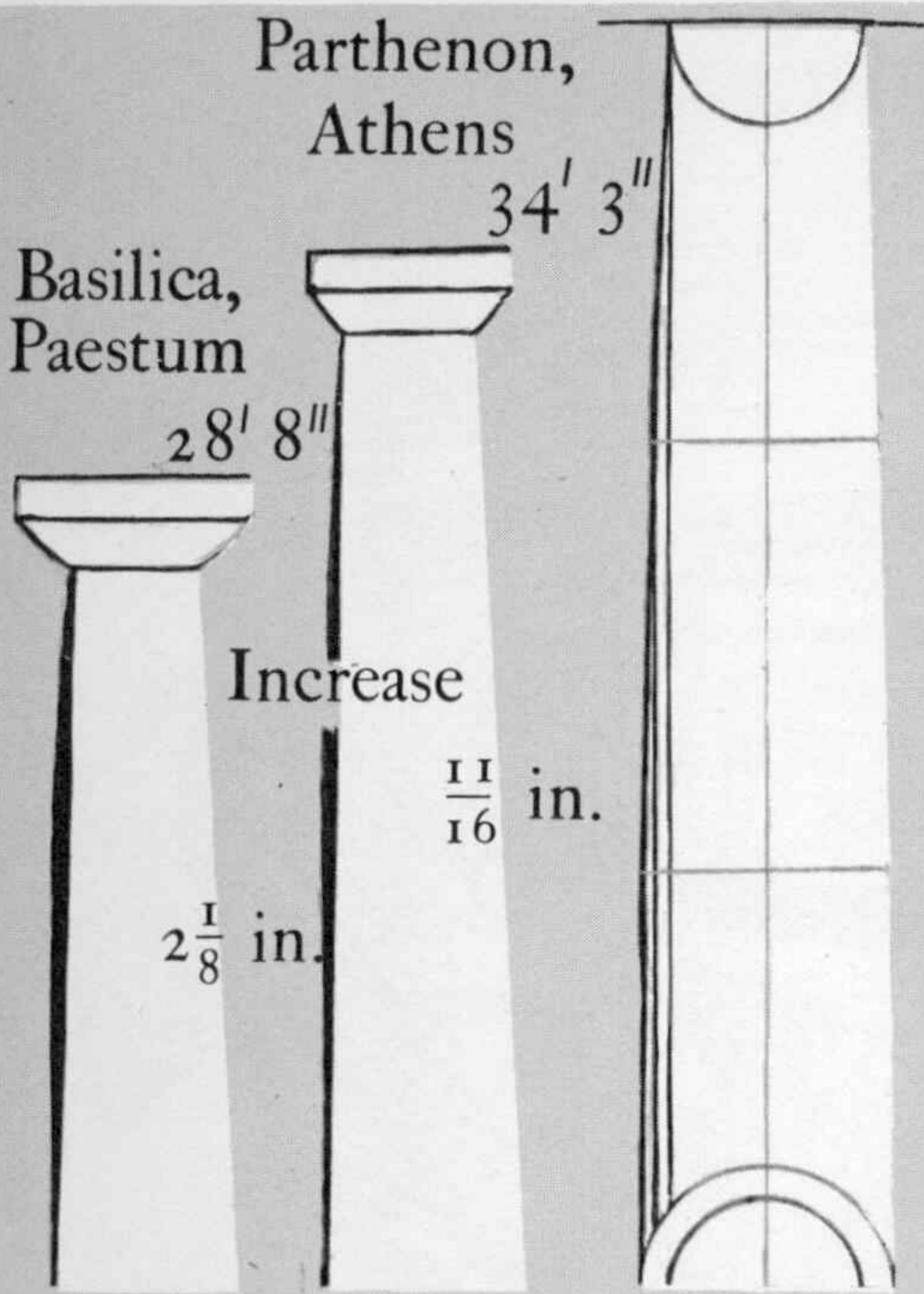
# PLANS, BUILDINGS AND HOUSES

## HELLENISTIC

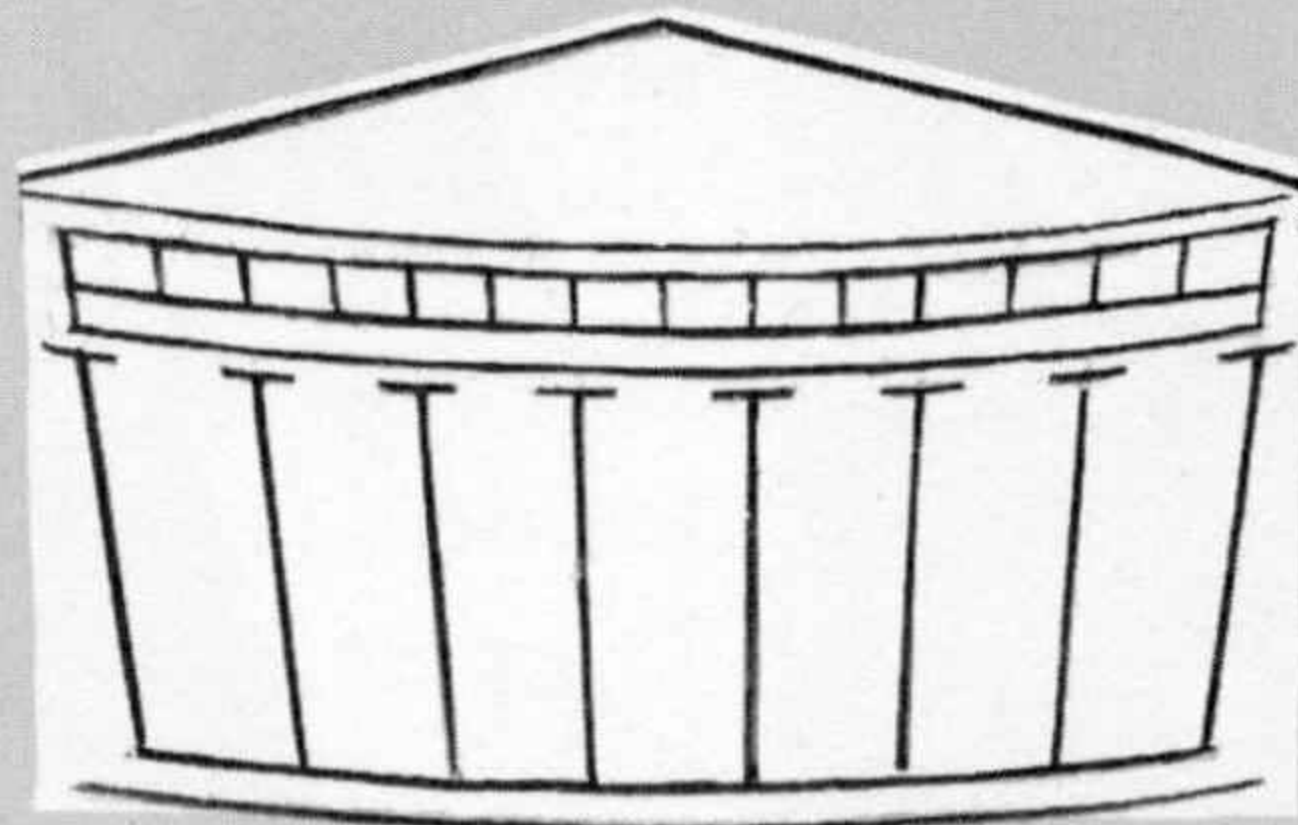


# GREEK

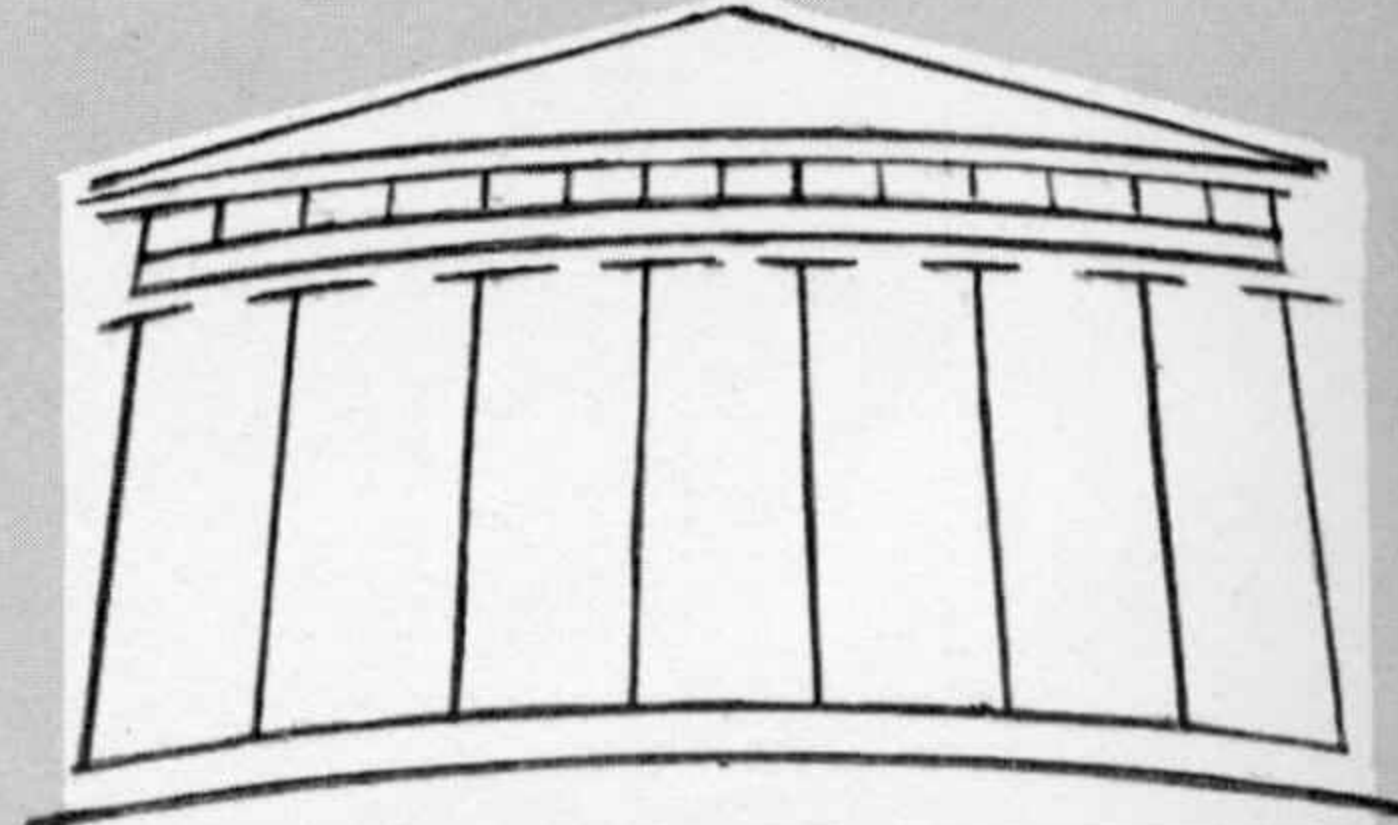
# REFINEMENTS



1 The Parthenon as seen

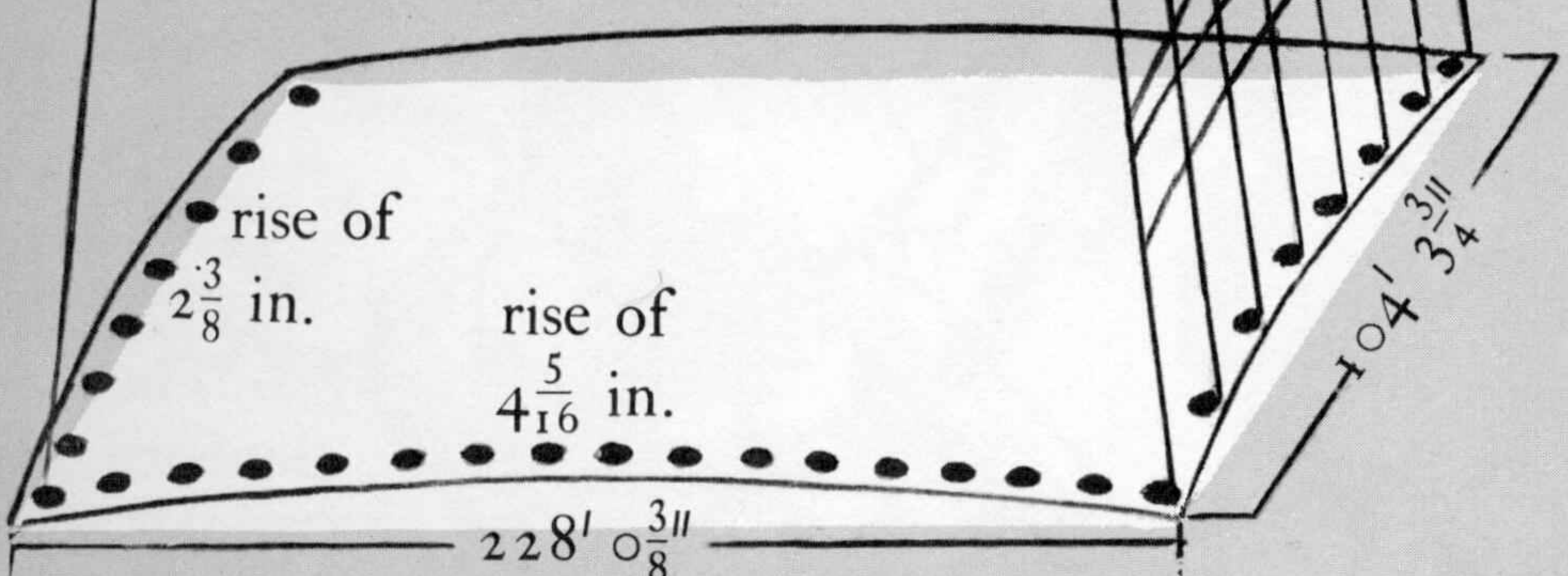


2 Without optical corrections

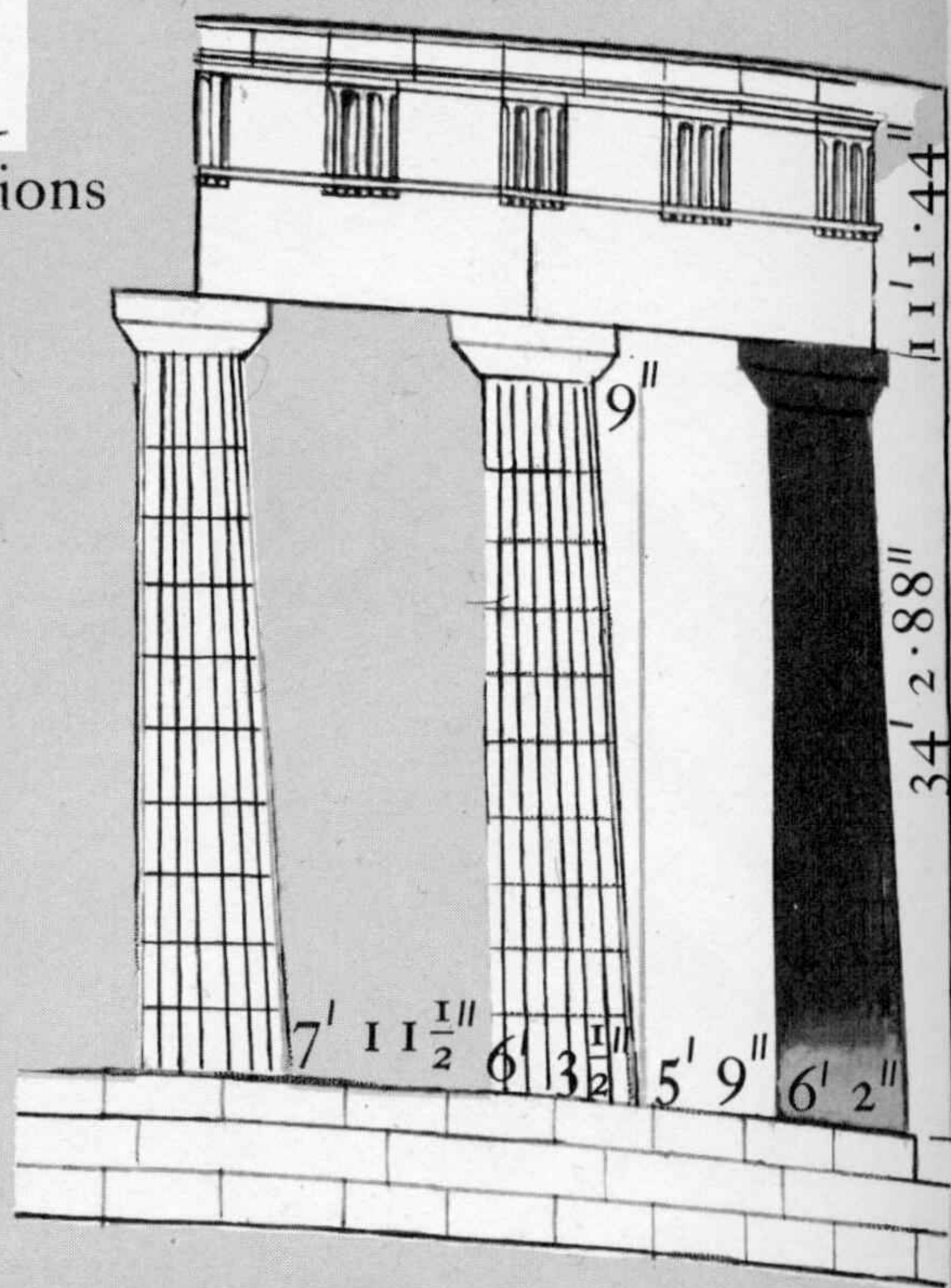


3 The front with inclined axes of columns and with convex stylobate and entablature producing the result seen at 1

Entasis (Gk: distension) designed to counteract the illusion of the outline of a column curving inwards

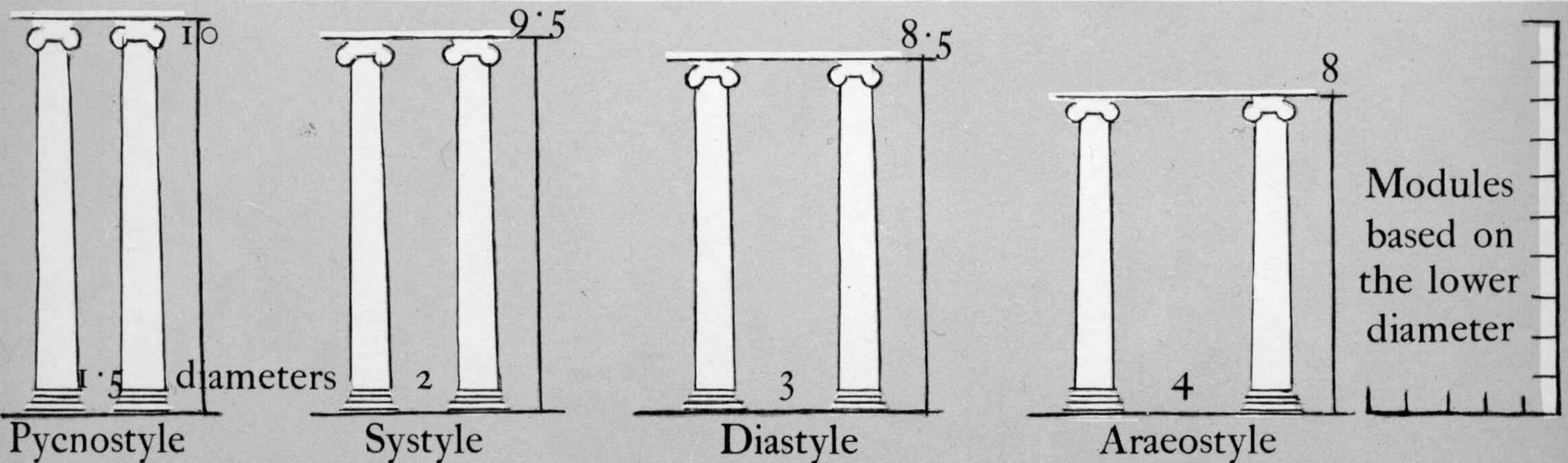


Exaggerated diagram of the rising curvature of the stylobate and inward inclination of the columns

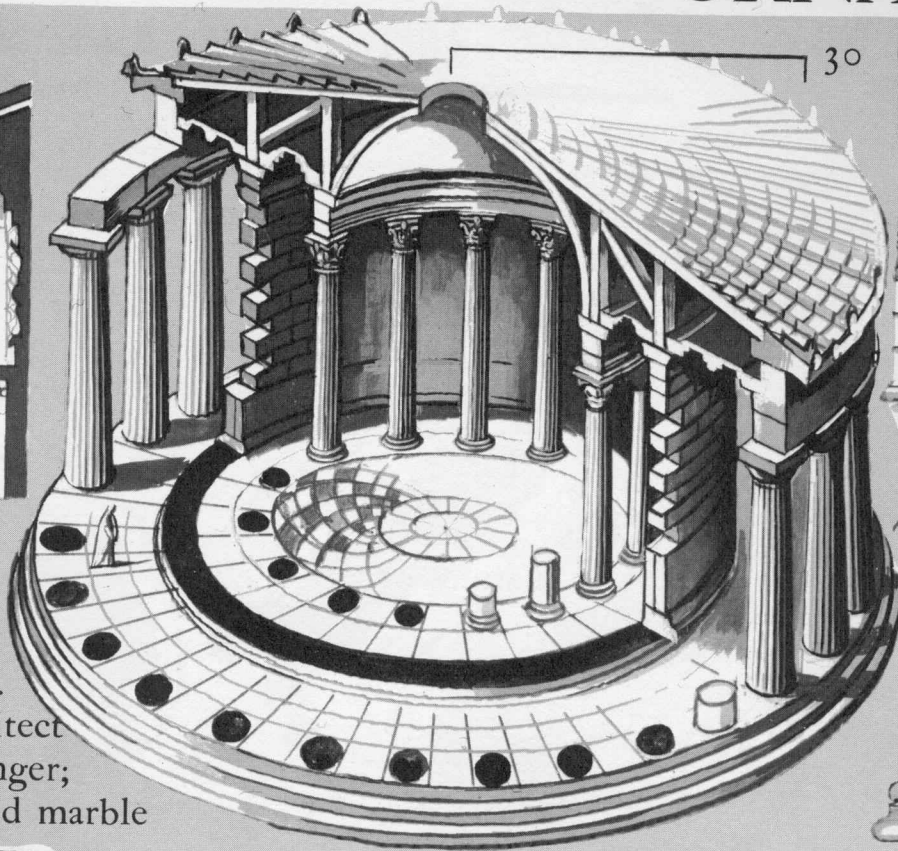
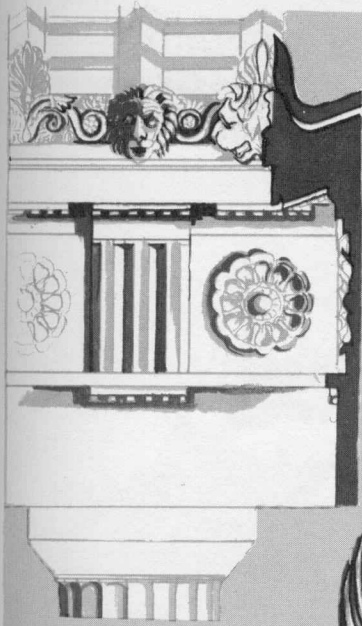


Angle columns look thinner seen dark against light and are thickened by  $1\frac{1}{2}$  in.

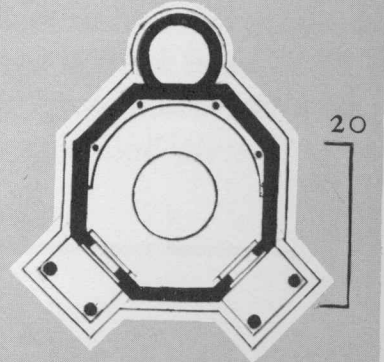
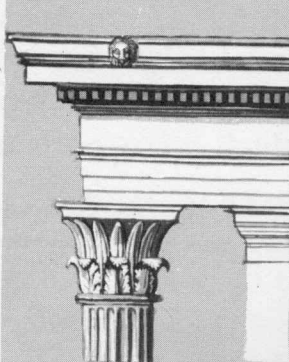
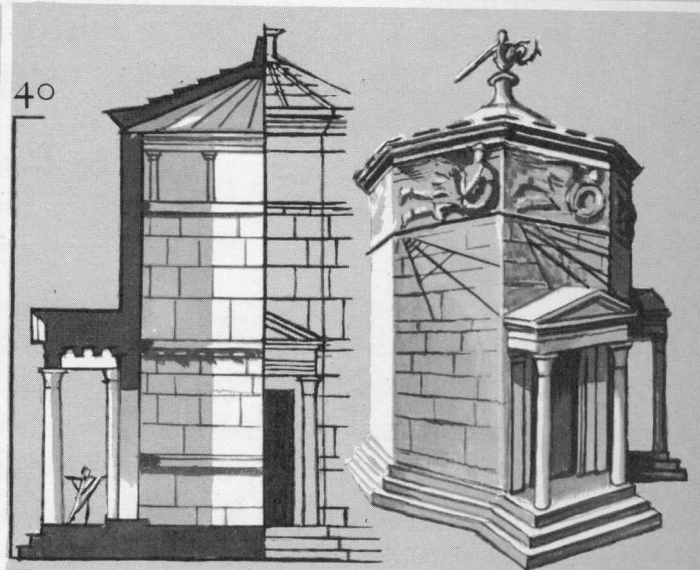
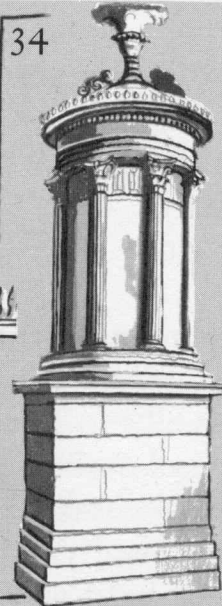
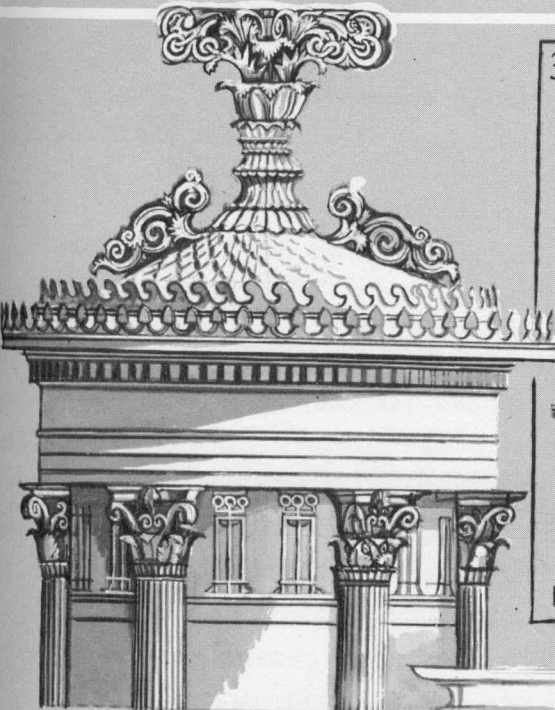
## OPTICAL CORRECTIONS, THE PARTHENON, ATHENS



Proportions of height, thickness & distance apart of columns according to Vitruvius (III,3)



The Tholos,  
Epidaurus, c. 360 B.C.  
by the sculptor-architect  
Polycleitus the Younger;  
built of sandstone and marble



The Choragic  
Monument of Lysicrates,  
Athens, c. 334 B.C.  
Podium of limestone,  
upper part white marble,  
Corinthian order used  
externally for the first time

The Tower of the Winds, Athens,  
c. 50 B.C. Clock-tower built of marble

# ROMAN

## THE ROMAN REPUBLIC

c.753 B.C.  
The foundation of Rome

Etruscan kings

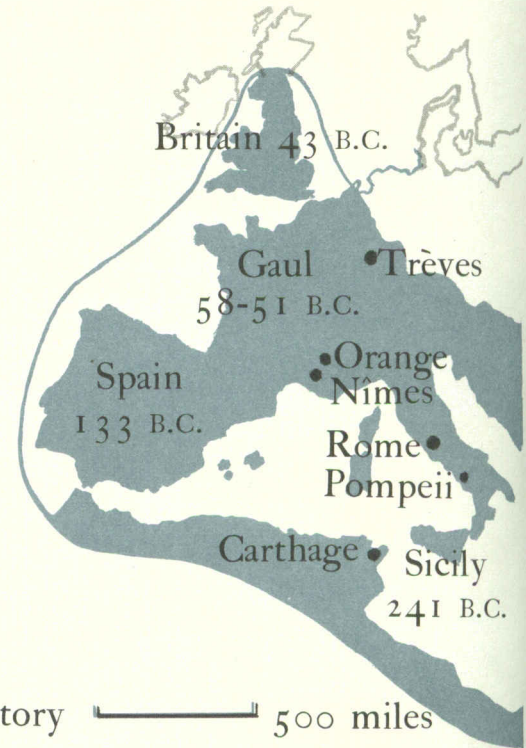
500



Italy at the beginning of the Roman Republic, c.500 B.C.



The Latin conquest of Italy, 275 B.C.



The Roman Empire

Early Rome, with its Republican magistrates, town-council (senatus) and town-meetings (comitia), by a series of systematic conquests created an Empire round the Mediterranean consisting of different nationalities accepted as allies. The Roman Empire became a fusion of the practical Western idea of one universal society in which all men might live in conformity with Roman law and the Oriental conception of an Emperor-God with a throne-altar demanding a common worship and loyalty. This union between the West and the East was a continual source of weakness and led to the ultimate division of the Empire. The Romans built roads and bridges for swift communication, military camps with a simple set plan (later incorporated in many city-plans) for speed of construction, and government and civic buildings, which were both useful and symbolic of Roman law and order.

### Greek Hellenic Period

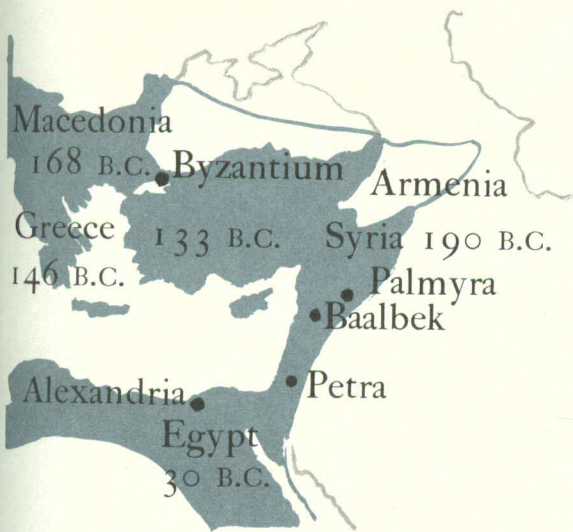
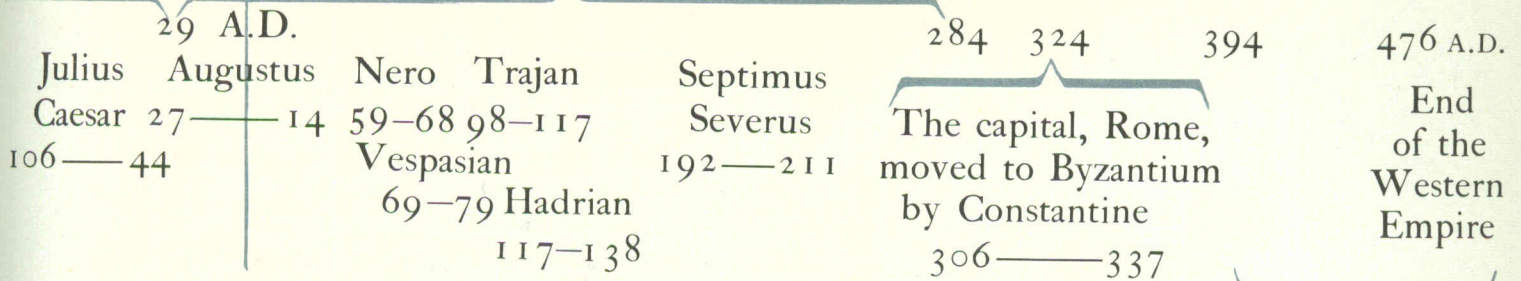
### Hellenistic

775/6

429/8 — Plato — 347  
384 Aristotle 322  
342-Epicurus-270  
326? — Zeno — 264? (Stoicism)

# INTRODUCTION

## THE ROMAN EMPIRE



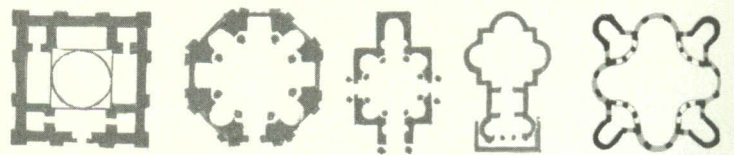
27 B.C. — A.D. 324



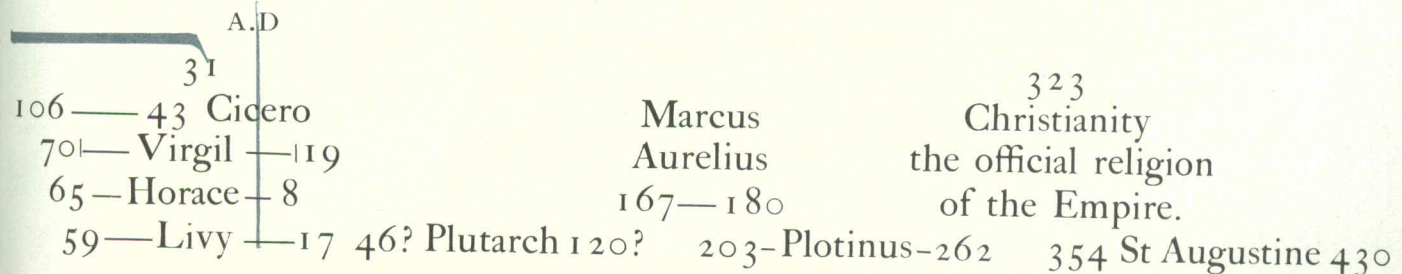
The Division of the Empire

394 A.D.

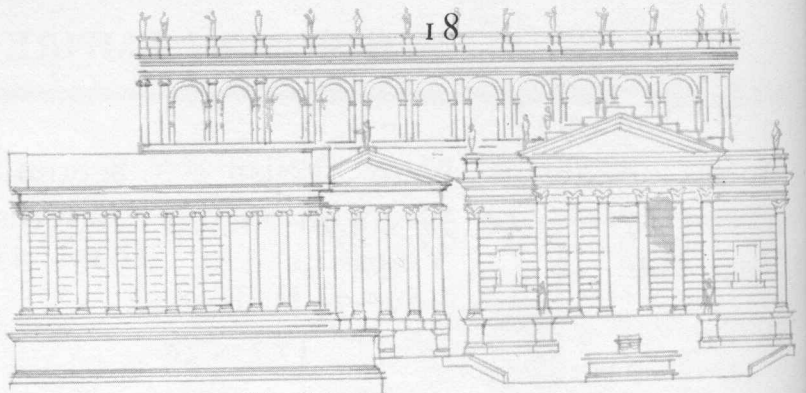
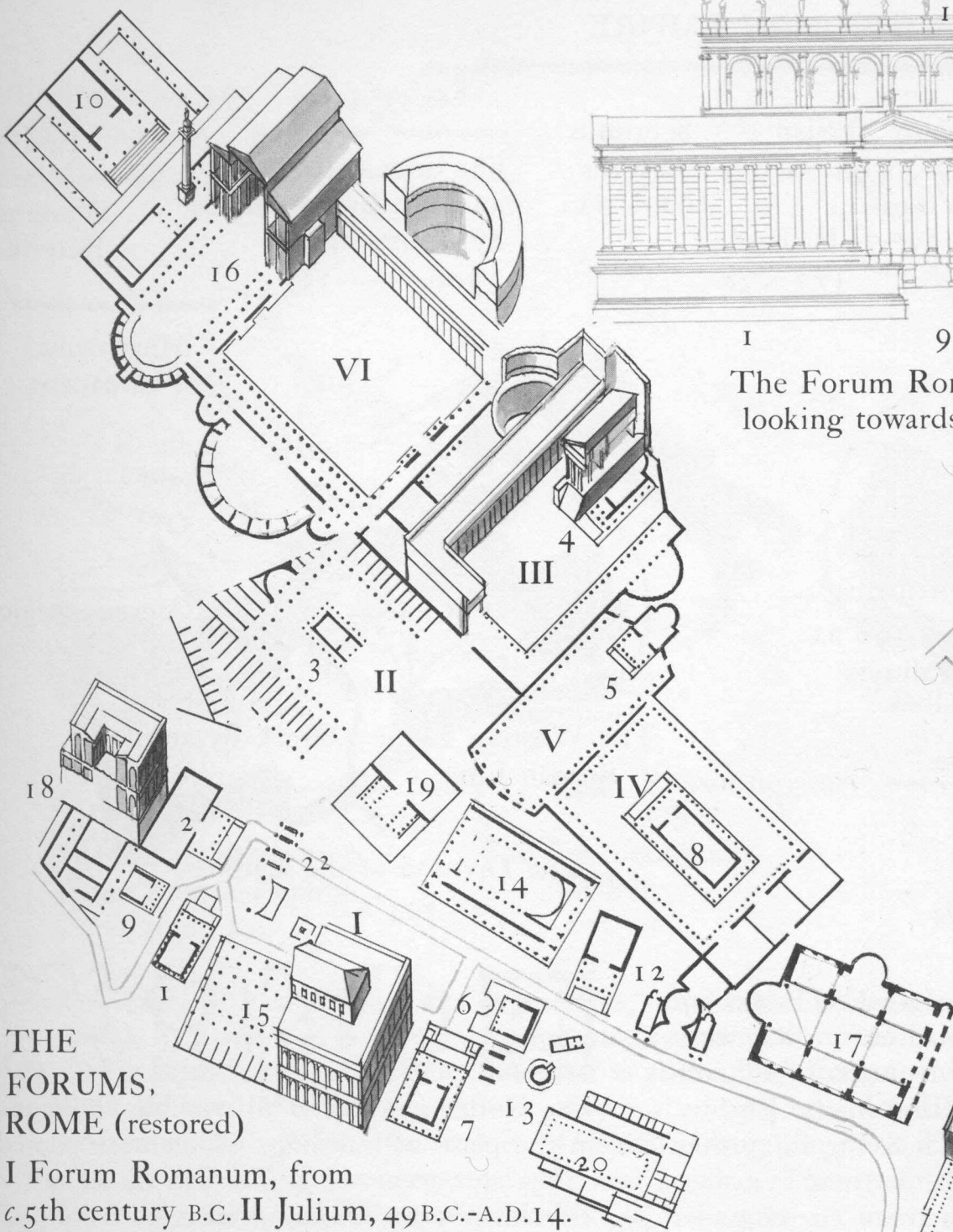
During the Republic kiln-baked bricks and stone blocks with or without mortar were used in building. The invention of concrete revolutionised construction in the Empire. Concrete was used with a facing for protection and a surface finish, & there is a sharp distinction between the art of the engineer constructing arches, vaults and domes and the applied art of decoration with columns and pilasters, marbles and mosaics.



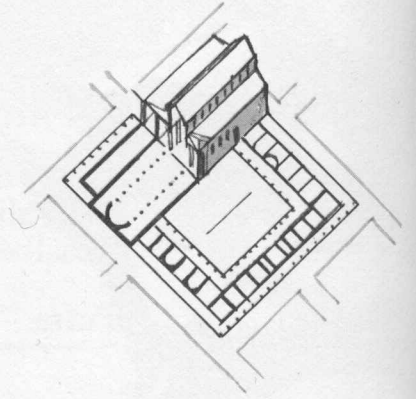
The Romans invented all possible variations in the plans of buildings which were copied by later architects. *The Ten Books on Architecture* by Marcus Vitruvius Pollio, a Roman architect and engineer who lived in the 1st century B.C. was widely read in the Renaissance and later.



# ROMAN



1 9 2  
The Forum Romanum (restored),  
looking towards the Tabularium



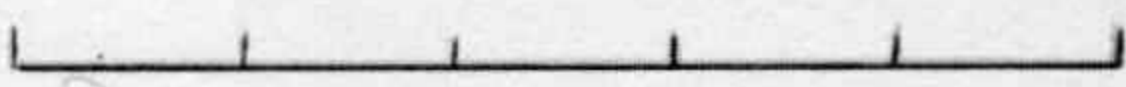
Forum and basilica,  
Silchester, England,  
c.A.D. 50-100

## THE FORUMS, ROME (restored)

I Forum Romanum, from c.5th century B.C. II Julium, 49 B.C.-A.D.14.  
III Augustus, 28 B.C.-A.D. 14. IV Vespasian, A.D. 67-79.  
V Nerva, c.A.D. 97. VI Trajan, A.D. 100-117.

TEMPLES: 1 Saturn, 44 B.C. 2 Concord, 7 B.C. 3 Venus Genetrix, 49 B.C.  
4 Mars Ultor, 14-2 B.C. 5 Minerva, 28 B.C.-A.D. 14. 6 Divus Julius, 8 B.C.-A.D. 14.  
7 Castor and Pollux, A.D.6. 8 Peace, A.D.67-79. 9 Vespasian, A.D.94. 10 Trajan, A.D.100-117.  
11 Venus and Rome, A.D. 123-135. 12 Faustina, A.D. 141. 13 Vesta, A.D. 205.  
BASILICAS: 14 Aemilia, c.179 B.C. 15 Julia, 46 B.C. 16 Trajan, A.D. 100-117.  
17 Constantine, A.D. 310-313.  
BUILDINGS: 18 Tabularium, 78 B.C. 19 Curia (Senate House), 49 B.C.-A.D.14. 20 House of the Vestal Virgins, c.A.D.17. 21 Colosseum, A.D. 70-82. 22 Arch of Septimus Severus, A.D.203.

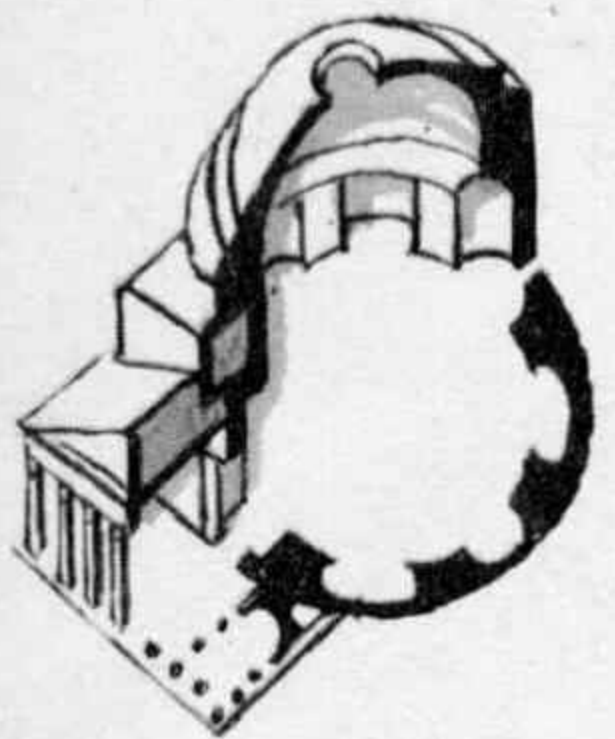
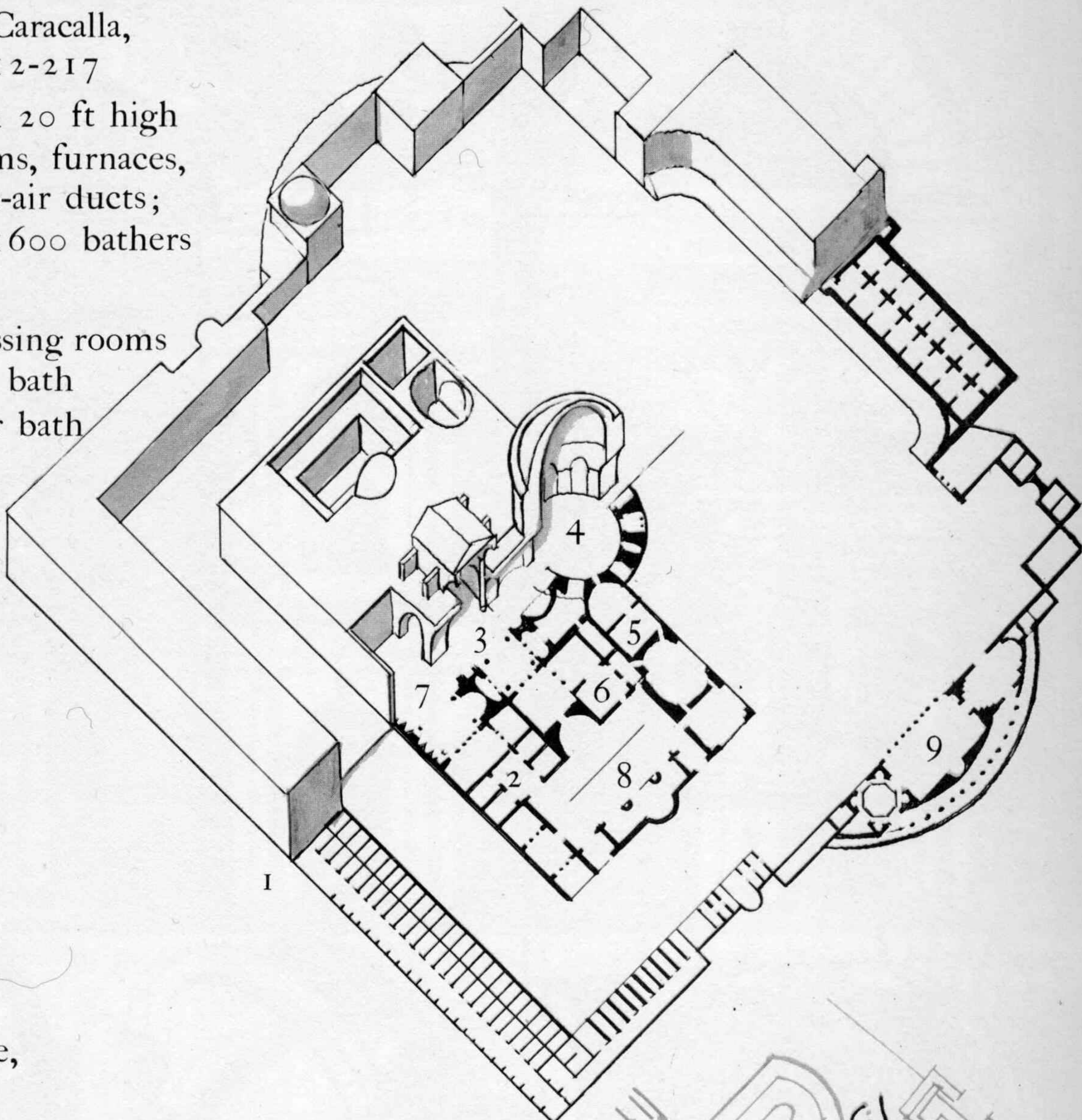
# BUILDINGS AND PLANS, ROME

Drawn to the same scale  500

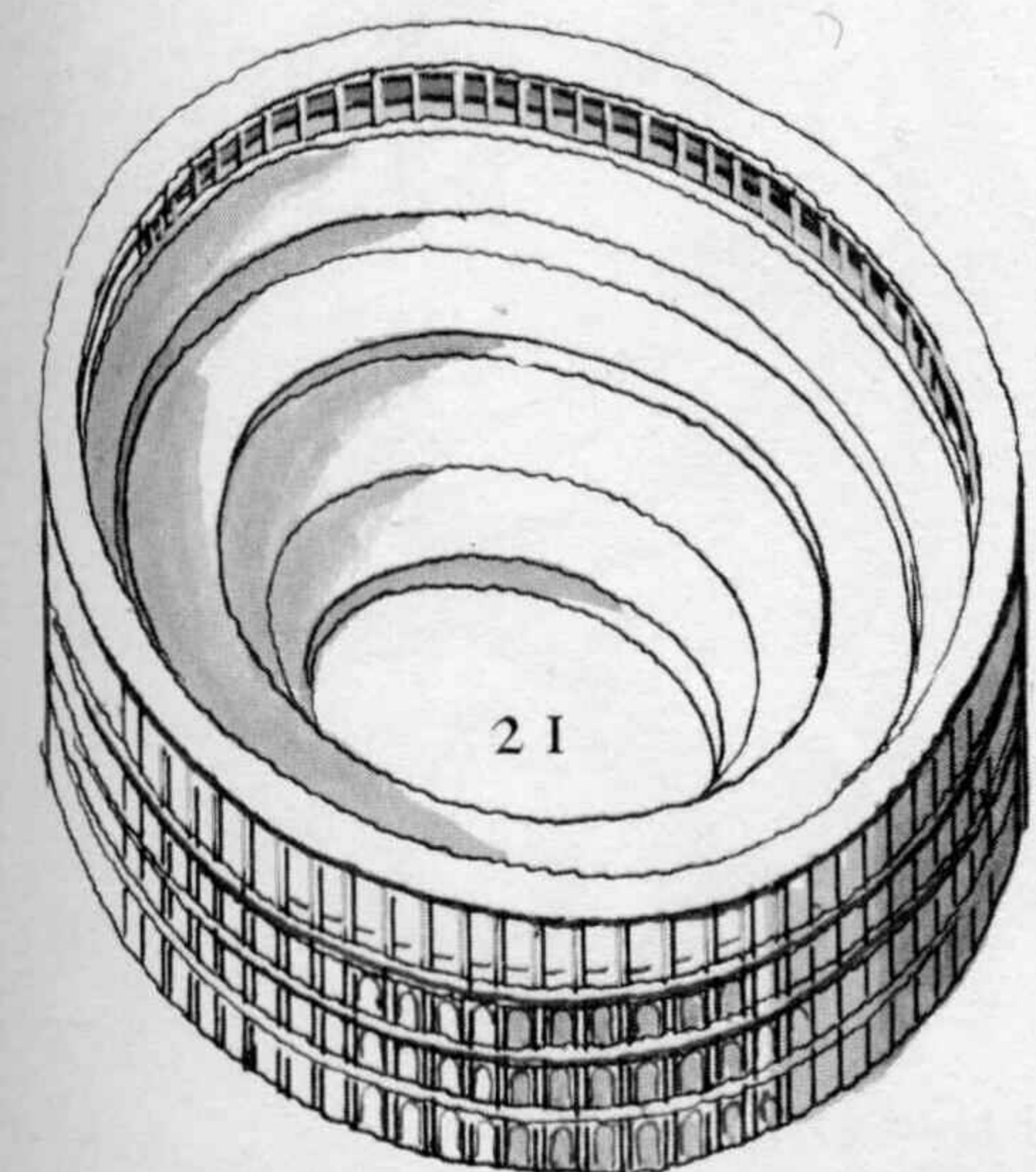
## The Thermae of Caracalla, Rome, c. A.D. 212-217

Stands on a platform 20 ft high containing store-rooms, furnaces, hypocausts and hot-air ducts; room for more than 1600 bathers

- 1 Main entrance
- 2 Apodyteria—undressing rooms
- 3 Tepidarium—tepid bath
- 4 Calidarium—hot-air bath
- 5 Warm baths
- 6 Hot baths
- 7 Frigidarium—open-air cold bath
- 8 Palaestra, peristyles
- 9 Lecture halls and libraries

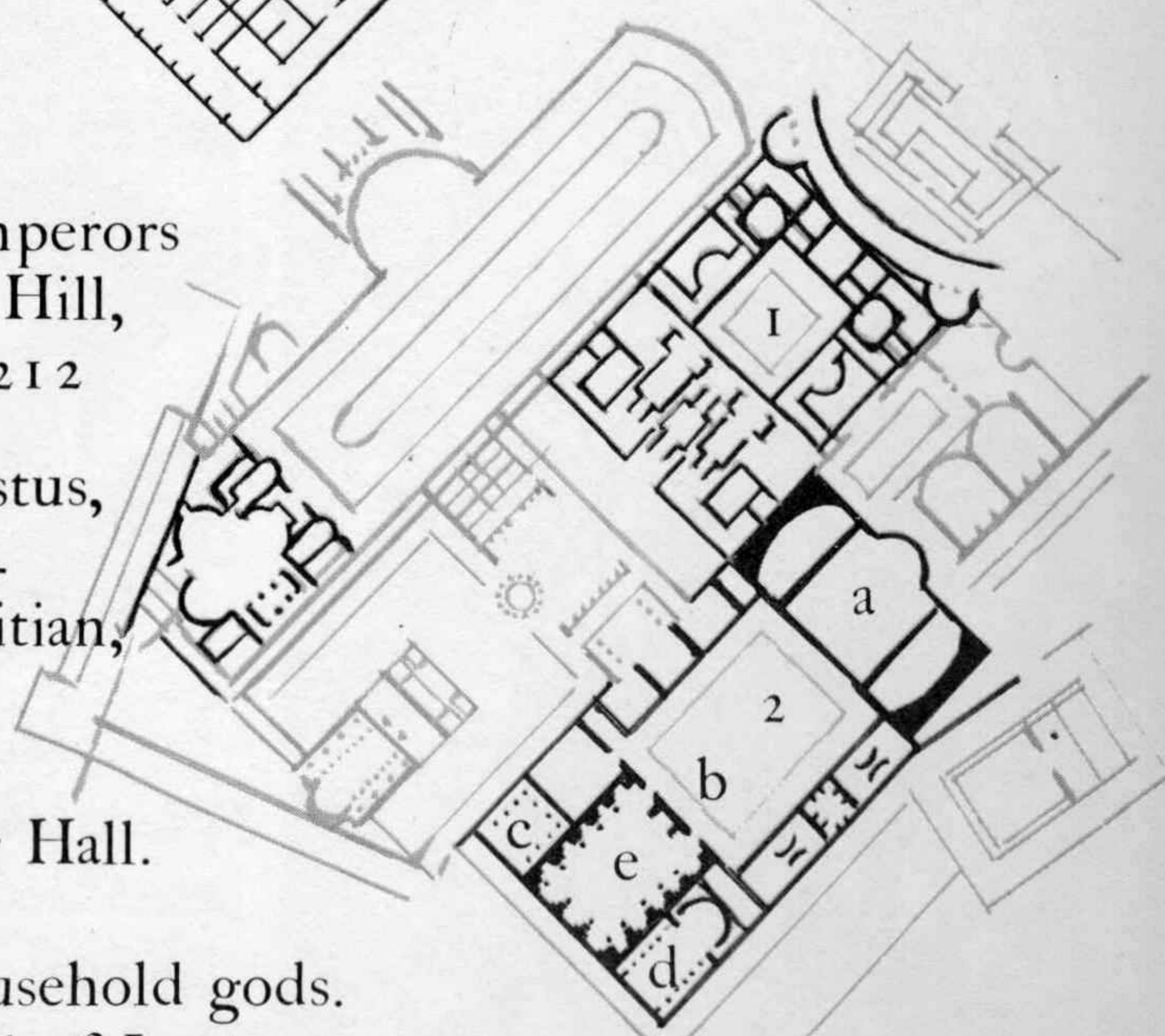


## The Pantheon, Rome, A.D. 120-124

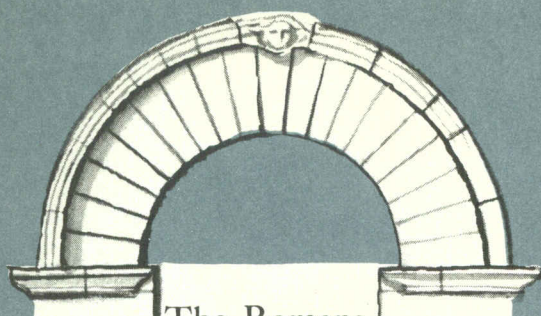


## Palaces of the Emperors on the Palatine Hill, Rome, A.D. 3-212

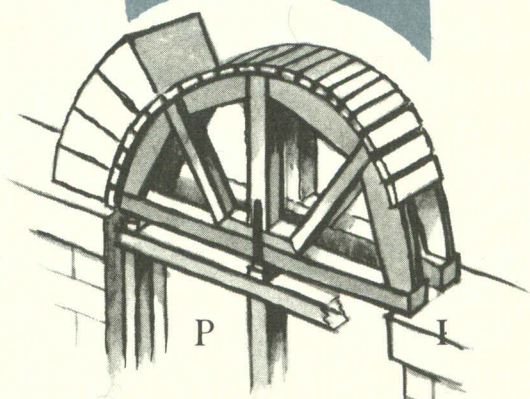
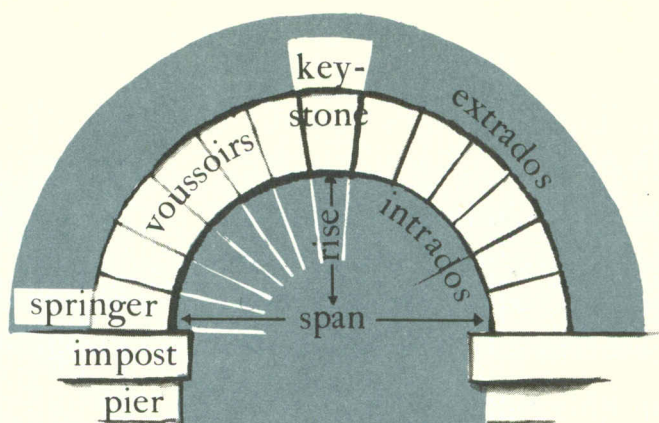
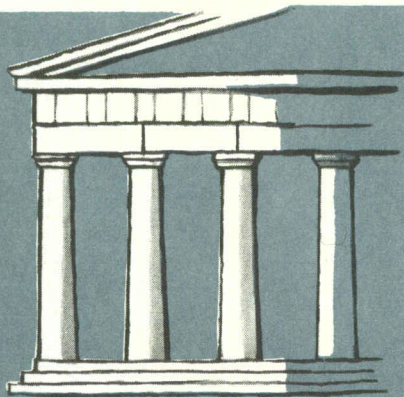
- 1 Palace of Augustus, 21 B.C.-A.D. 14
- 2 Palace of Domitian, A.D. 81-96
- a. Triclinium or Banqueting Hall.
- b. Peristyle.
- c. Temple of household gods.
- d. Basilica or Hall of Justice.
- e. Tablinum or Throne Room



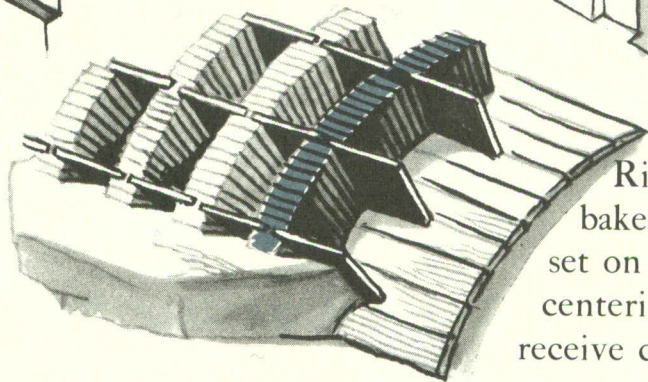
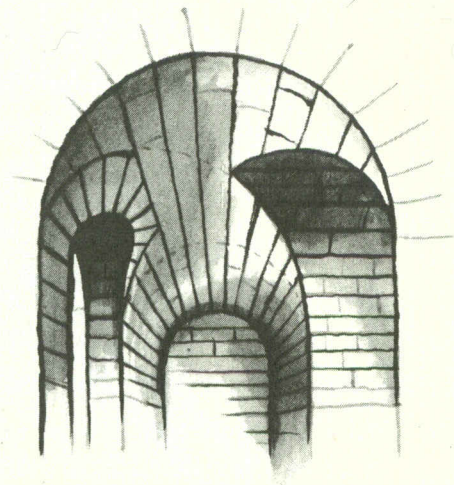
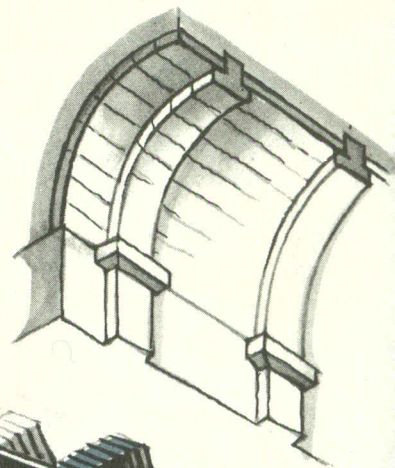
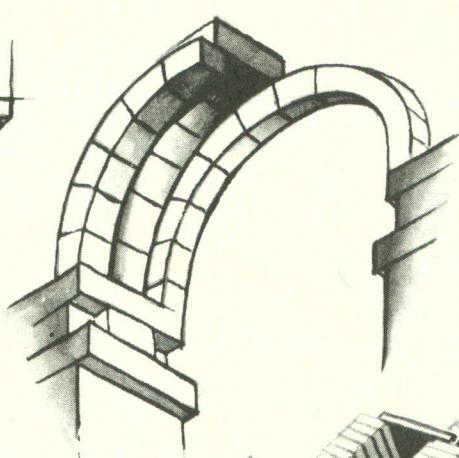
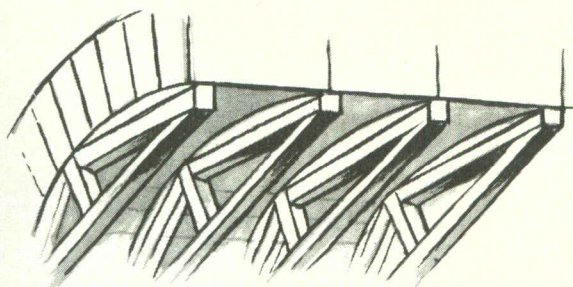
# ROMAN



The Romans developed the arch as a constructive principle and added the Greek column and entablature as decoration



Wooden centering supported on piles P or on the impost I

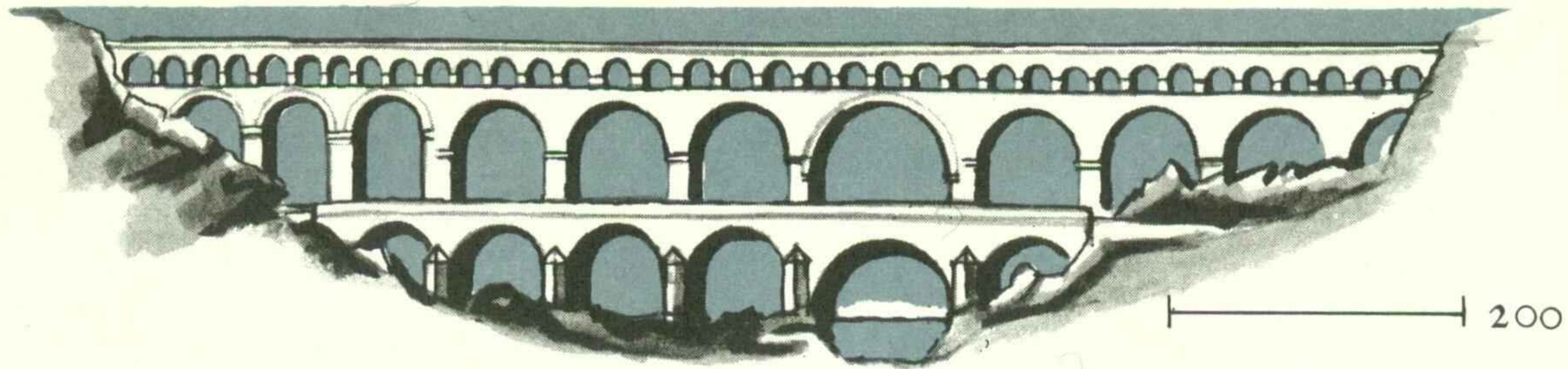


Ribs of baked brick set on wooden centering to receive concrete

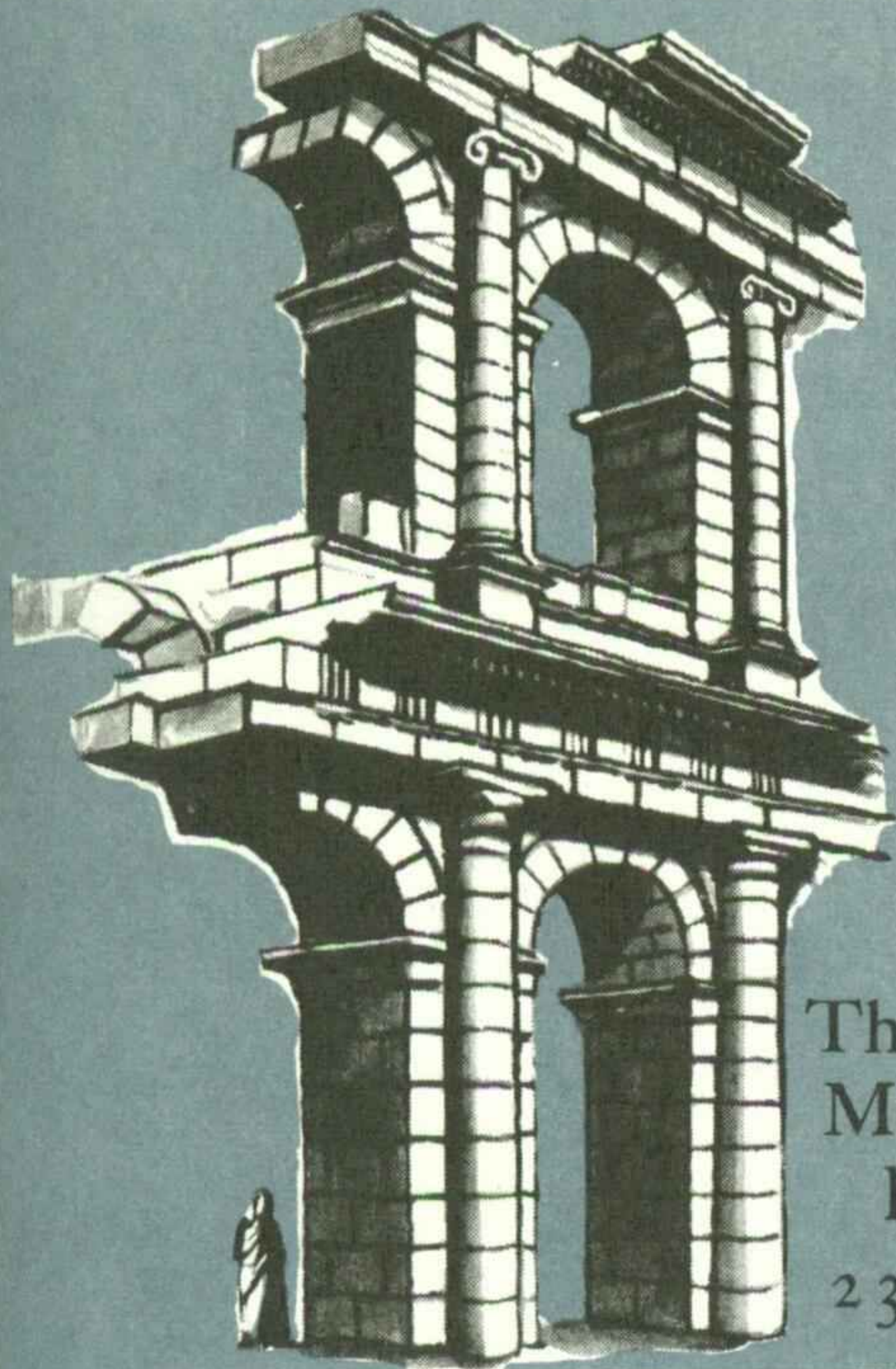
Methods of constructing stone and concrete vaults



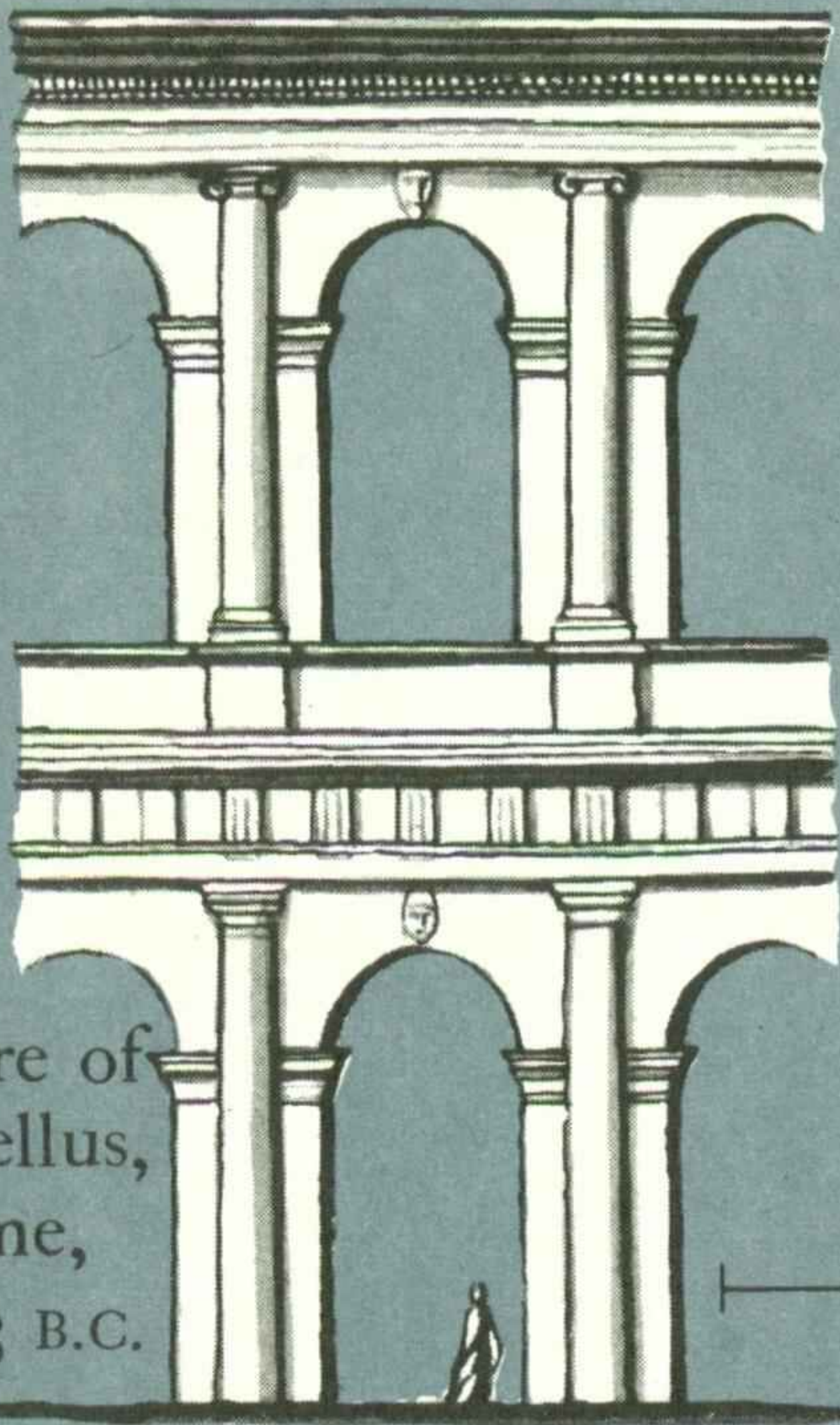
# THE ARCH



Arches supported on piers: Aqueduct, Pont du Gard, Nîmes, c.A.D. 150



Theatre of Marcellus, Rome, 23-13 B.C.

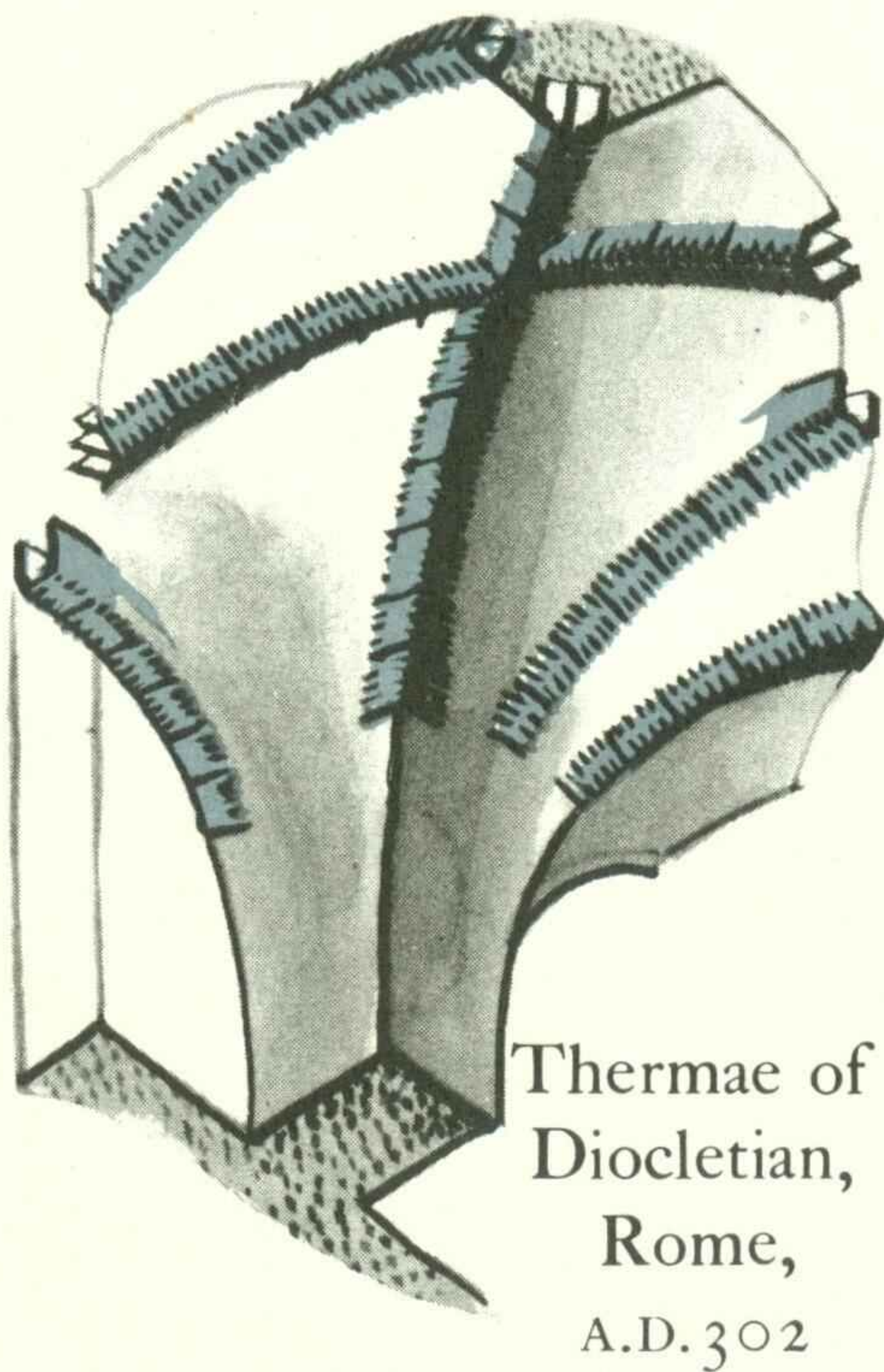


Theatre, Arles, 1st-3rd cent. A.D.

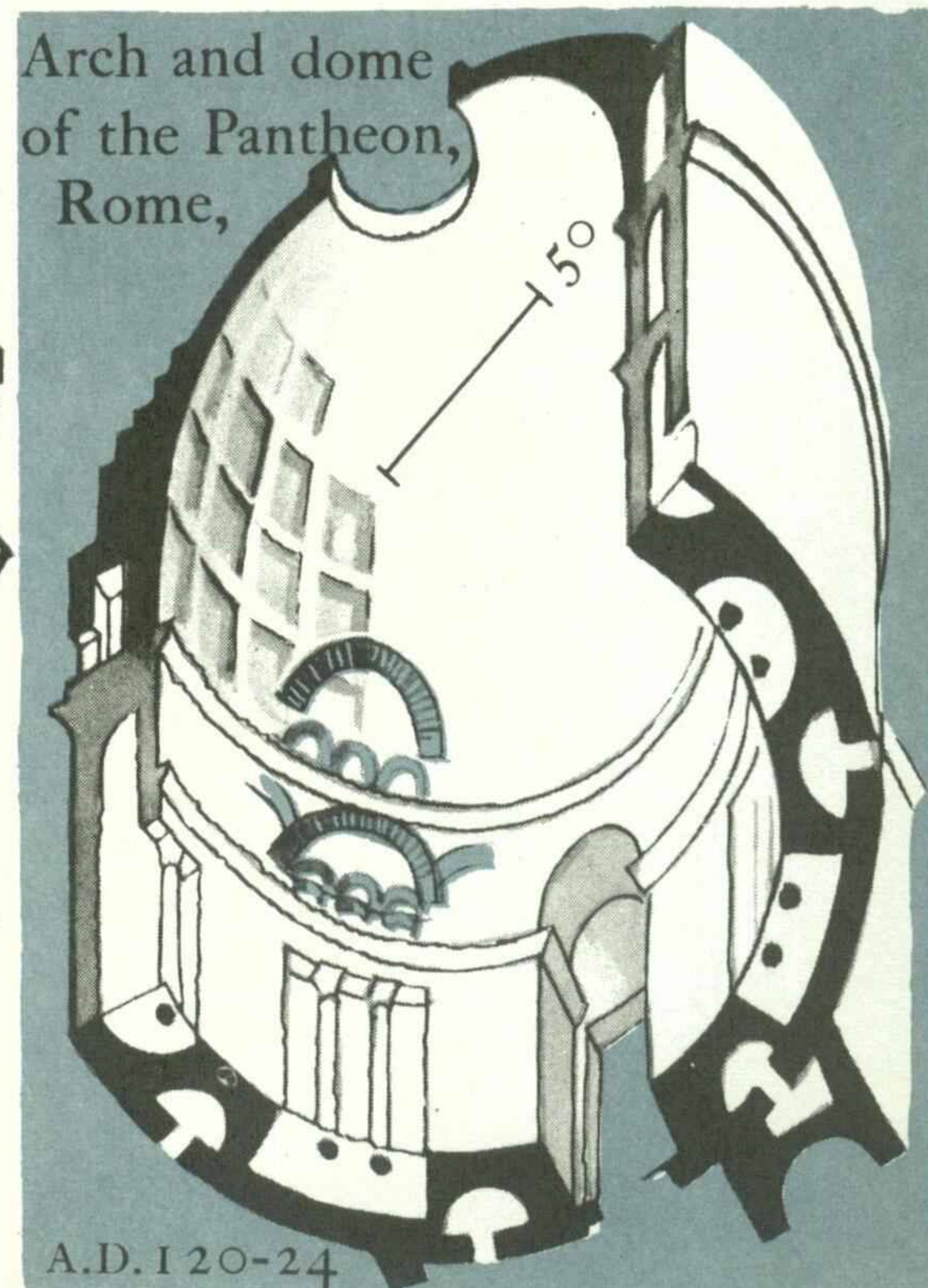
Construction of arches on piers with non-constructural facing of columns and entablature



The Basilica of Constantine, Rome, A.D. 310-13



Thermae of Diocletian, Rome, A.D. 302



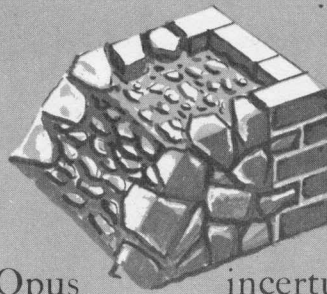
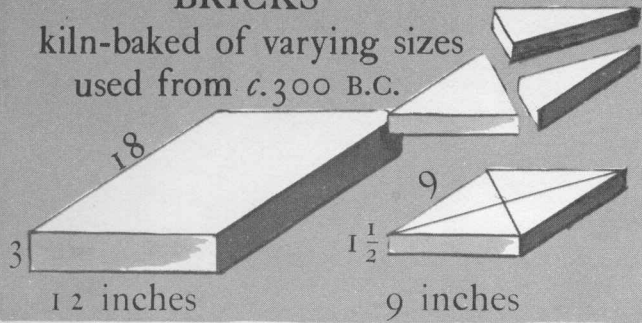
Arch and dome of the Pantheon, Rome, A.D. 120-24

Brick ribs in concrete cross-vaults

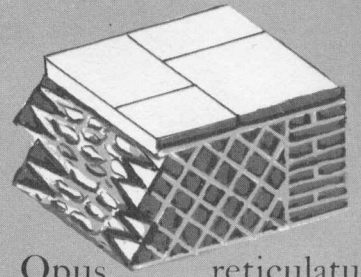
# ROMAN

## BRICKS

kiln-baked of varying sizes  
used from c. 300 B.C.



Opus incertum  
from c. 200 B.C.

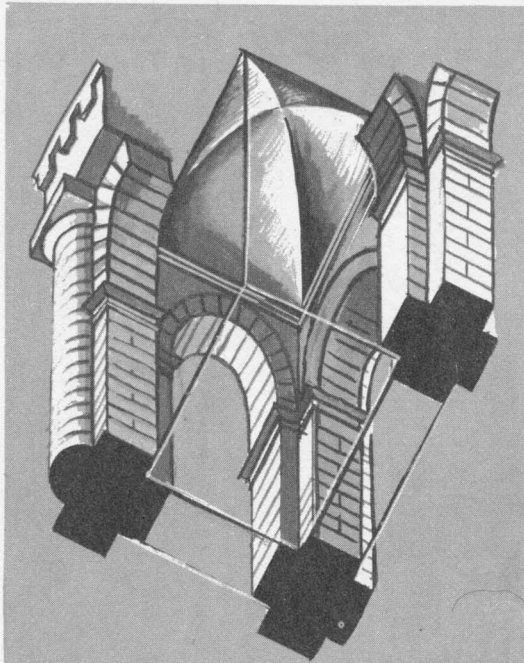


Opus reticulatum  
Concrete walls faced

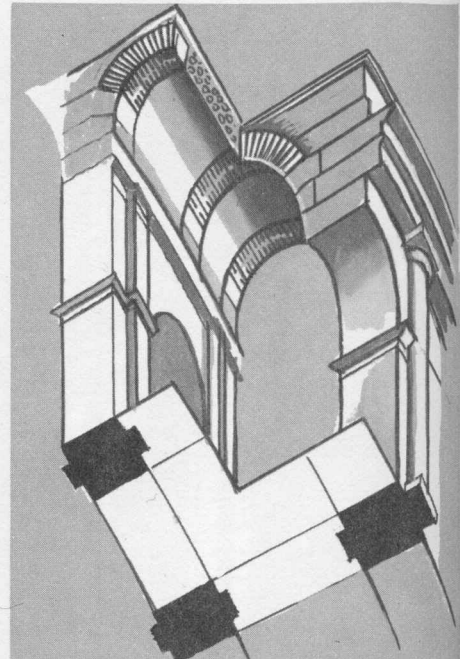
## CONCRETE

used by the Romans from the 2nd century B.C., consisting of sand, gravel, pebbles, chippings of stone, mixed with a cement of lime and water and spread over a temporary wooden or permanent brick centering, to solidify into the required shape—arch, vault or dome. The dead weight rested upon supporting walls or piers without exerting an outward thrust. Pozzolana, a volcanic rock found near Rome, made a concrete of great hardness and durability.

Concrete surfaces were faced with stucco, brick or marble for protection and finish.

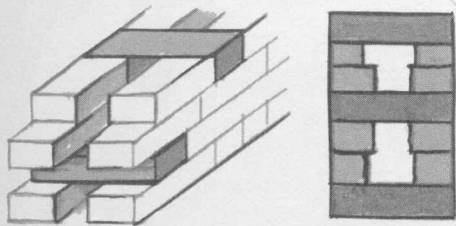


Cloister vault of concrete supported on cruciform piers  
Tabularium, Rome, 78 B.C.

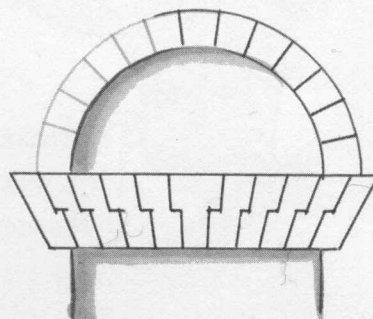
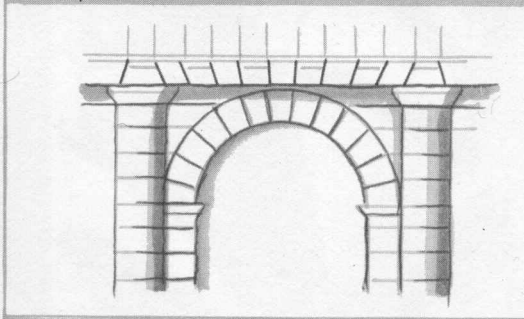


Concrete barrel vault  
The Colosseum, Rome,  
A.D. 70-82

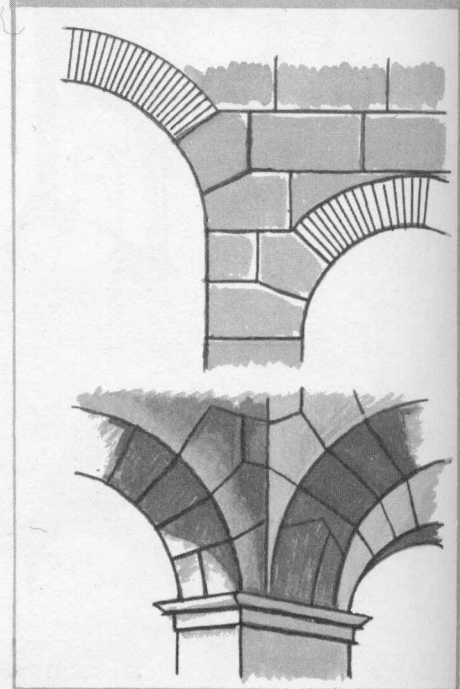
## MASONRY



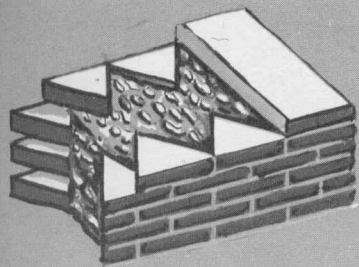
The Romans copied the Greek technique, building courses of dressed blocks, held by through stones laid dry without mortar or with iron cramps and dowels set in molten lead. The space between the courses was left empty or filled with undressed stones, earth or concrete.



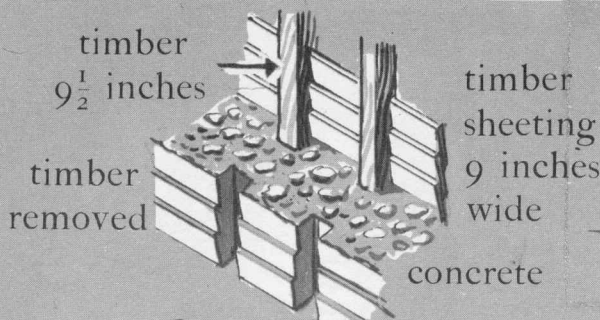
Flat arch : Orange



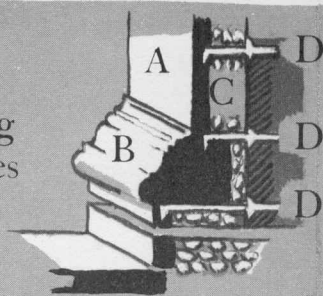
# MATERIALS & METHODS



Opus testaceum  
with brick from c.78 B.C.

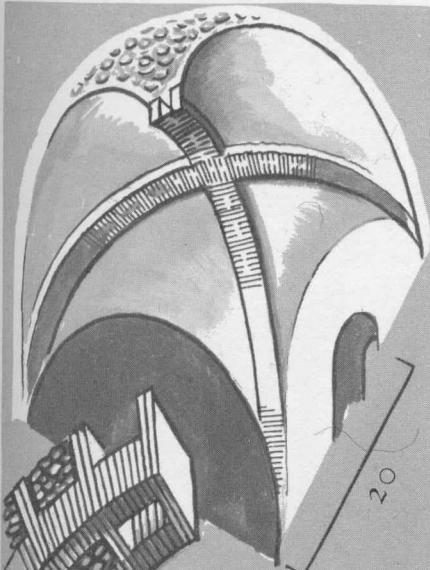


Cast concrete wall

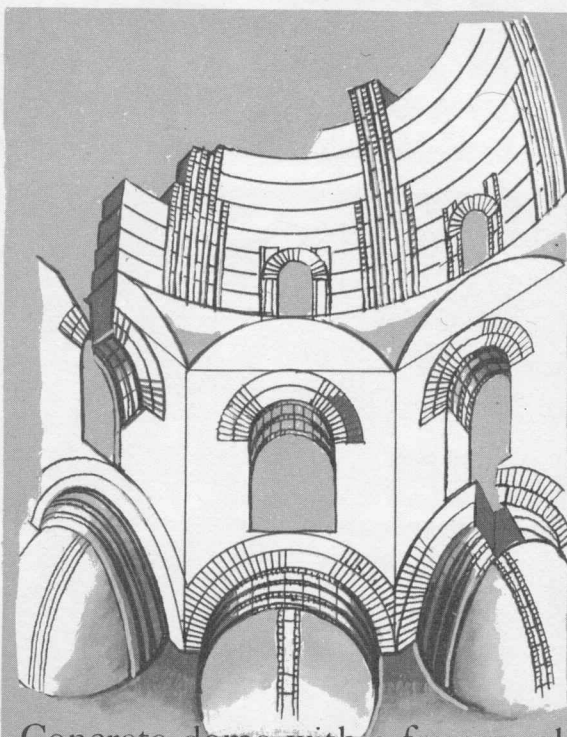


A marble slab  
B plinth  
C cement  
D iron clamps

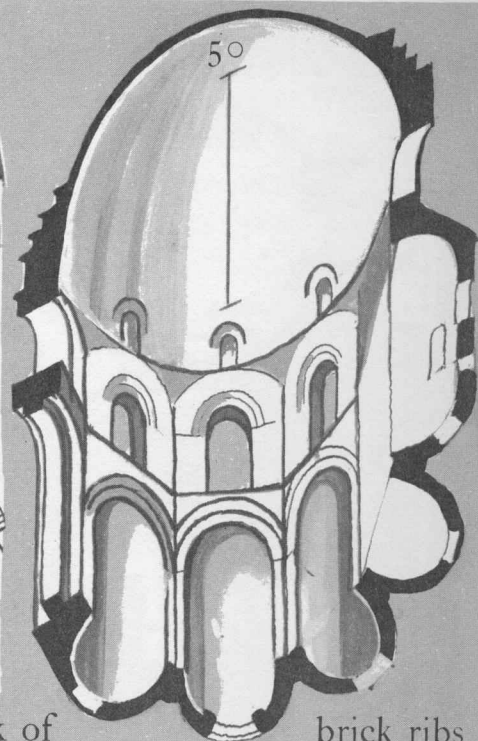
Method of fixing marble facing



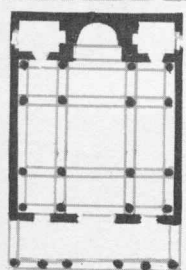
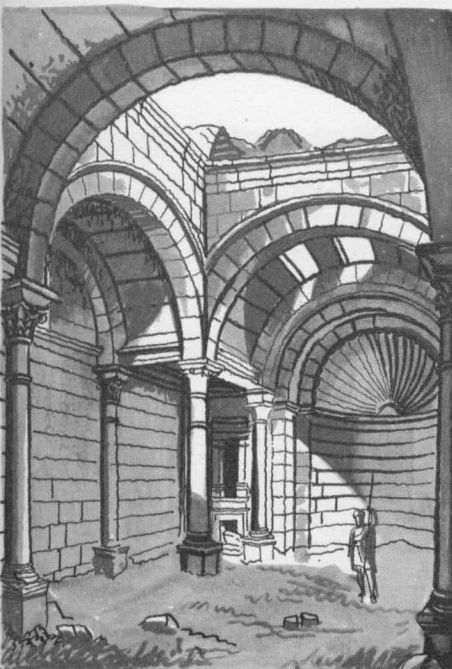
Cross-vault  
built of brick ribs  
and filled in with concrete  
Villa Sette Bassi, near  
Rome, c. A.D. 123-134



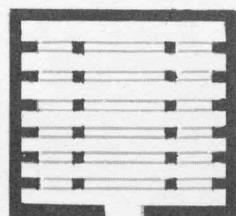
Concrete dome with a framework of  
brick ribs  
Temple of Minerva Medica, Rome, c. A.D. 260



brick ribs



The  
Pretorium,  
Musmiyeh,  
c. A.D. 180



65

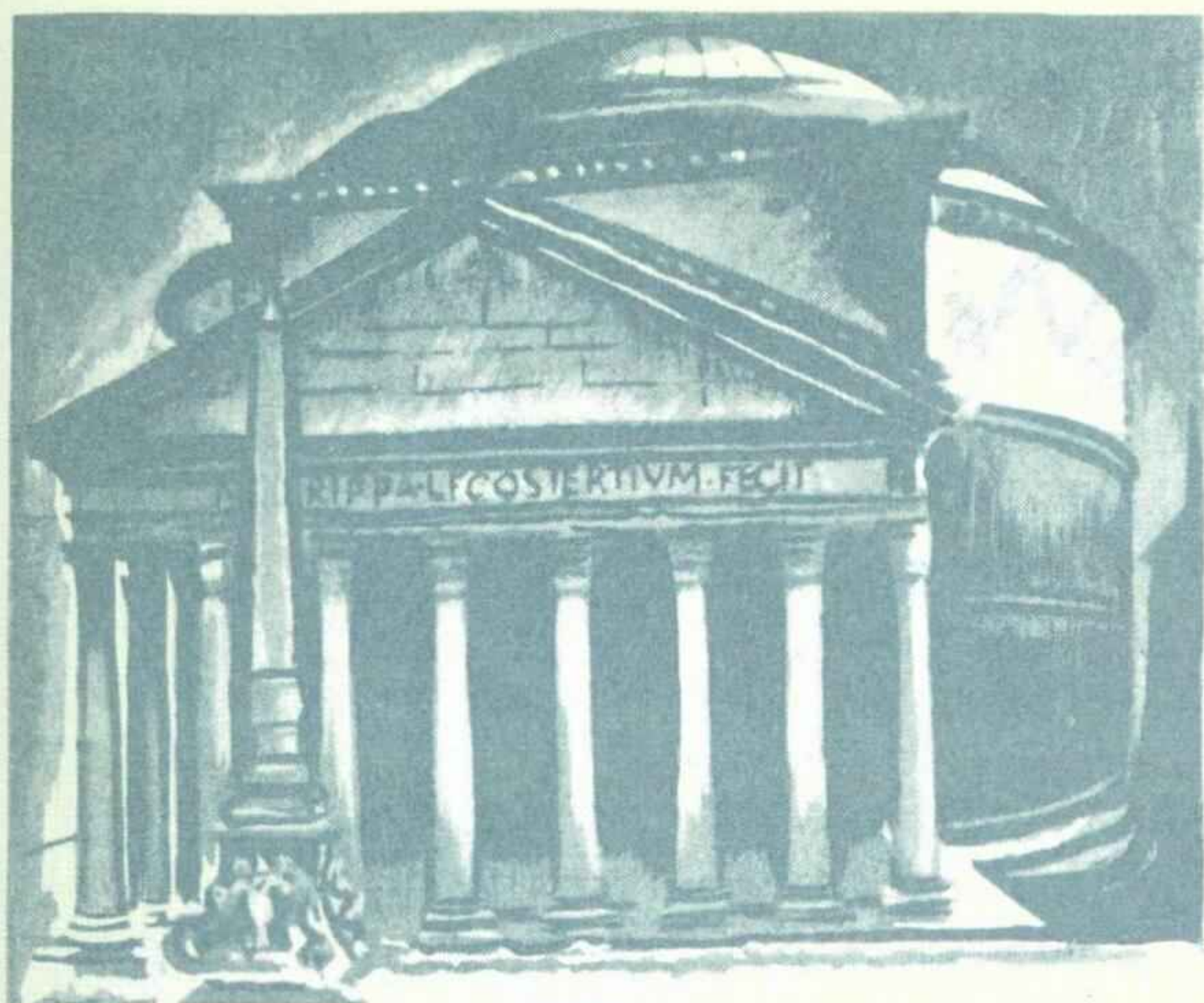
The Basilica,  
Shakka,  
c. A.D. 175-200

Syria:

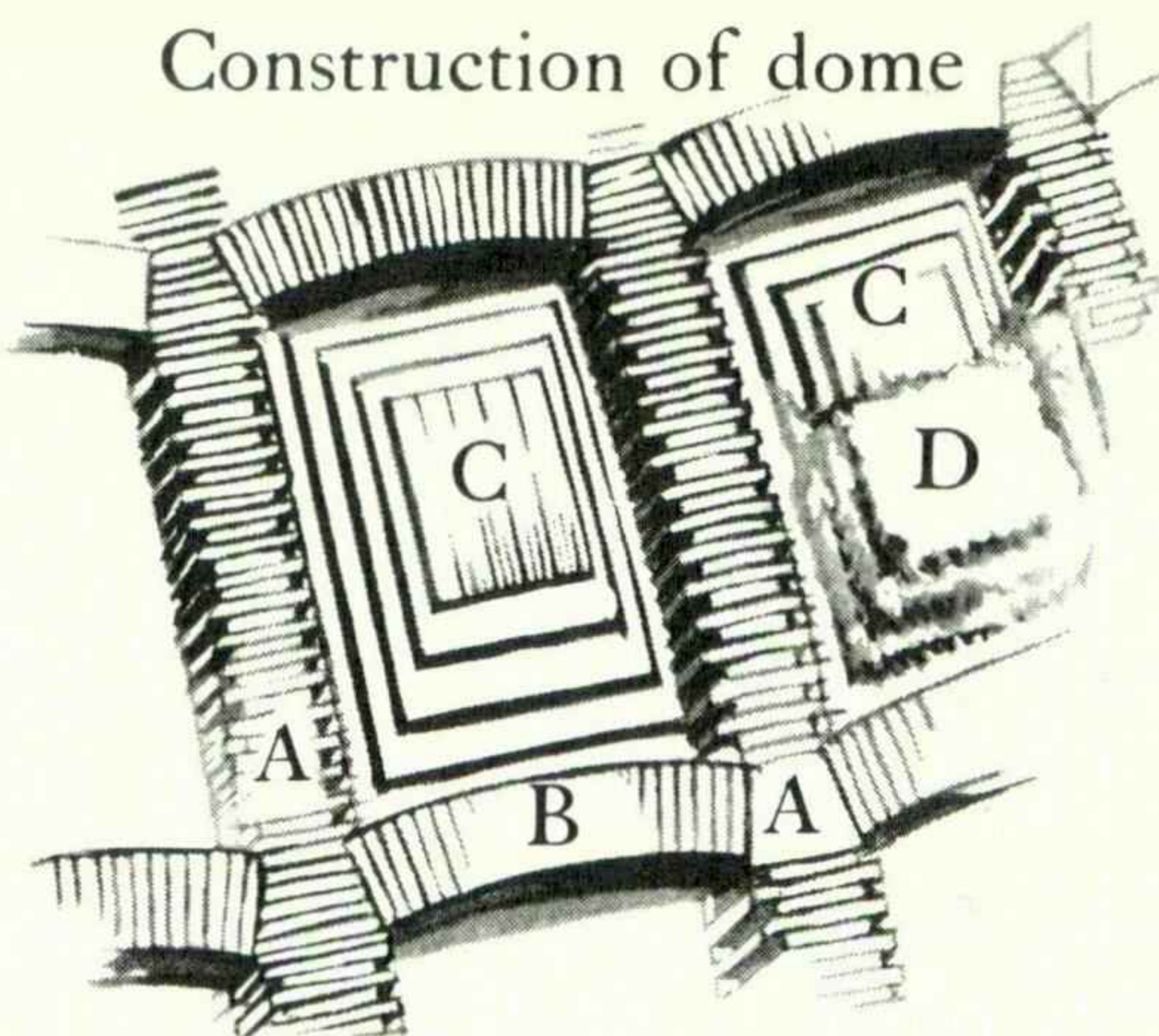
buildings of dressed stone  
continued in the period of  
Early Christian architecture in  
the 5th to 7th centuries



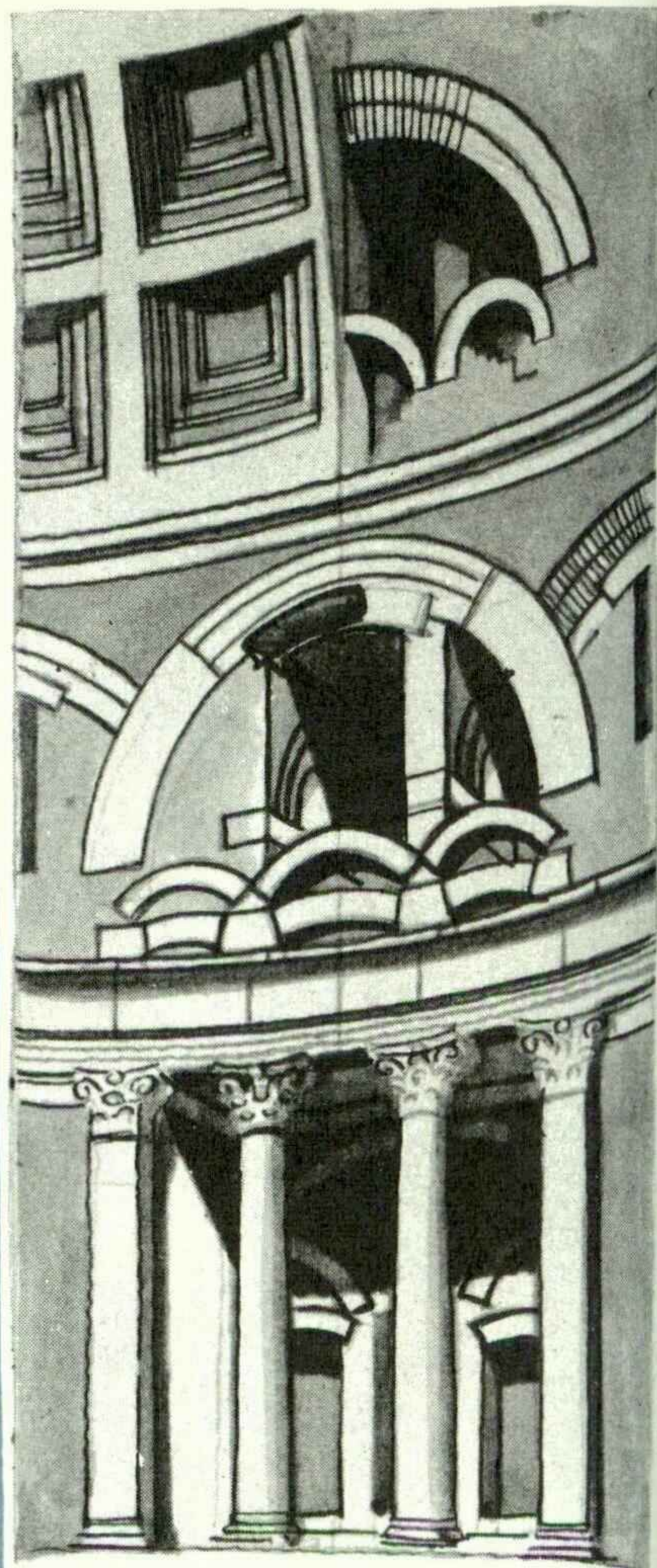
# ROMAN



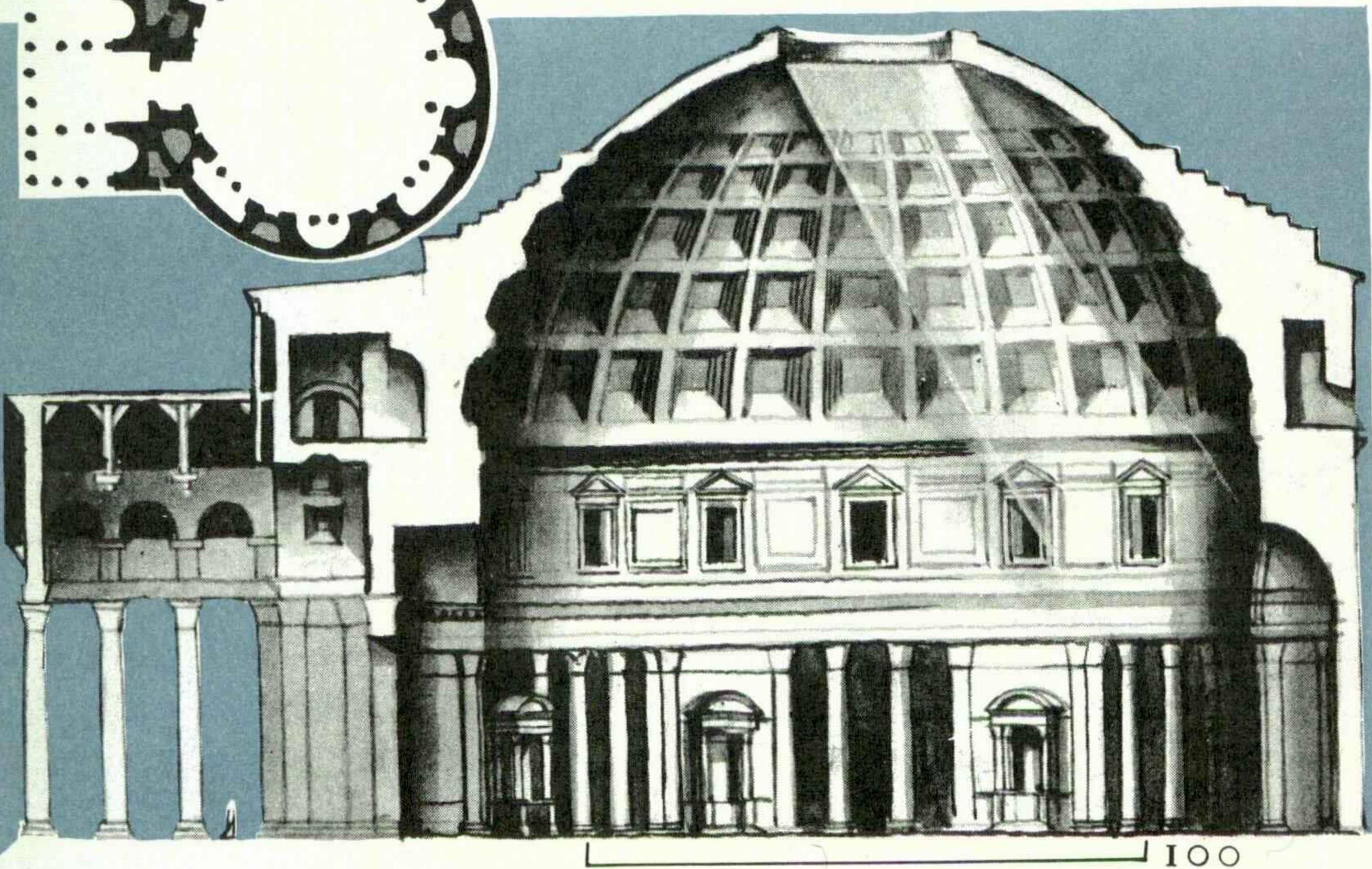
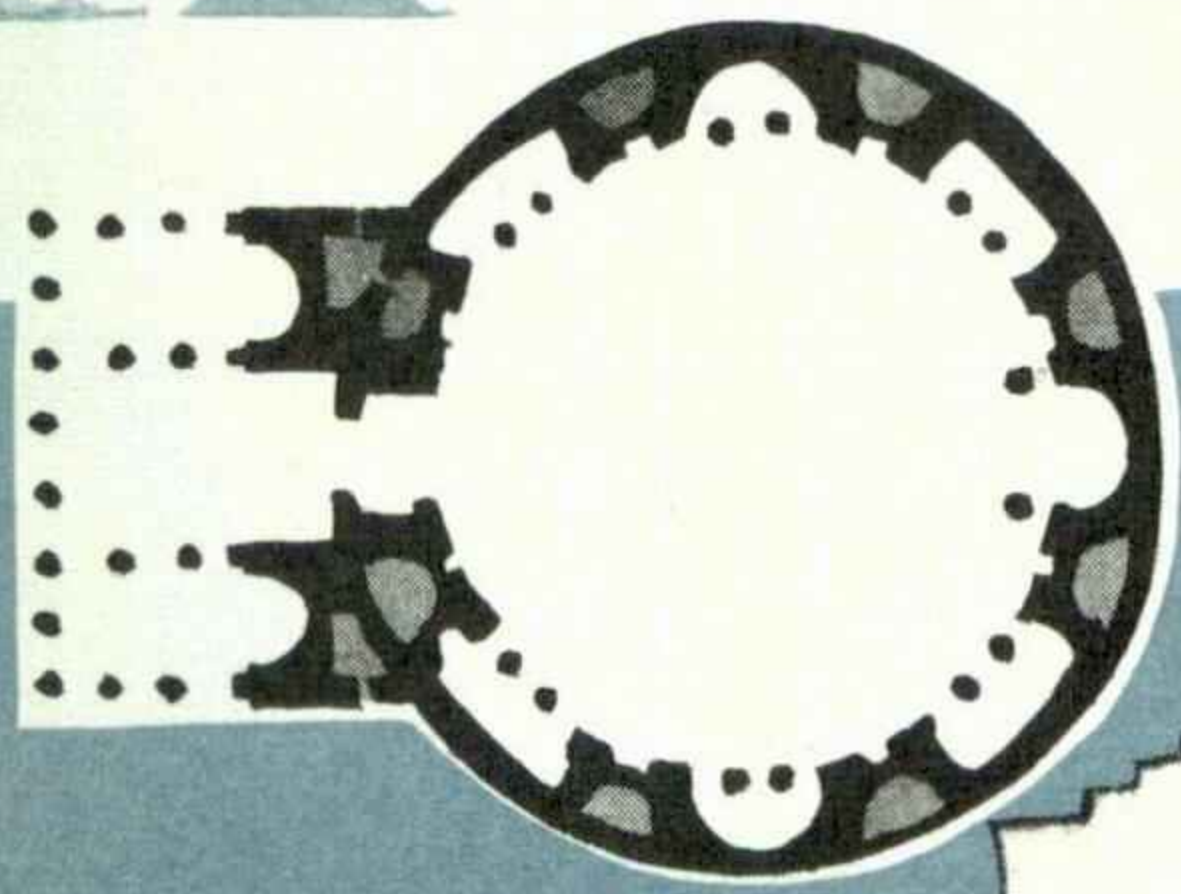
Construction of dome



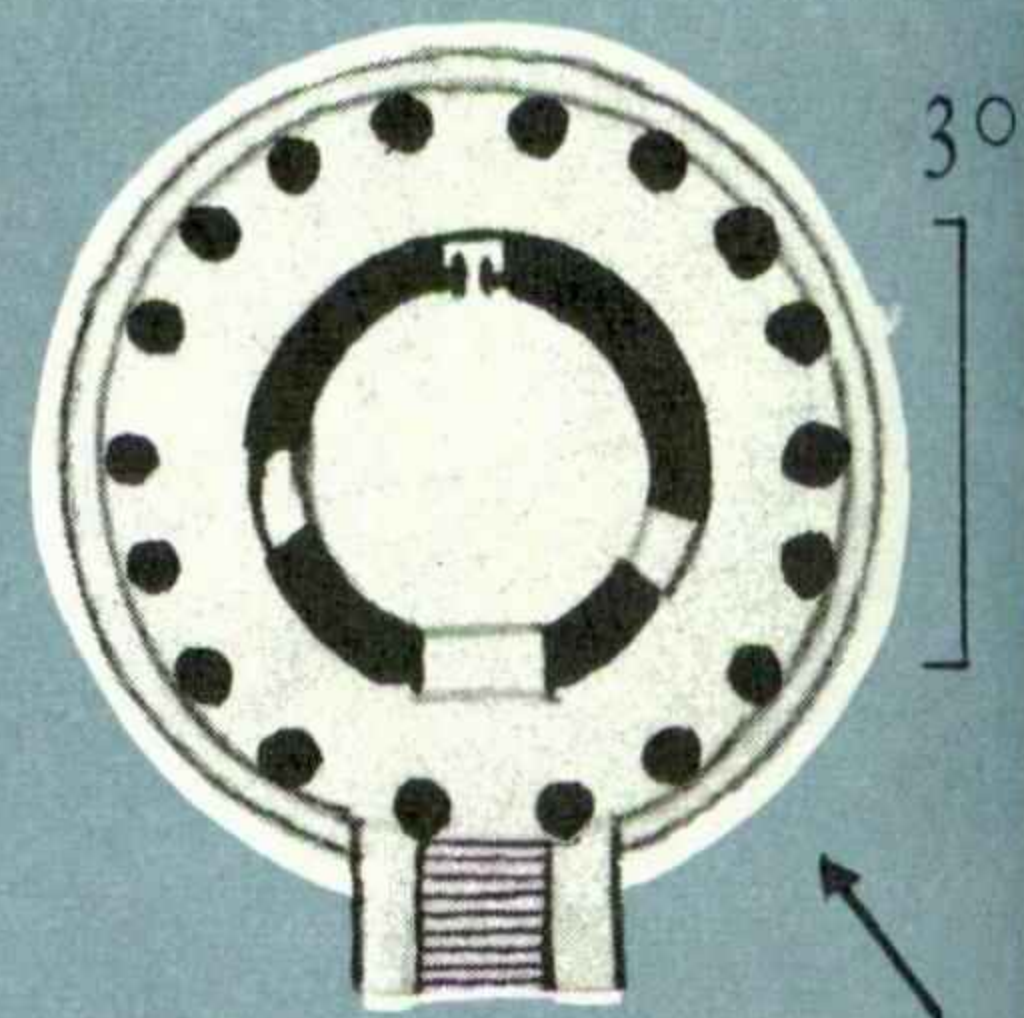
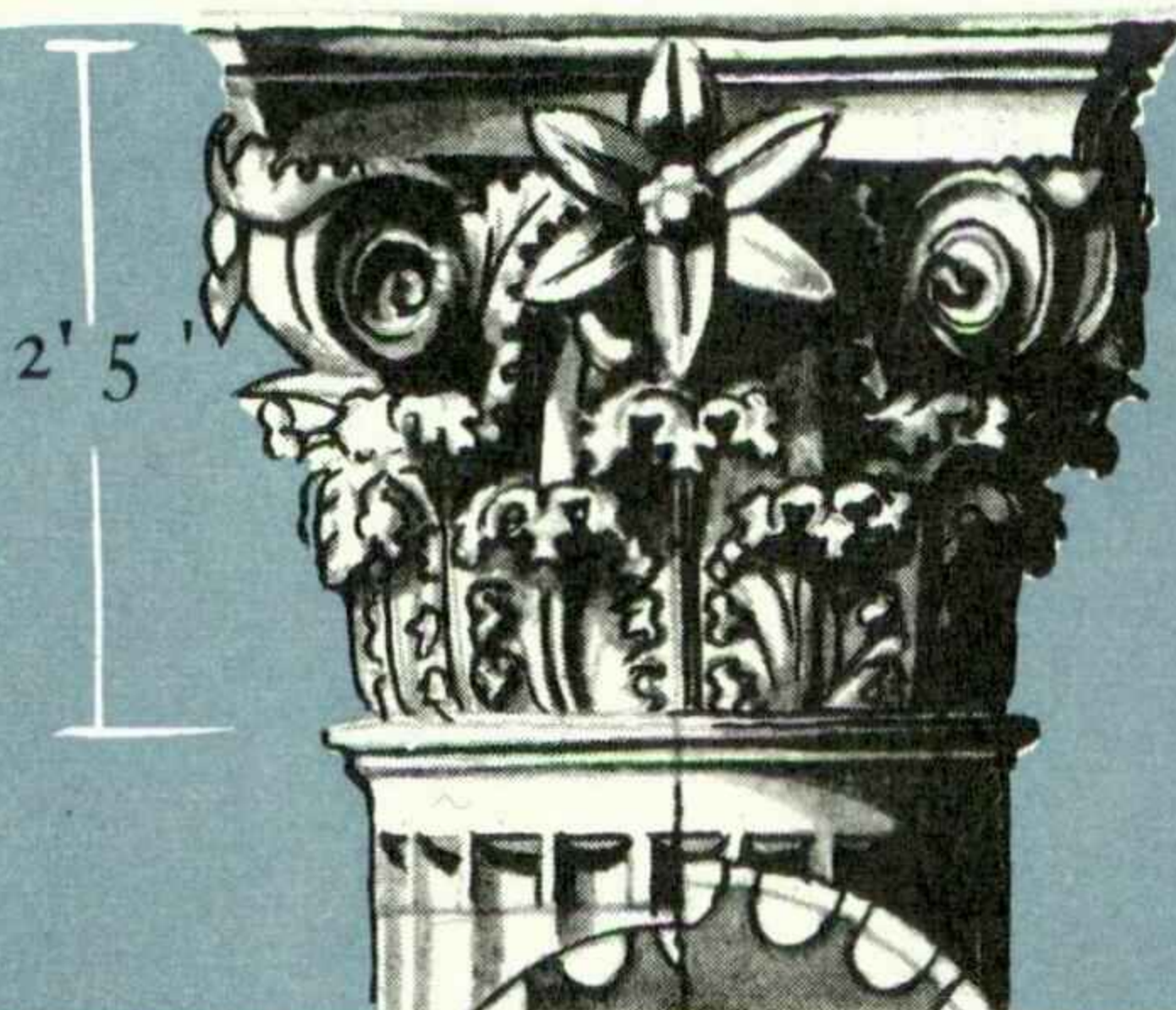
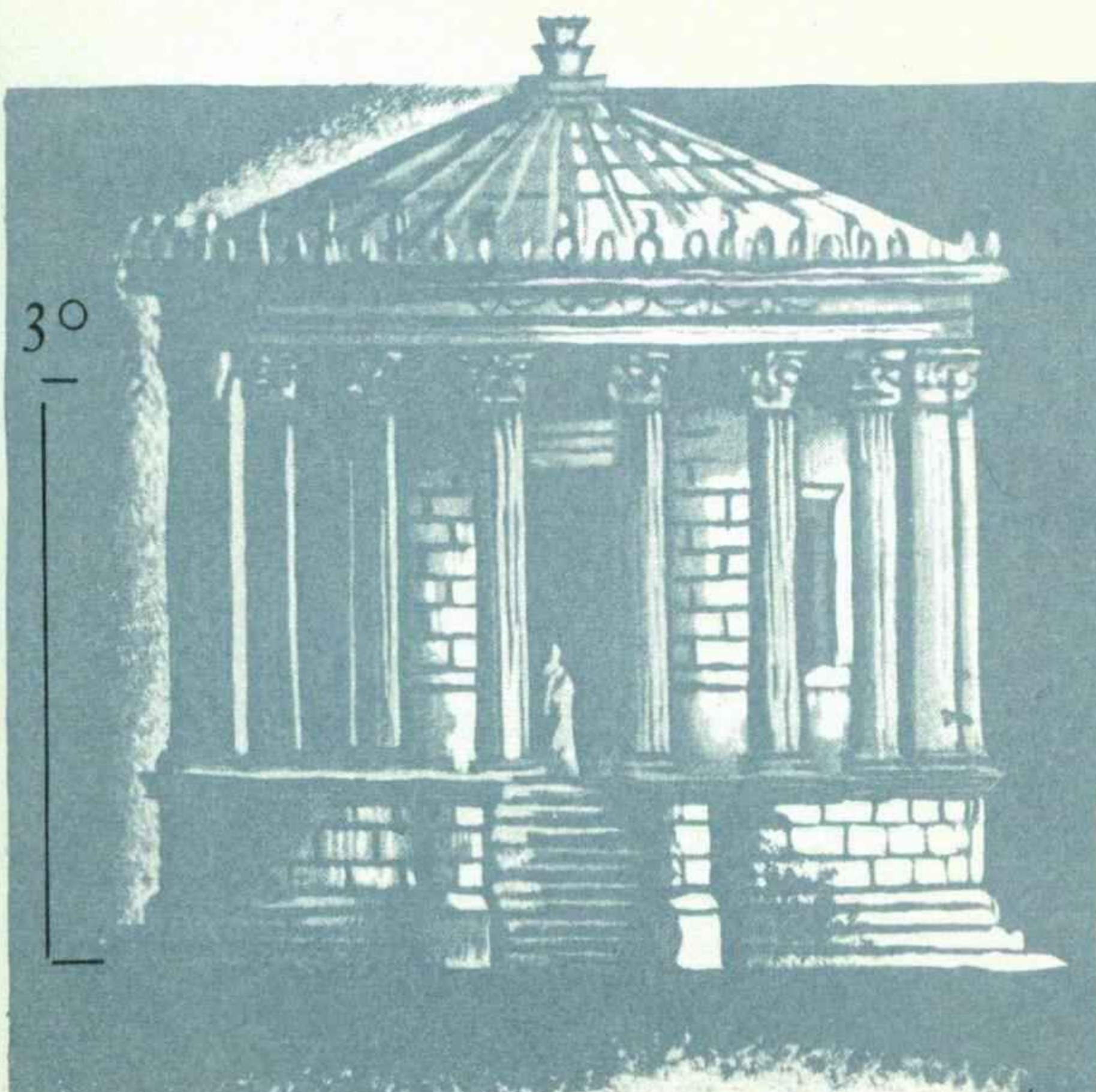
A Brick ribs B Brick Arches  
C Wooden moulds D Concrete



Concealed brick arches link together 8 massive brick piers supporting the dome

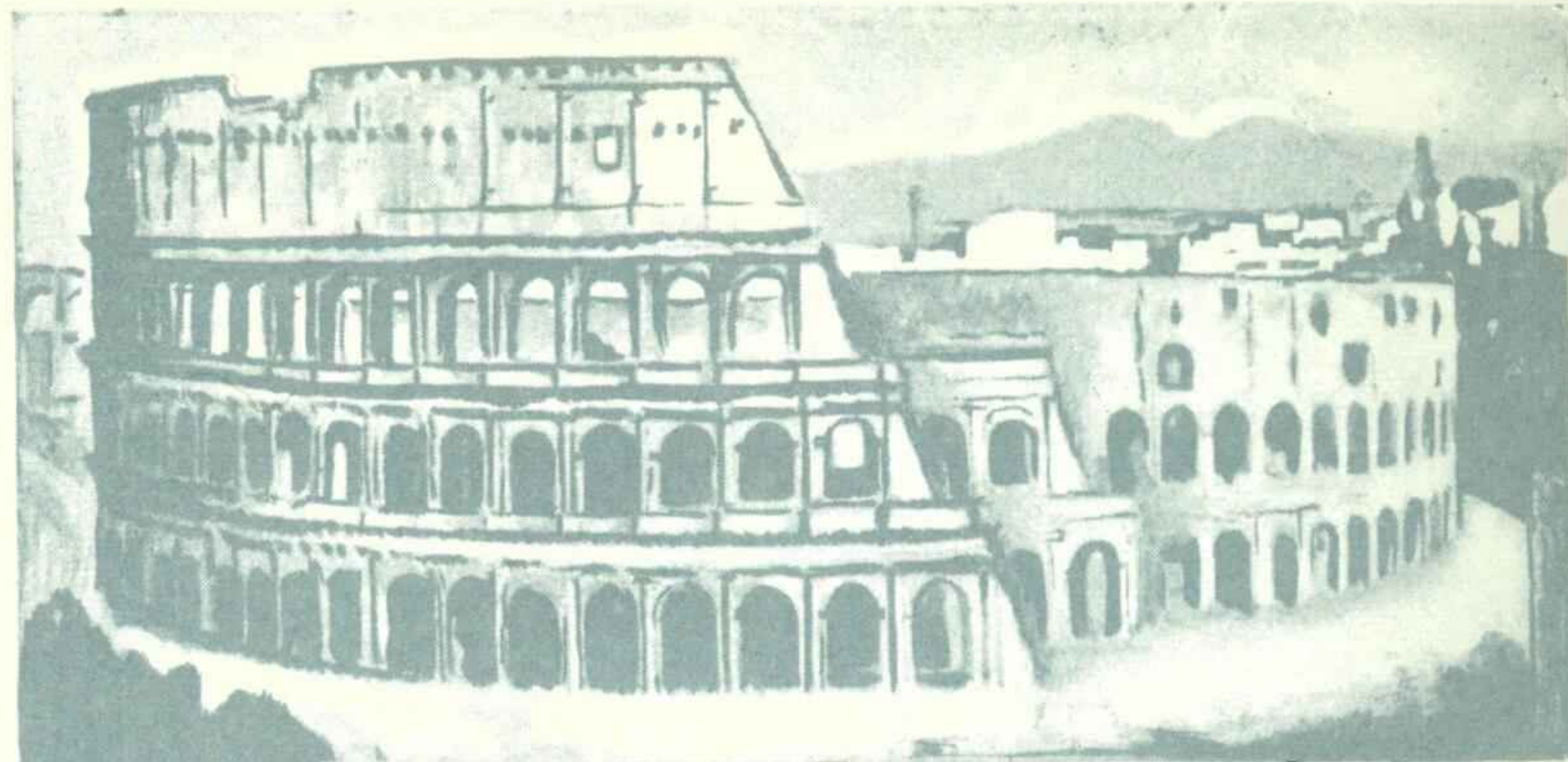
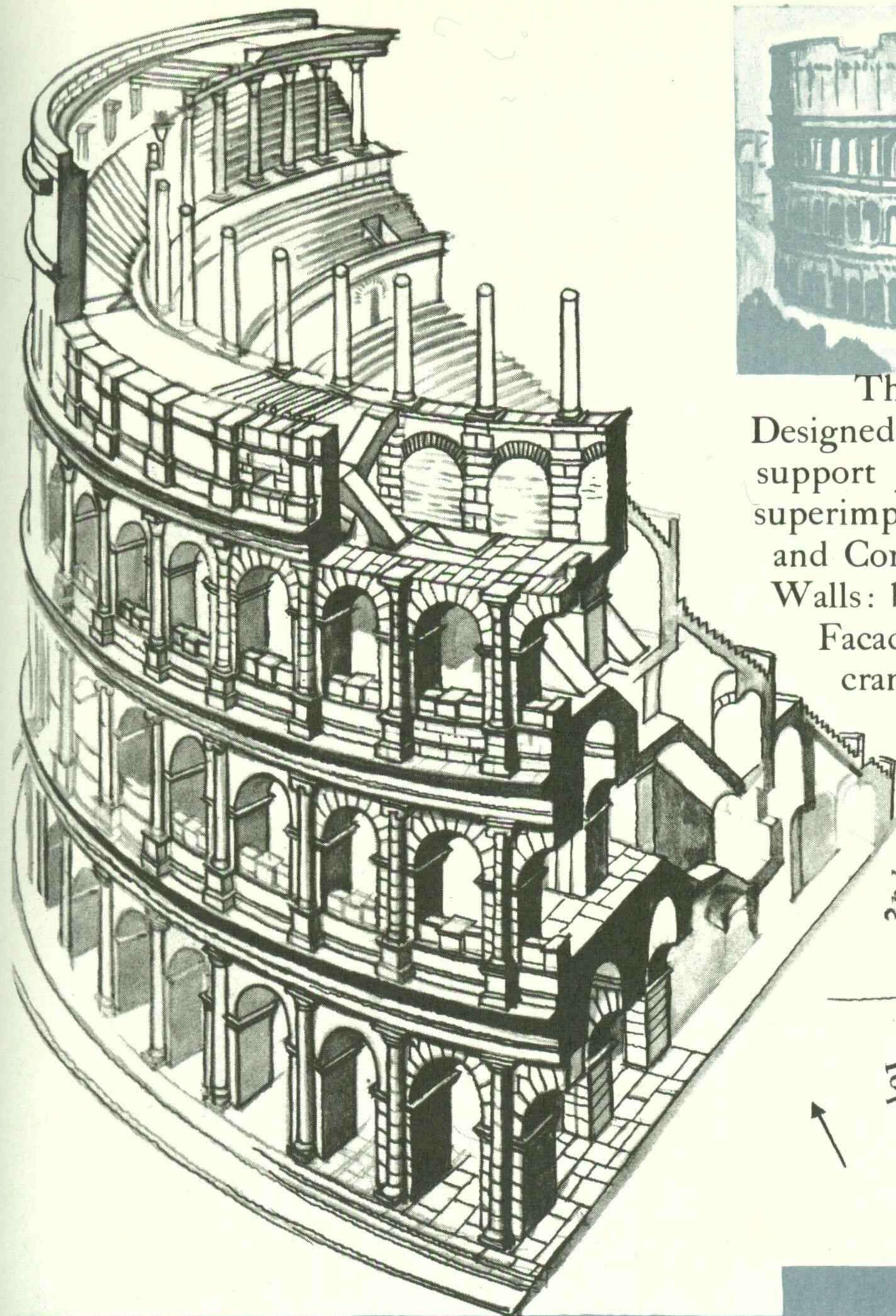


The Pantheon, Rome, A.D. 120-24. Erected by Hadrian

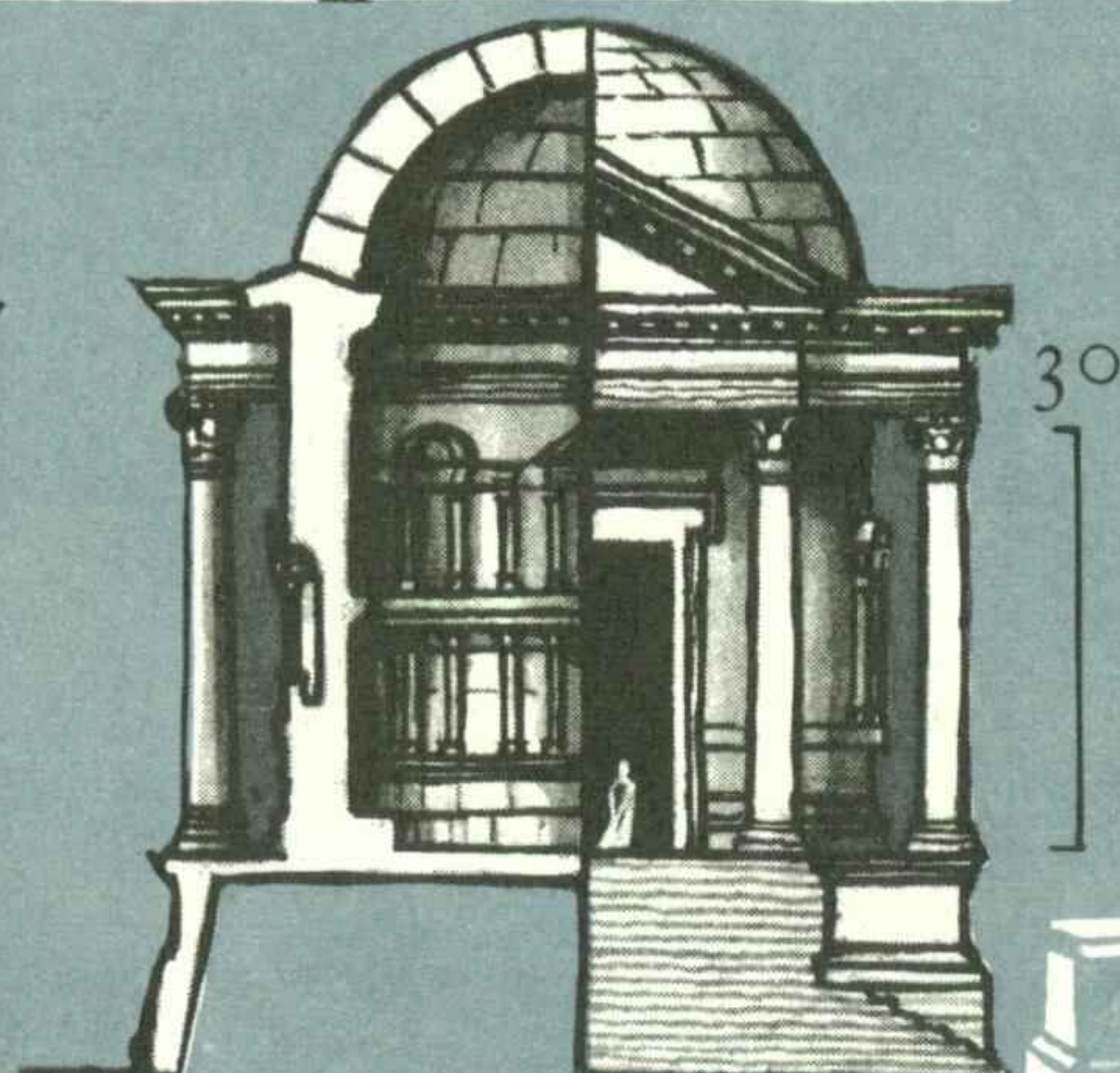
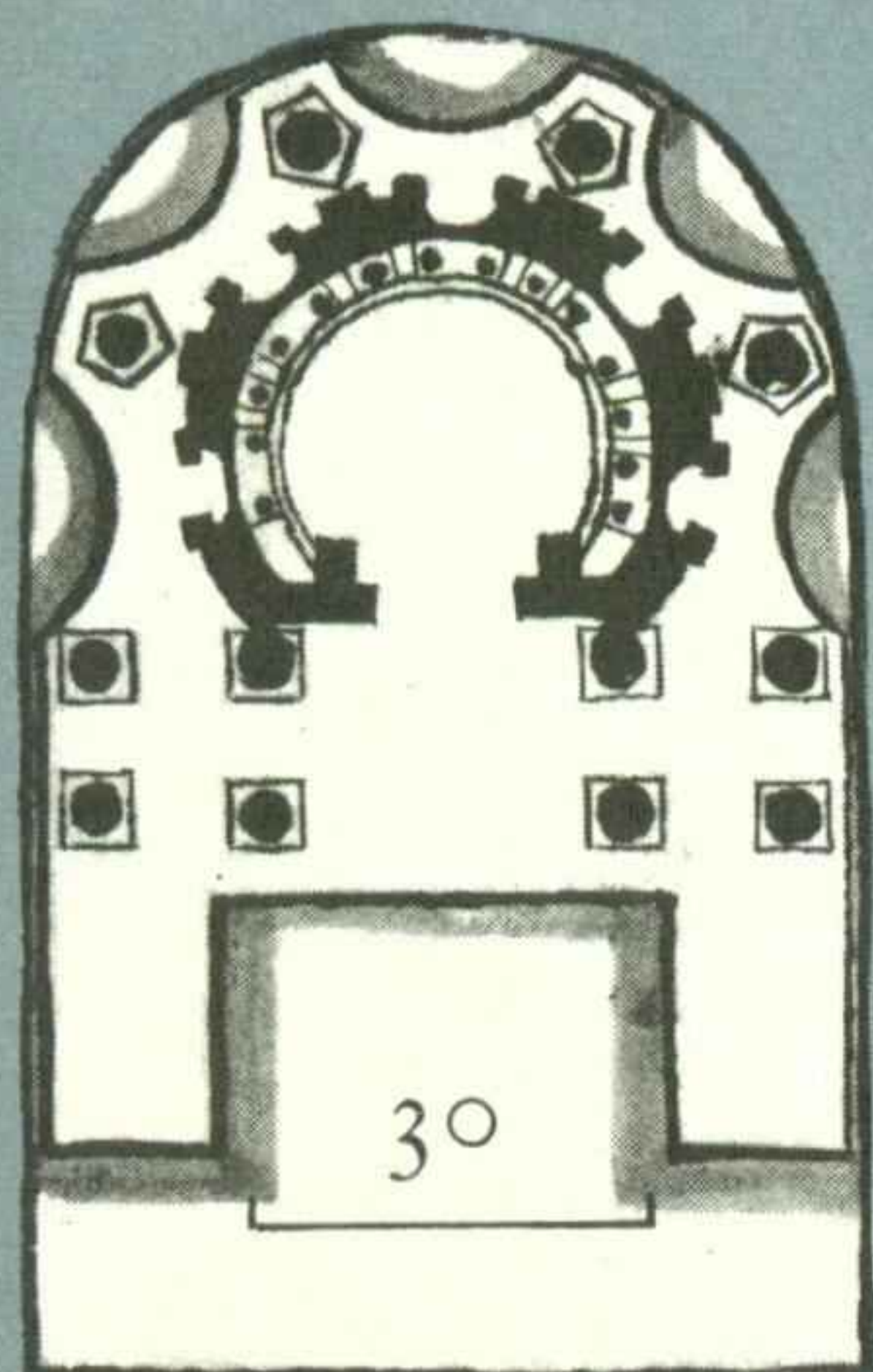
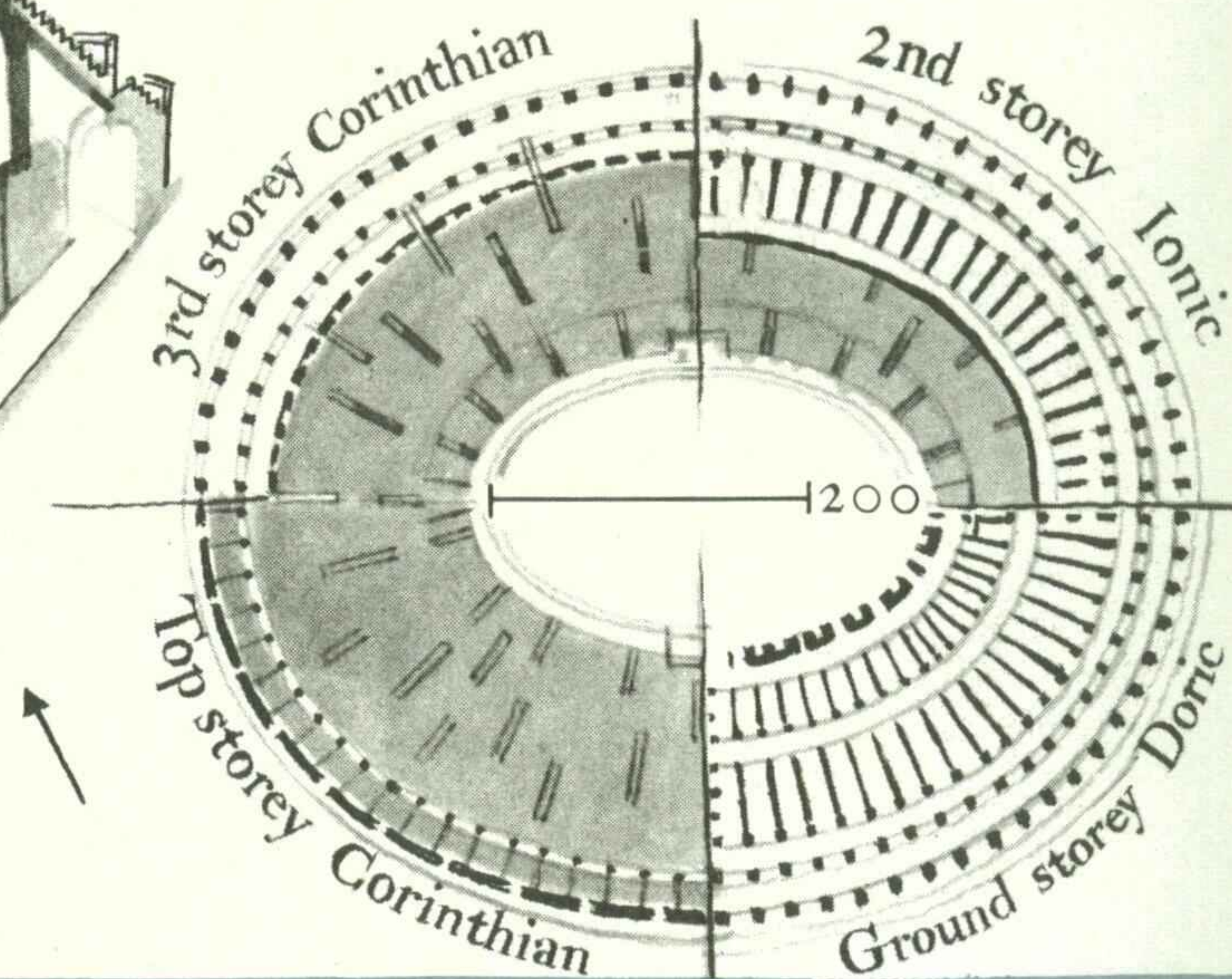


The Temple of Vesta, Tivoli (restored), 27 B.C.-A.D. 14  
Foundations: tufa. Podium and walls: concrete.  
Columns and door: travertine. Roof: probably a low concrete dome

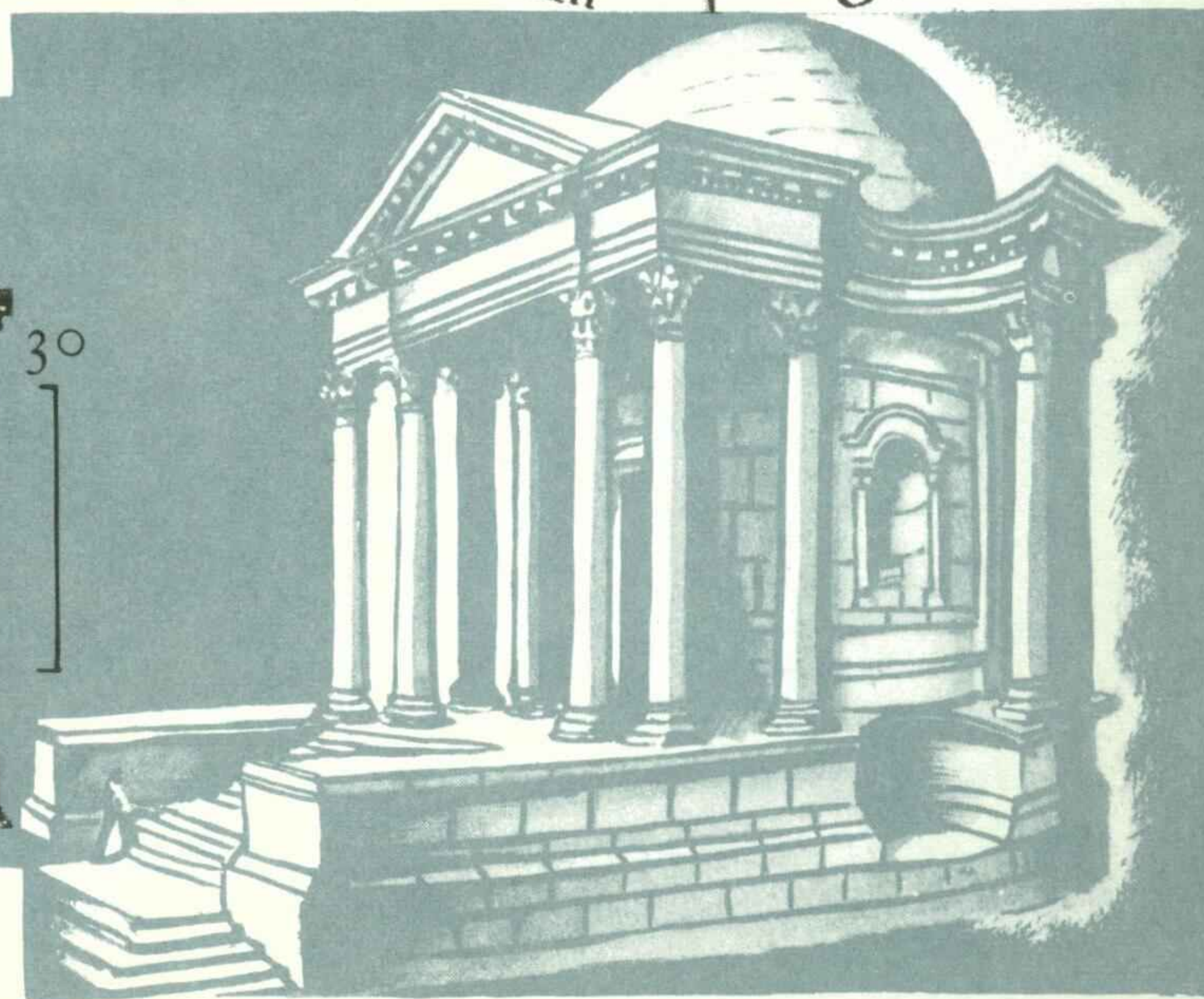
# CIRCULAR & OVAL BUILDINGS



The Colosseum, Rome, A.D. 70-82  
 Designed for about 45,000 spectators. 80 piers support 3 tiers of arcading. Decorative use of superimposed orders of  $\frac{3}{4}$  external Doric, Ionic and Corinthian columns. Foundations: lava. Walls: brick and tufa. Vaults: pumice-stone. Facade: travertine blocks held by metal cramps. Columns and seats: marble



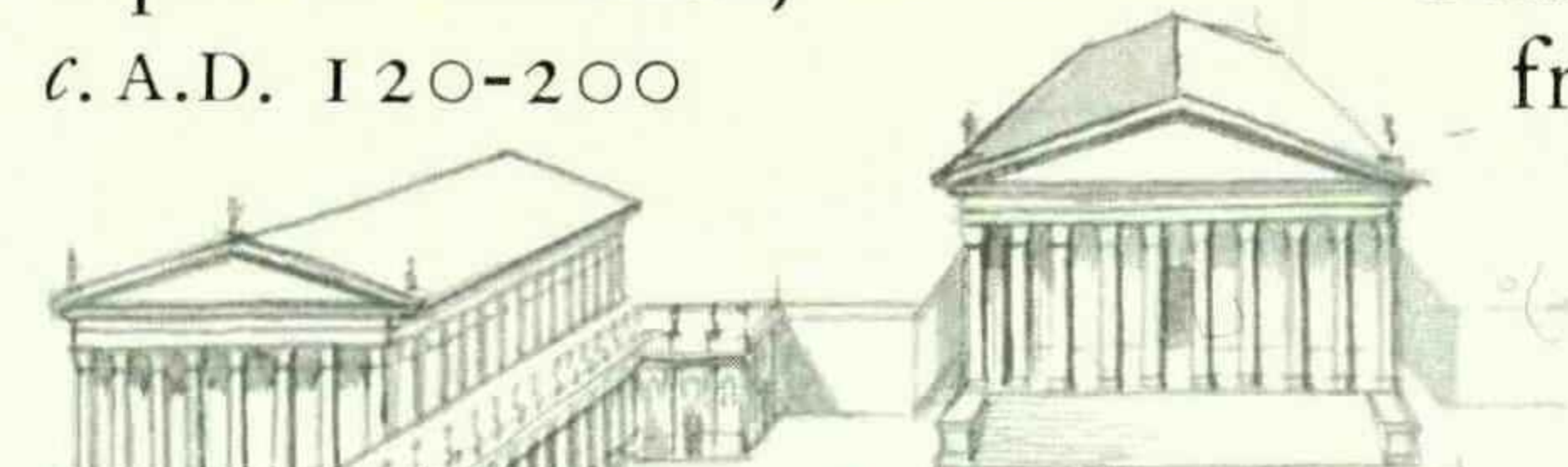
The Temple of Venus, Baalbek (restored),  
 c.A.D. 245



# TEMPLES

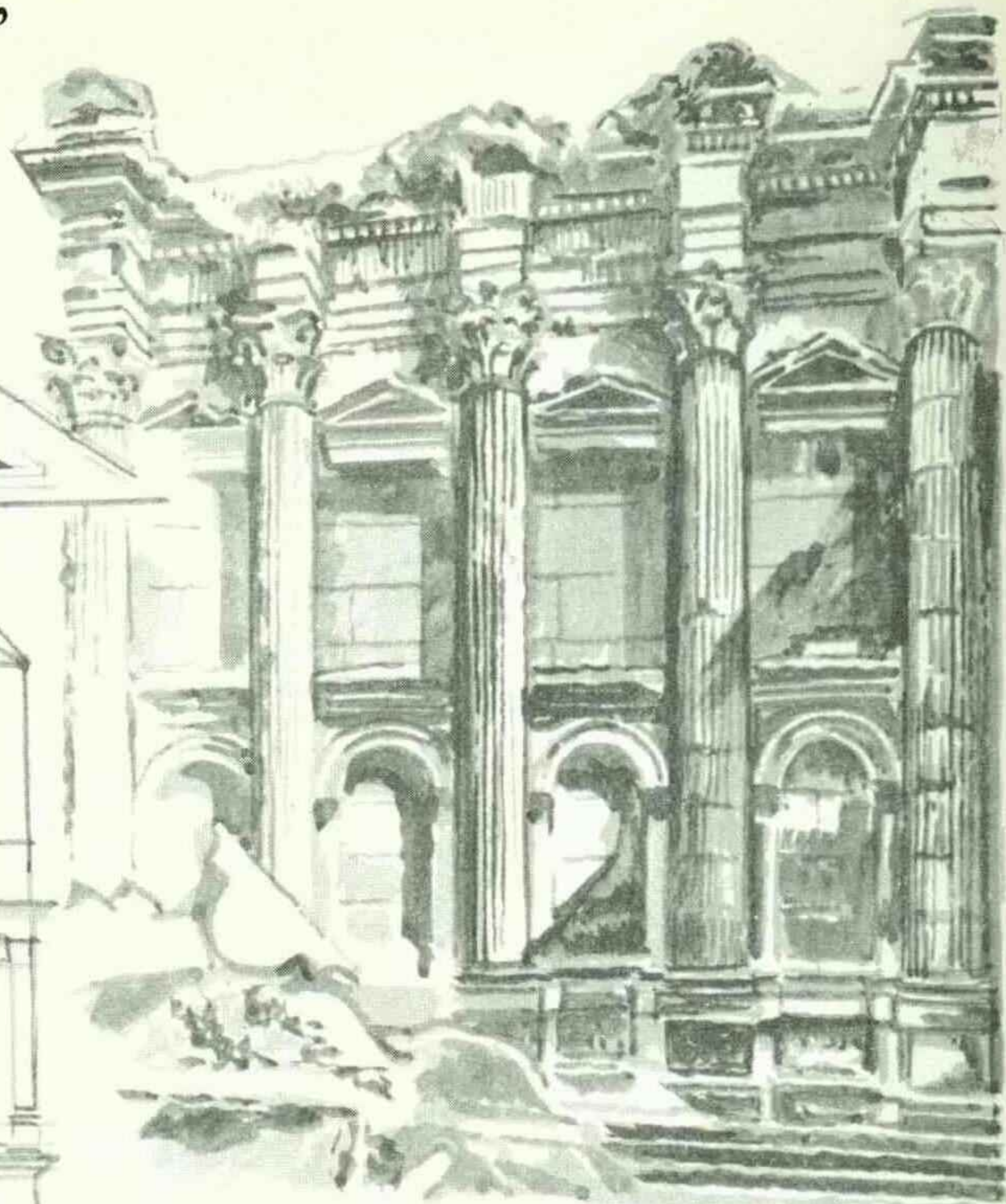
Temple of Bacchus,  
c. A.D. 120-200

Temple of Jupiter,  
from c. A.D. 10



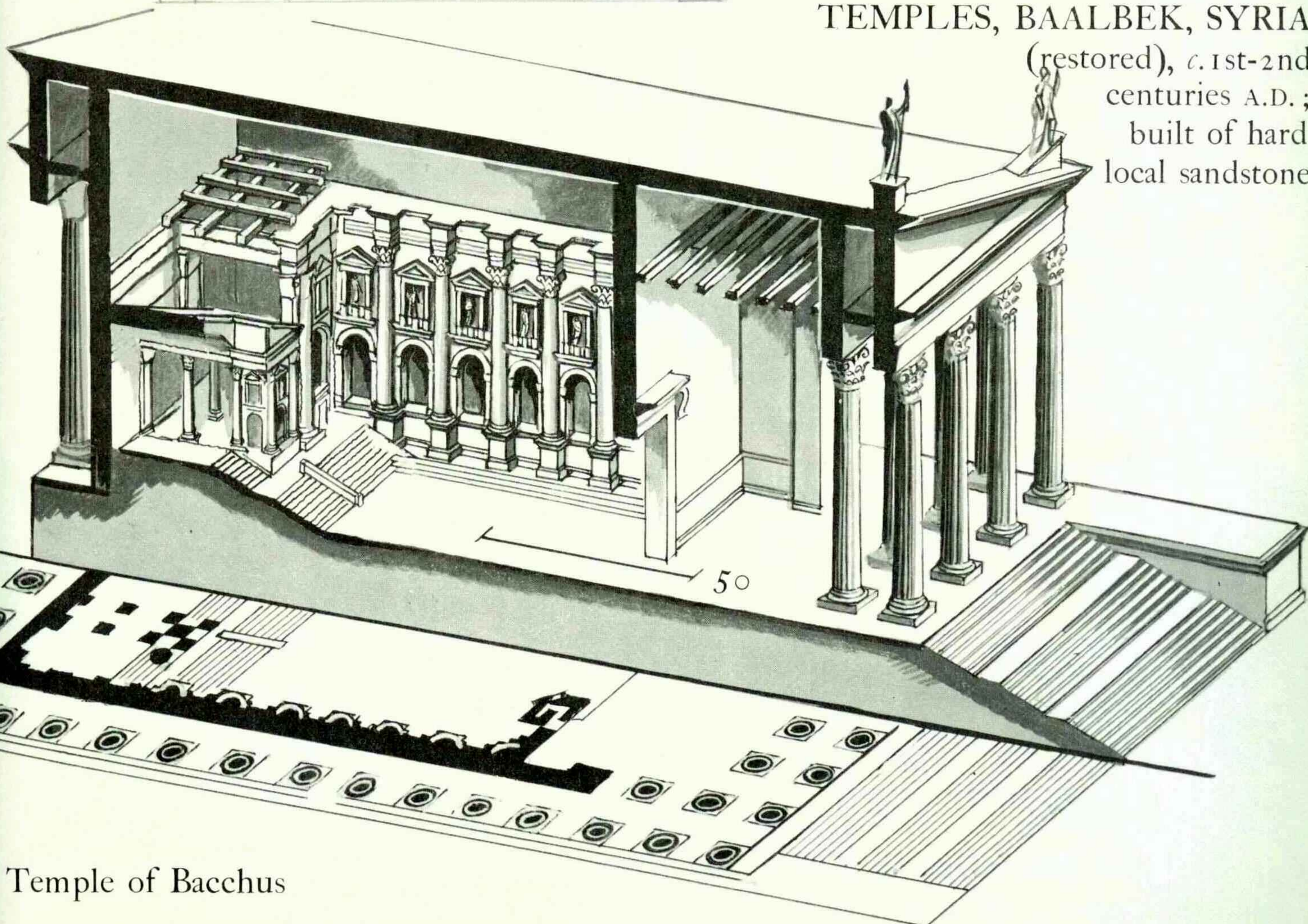
Court, c. A.D. 200

34°



Temple of Bacchus: interior

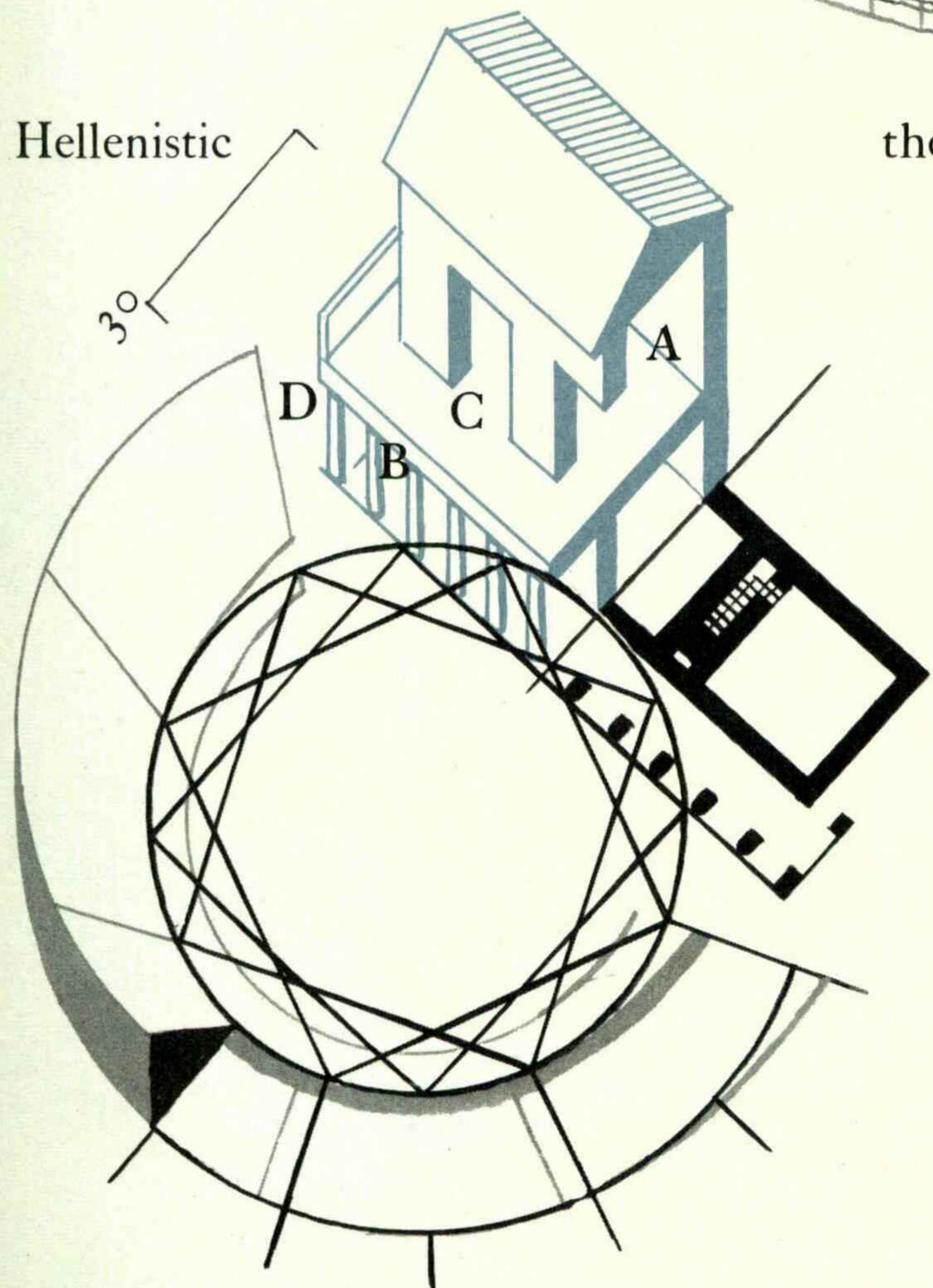
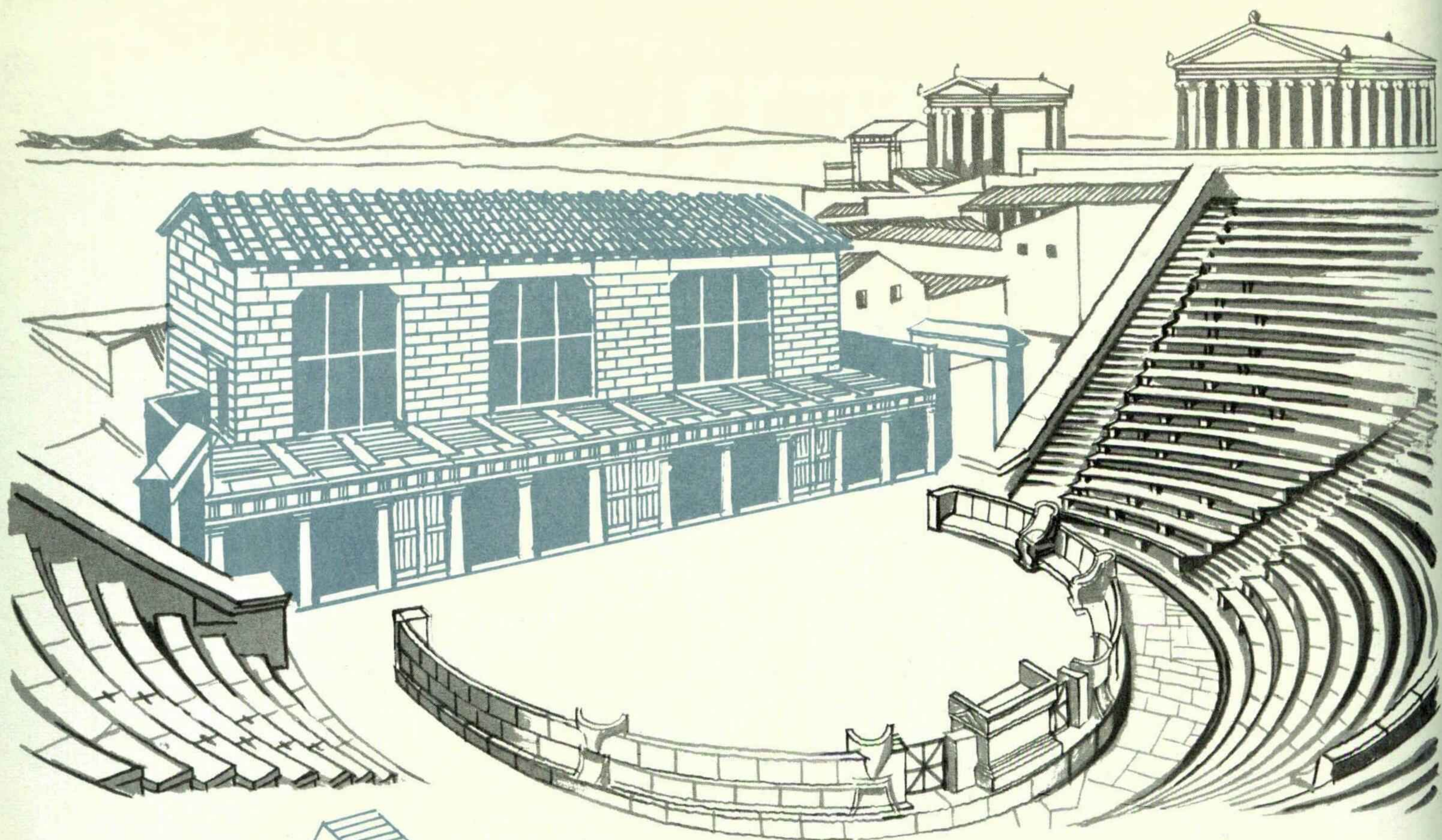
TEMPLES, BAALBEK, SYRIA  
(restored), c. 1st-2nd  
centuries A.D.;  
built of hard  
local sandstone



Temple of Bacchus

# GREEK

# THEATRE



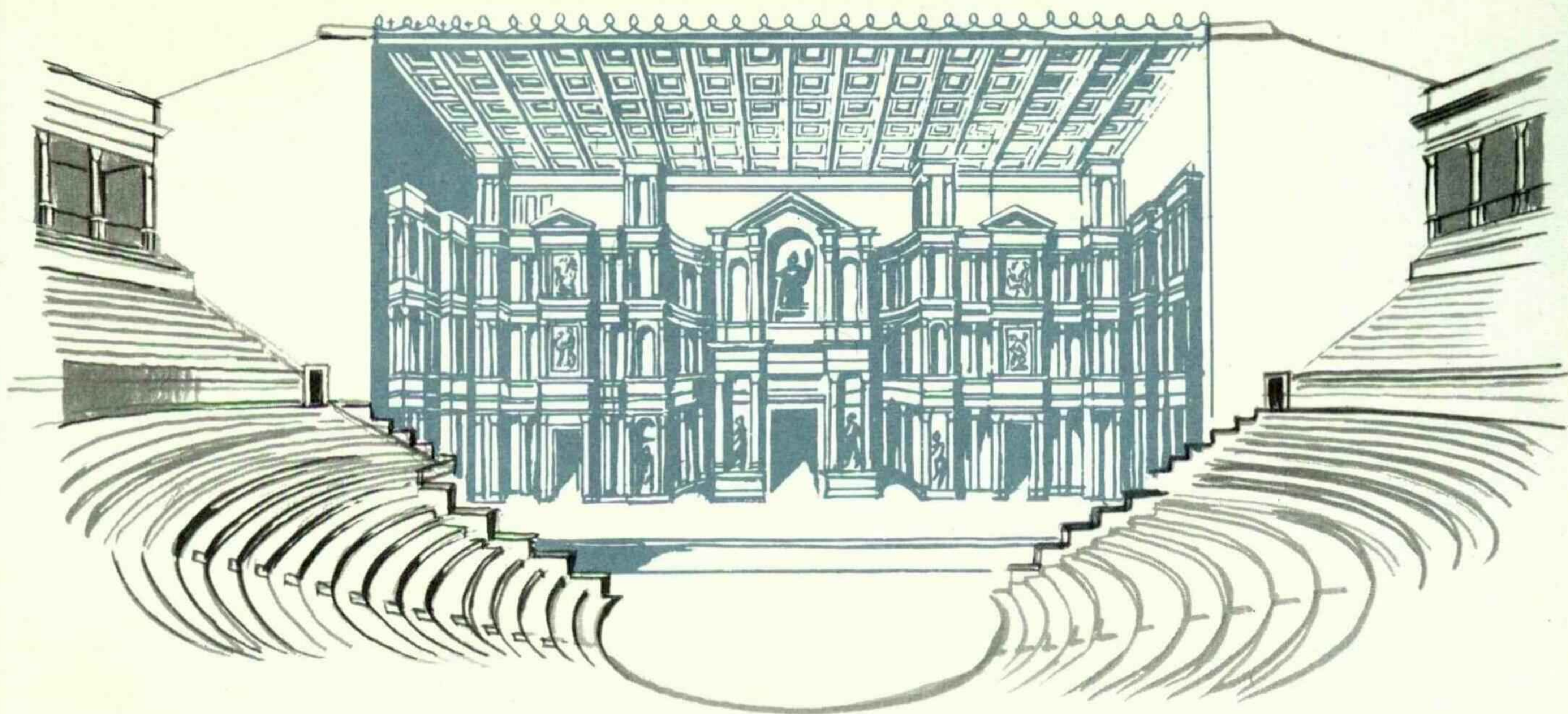
theatre, Priene, Asia Minor (restored), c.50 B.C.

The early Greek theatre consisted of an auditorium (simply a hill slope with stone seats), a semi-circular orchestra where the chorus sang and danced, and a wooden stage from which a single actor would hold a dialogue with the chorus. The number of actors was raised to two or three by Aeschylus (525-456 B.C.) and Sophocles (495-406 B.C.), who also introduced painted scenery and a dressing hut or skene. In the 4th century B.C. a wooden skene A was erected with a proscenium B having a row of columns, usually Doric, 8-12 ft from the skene wall supporting a stage of planks called the logeion or speaking-place C. Three doors in the skene wall were for entrances and exits of actors. At the two ends of the proscenium were the parodoi or open passage-ways D.

Plan of a Greek theatre based on 3 squares within the orchestra circle (Vitruvius, v.7)

# ROMAN

# THEATRE



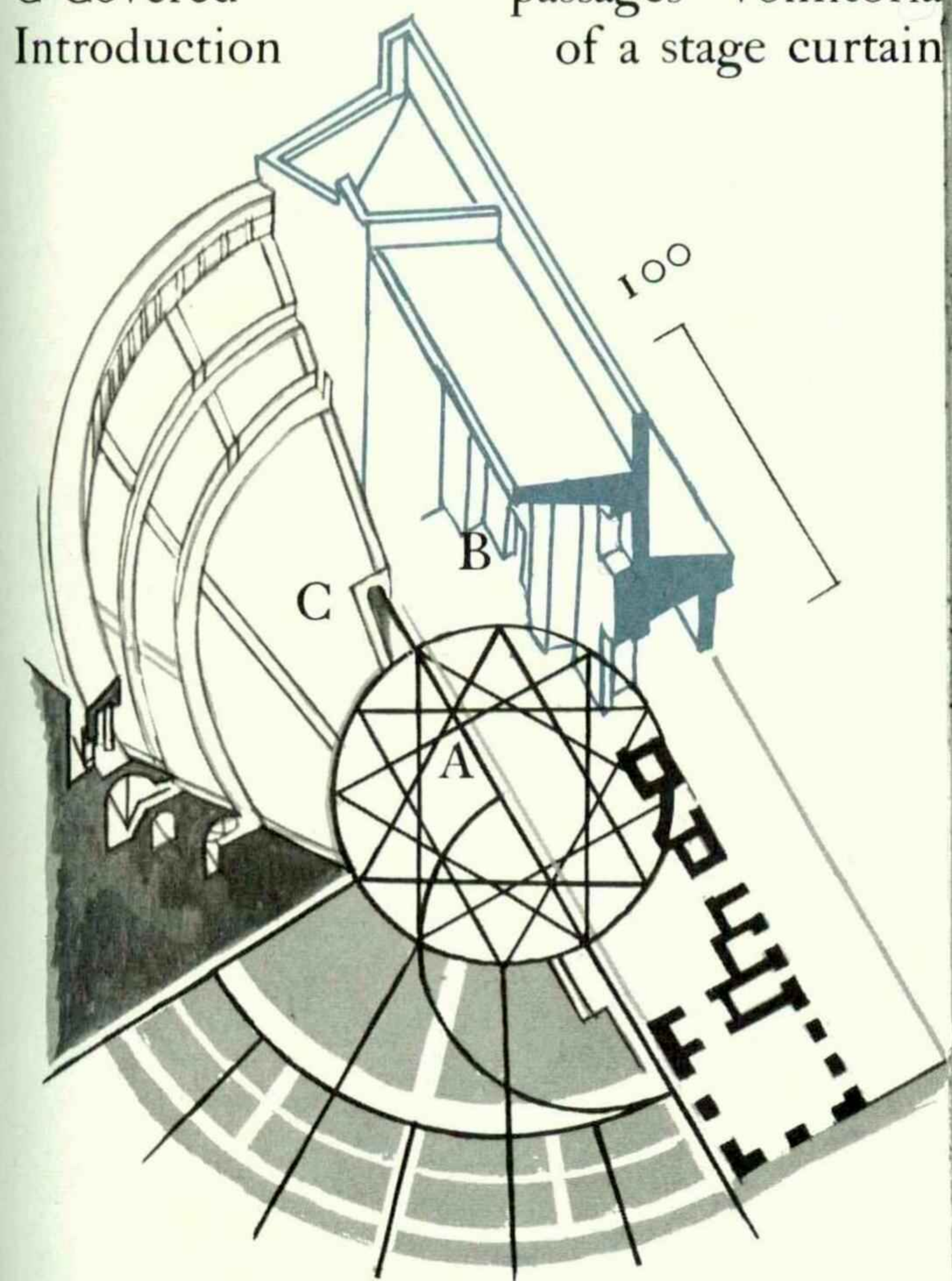
The Theatre, Orange (restored), c.A.D.50. Designed to seat 7000. Stage 5 ft high, 23 ft deep.

Built up on stone and concrete piers.

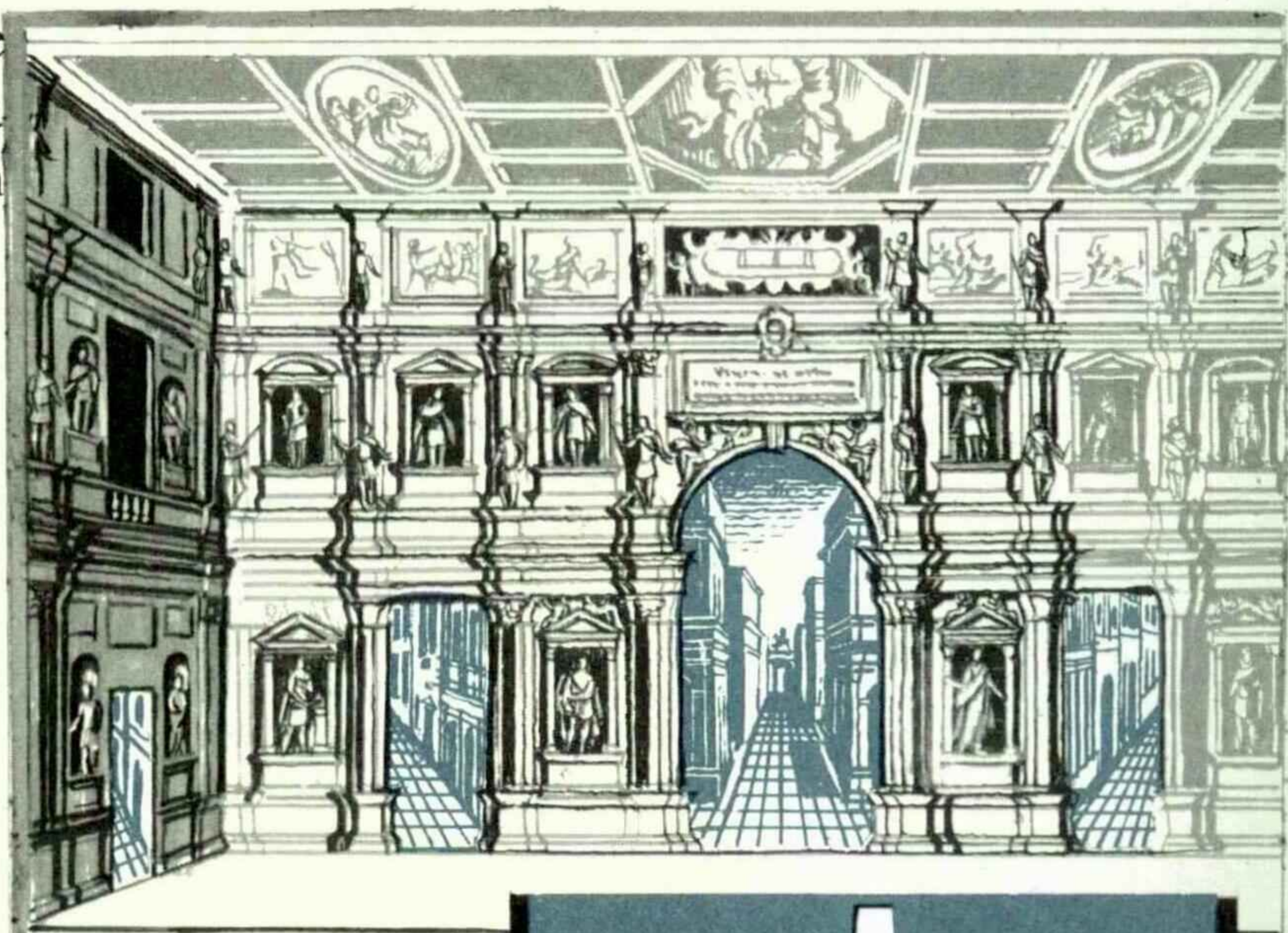
A Semi-circular cavea or auditorium

B Proscenium replaced by a frons scaenae

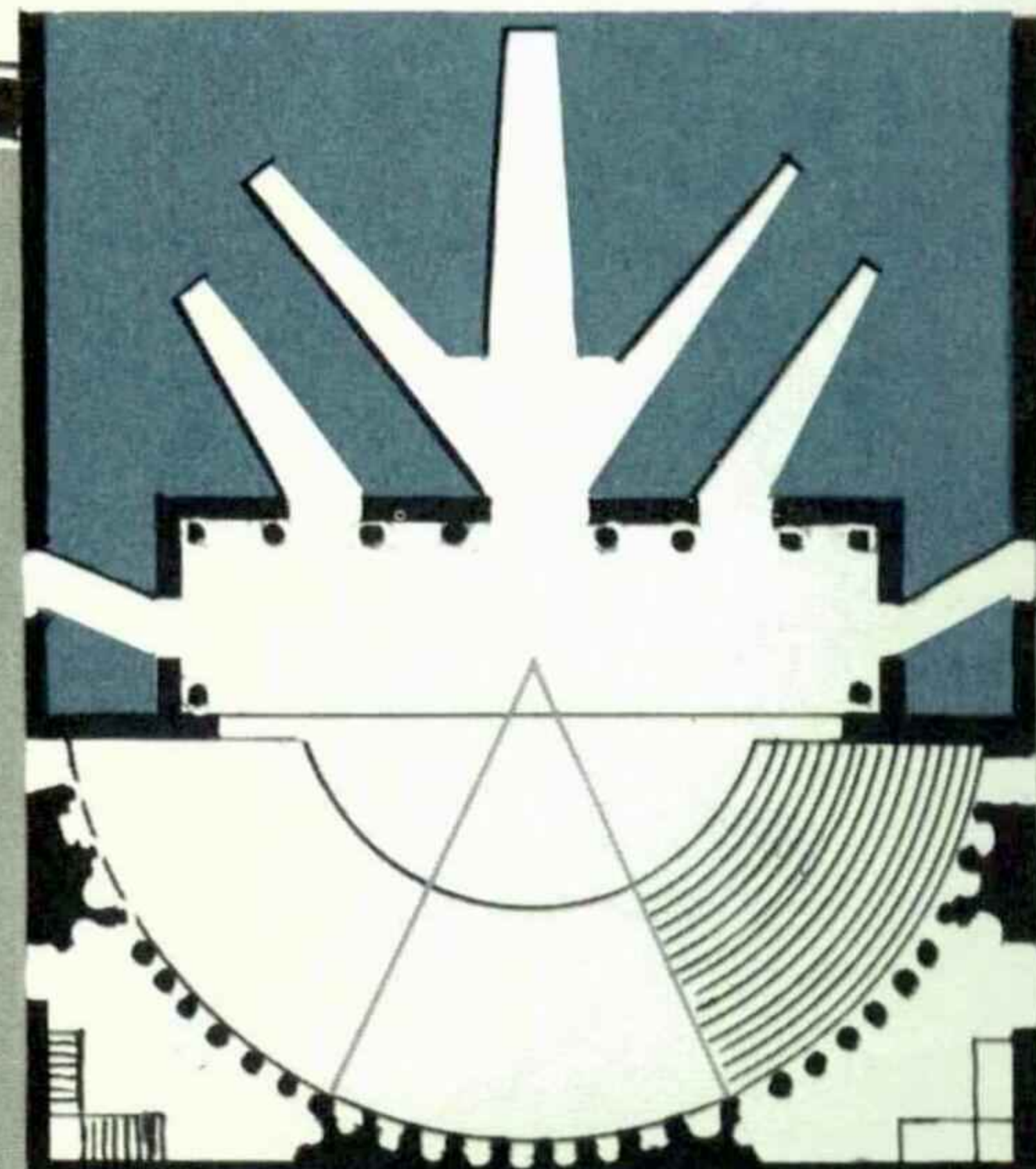
C Covered passages—vomitoria  
Introduction of a stage curtain



Plan of a Roman theatre based on 4 equilateral triangles in a circle (Vitruvius v,6)

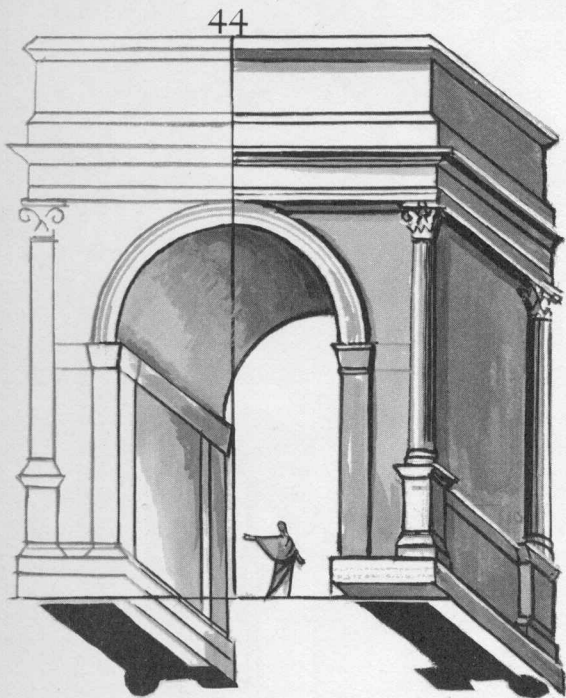


A Renaissance adaptation of a Roman theatre. The Teatro Olimpico, Vicenza, Italy, designed by Palladio and completed by Scamozzi, A.D. 1584

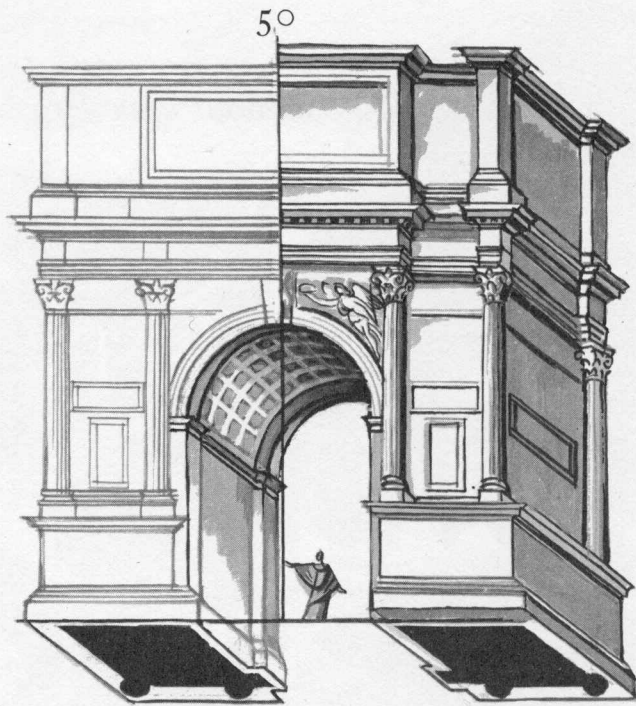




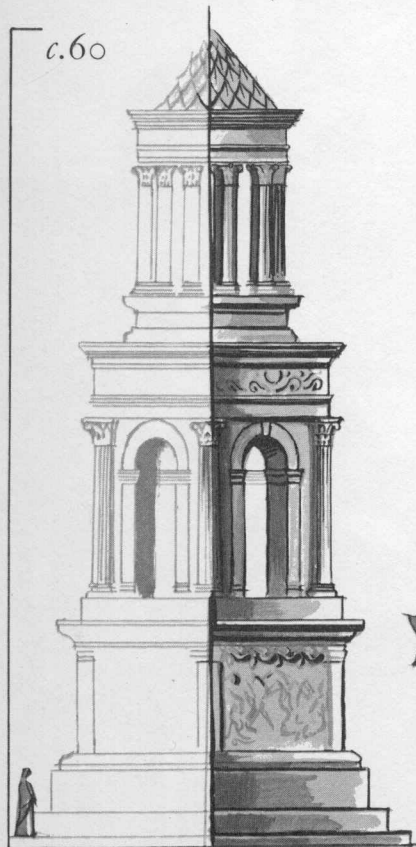
# ROMAN



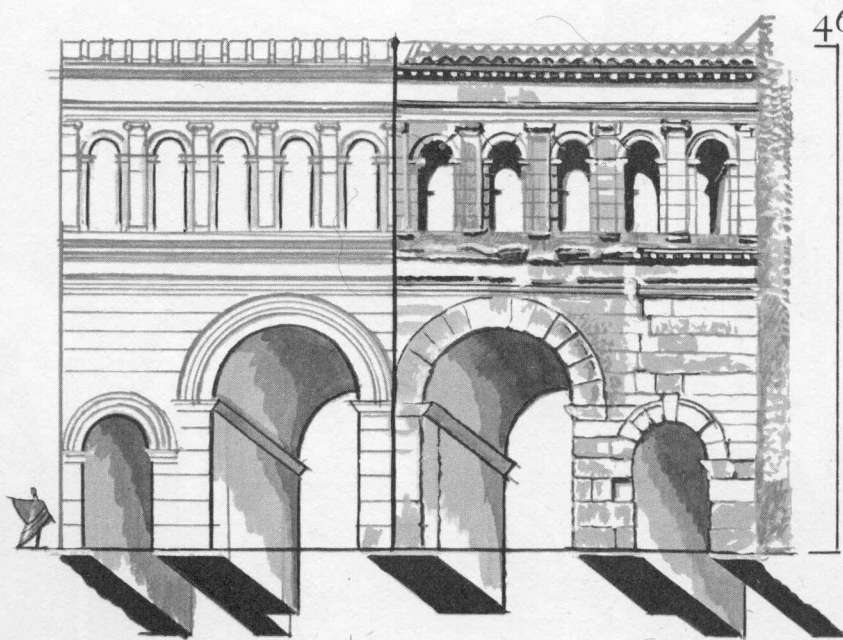
Arch of Augustus, Susa,  
Piedmont, c. A.D. 8



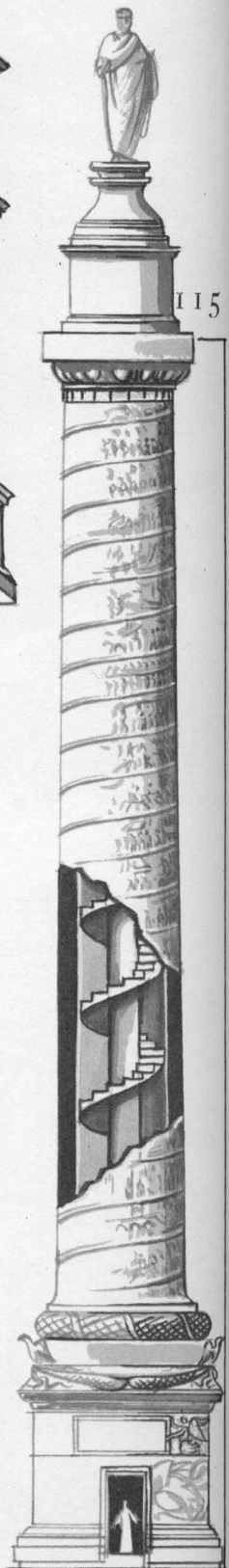
Arch of Titus, Rome, A.D. 70  
Earliest use of the Composite order.



Tomb of the Julii,  
Provence, S. Remy,  
c. 30 B.C.-A.D. 14

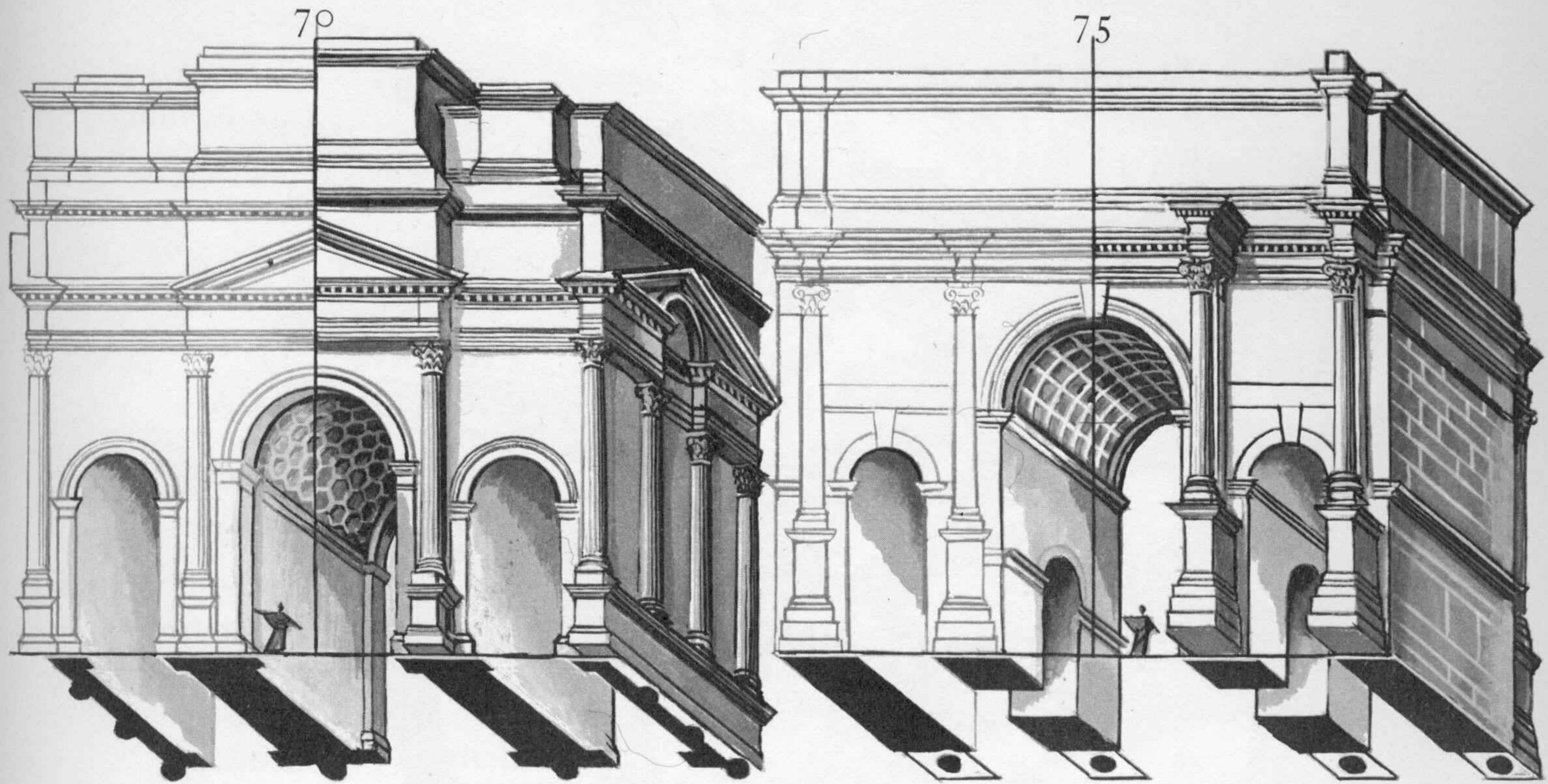


Town gateway with four archways  
The Porte S. André, Augustodunum (Autun).  
An arcaded gallery with Ionic pilasters creates  
an antiphonal response with the rise and fall  
of the large and small arches below



Trajan's  
Column,  
Rome,  
A.D. 114.

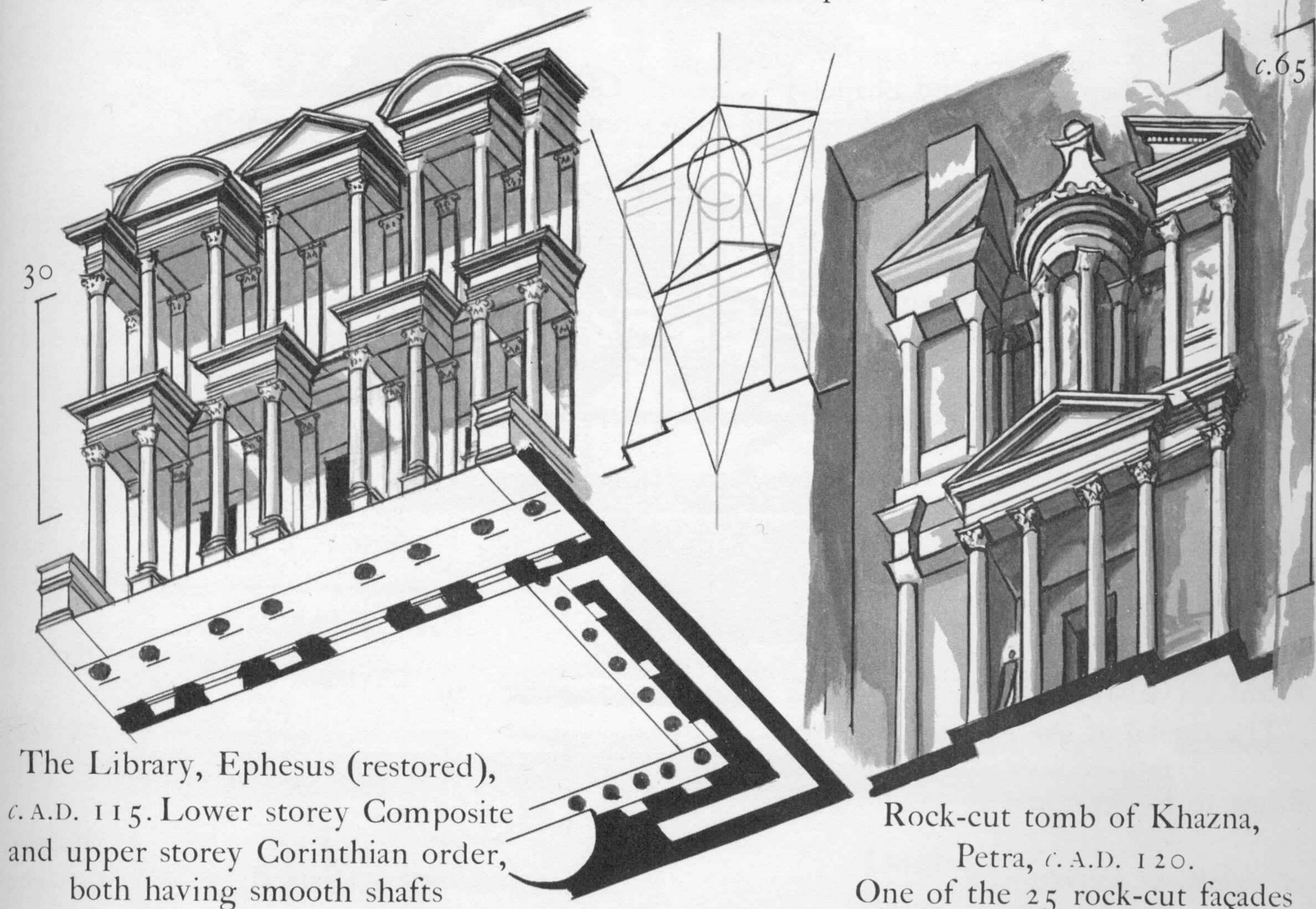
# ARCHES AND MONUMENTS



Triumphal Arches with three openings.

Arch of Tiberius, Orange, *c.* A.D. 21

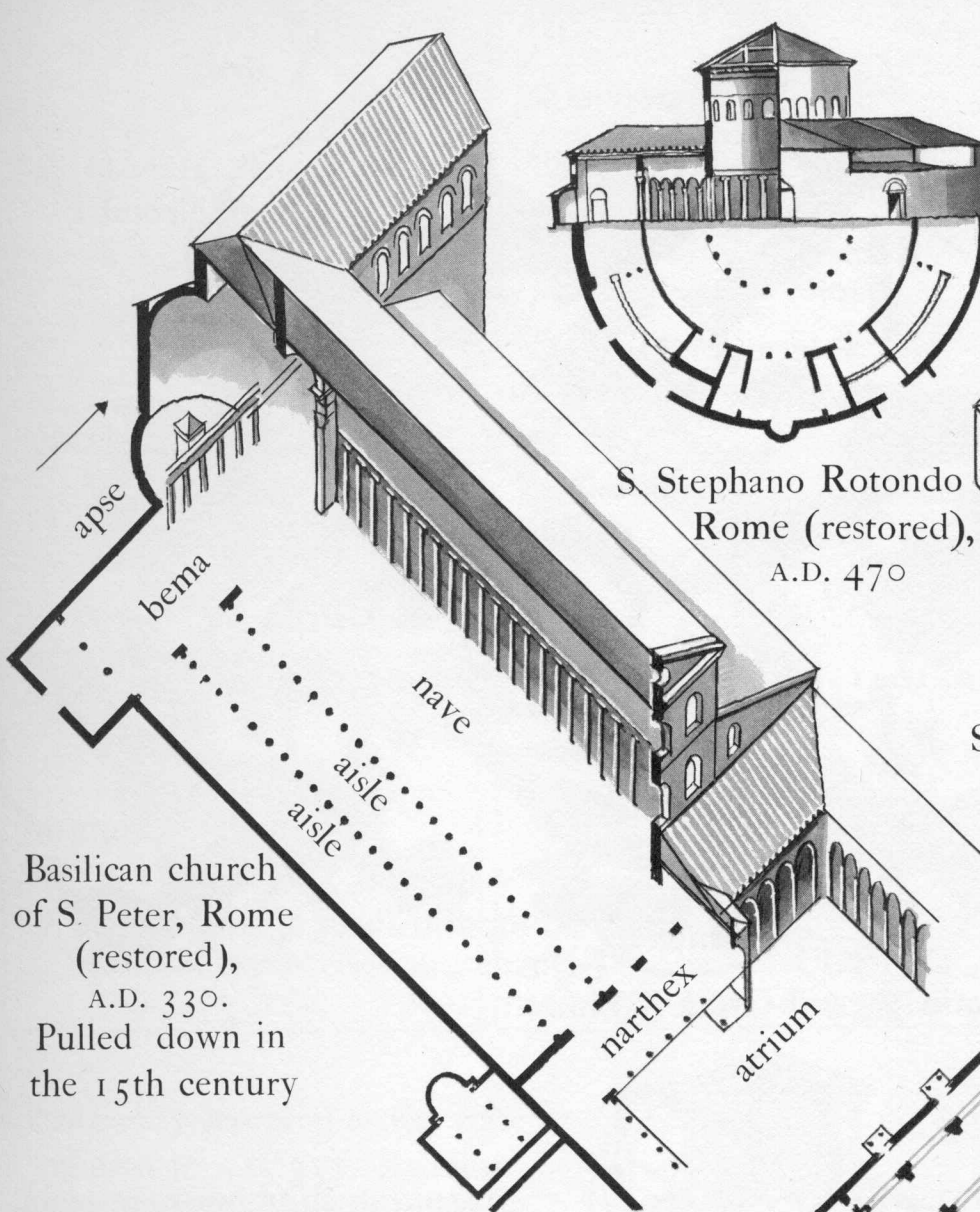
Arch of Septimius Severus, Rome, A.D. 200



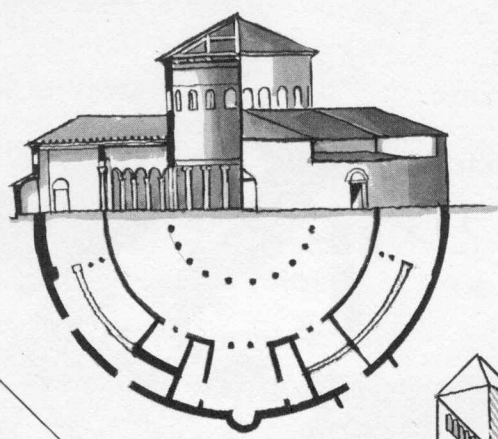
The Library, Ephesus (restored),  
*c.* A.D. 115. Lower storey Composite  
and upper storey Corinthian order,  
both having smooth shafts

Rock-cut tomb of Khazna,  
Petra, *c.* A.D. 120.  
One of the 25 rock-cut façades

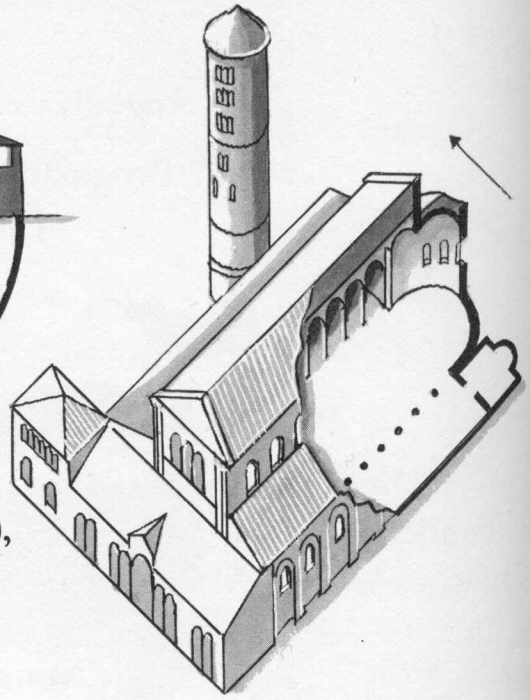
# EARLY CHRISTIAN



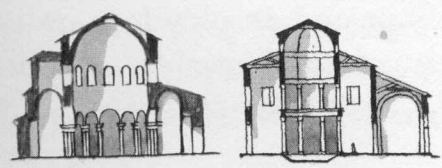
Basilican church of S. Peter, Rome (restored), A.D. 330. Pulled down in the 15th century



S. Stephano Rotondo Rome (restored), A.D. 470



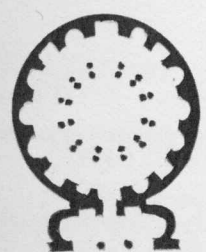
S. Apollinare in Classe, Ravenna, A.D. 534-539



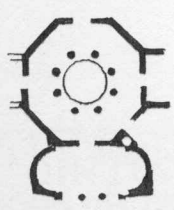
Syria, 5th-6th centuries: churches built of large stone blocks and timber roofs



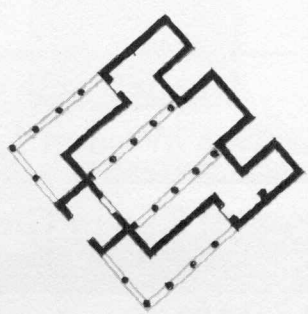
Church, Roueiha (restored), c. 6th century A.D.



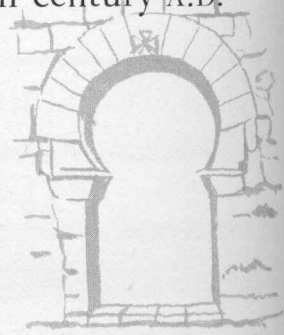
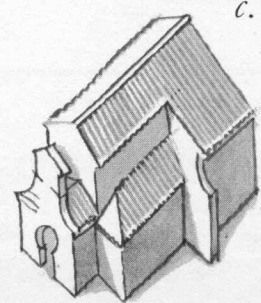
S. Costanza, Rome, A.D. 330



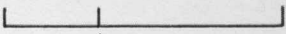
Baptistry of Constantine, Rome, A.D. 430-440

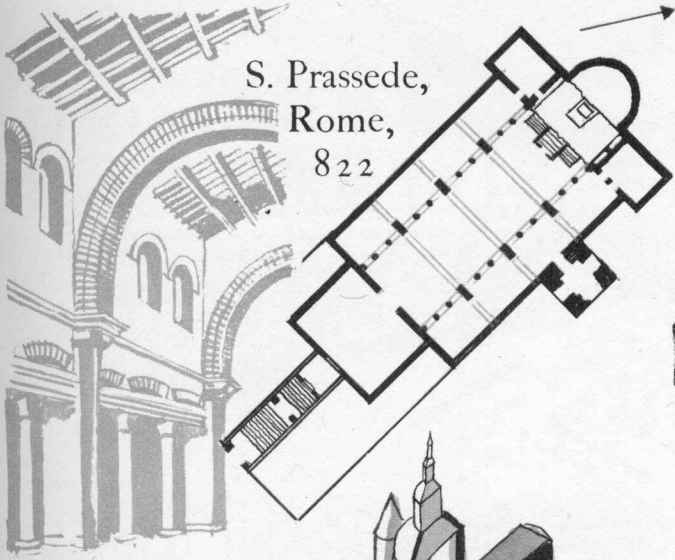


Visigothic before the Moslem invasion, with horse-shoe arch: S. Juan de Baños, Cerrato, Spain, c. A.D. 500-713

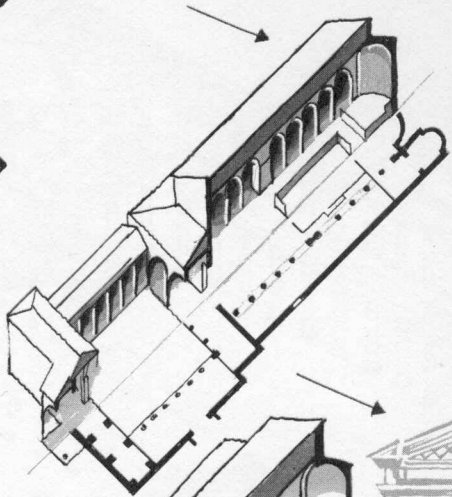


# COMPARATIVE PLANS

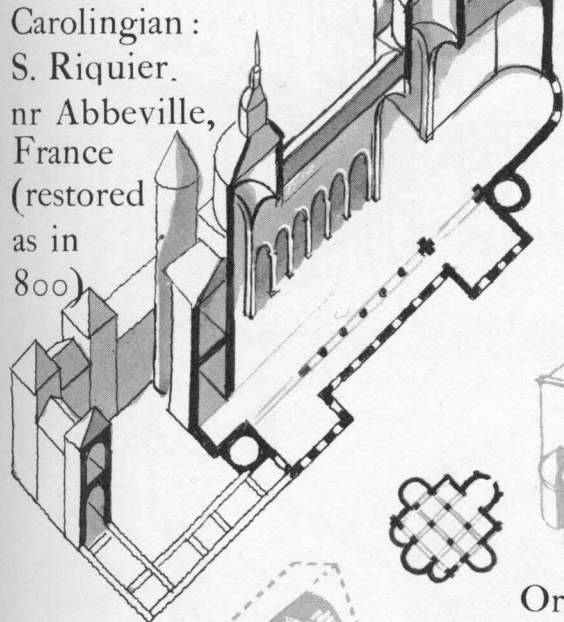
plans and sections in black to the same scale  150



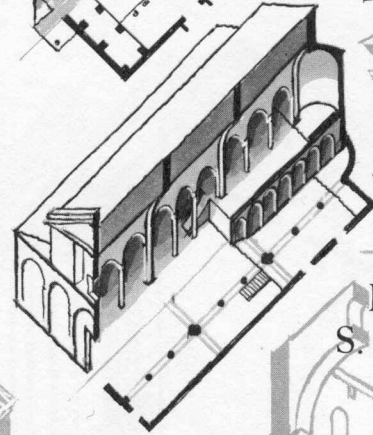
S. Prassede,  
Rome,  
822



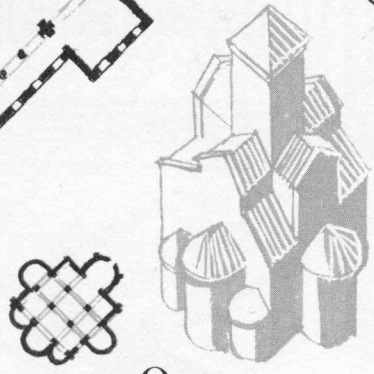
S. Clemente, Rome,  
rebuilt 1084-1108 over  
a 4th-century church



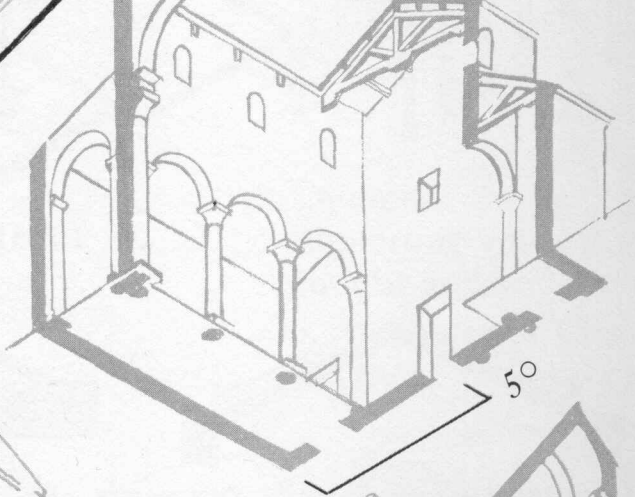
Carolingian :  
S. Riquier,  
nr Abbeville,  
France  
(restored  
as in  
800)



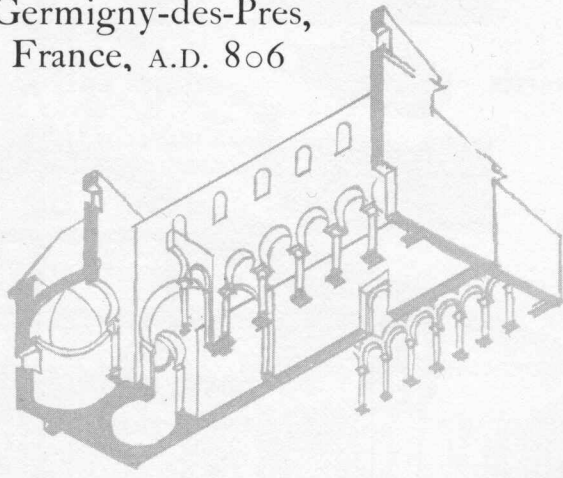
Early Christian-Romanesque :  
S. Miniato, Florence, A.D. 1013



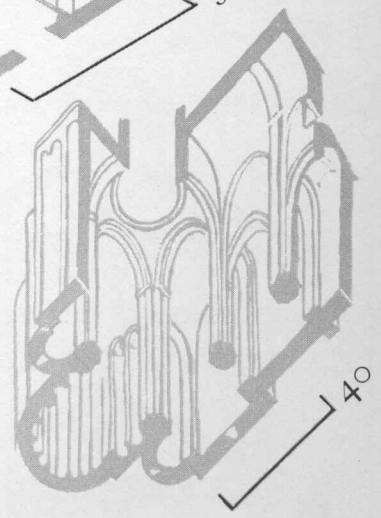
Oratory,  
Germigny-des-Pres,  
France, A.D. 806



S. Maria de Naranco  
Asturia, Spain,  
A.D. 824-840

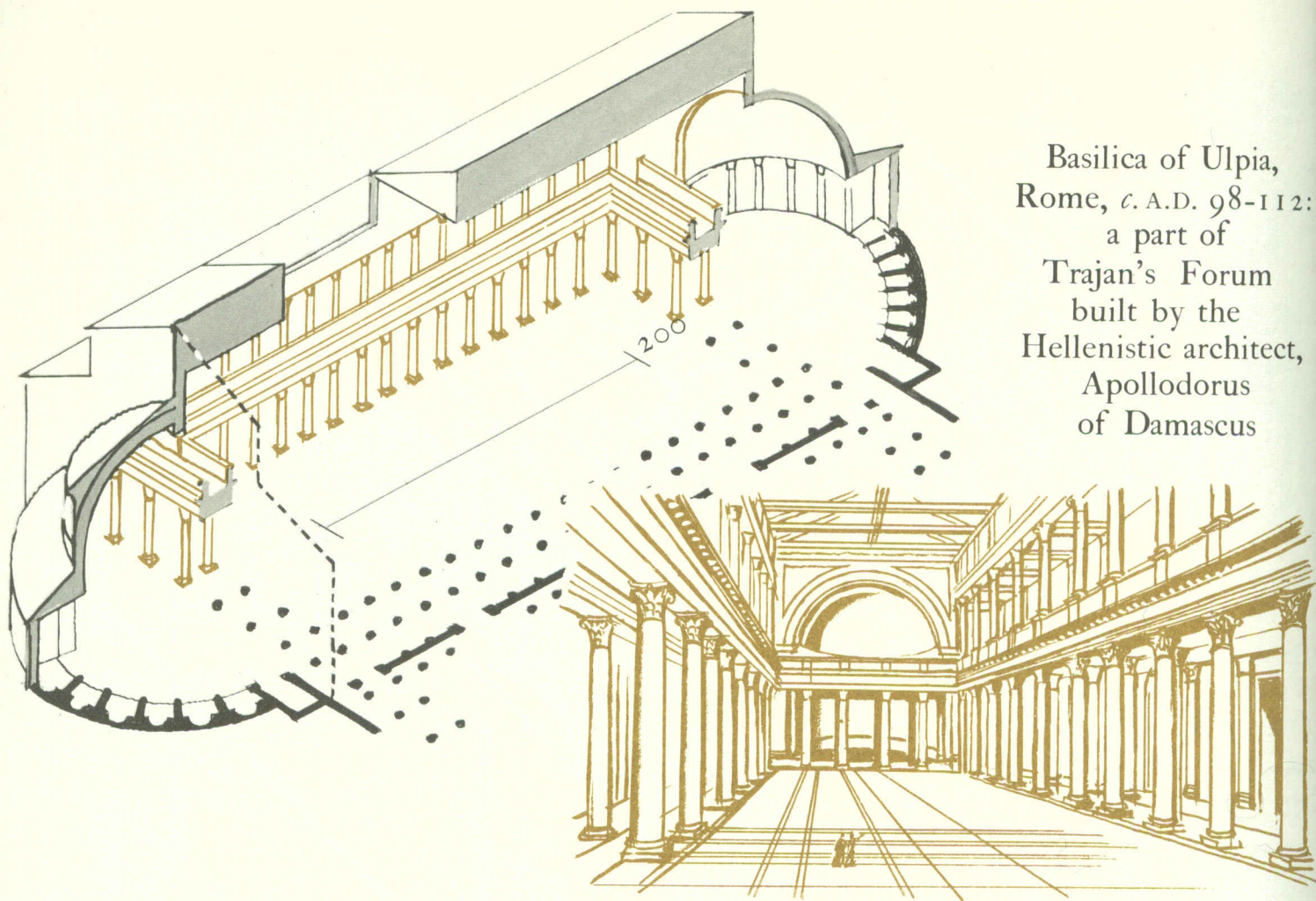


Mozarabic, 'Arabized Spanish':  
S. Miguel de Escalada, León, A.D. 913



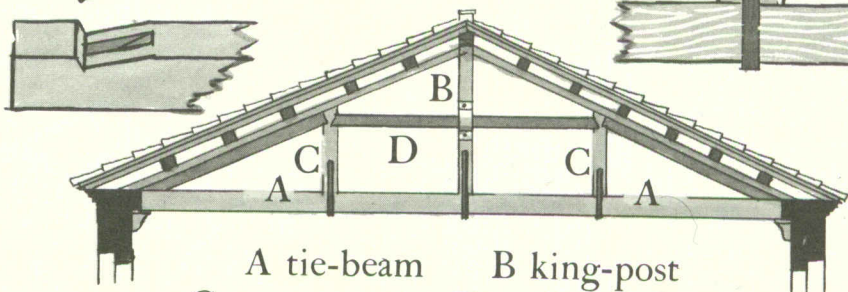
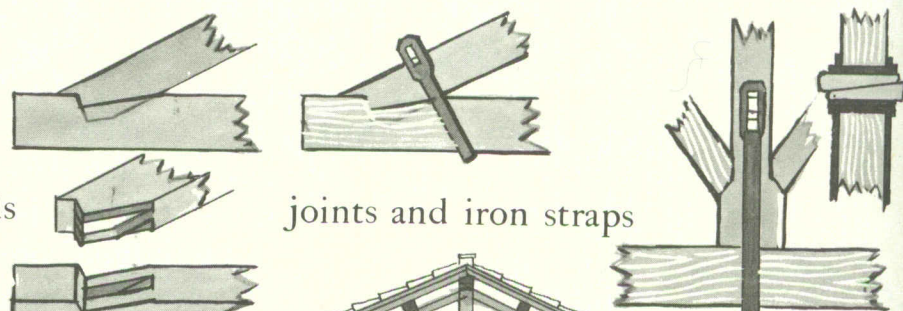
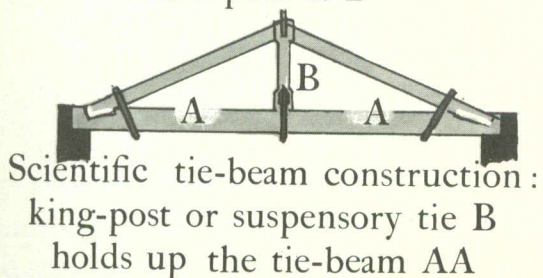
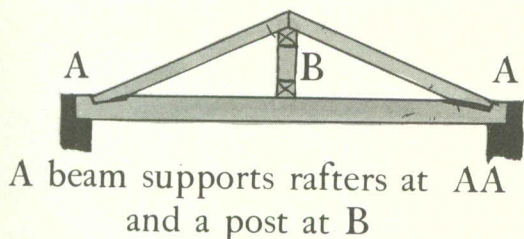
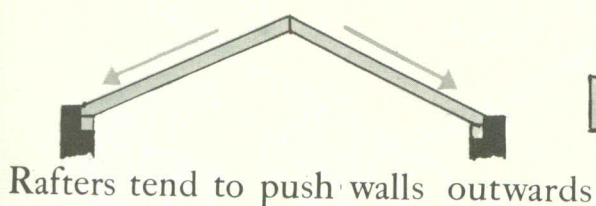
Spanish-Romanesque :  
S. Vicente de Cardona,  
Catalonia, c. 1024-1040

# ROMAN BASILICA EARLY

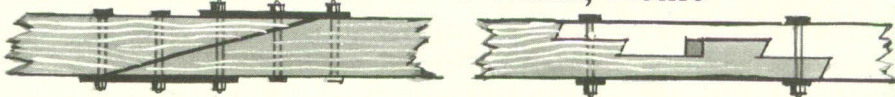


Basilica of Ulpia,  
Rome, c. A.D. 98-112:  
a part of  
Trajan's Forum  
built by the  
Hellenistic architect,  
Apollodorus  
of Damascus

## TIMBER ROOFS

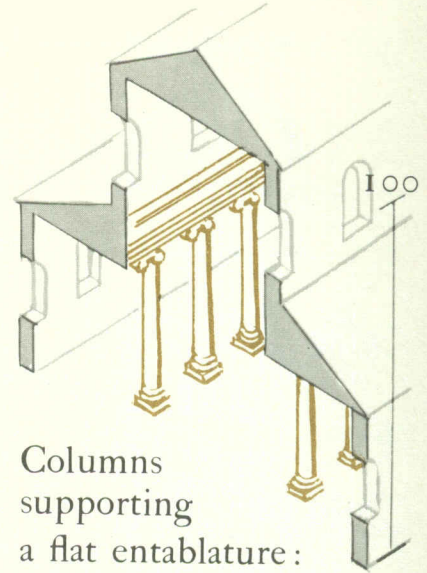
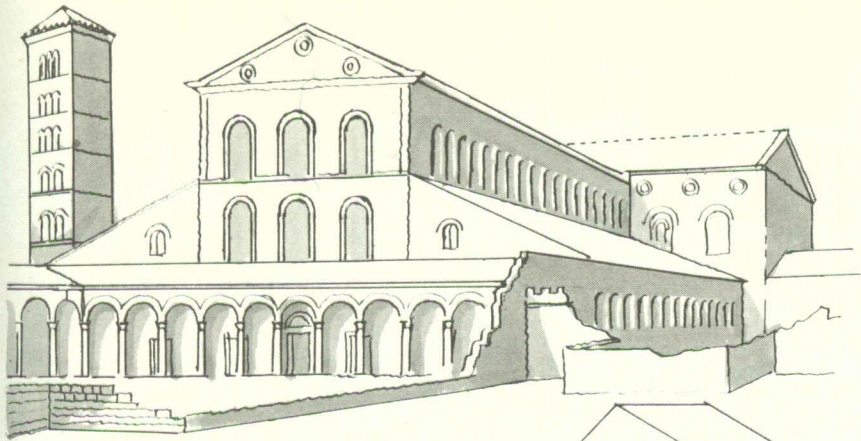


A tie-beam B king-post  
C queen-posts D straining-piece  
S. Paolo fuori le Mura, Rome

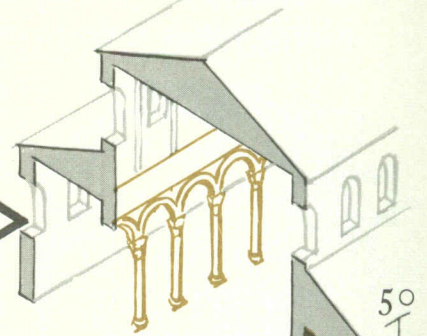
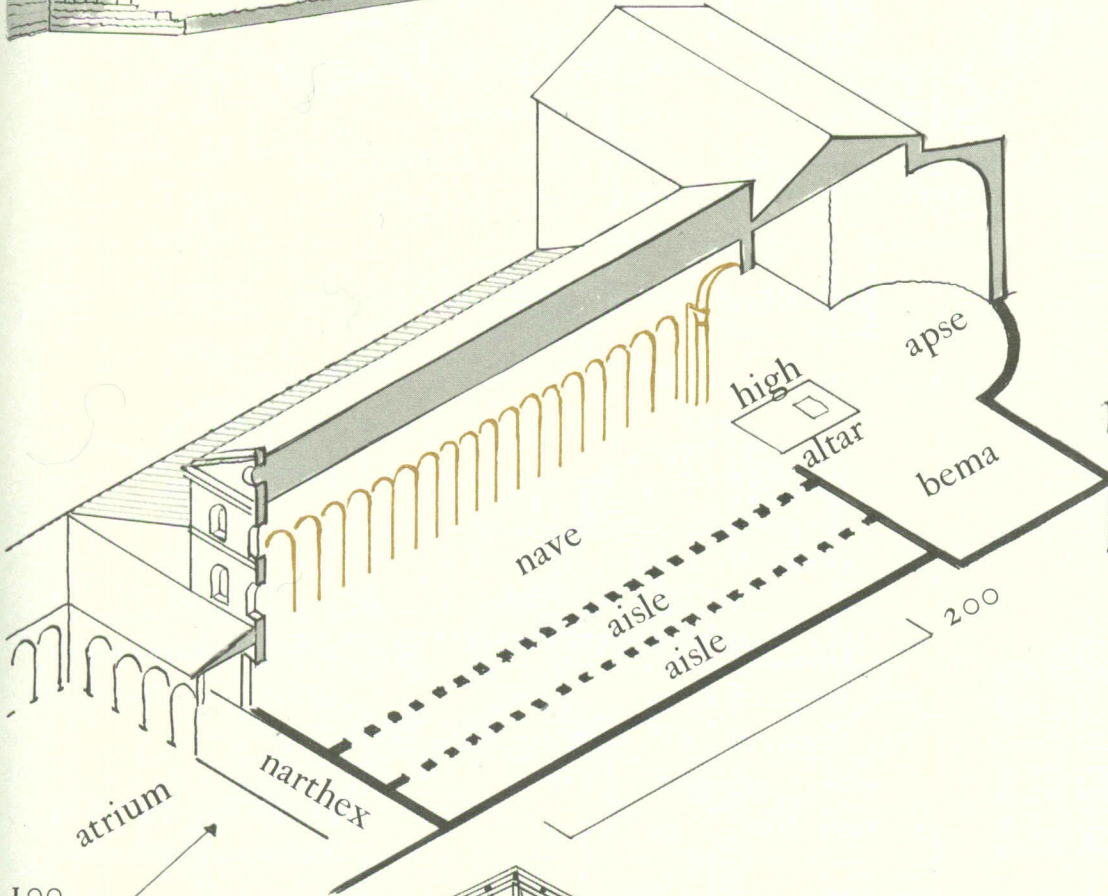


# CHRISTIAN

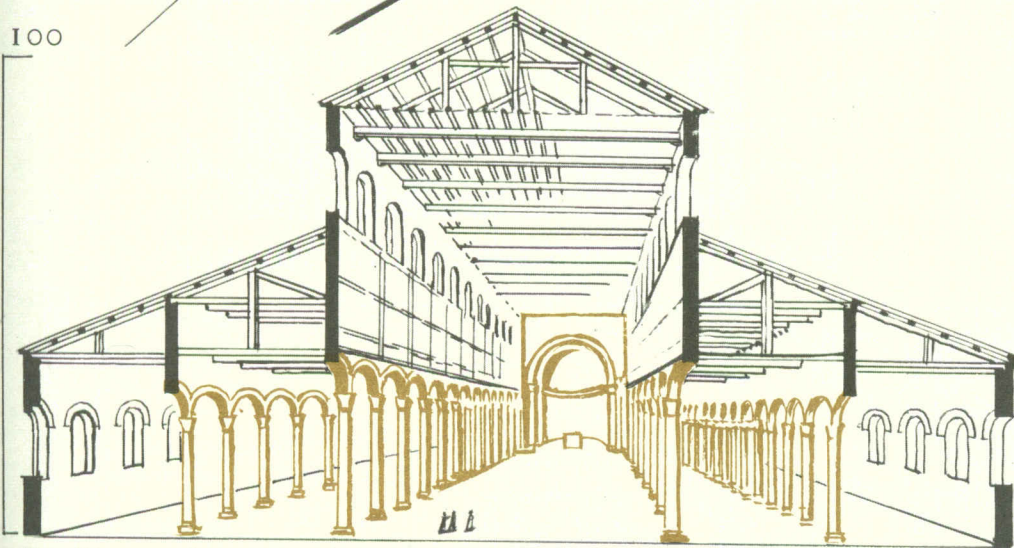
# CHURCHES



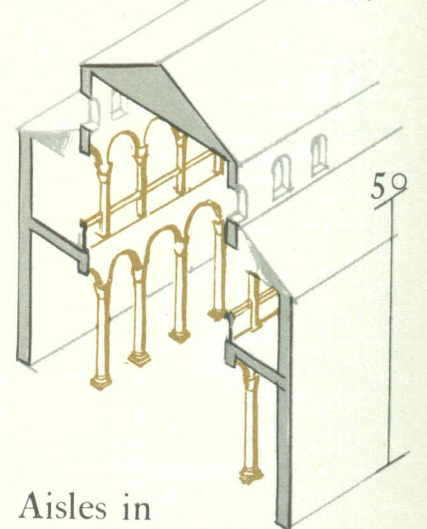
Columns supporting a flat entablature: S. Maria Maggiore, Rome, A.D. 432



Columns supporting semi-circular arches: S. Apollinare in Classe, Ravenna, A.D. 534-539



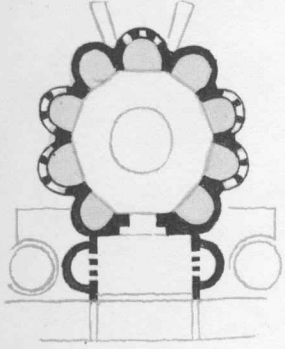
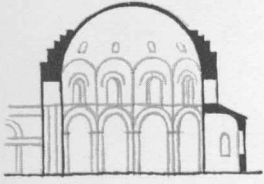
Basilican church of S. Paolo fuori le Mura, Rome, A.D. 320; burnt down in 1832 and rebuilt to the original design



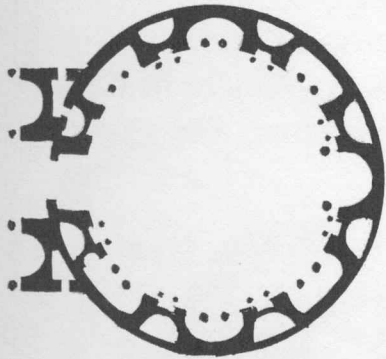
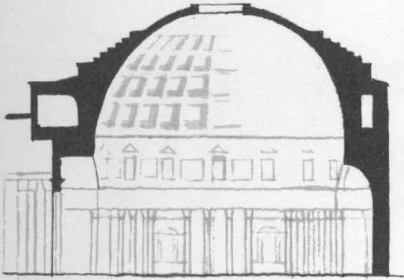
Aisles in two storeys: S. Agnese fuori le Mura, Rome, A.D. 625-638

# BYZANTINE

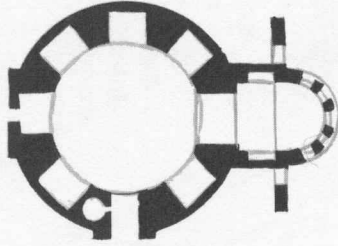
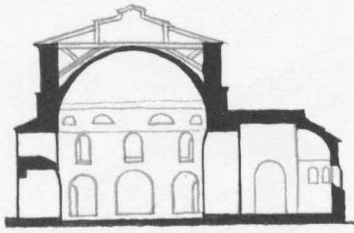
## ROMAN



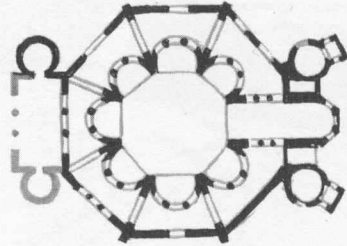
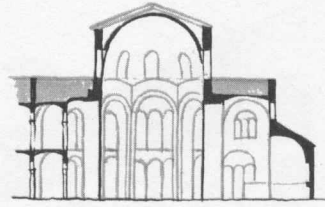
The Minerva Medica,  
Rome, c. A.D. 260



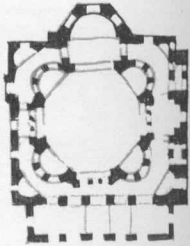
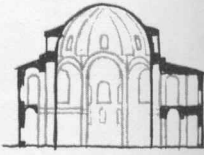
The Pantheon, Rome,  
A.D. 120-124



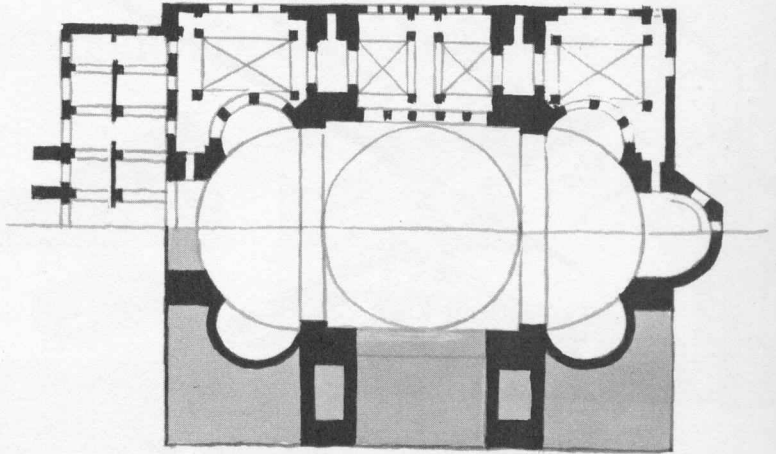
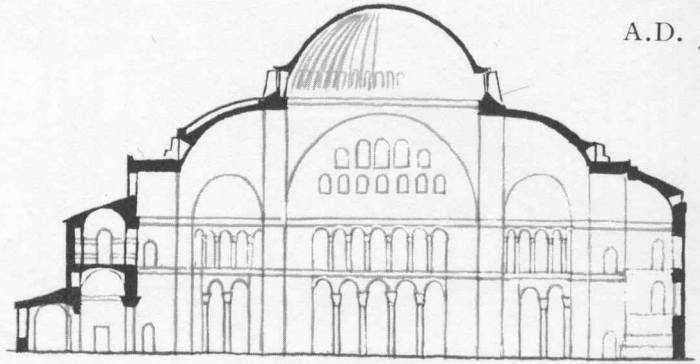
S. George, Salonika,  
c. A.D. 400



S. Vitale, Ravenna,  
A.D. 526-547

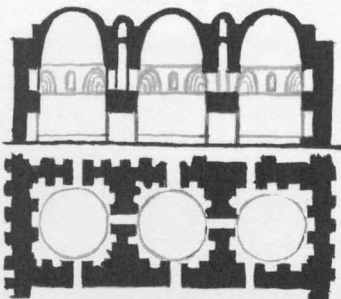


SS. Sergius  
and Bacchus,  
Constantinople  
A.D. 527-553

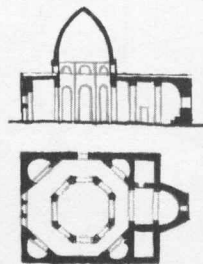


S. Sophia, Constantinople, A.D. 532-537

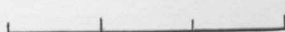
PERSIA:  
detail of Palace,  
Feruz-abad,  
A.D. 450

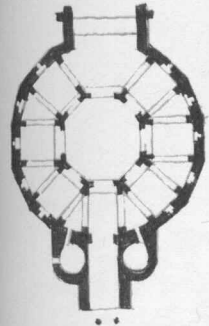
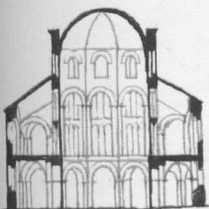


SYRIA:  
S. George,  
Ezra,  
c. A.D. 510

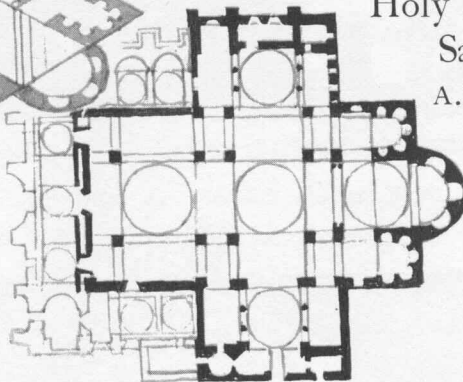
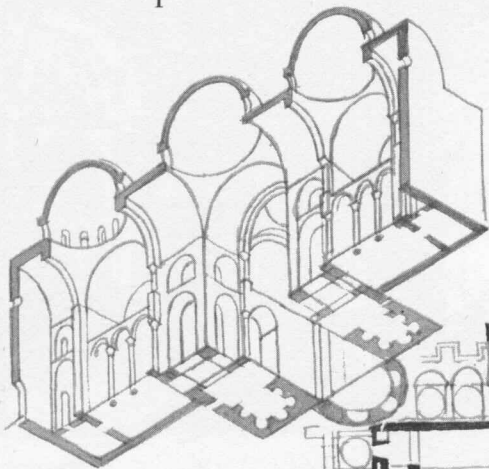


# COMPARATIVE PLANS

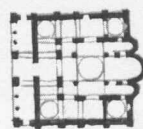
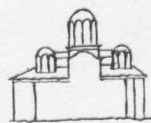
plans and sections in black to the same scale  150



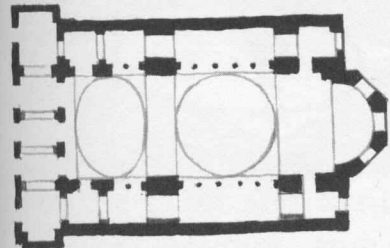
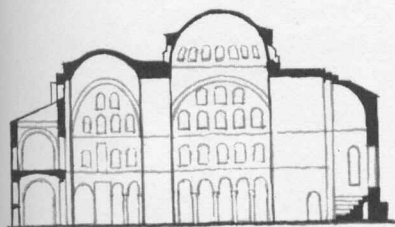
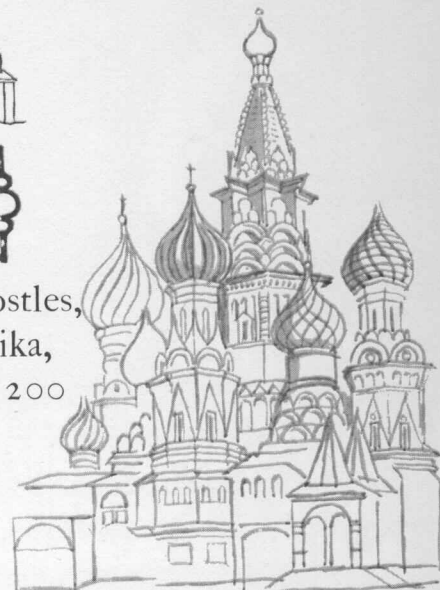
Carolingian cathedral,  
Aix-la-Chapelle,  
A.D. 796-804



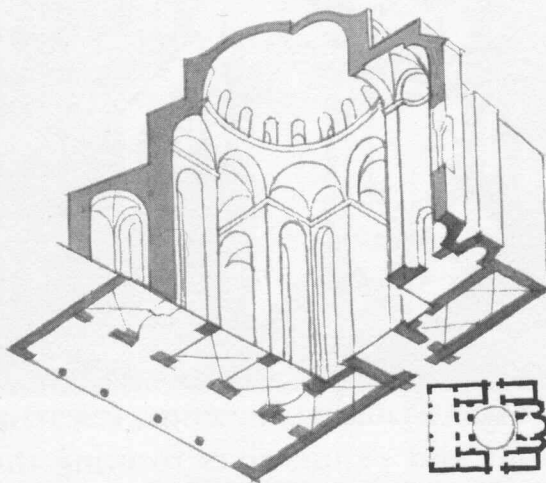
S. Mark, Venice, A.D. 1042-1085



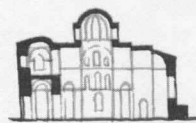
Holy Apostles,  
Salonika,  
A.D. 1200



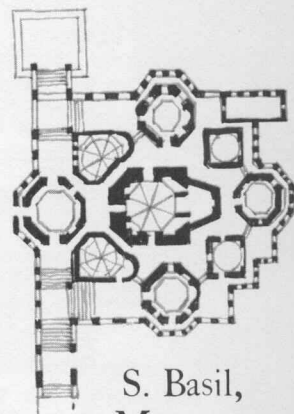
S. Irene, Constantinople,  
A.D. 740



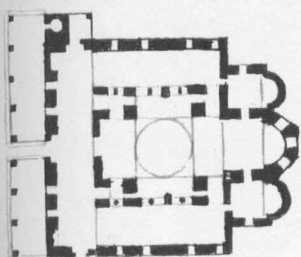
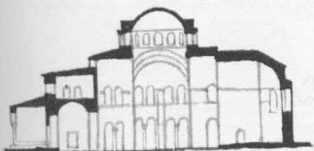
Church, Daphni, nr Athens,  
c. 11th century A.D.



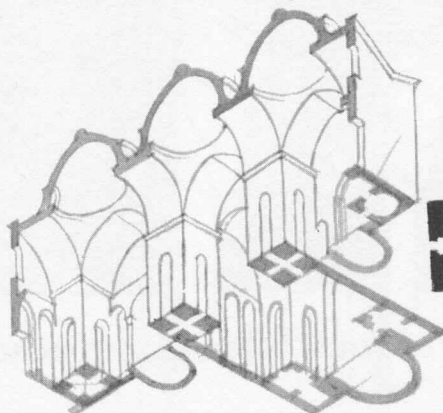
S. Saviour  
Pantepoptes,  
Constantinople,  
early 12th century



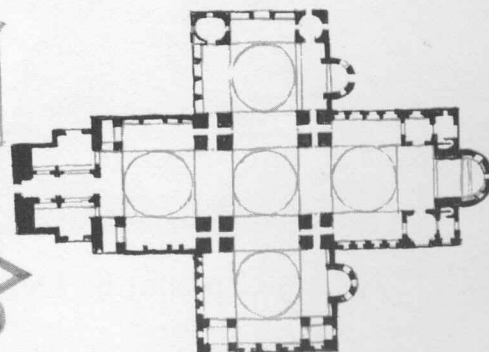
S. Basil,  
Moscow,  
A.D. 1554-1560



S. Sophia, Salonika,  
c. 6th century A.D.

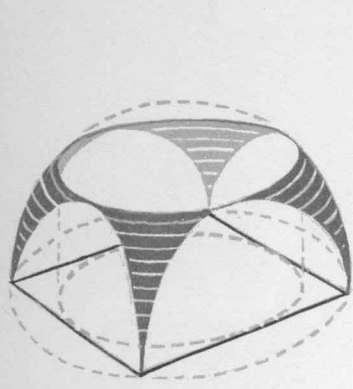


S. Front, Perigueux, France, A.D. 1120

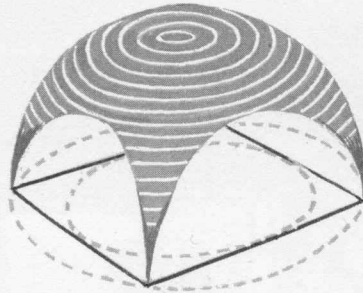
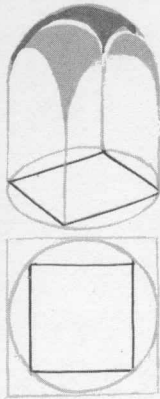




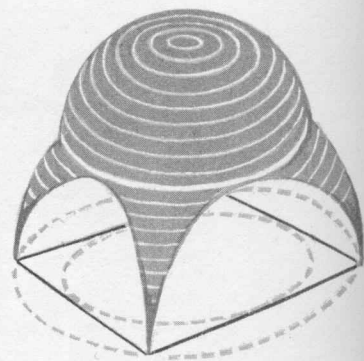
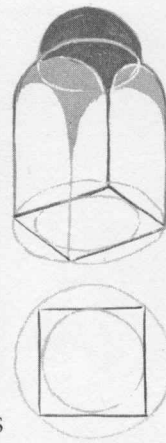
# BYZANTINE



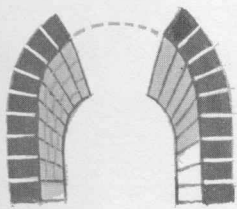
Pendentives



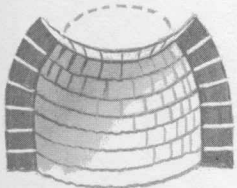
Dome and pendentives parts of one hemisphere



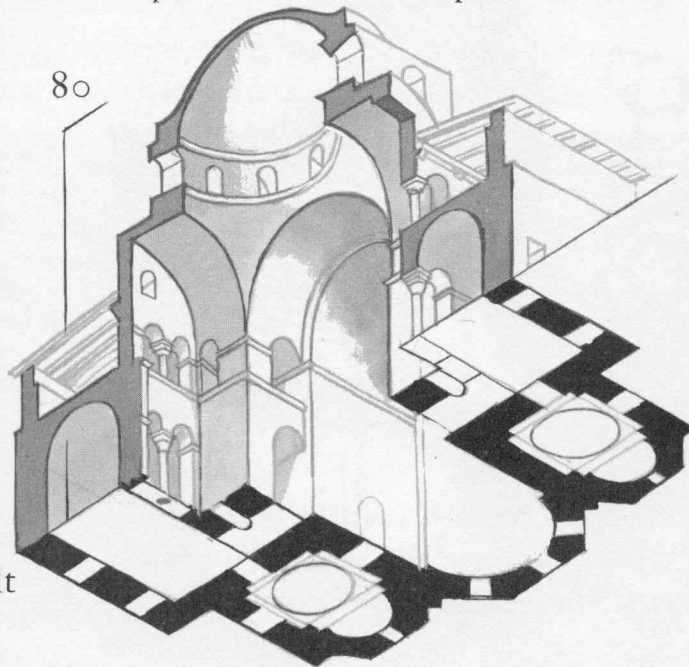
The dome a hemisphere set above pendentives



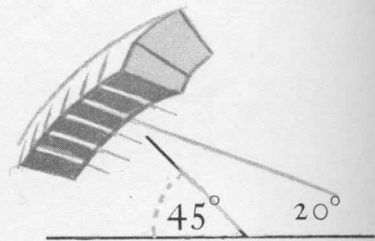
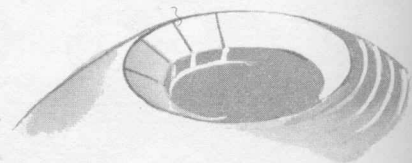
To build an arch centering is necessary,



but a dome can be built in successive rings of horizontal arches without centering



S. Sophia, Salonika, c. A.D. 495

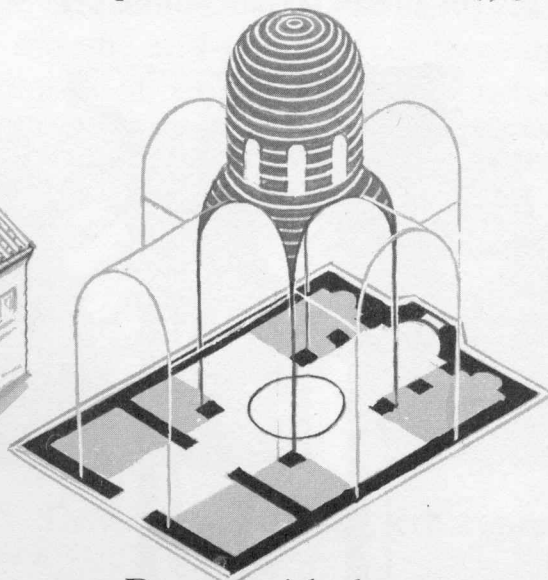


Domes on pendentives built with bricks not radiating from centre

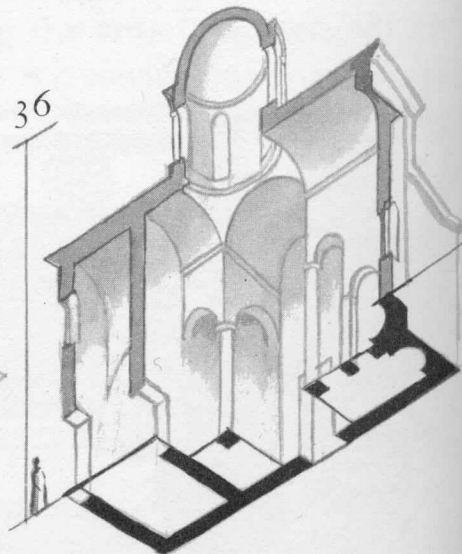


Little Cathedral,

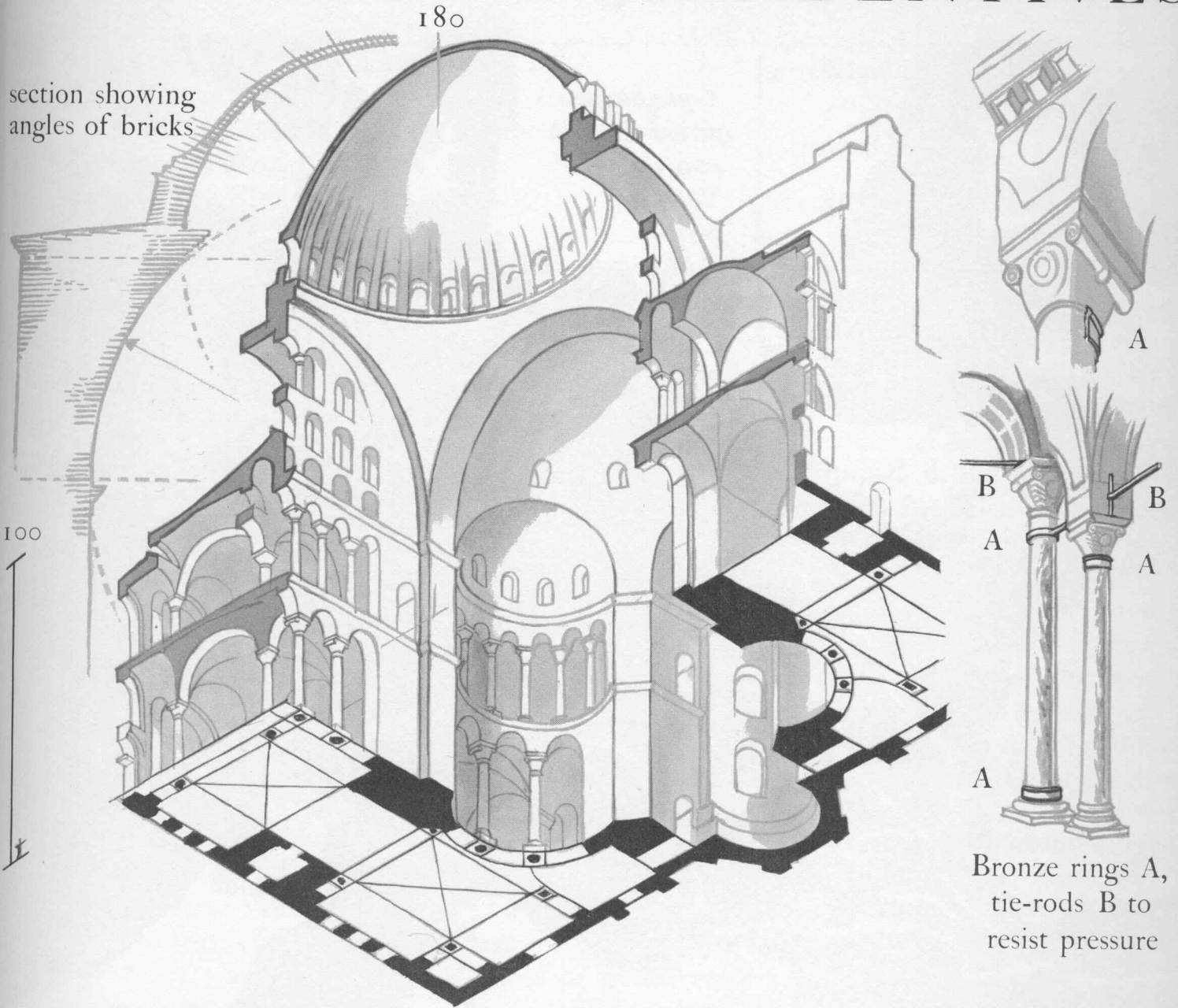
Metropole Athens, A.D. 1250



Dome with drum: cross-in-square plan

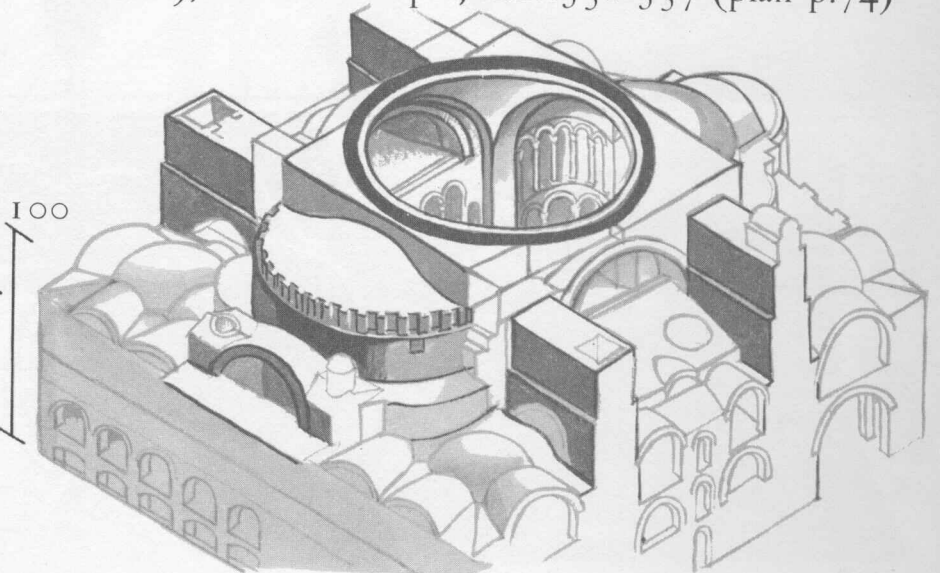


# DOMES ON PENDENTIVES



S. Sophia (Hagia Sophia = divine wisdom), Constantinople, A.D.-532-537 (plan p.74)

Built for Justinian by two Greek architects, Anthemius of Tralles and Isidorus of Miletus. Built of brick; the dome probably erected without centering, with bricks about 24-27 inches square and 2 inches thick laid in deep mortar and covered with  $\frac{1}{4}$  inch lead; the dome supported on 4 piers, the thrust being taken by 2 semi-domes and 4 massive buttresses; the interior lined throughout in coloured marbles and mosaics

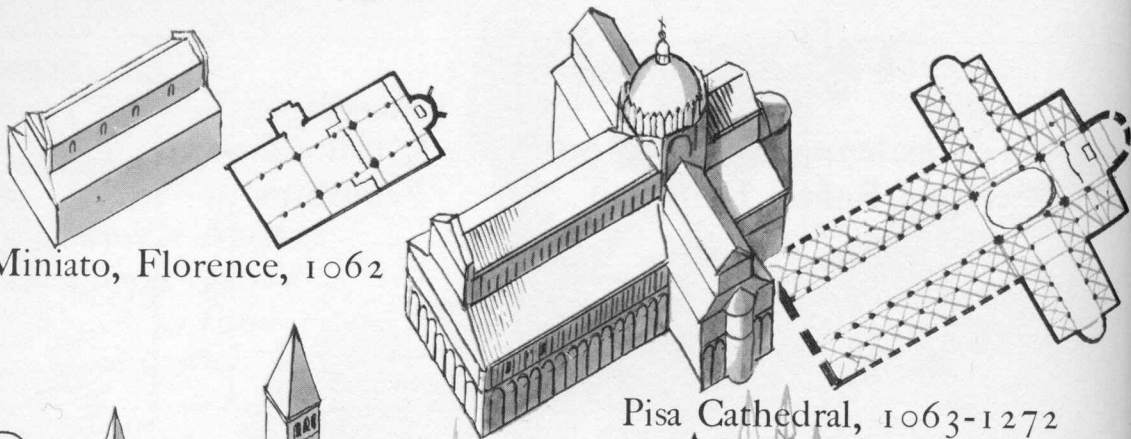


# ROMANESQUE

plans and elevations  
to the same scale

200

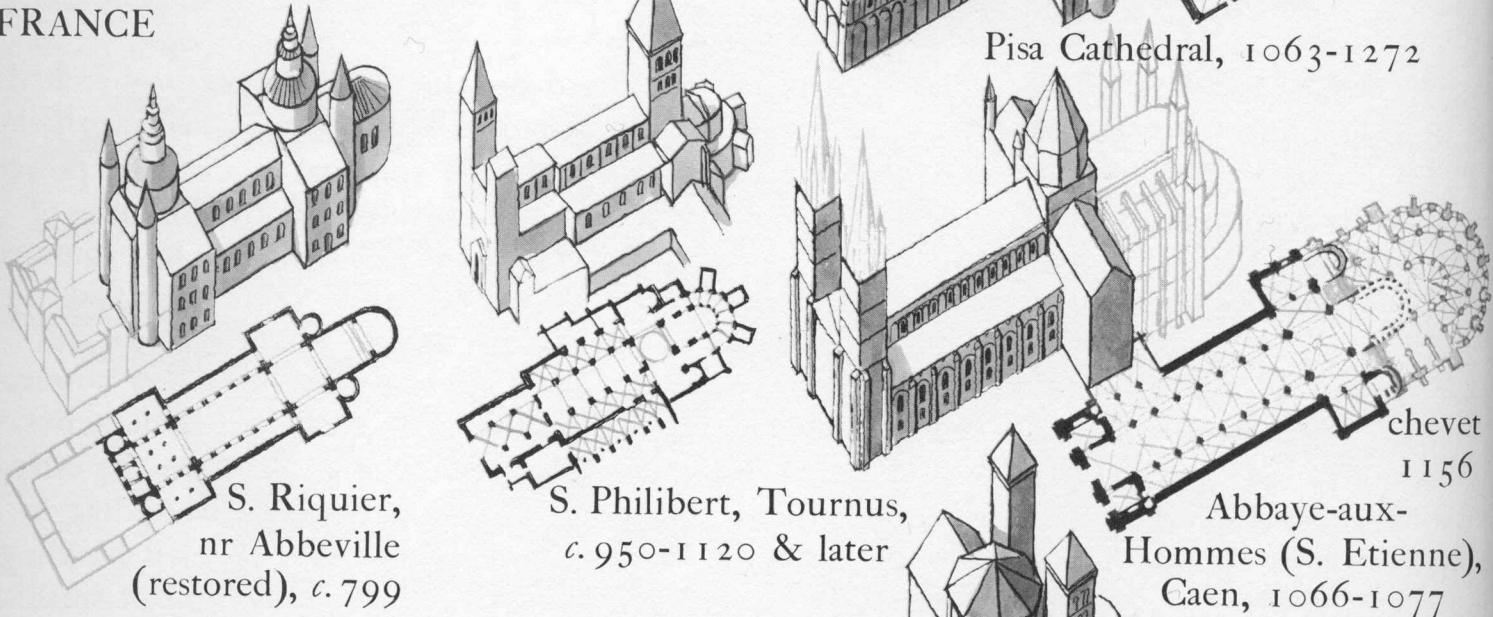
## ITALY



S. Miniato, Florence, 1062

Pisa Cathedral, 1063-1272

## FRANCE

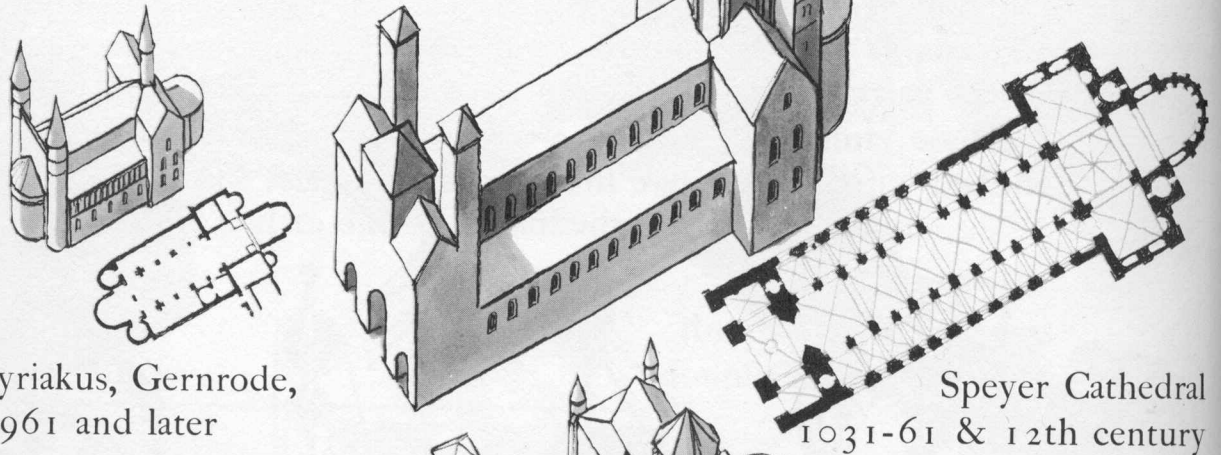


S. Riquier,  
nr Abbeville  
(restored), c. 799

S. Philibert, Tournus,  
c. 950-1120 & later

chevet  
1156  
Abbaye-aux-  
Hommes (S. Etienne),  
Caen, 1066-1077

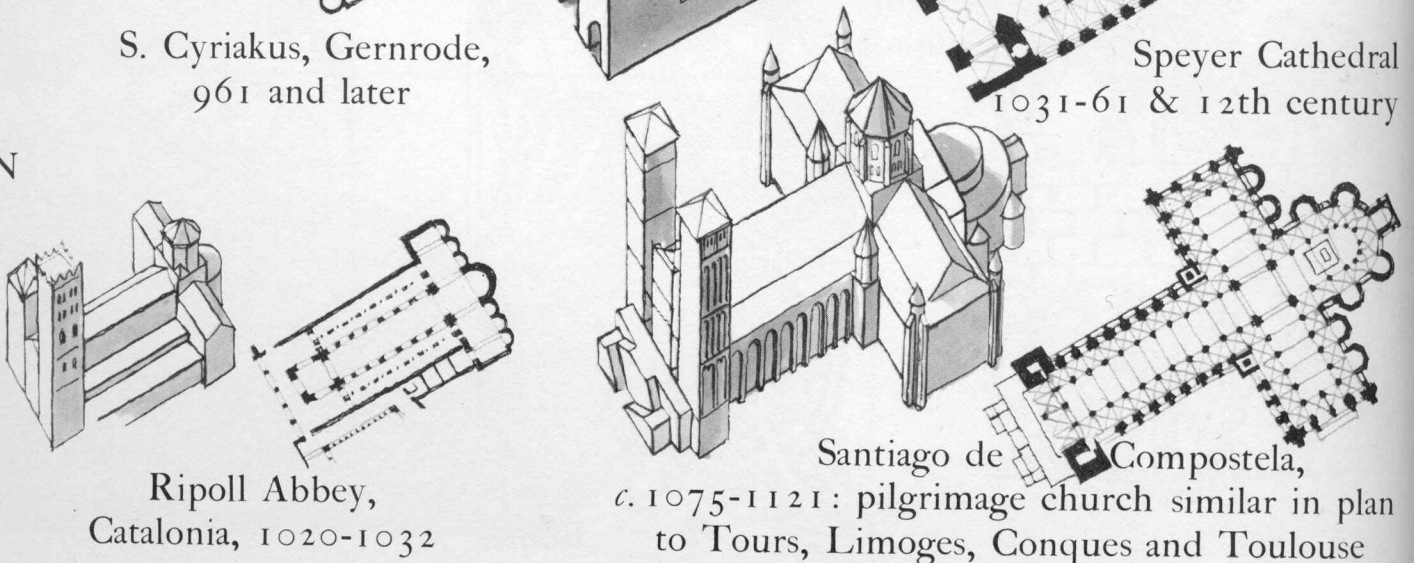
## GERMANY



S. Cyriakus, Gernrode,  
961 and later

Speyer Cathedral  
1031-61 & 12th century

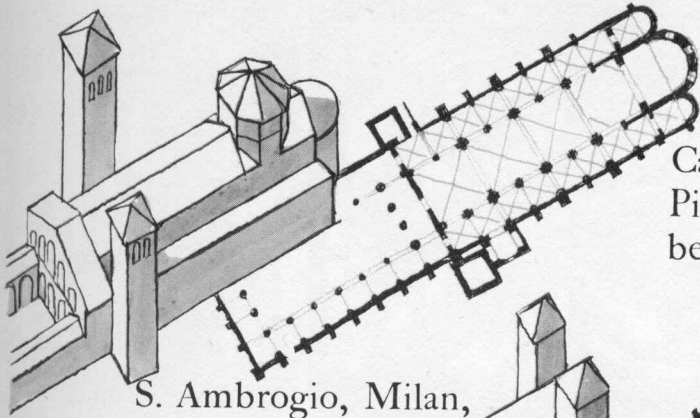
## SPAIN



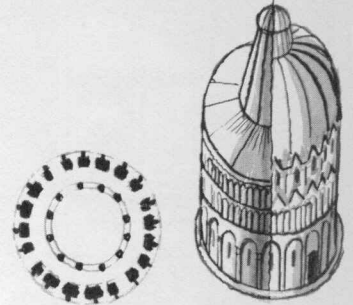
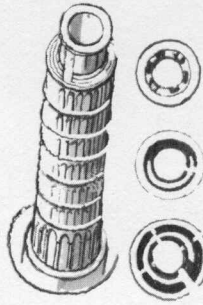
Ripoll Abbey,  
Catalonia, 1020-1032

Santiago de Compostela,  
c. 1075-1121: pilgrimage church similar in plan  
to Tours, Limoges, Conques and Toulouse

# PLANS & ELEVATIONS

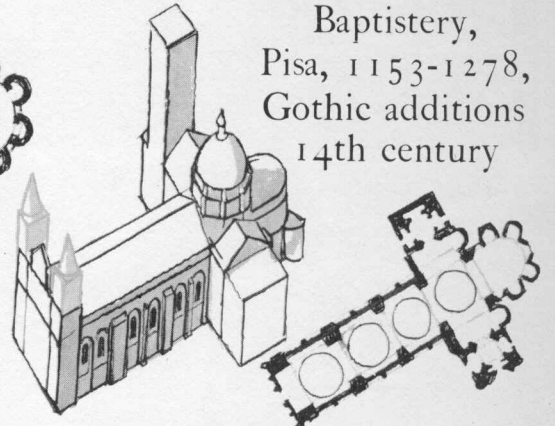
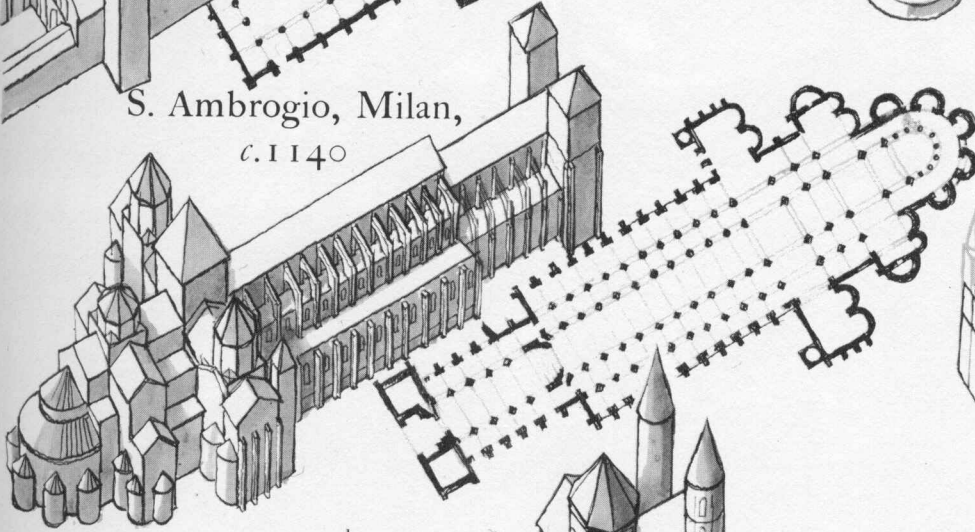


Campanile,  
Pisa, 1174;  
belfry 1350



Baptistry,  
Pisa, 1153-1278,  
Gothic additions  
14th century

S. Ambrogio, Milan,  
c. 1140

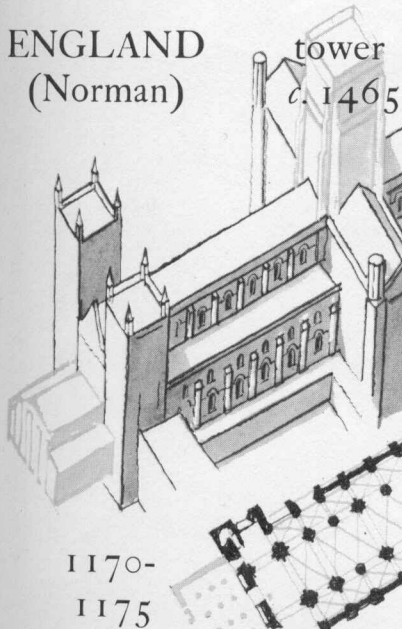
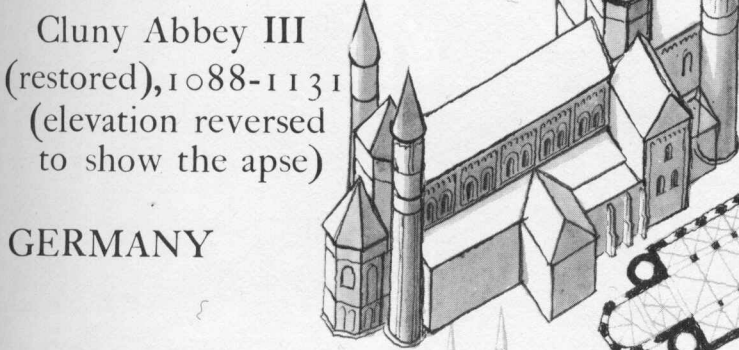


Angoulême Cathedral,  
1105-1128 and later

Cluny Abbey III  
(restored), 1088-1131  
(elevation reversed  
to show the apse)

## GERMANY

## ENGLAND (Norman)



1170-  
1175

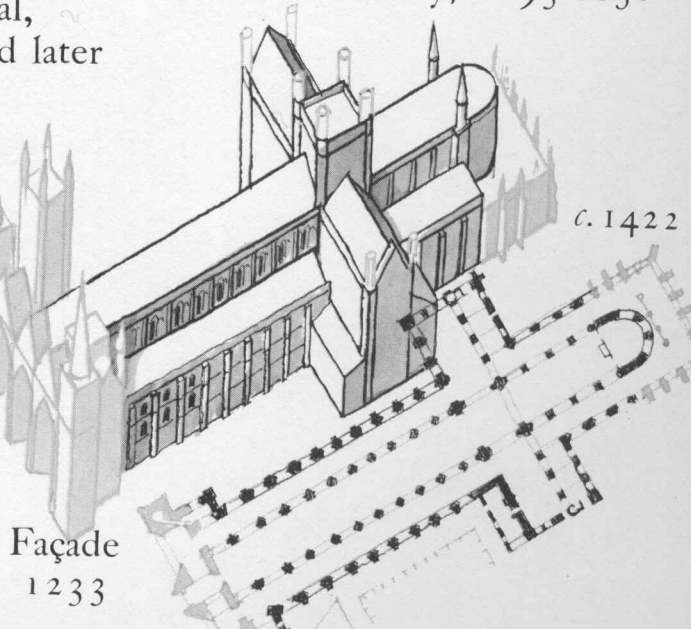
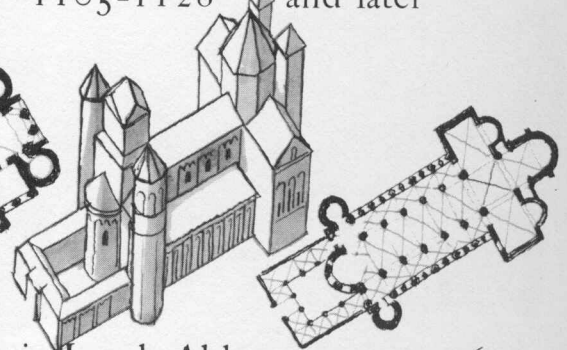
Durham Cathedral, 1093-1133

Worms Cathedral,  
1105-1128 and later



1240-  
1290

Maria Laach Abbey, 1093-1156

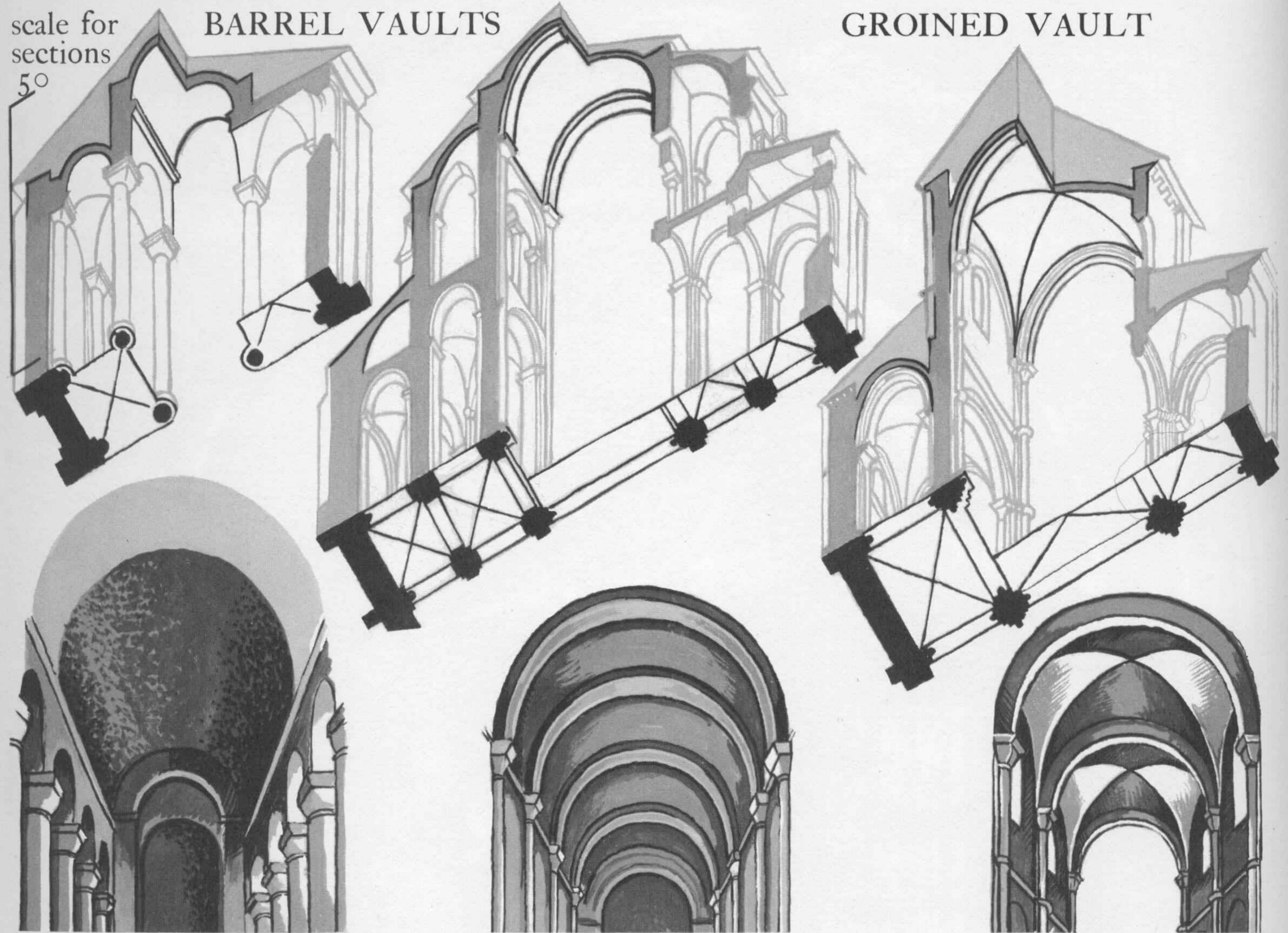


Façade  
1233

Peterborough Cathedral, 1177-1190

c. 1422

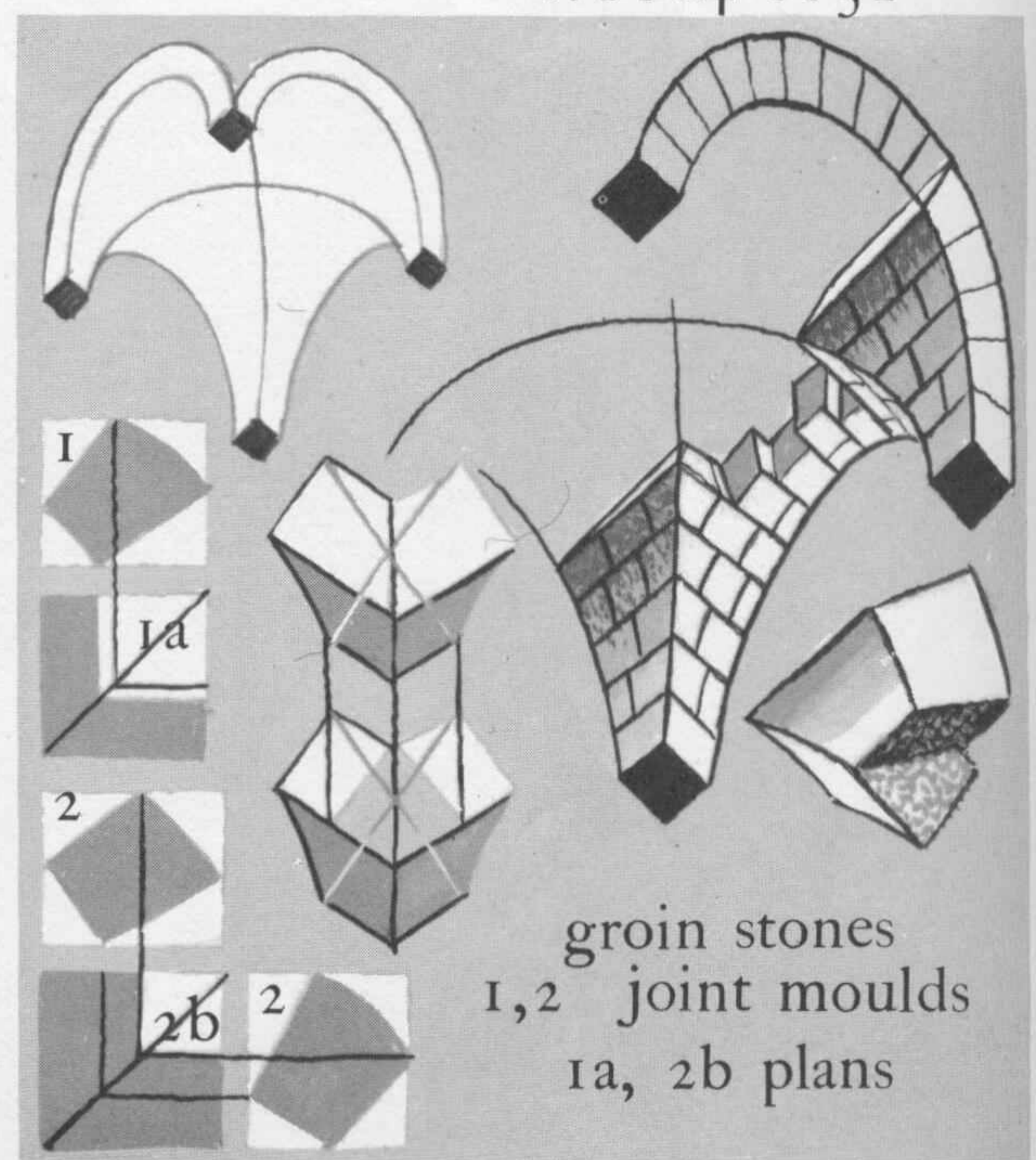
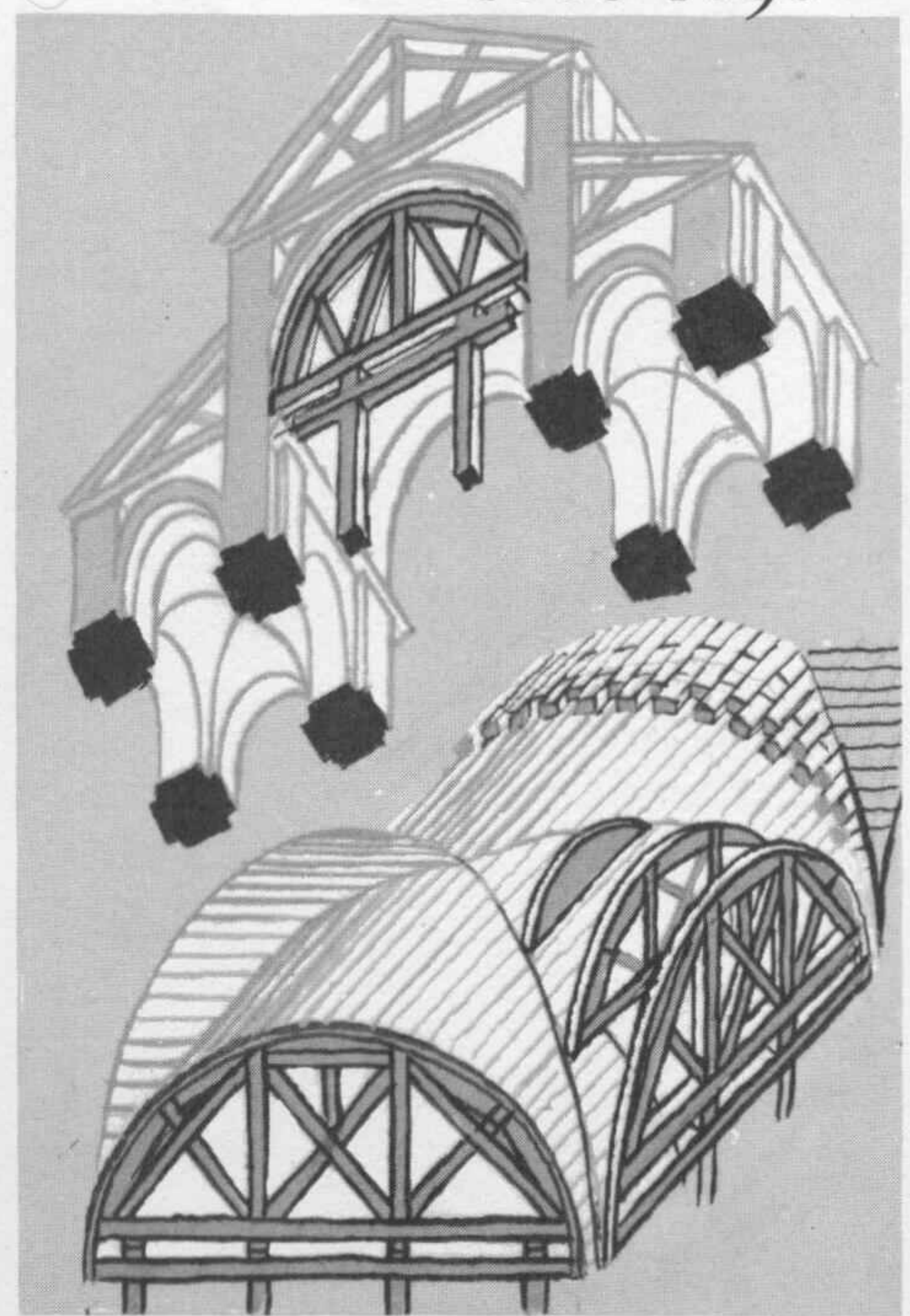
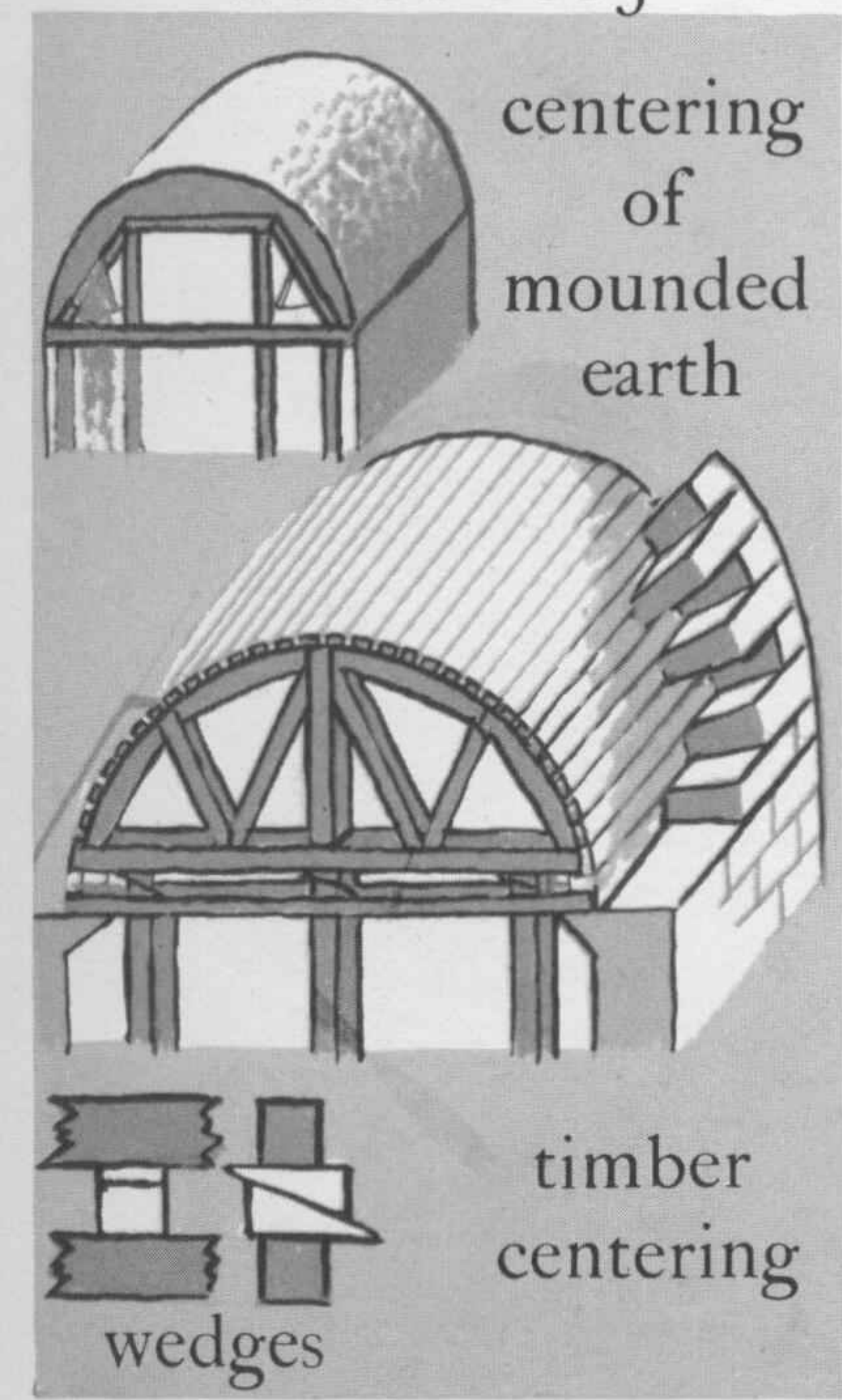
# ROMANESQUE



S. Savin-sur-Gartempe,  
c. 1060-1115

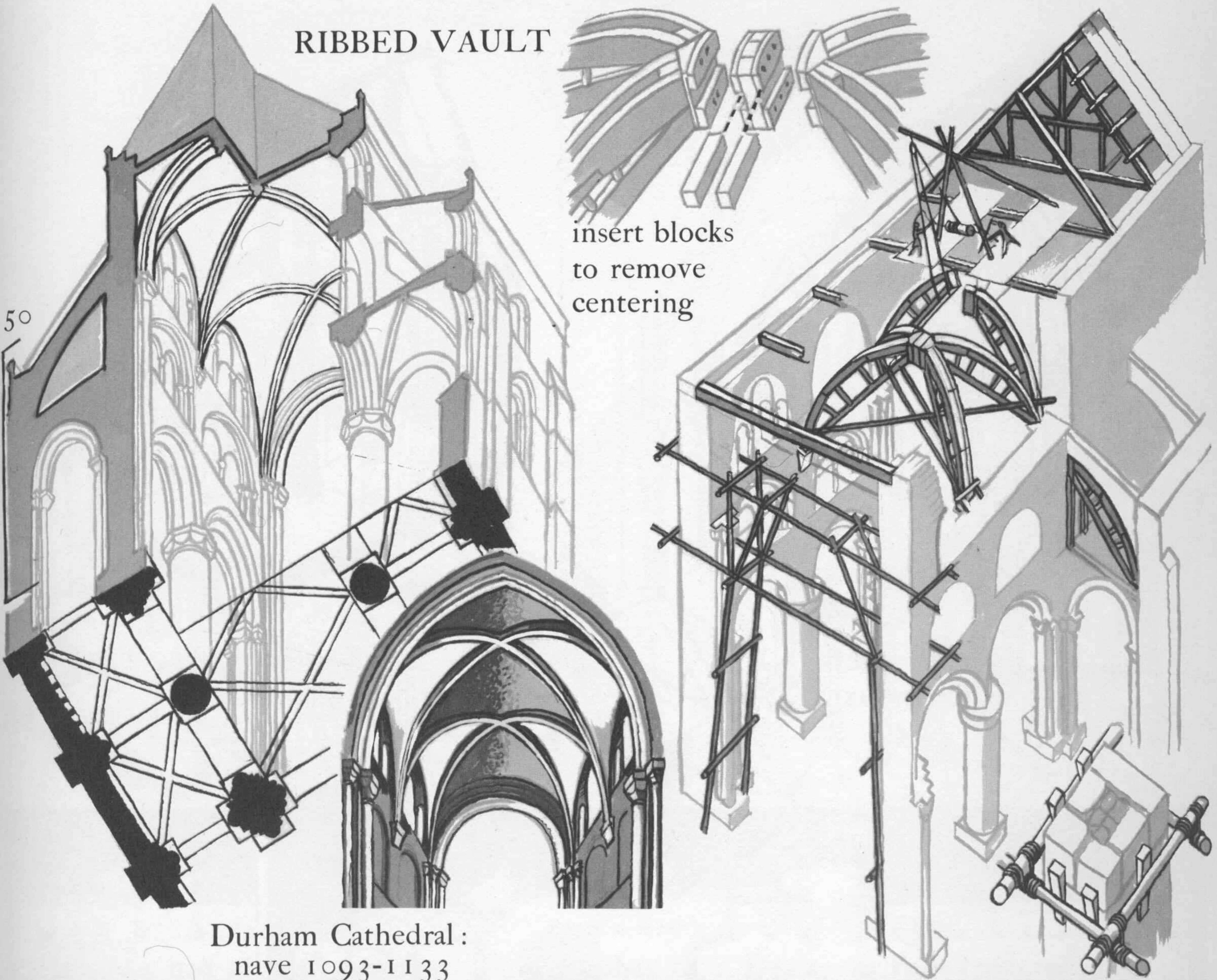
S. Sernin, Toulouse,  
1080-1096

S. Madelaine, Vézelay,  
c. 1104-1132

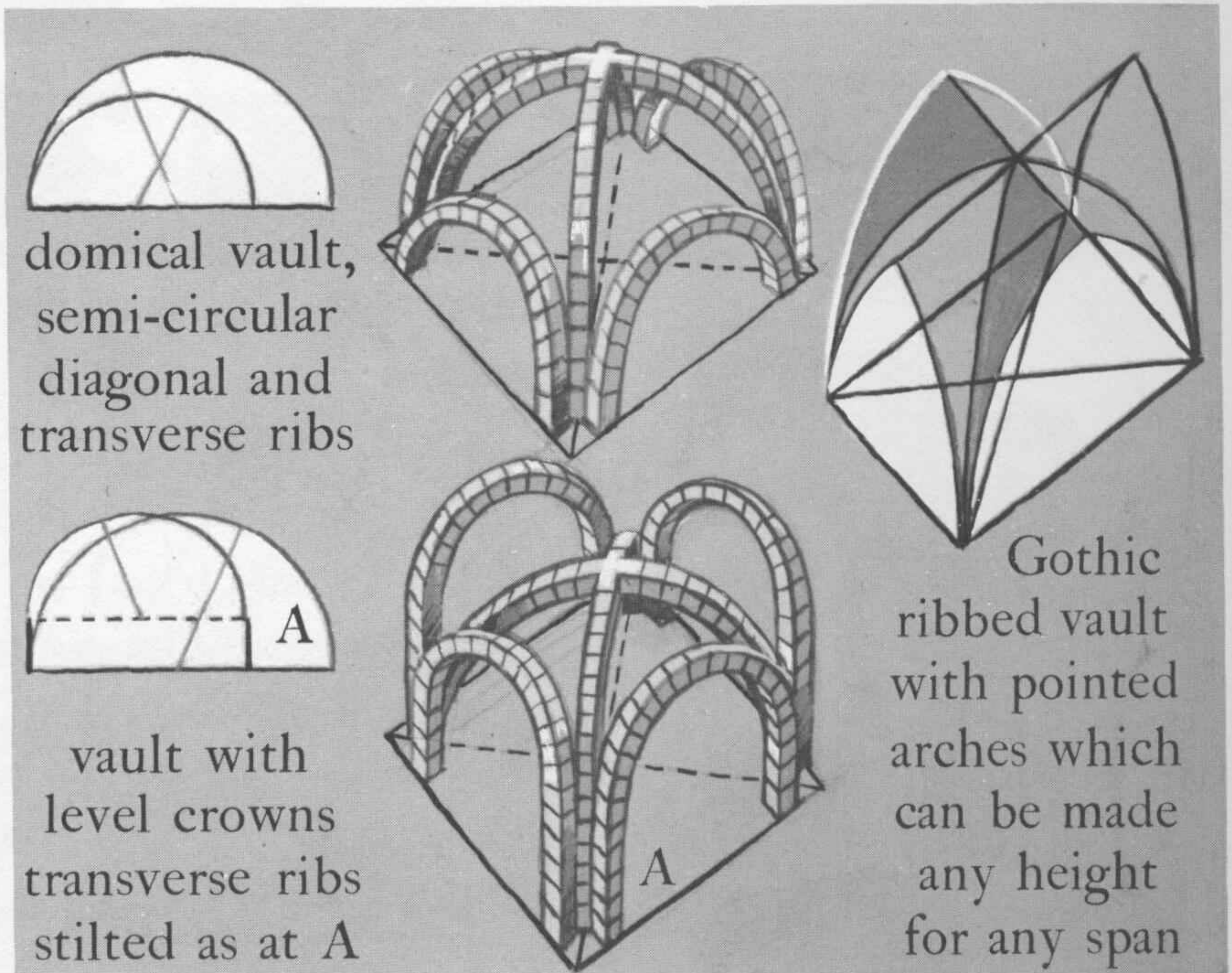
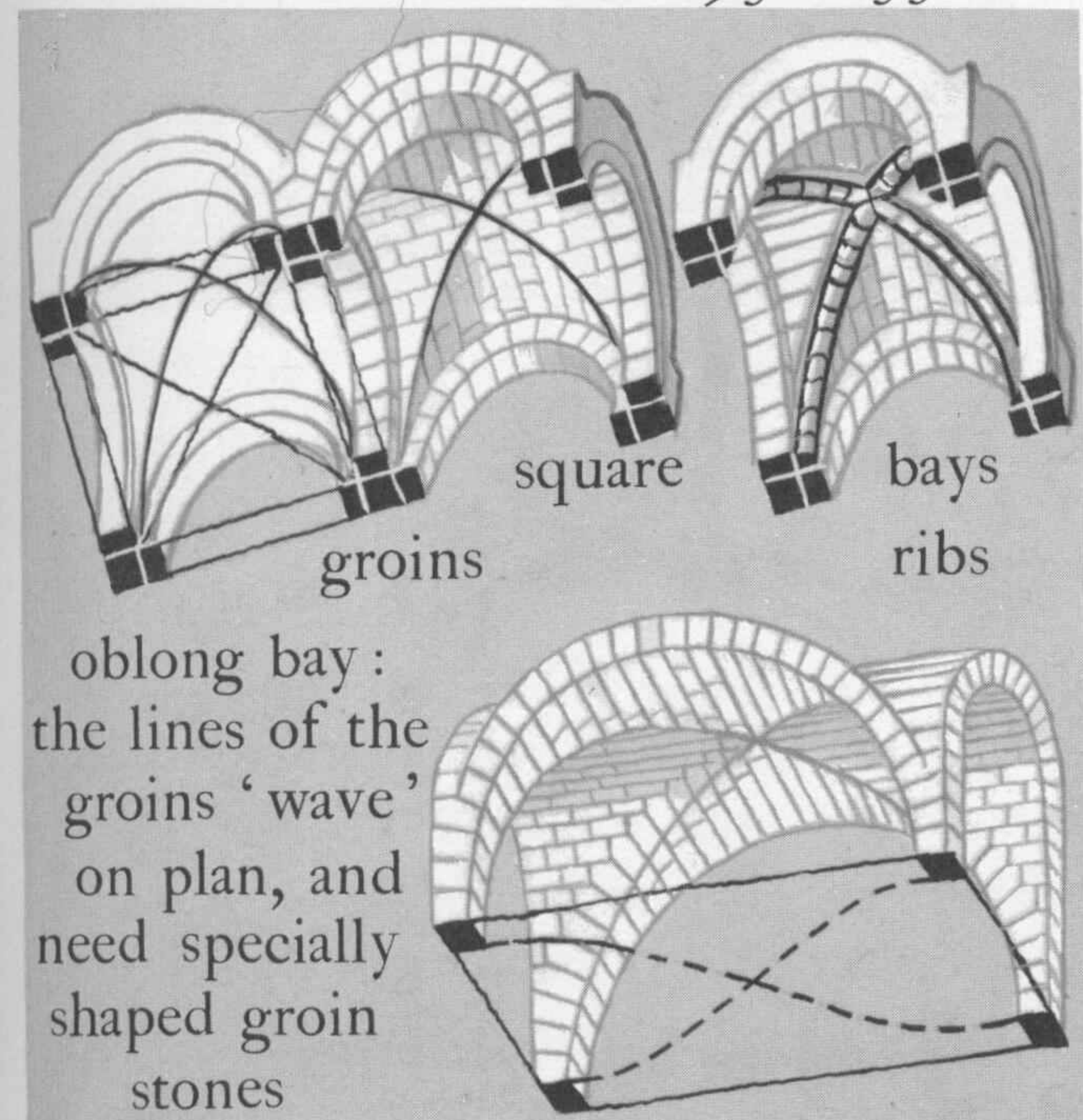


# STONE VAULTING

## RIBBED VAULT



Durham Cathedral:  
nave 1093-1133

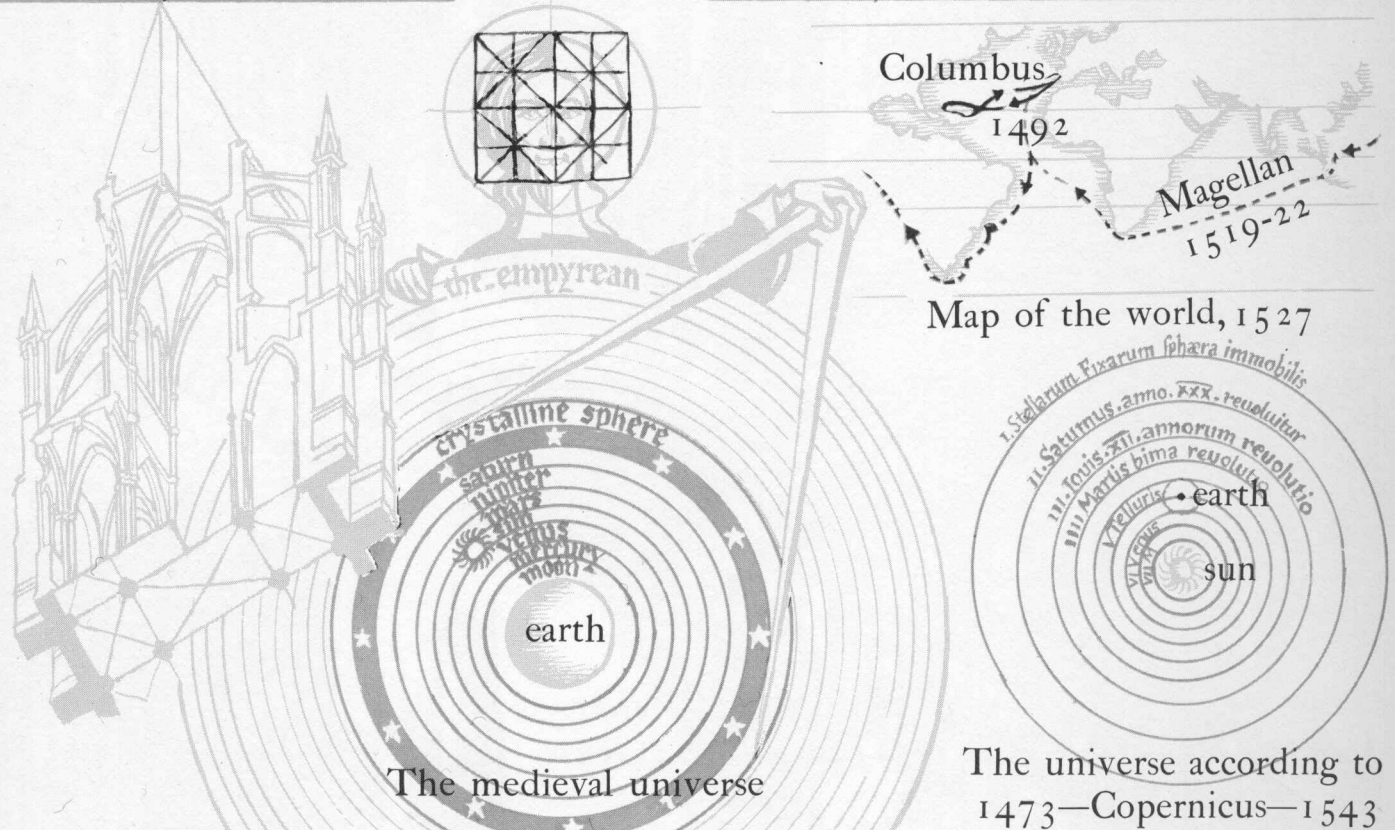


# GOTHIC



# INTRODUCTION

1100	1200	1300	1400	1500	1550
Increase of trade, growth of towns, & rise of guilds	Ascension of Gothic in Ile de France	Black Death 1348-49	1346-1453 The 100 Years' War	1453	End of Eastern Byzantine Empire
Universities Aristotle (via Arabs)	Scholasticism c.1225-S. Aquinas-c.1275	Humanism 1304-Petrarch-1374 1265-Dante-1321	Italian RENAISSANCE 1452-Leonardo da Vinci-1519		
Discoveries: optical lens,	1214-Roger Bacon-	1294	c.1450 printing		



The medieval universe

The universe according to 1473—Copernicus—1543

The enlargement of S. Denis, 1144 (p.89) inaugurated a lyrical form of construction in which pointed arches, high stone vaults and flying buttresses were fused into an organic whole, and which reached a crescendo in the cathedrals built in the Ile de France (pp.100-101). Gothic, or the 'style Ogivale' (Fr.: pointed) was known as 'Opus Modernum' or 'Opus Francigenum' (French work); the term 'Gothic', i.e. barbarian, was first used by the Humanists of the Renaissance. Few plans survive by the lay master-masons, who designed their buildings with 'a good wit of geometry' and who directed the quarry-men, stone-cutters, smiths, carpenters & workmen. In England (pp.102-105), France (pp.106-107), Italy (pp.108-109) and Germany (pp.110-111) castles, parish churches, guild-halls and houses followed the same pattern of pointed arches, pinnacles, spires & high-pitched roofs. South of the Alps in Italy Gothic was neutralised by the Roman tradition and ceased with the advent of the Renaissance in the 15th century.



# GOTHIC

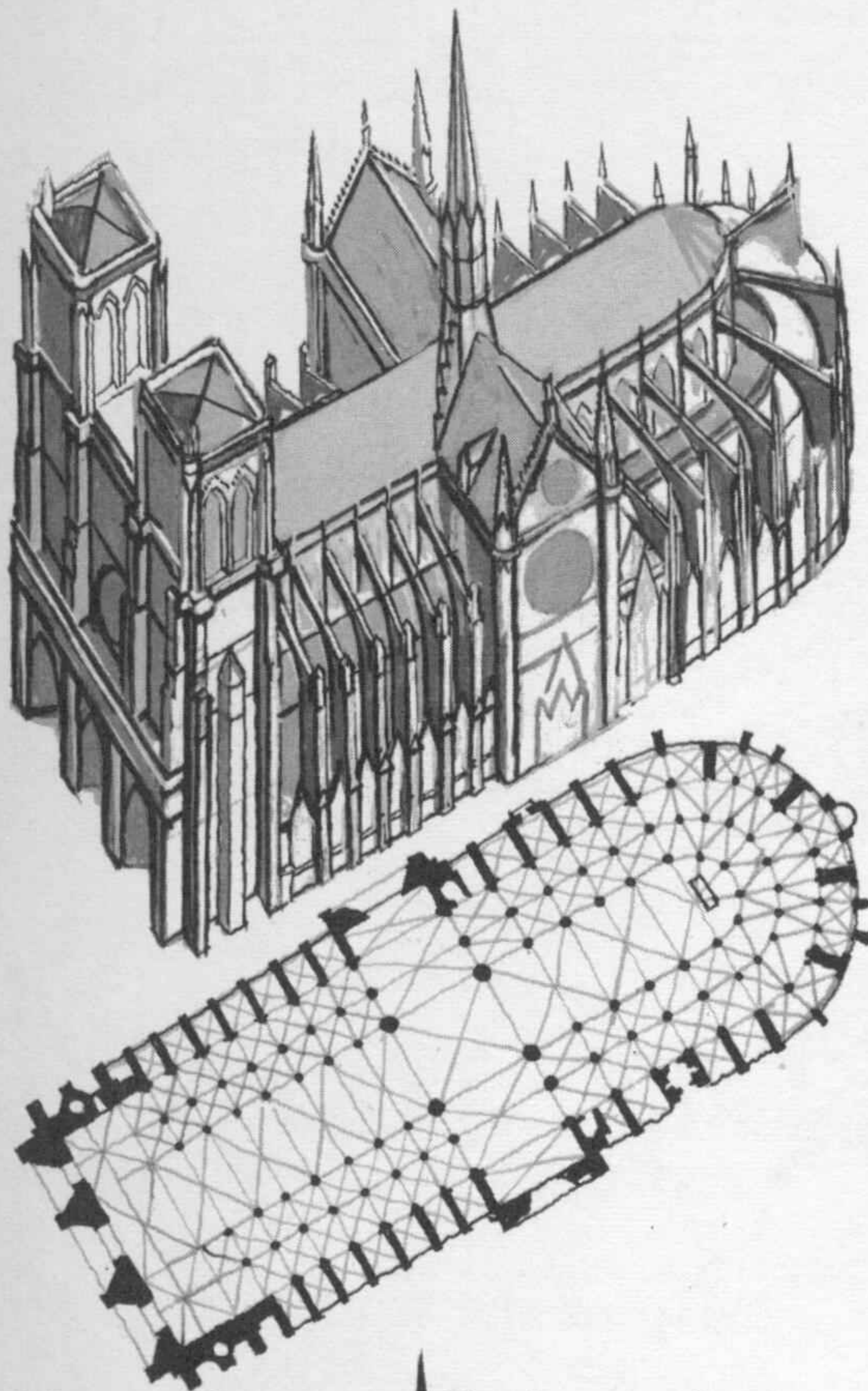
plans  
and elevations  
to the same scale

Amiens Cathedral,

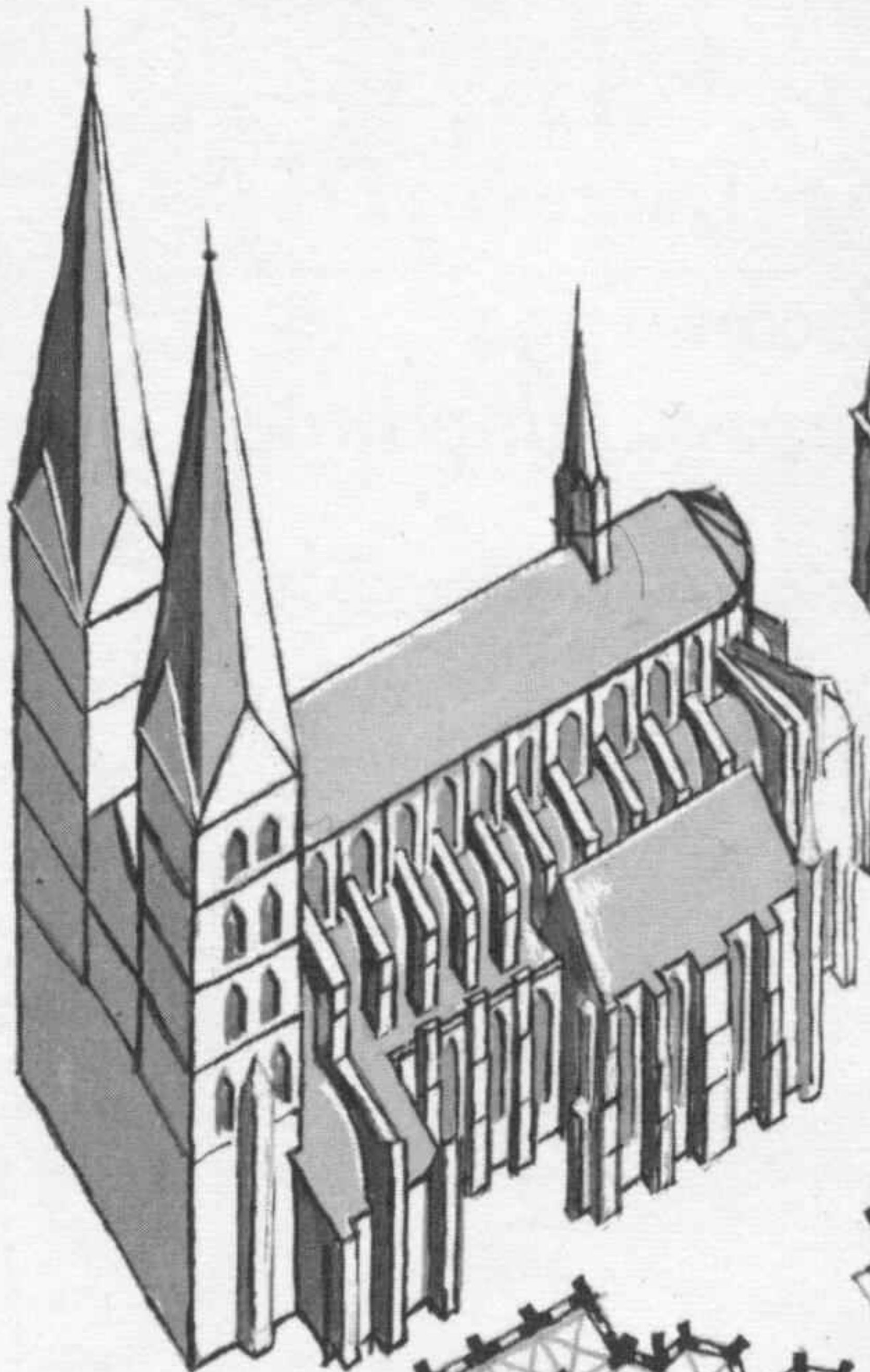
220-1288

200

FRANCE

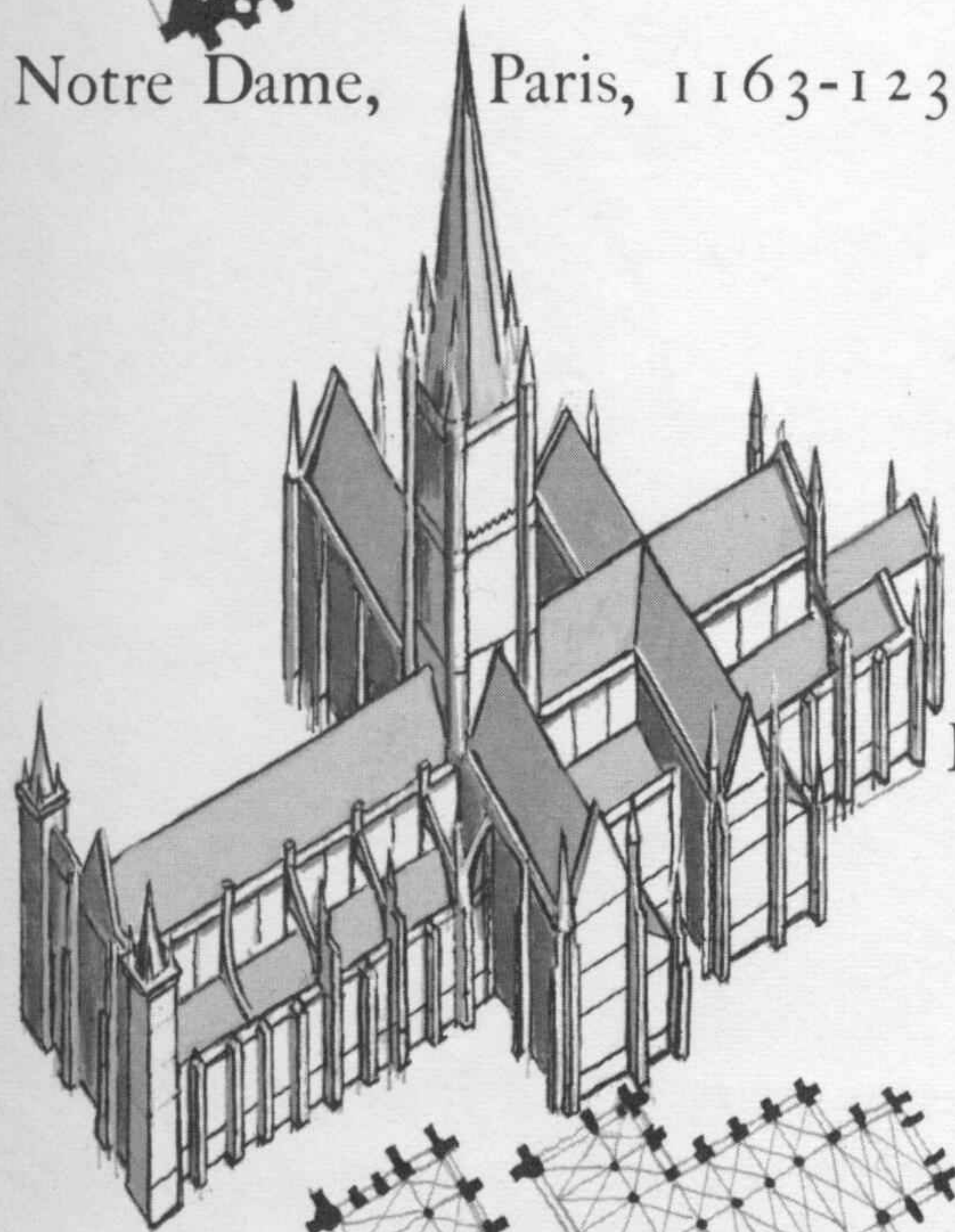
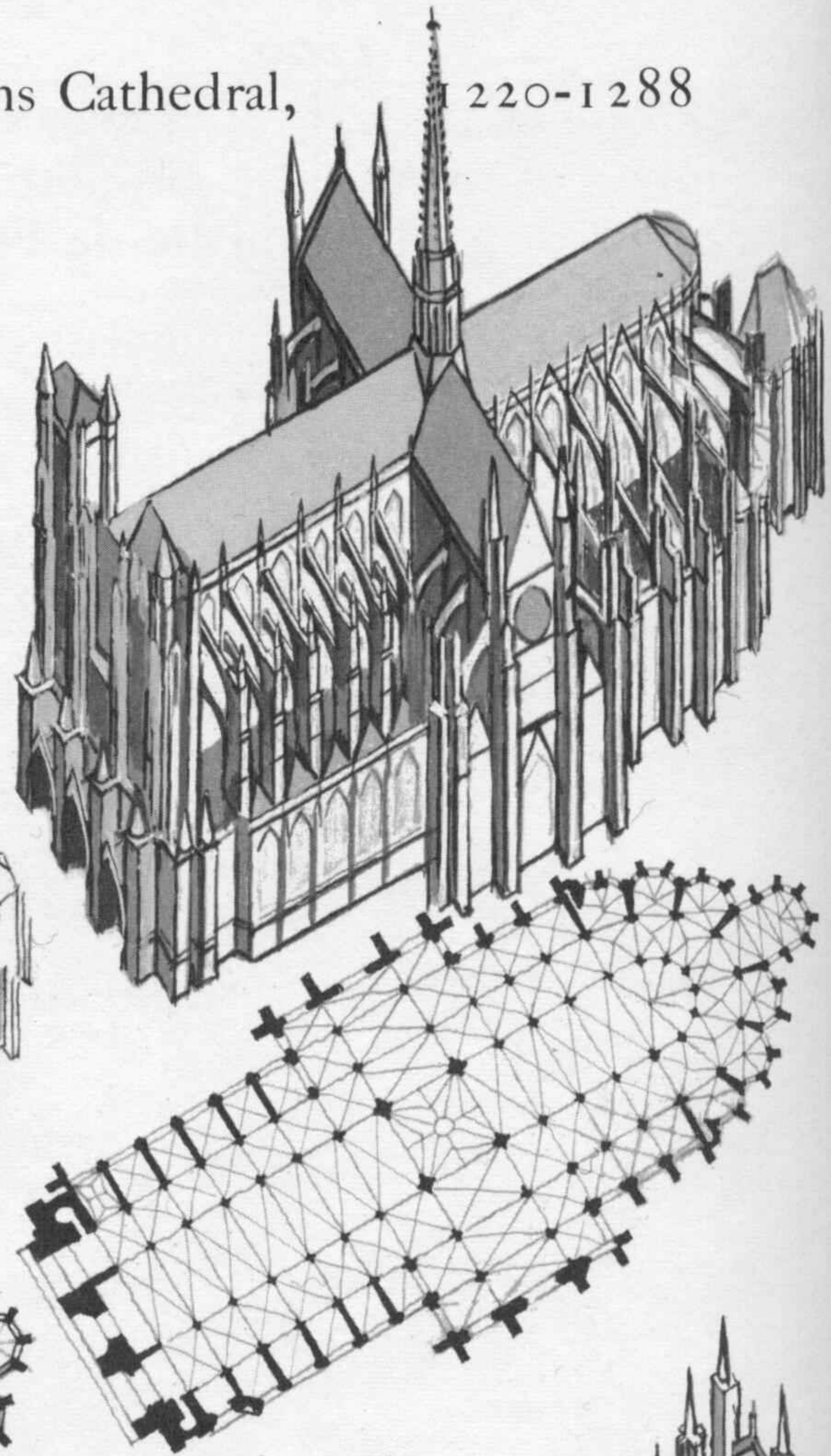


Notre Dame, Paris, 1163-1235



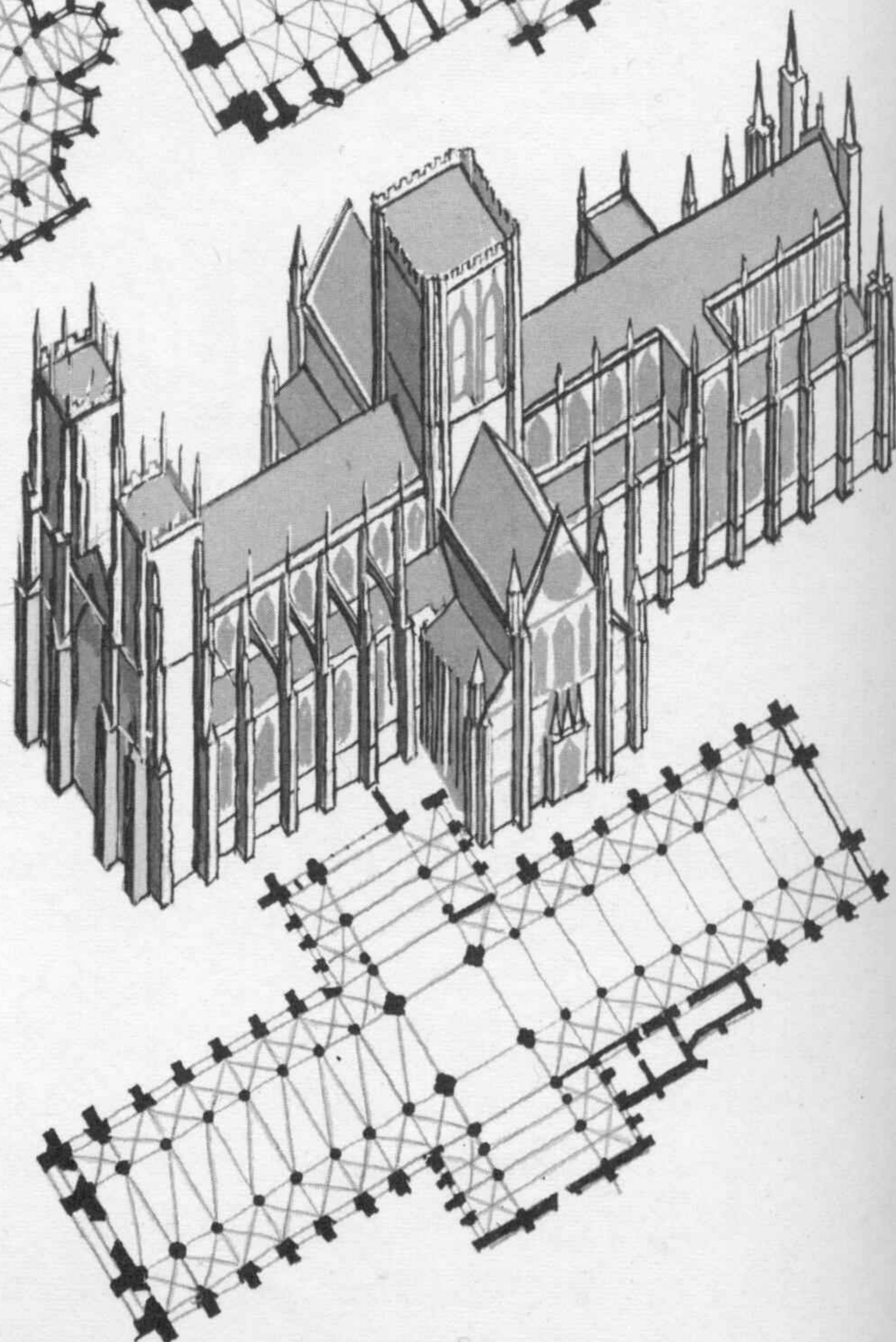
Marienkirche,  
Lübeck, 1251-1310

GERMANY



Salisbury Cathedral, 1220-1258

ENGLAND



York Cathedral, 1261-1324

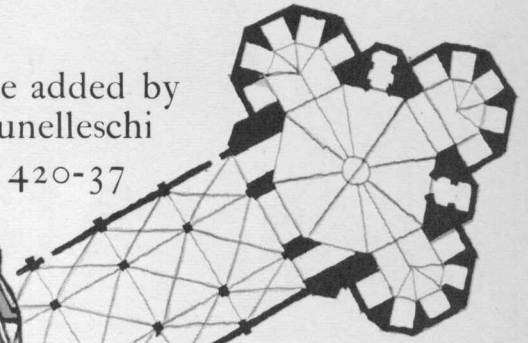
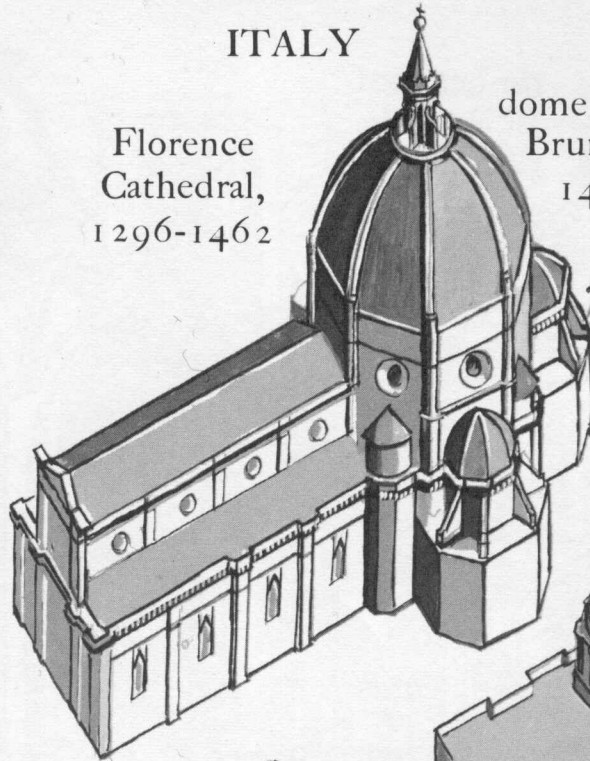
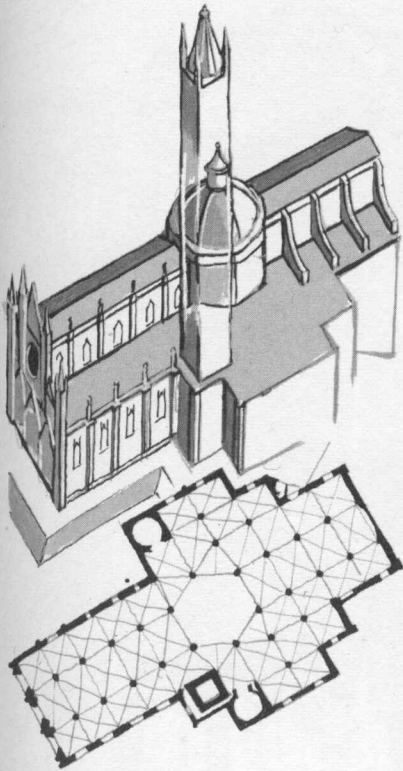
# PLANS & ELEVATIONS

## ITALY

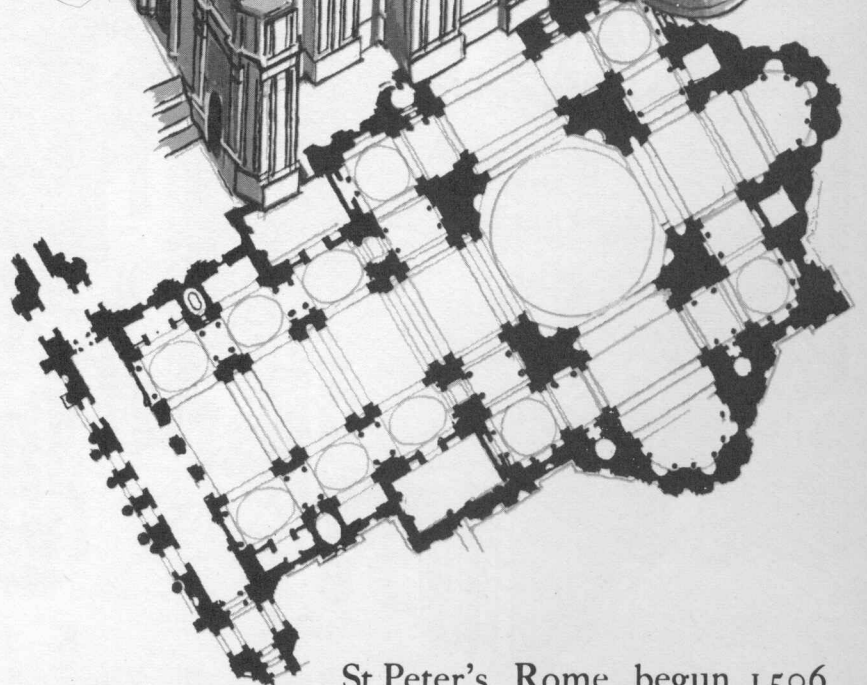
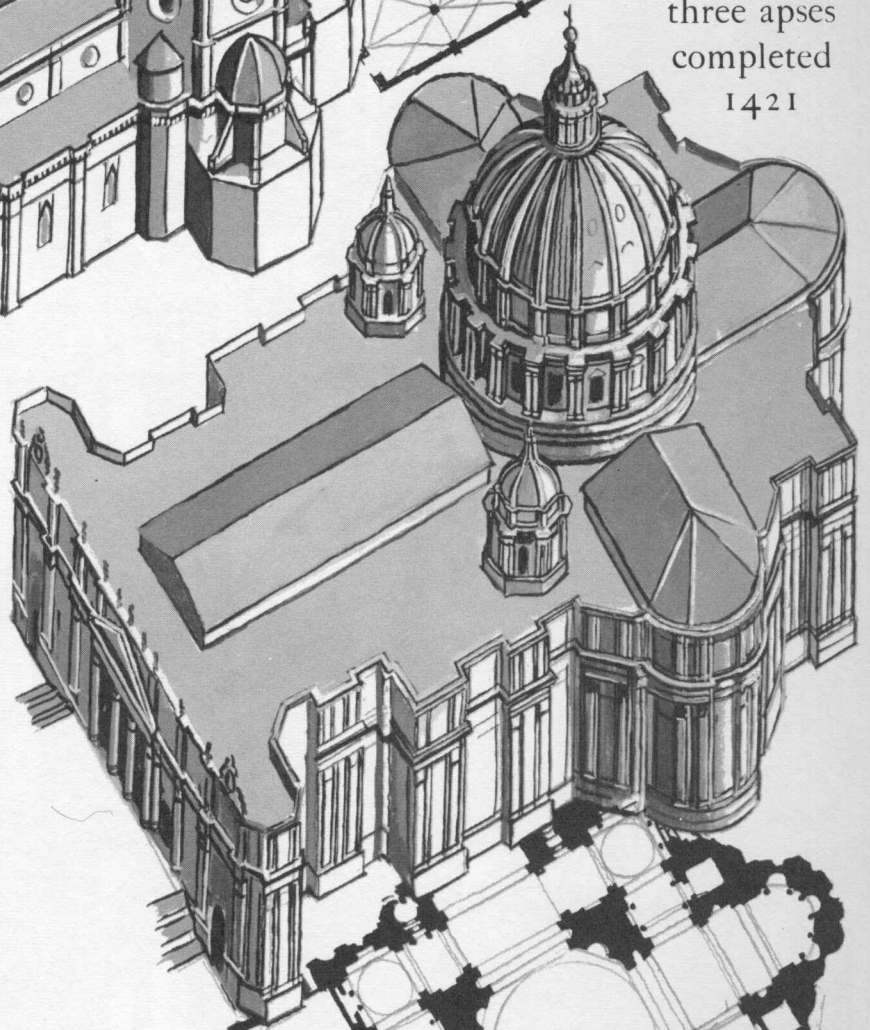
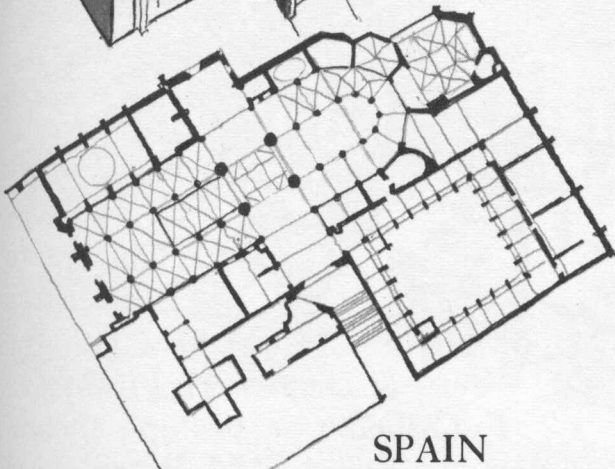
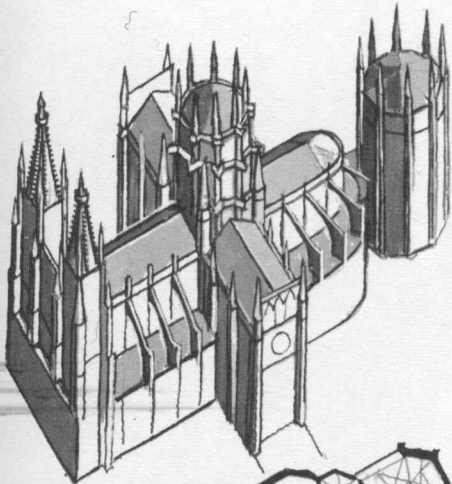
Florence Cathedral,  
1296-1462

dome added by  
Brunelleschi  
1420-37

three apses  
completed  
1421



Siena Cathedral,  
1245-1380

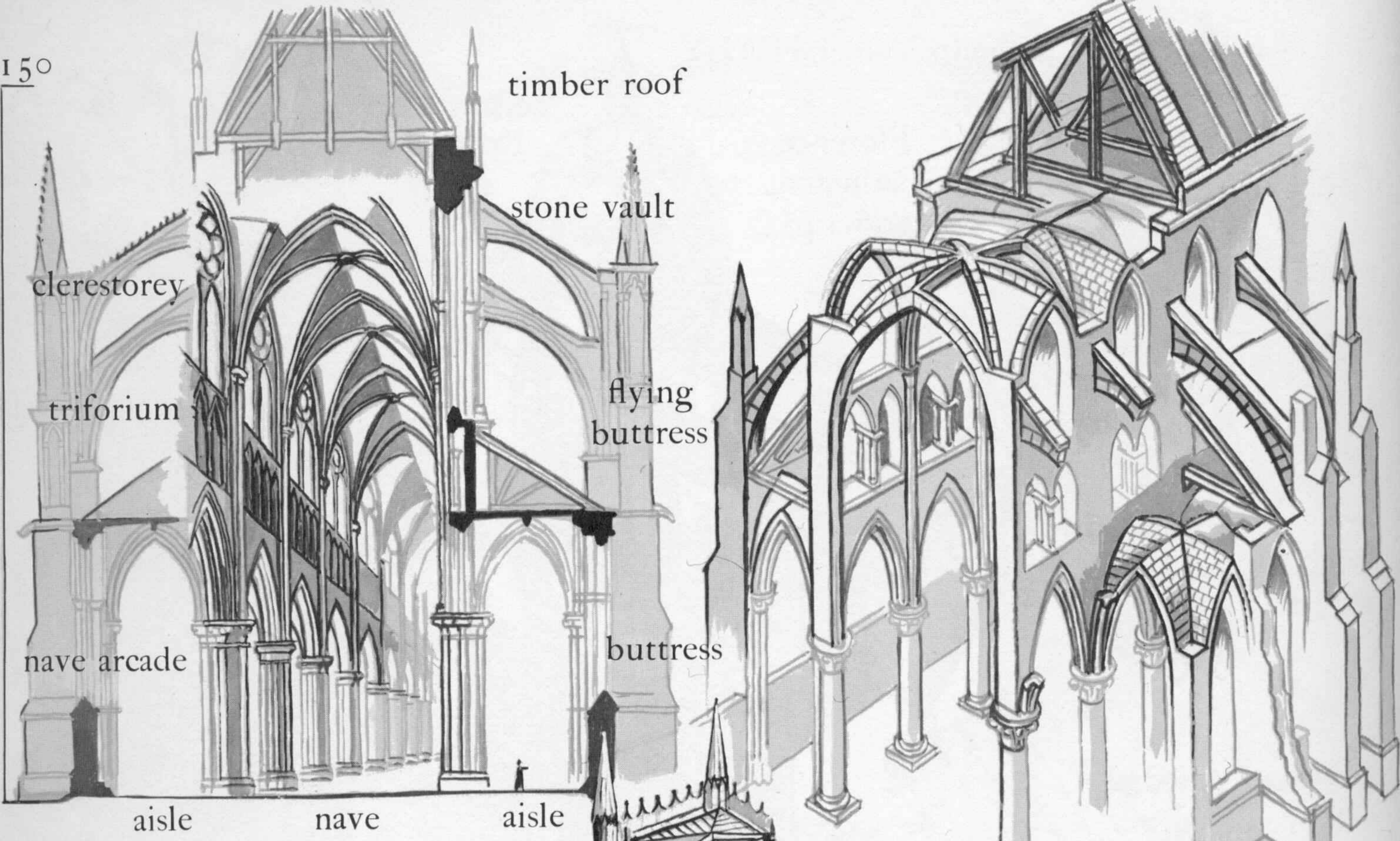


## SPAIN

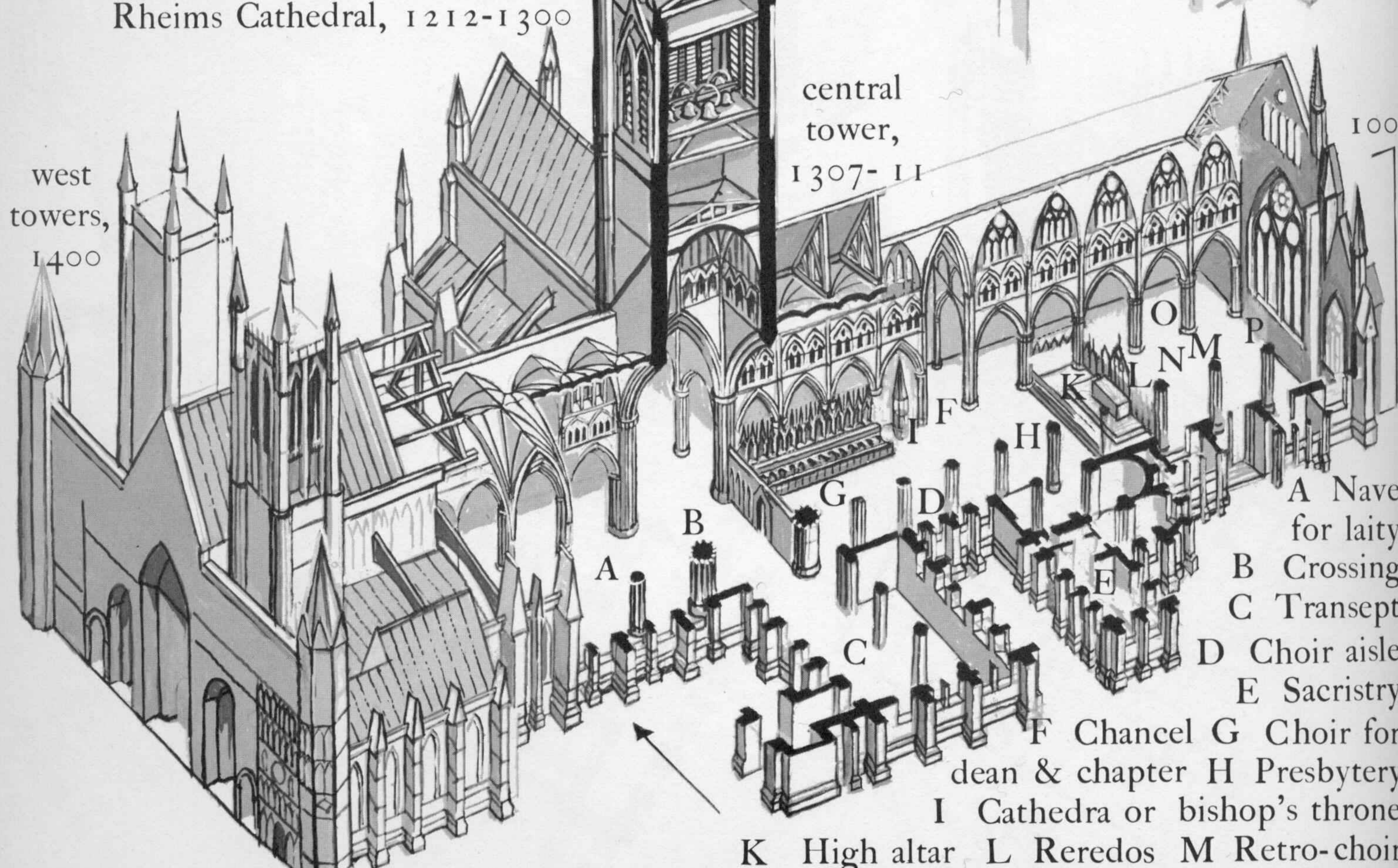
Burgos Cathedral, 1220-1500

St Peter's, Rome, begun 1506

# GOTHIC



Rheims Cathedral, 1212-1300



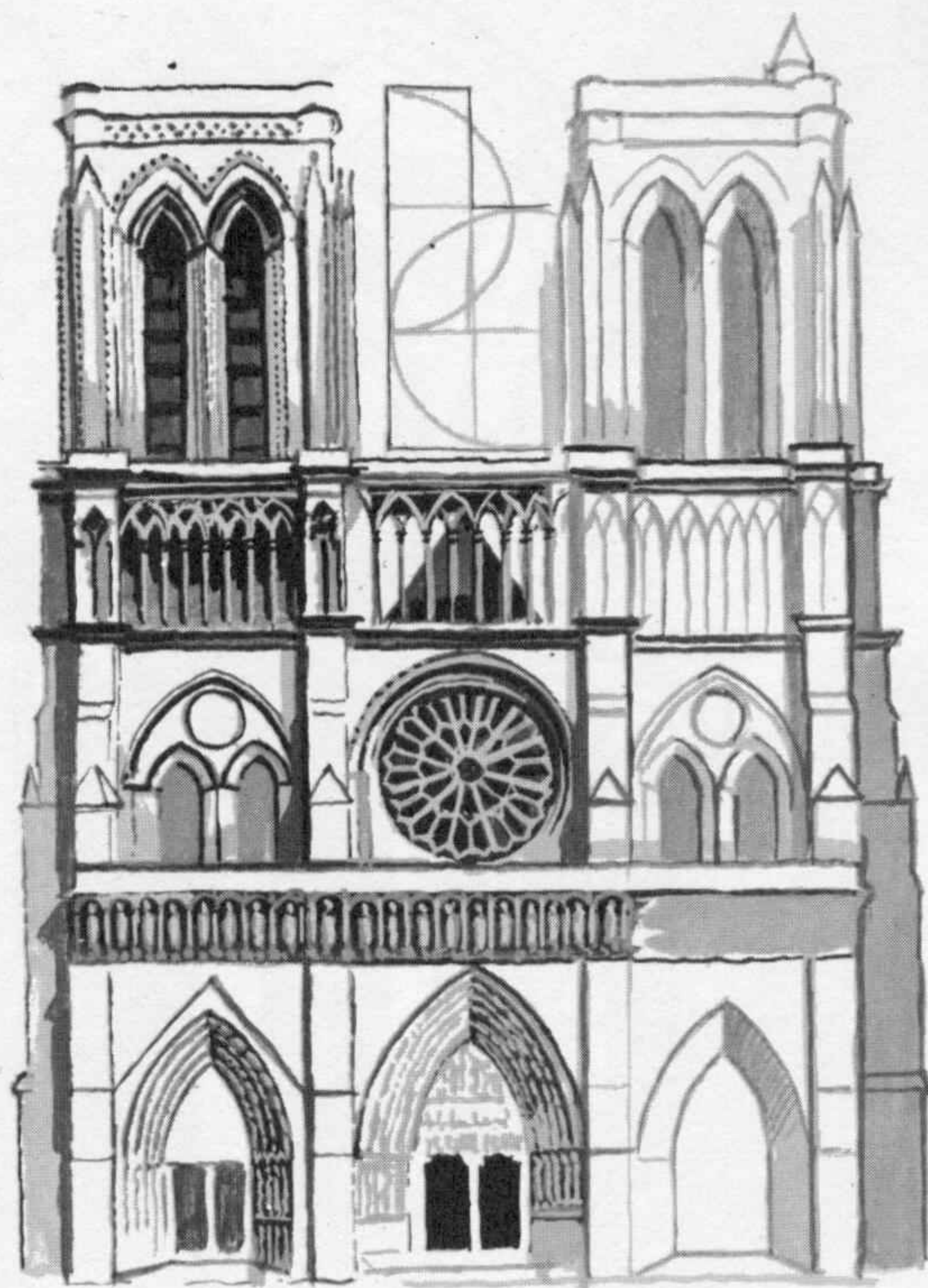
Lincoln Cathedral, 1220-1280

N Principal shrine O Ambulatory P Lady chapel

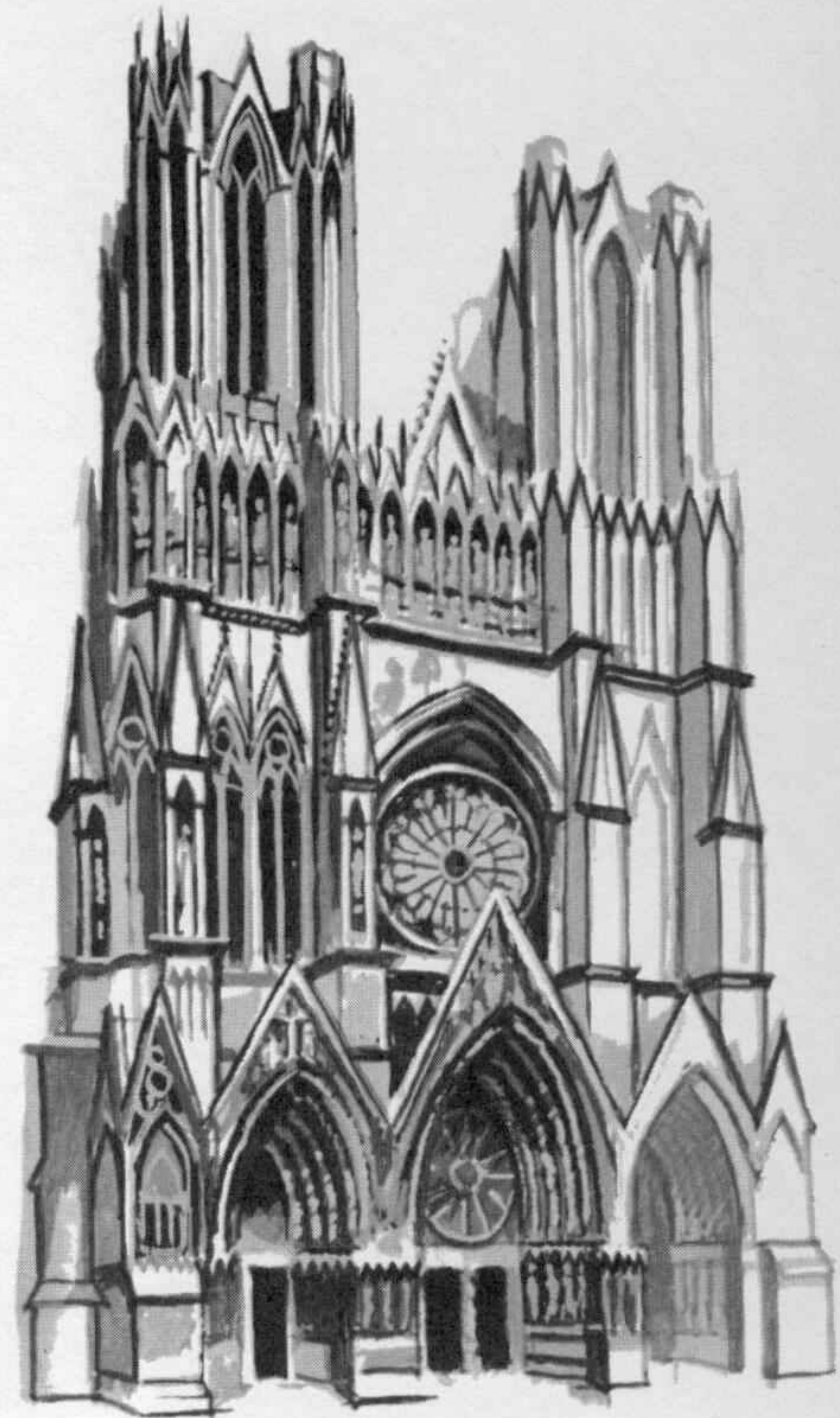
# THE PARTS OF A CATHEDRAL



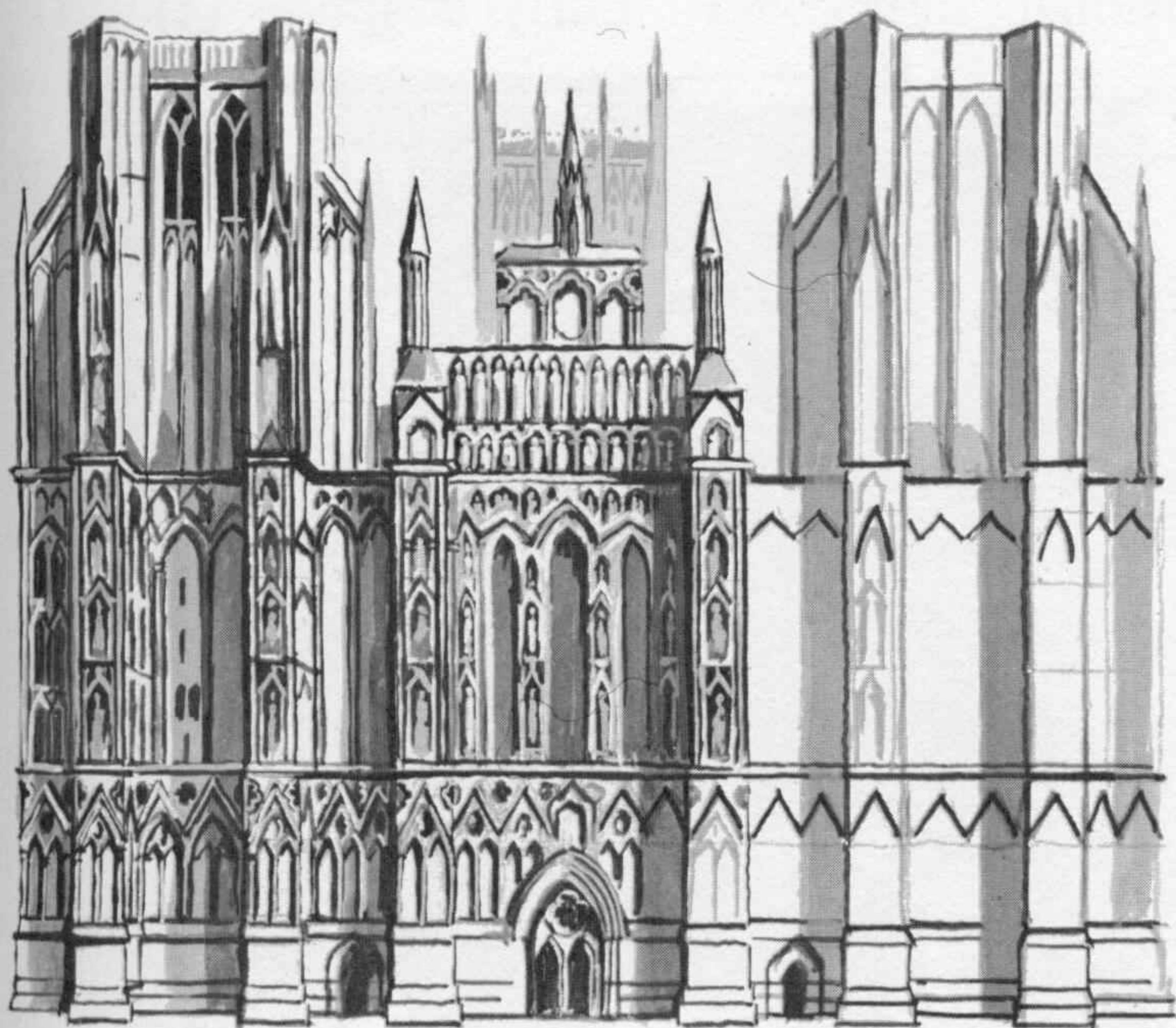
Laon Cathedral,  
c. 1235



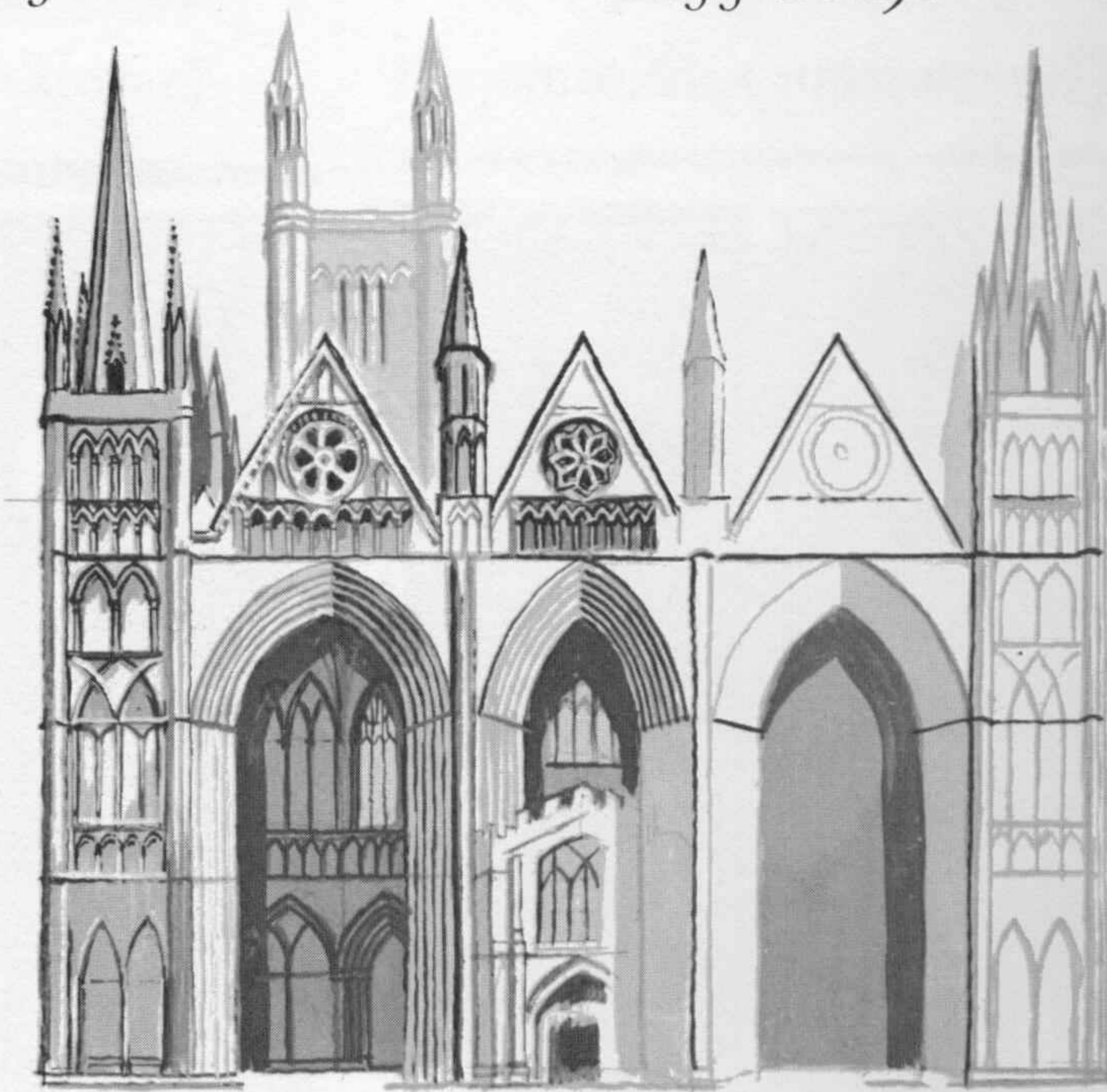
Notre Dame, Paris,  
c. 1200-1250



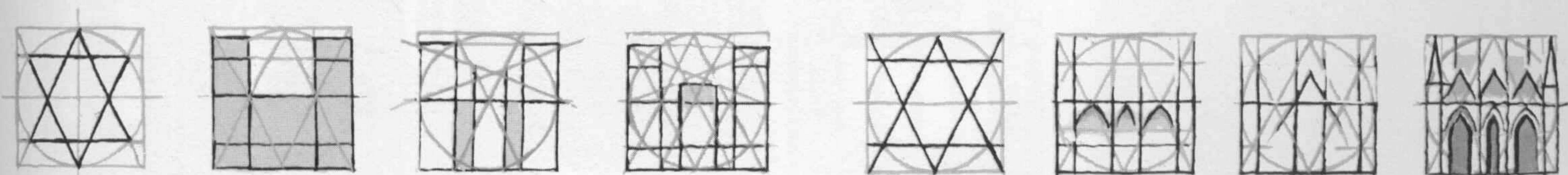
Rheims Cathedral,  
c. 1255-c. 1290



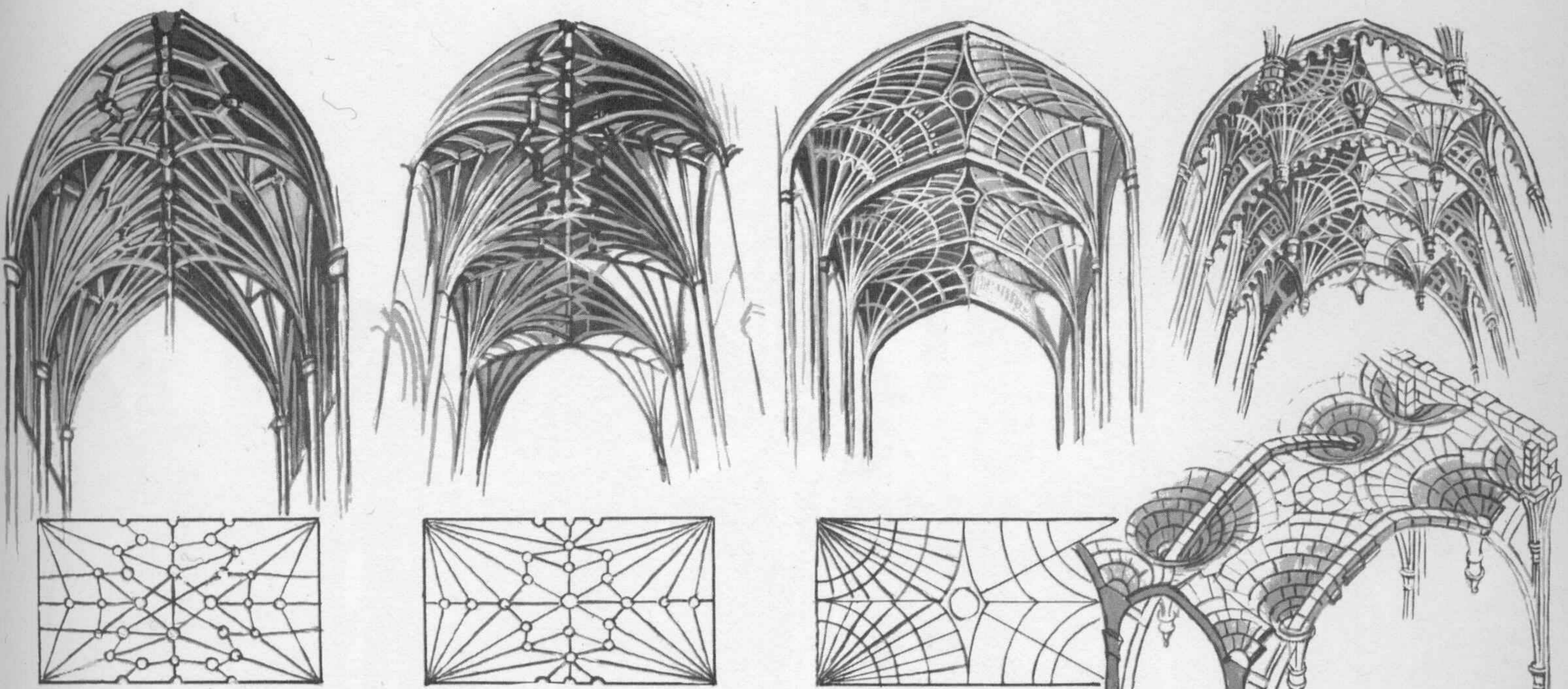
Wells Cathedral, c. 1220-1242



Peterborough Cathedral, c. 1235



# ENGLAND, STONE VAULTING

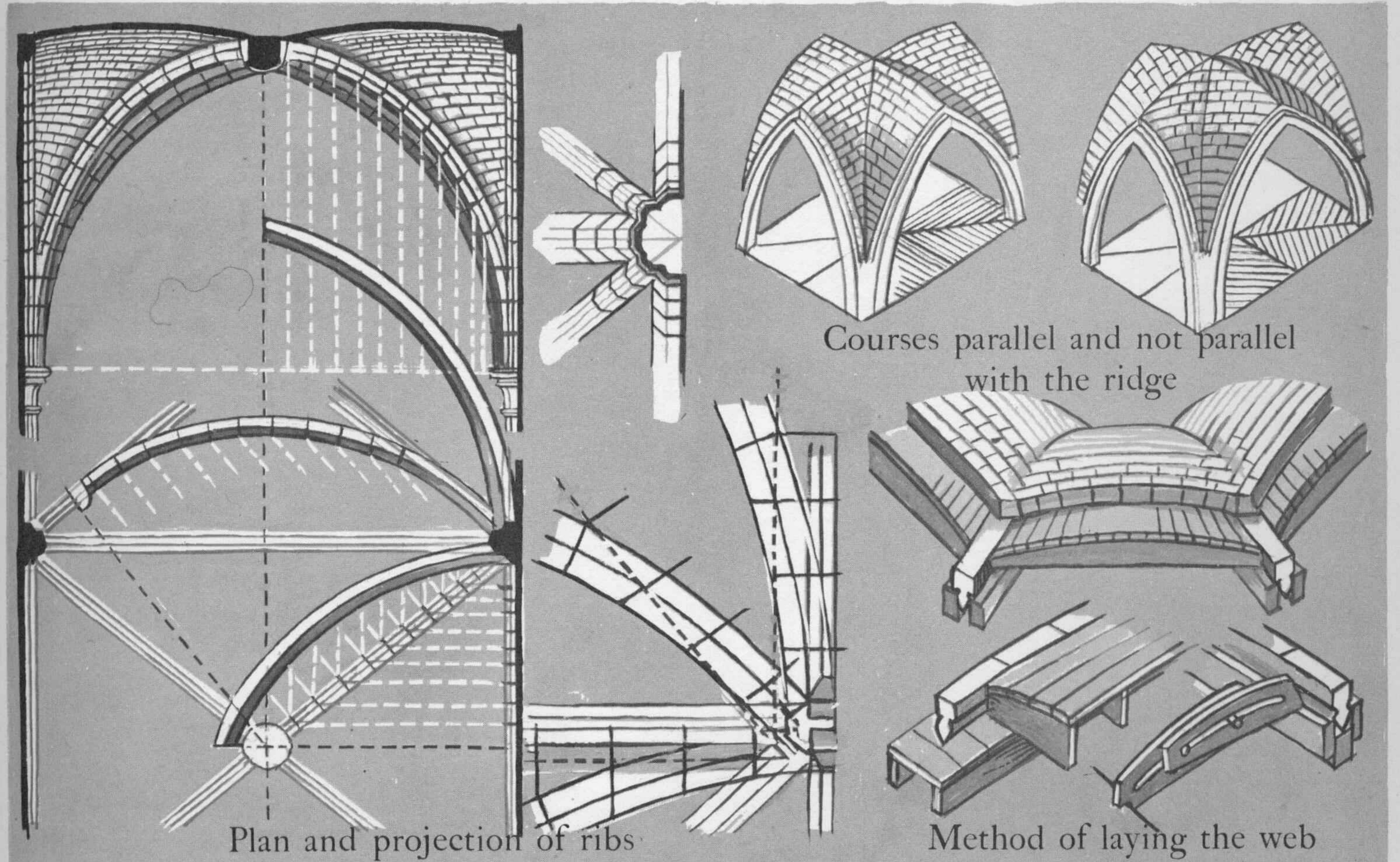


Introduction of liernes or small ribs  
with shorter web courses

Winchester  
Cathedral nave,  
1371-1460

Norwich  
Cathedral nave,  
1463-1472

Fan vaults: all ribs of equal span  
and the web carved from the same stone  
King's College Chapel, Cambridge,  
1446-1515  
Henry VII's Chapel,  
Westminster Abbey,  
1502-1512

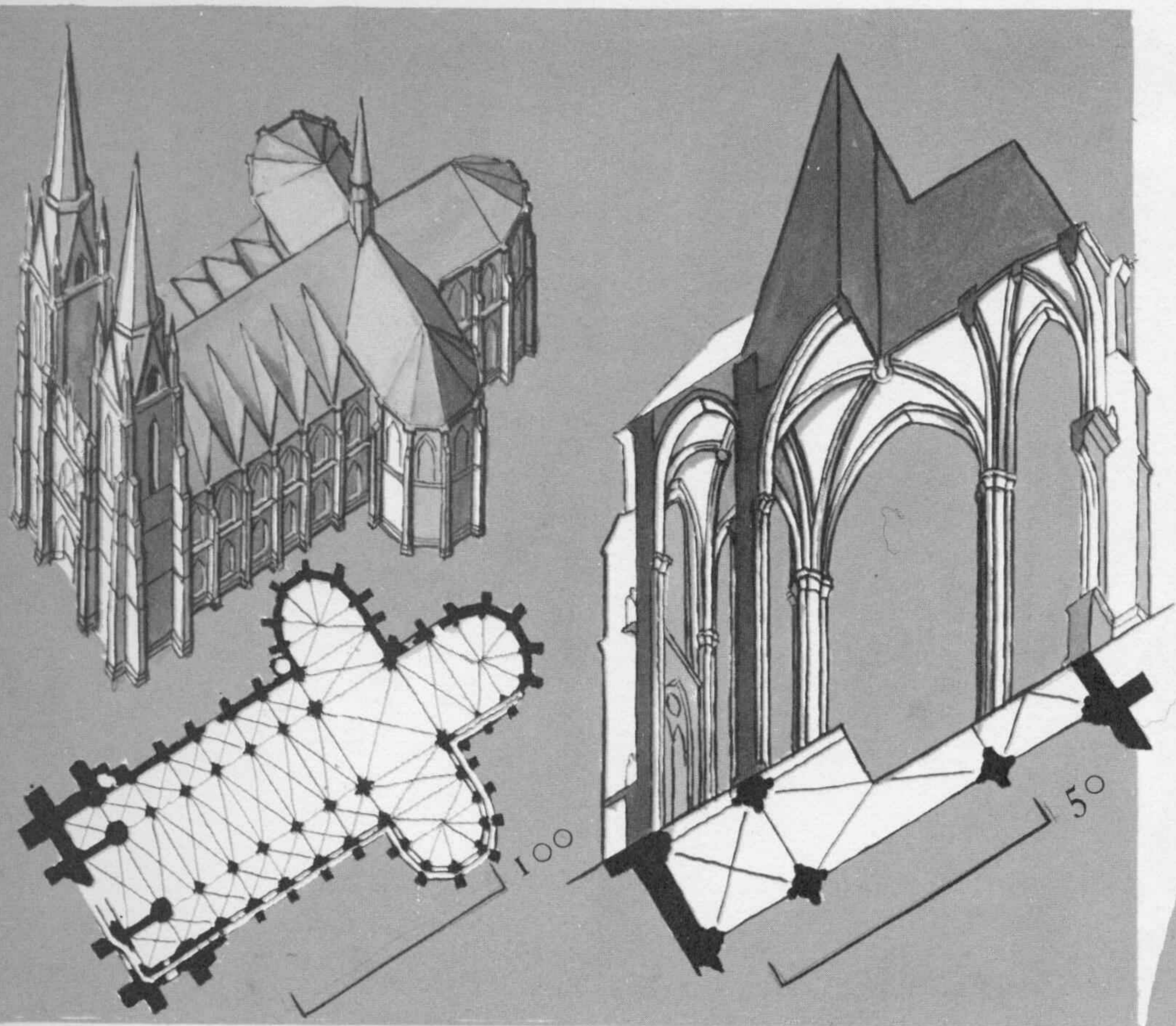


Plan and projection of ribs

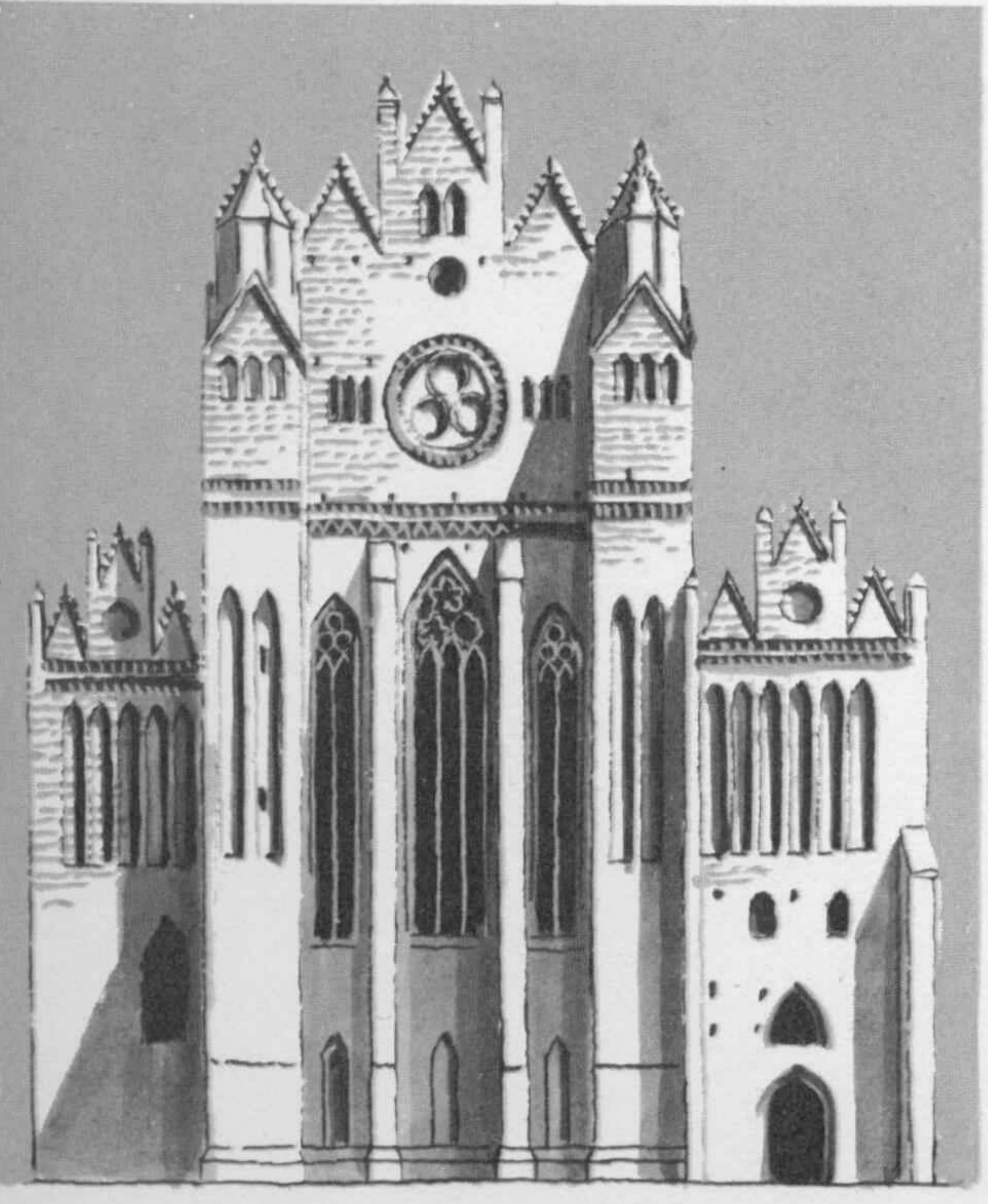
Courses parallel and not parallel  
with the ridge

Method of laying the web

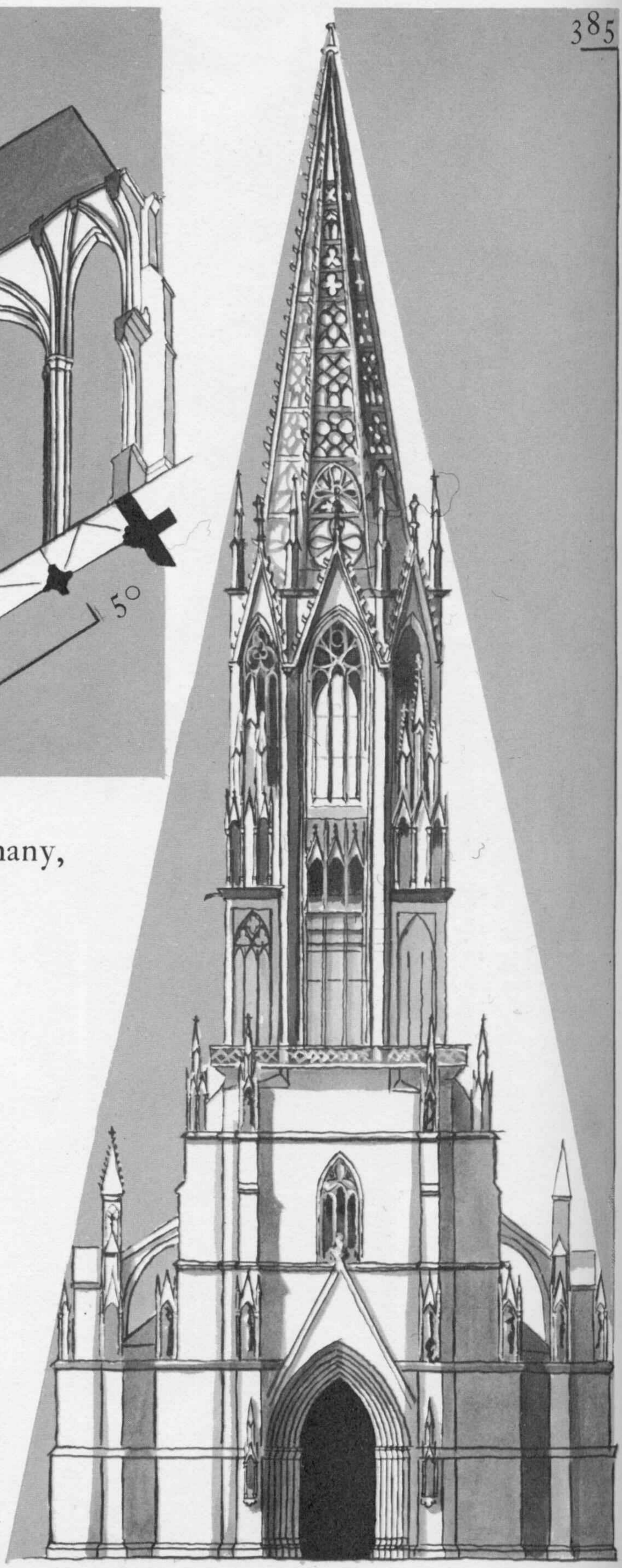
# GOthic



S. Elizabeth, Marburg, c.1233-1283:  
one of the many 'Hall' churches in North Germany,  
having the nave and aisles of equal height



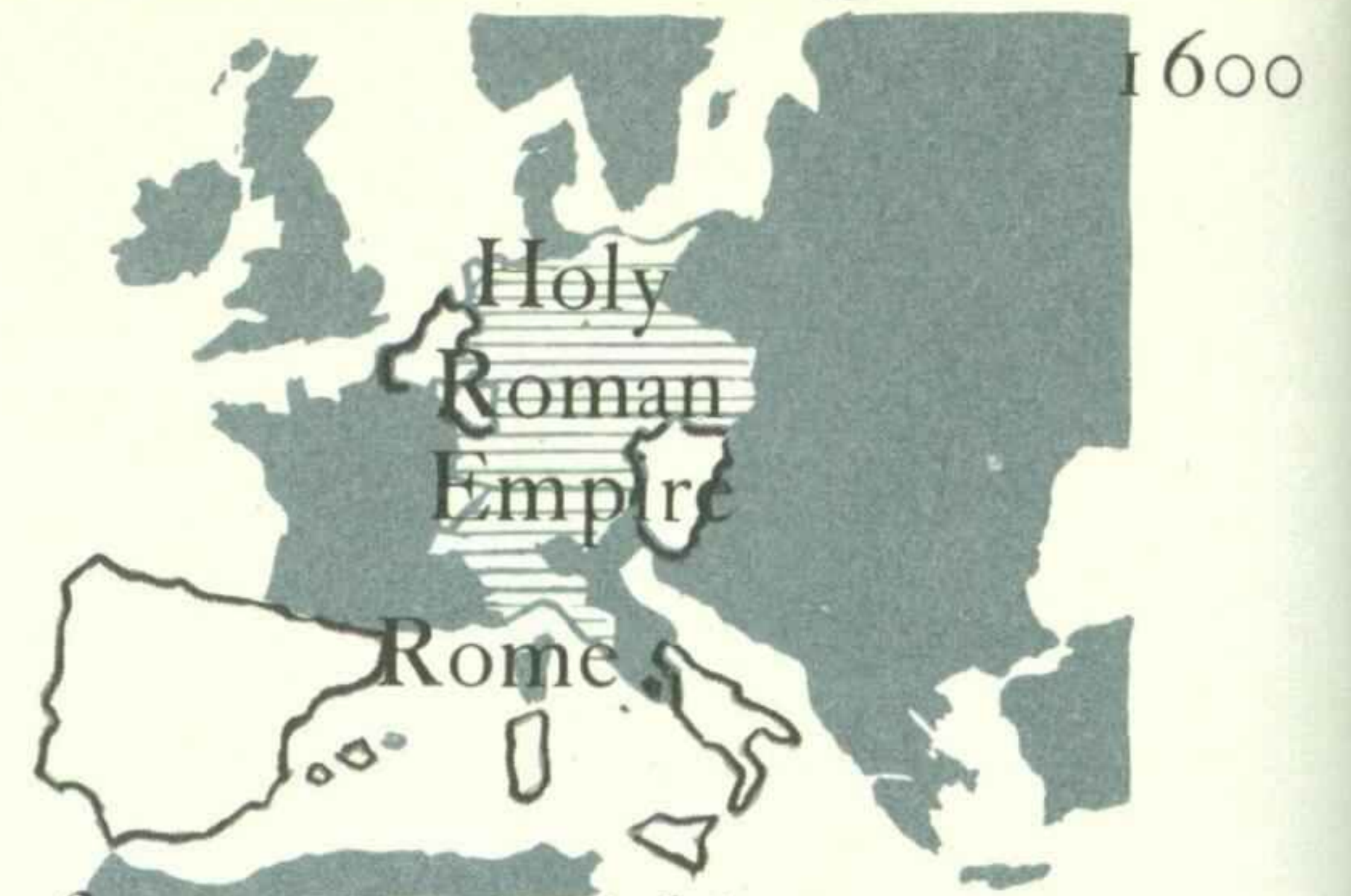
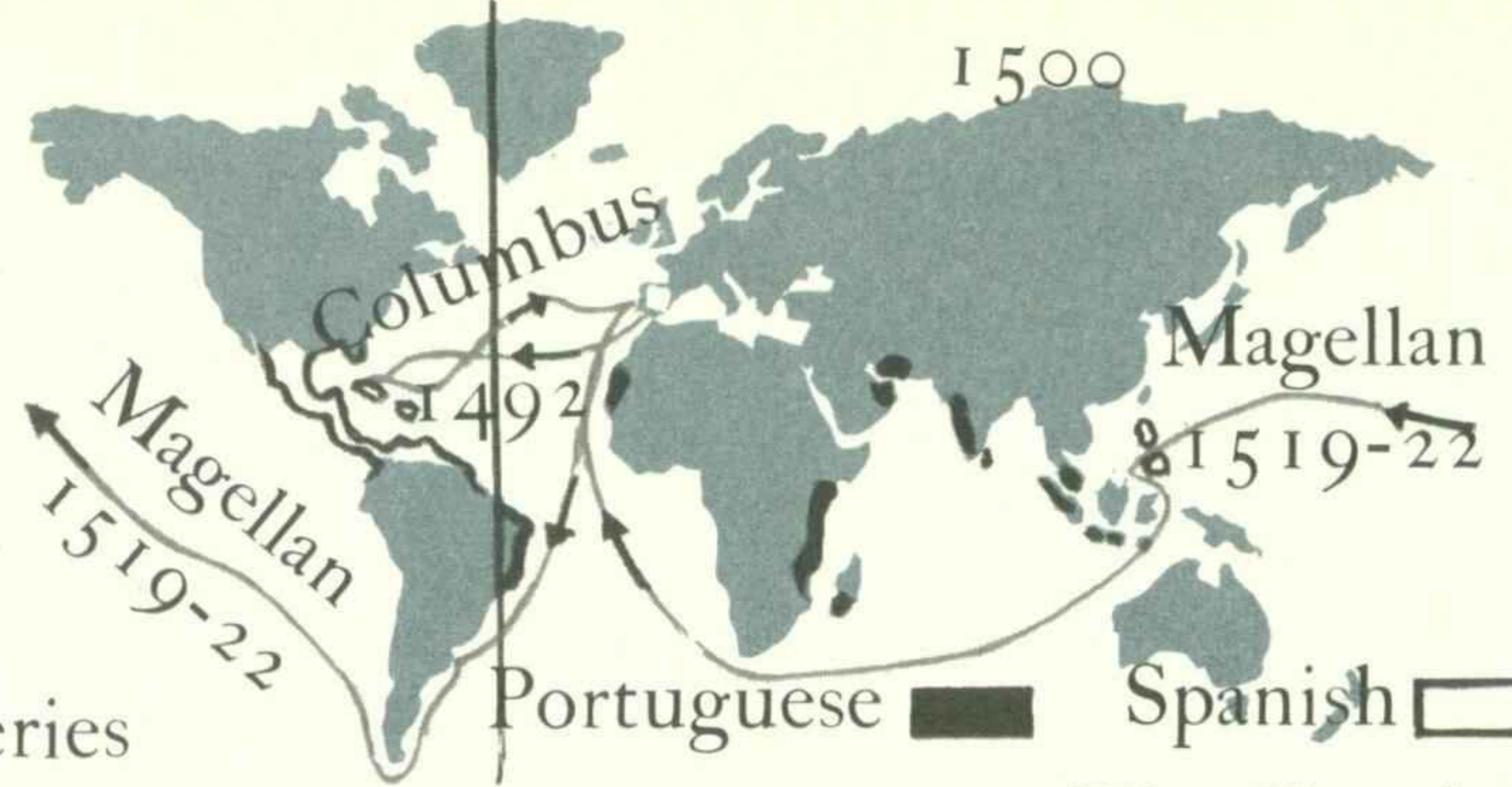
Chorin Abbey, c.1273-1334:  
west front



Freiburg Cathedral, c.1268-1288:  
west front

# RENAISSANCE BAROQUE

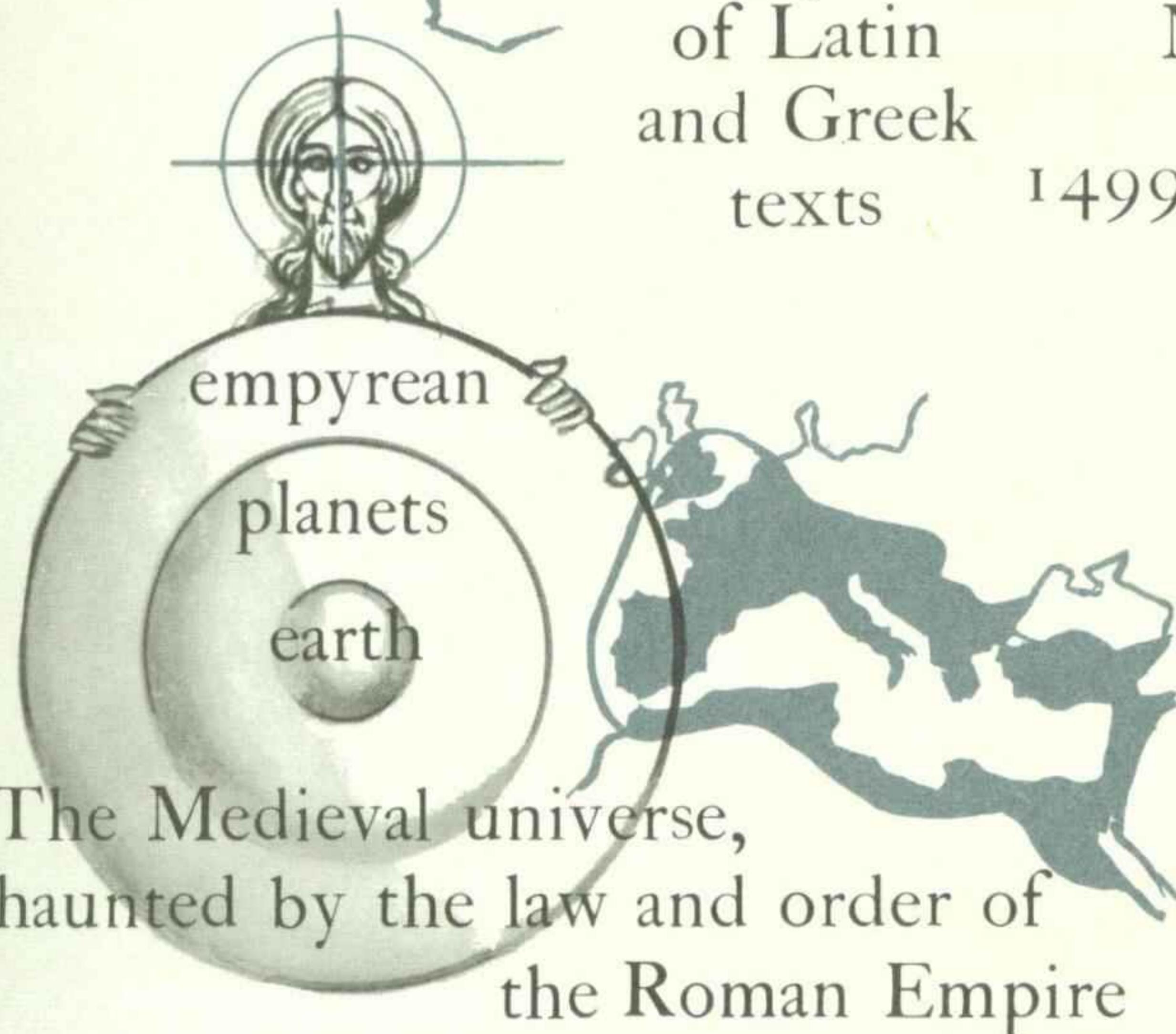
1400  
The Turks take Constantinople  
1453  
& block trade with the Orient: this leads to maritime discoveries



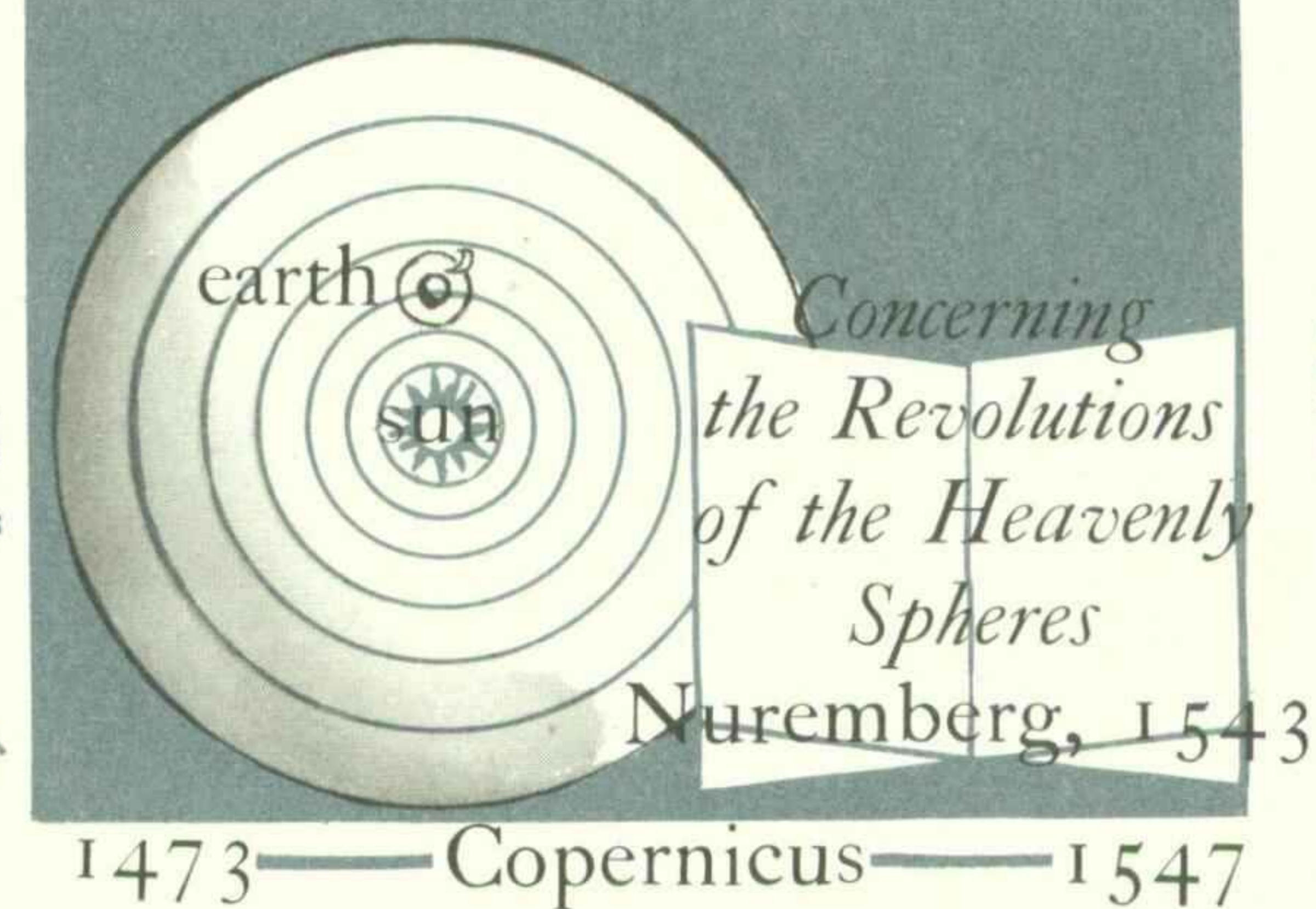
Spain Spain united 1497 1519—Charles V—1556—Philip II of Spain—1598  
Italy Florence: the Renaissance Rome: temporal power of the Popes Venice: trade lost  
France Franco-Spanish rivalry in Italy 1515—Francis I—1547 Italian influence  
Holland 1568 Revolt of the  
England 1485—Henry VII—1509—Henry VIII—1547—1558—Elizabeth I—1603  
War of the Roses Italian influence Mary I marries Philip II of Spain

Germany head of some 300 states 1483—Martin Luther—1546  
Protests (hence Protestants) against the Roman Church leads to the Reformation  
1483 Invention of printing  
1480 Mainz, c. 1450 brought the revival and spread of Latin and Greek texts  
1470  
1469  
1467  
1466  
1467  
1471  
1499

1499—S. Ignatius Loyola—1556 founded the Society of Jesus  
Internal Reformation of the Roman Church at the Council of Trent 1545-63, aided by  
the Counter-Reformation  
Trent  
Rome



The Medieval universe, haunted by the law and order of the Roman Empire



1473—Copernicus—1547



1564—Bruno—1600

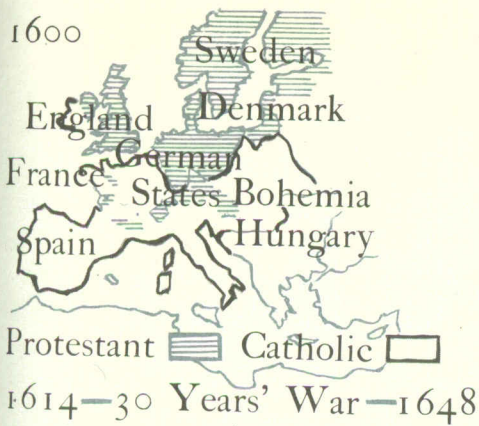
## THE RENAISSANCE

The Renaissance (Florence) High Renaissance (Rome) Mannerism

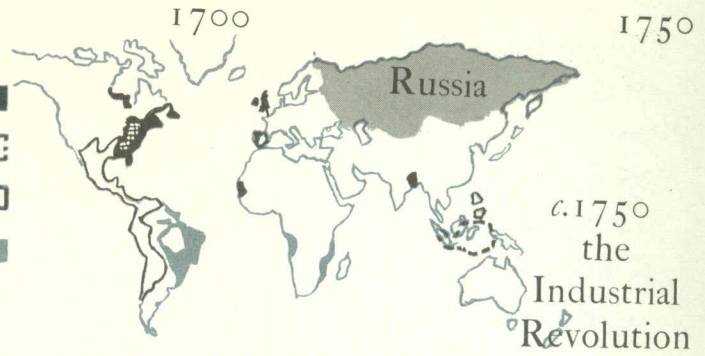
1400 Renaissance churches were centralized and designed on the drawing-board. They were inspired by classical architecture, as interpreted by Vitruvius (above all, by Roman temples, arches, domes & the Five Orders (pp. 116-117)), & obeyed the canon

of the Divine Proportions (pp. 118-119). The increasingly dramatic movements of High Renaissance and Mannerist buildings became, especially in the 'theatrical' churches of the Counter-Reformation, an interplay of forces. (This required the drawing of

# INTRODUCTION



English  
Dutch  
Spanish  
Portuguese



Conflict for colonies and overseas trade

to new Atlantic seaports. Domination of Spain in Italy ends 1710

1610-Age of the Cardinals-1643-Ascension of France: Louis XIV-1715-Louis XV-1774

Netherlands from Spain 1648 Republic of the United Provinces

James I-1625-Charles I-1649-1660-Charles II-1685-1702-Anne-14-George I-1727

Divine Right of Kings Commonwealth James II Colonial Expansion

Impoverished by the 30 Years' War Kingdom of Prussia 1701 Frederick the Great 1740-85

*The New Astronomy . . . the Motions of Mars*  
Prague, 1609

planets move in ellipses

*Horologium Oscillatorium*  
Paris 1673

dynamics

motions of the earth undulating

1630 — Huygens — 1695

ellipse  
parabola  
hyperbola

*Discours de la Methode*  
1637

analytical geometry

*Philosophiae Naturalis Principia Mathematica*  
1687

varying ellipse

1571 — Kepler — 1630 1596 — Descartes — 1650

1564 Galileo 1642

*Two New Sciences*  
1638

statics & dynamics

the law of gravitation  
a mechanical universe

tangential and centripetal movements

1707 — Euler — 1783

1727 — Newton —

## THE BAROQUE

Baroque

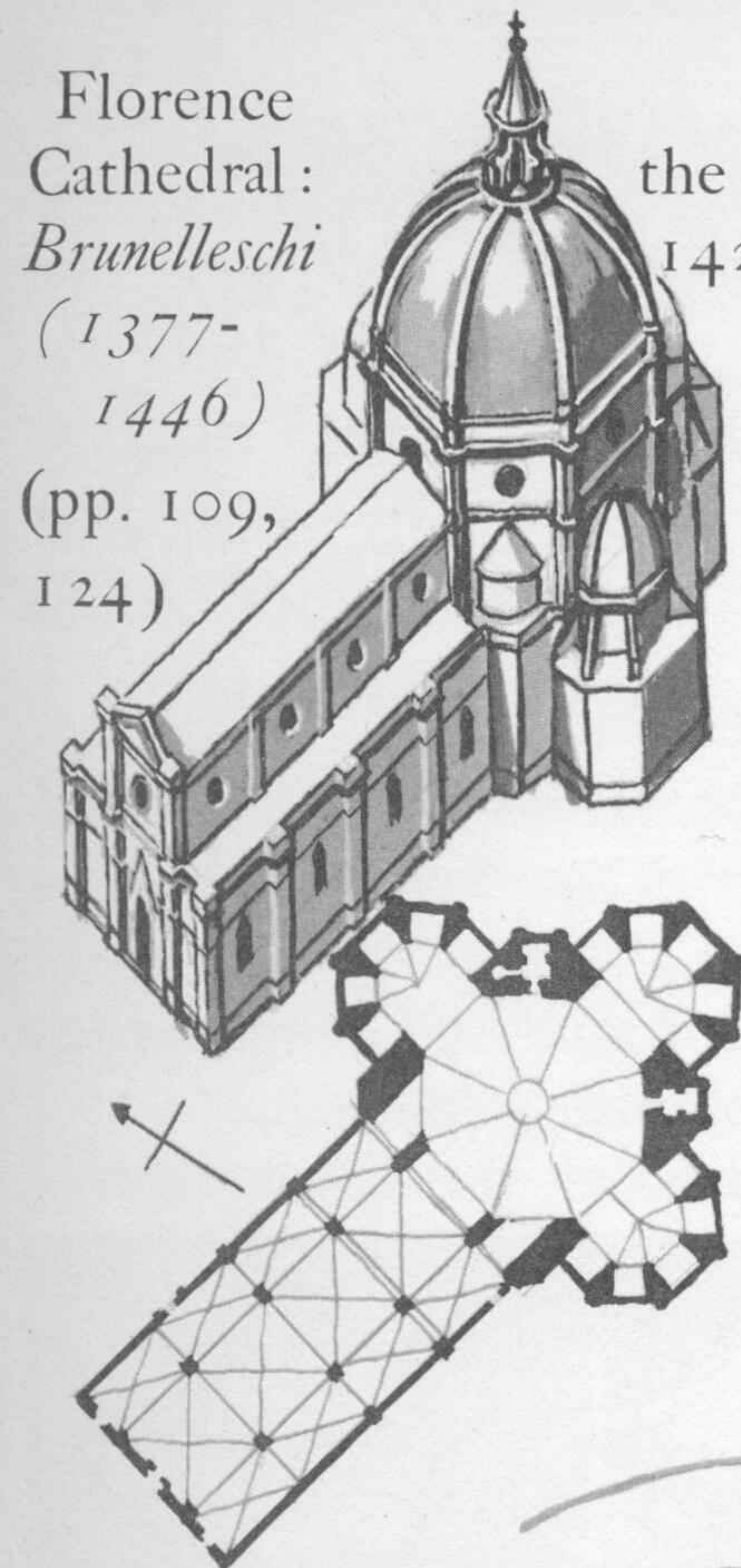
Rococo

1600  
three-dimensional elevations and curved details by means of projective geometry, which had been developed by the new science of dynamics.)  
This Baroque style was finally resolved into the lighter curves of the Rococo.

1700 1750  
The architecture of each European country was a reaction to that of Italy, modified by its own native characteristics.  
France (pp.130-133), Germany & Austria (pp.134-135), Spain (pp.136-137), England (pp.138-159).

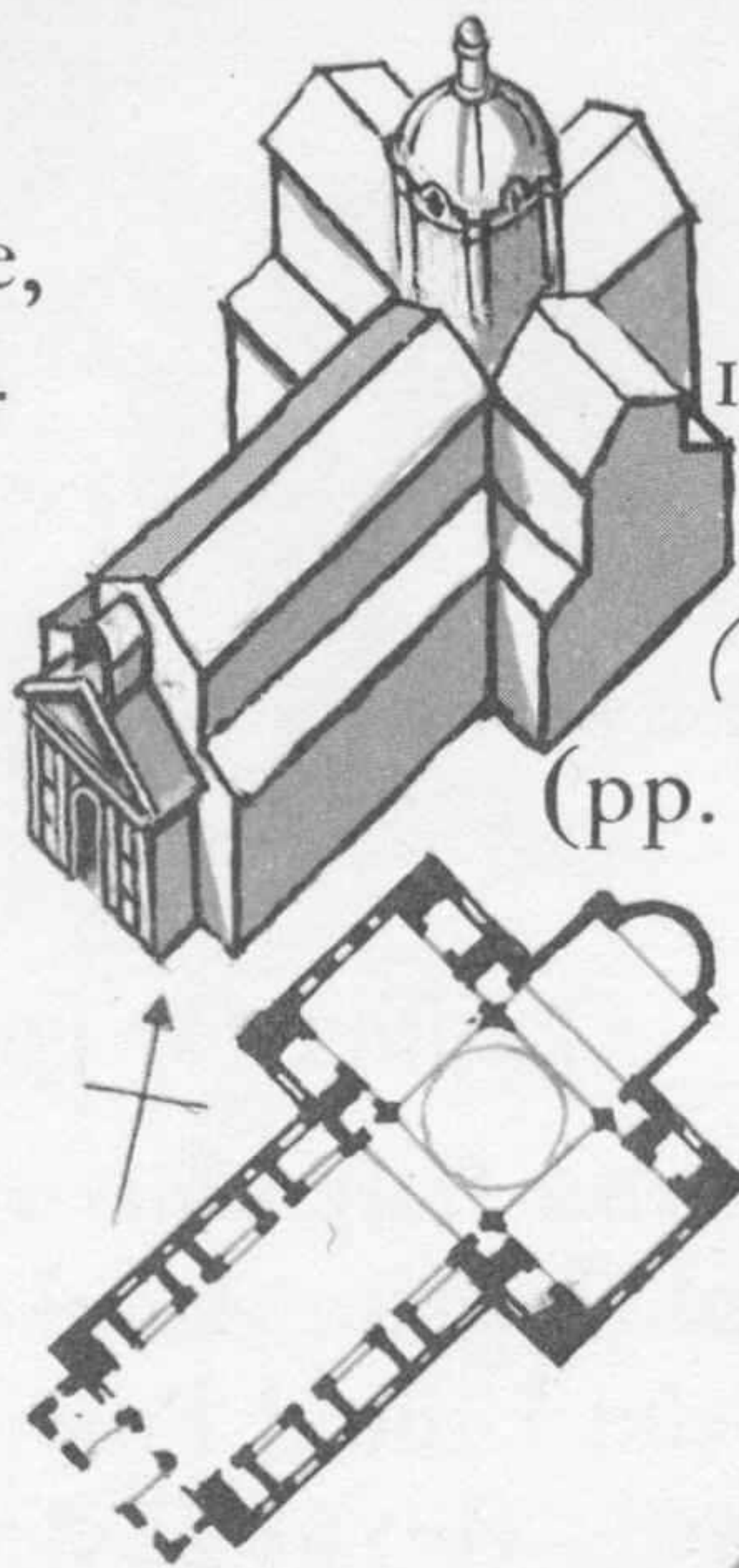


# RENAISSANCE - BAROQUE

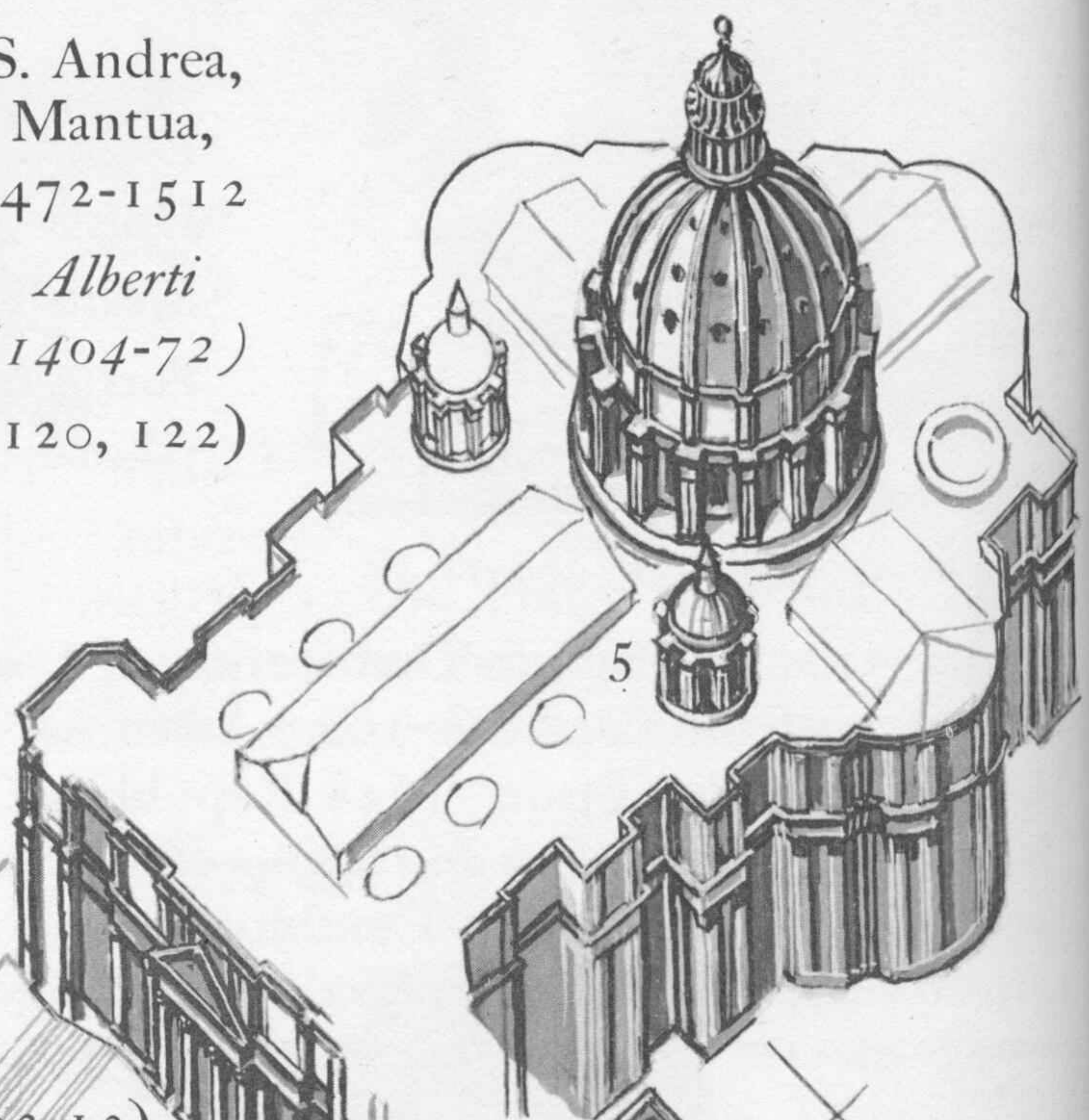


Florence Cathedral:  
*Brunelleschi*  
(1377-1446)  
(pp. 109, 124)

the dome,  
1420-34

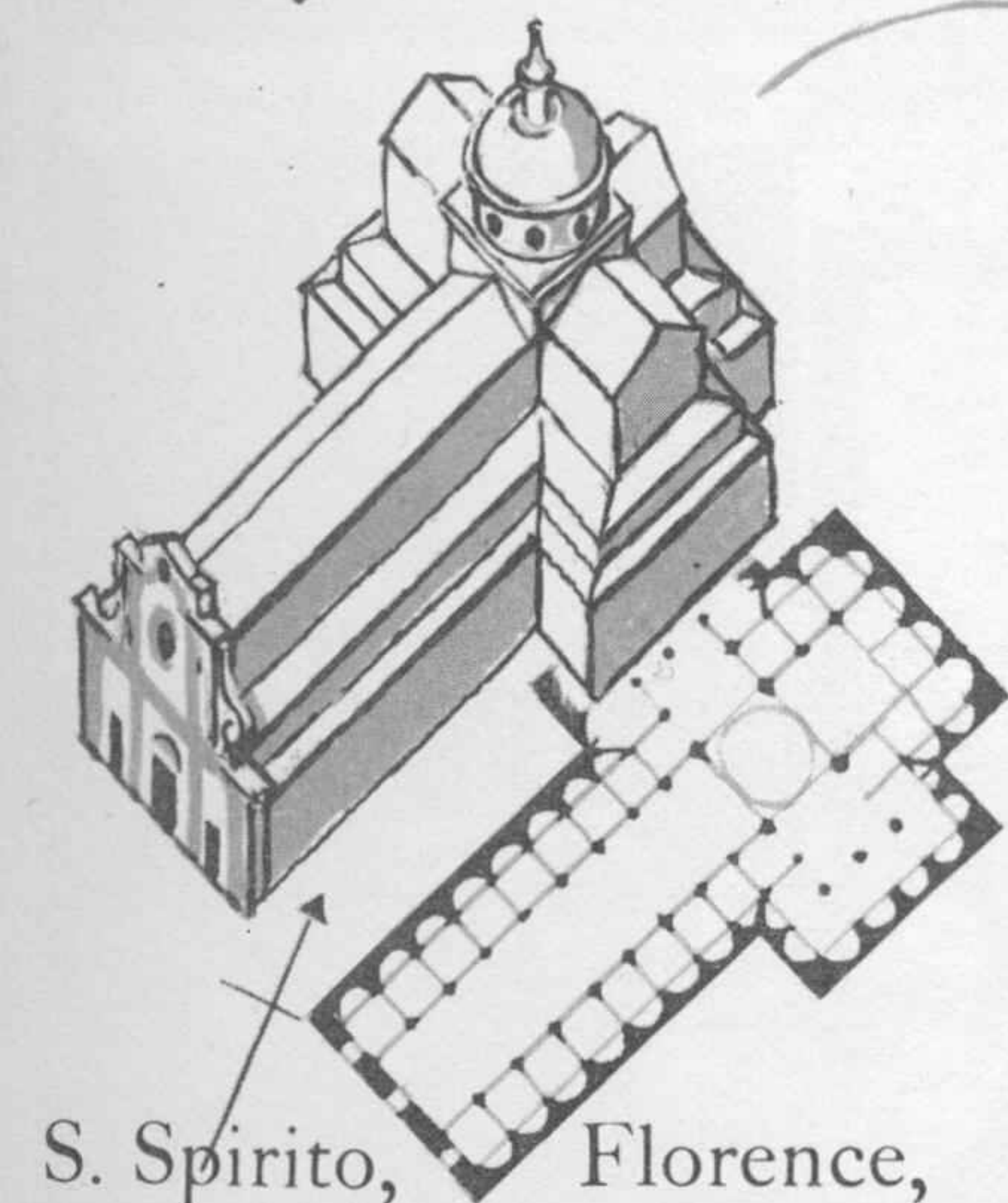


S. Andrea,  
Mantua,  
1472-1512  
*Alberti*  
(1404-72)  
(pp. 120, 122)



Pope Julius II (1503-13) had the old basilican church pulled down (p.70), and successive plans were made for the new church:

- 1 *Bramante* (1444-1514)  
1506
- 2 *Raphael* (1483-1520)  
1515-20
- 3 *Sangallo the Younger*  
(1485-1546)  
1539
- 4 *Michelangelo* (1474-1564)  
1546-64  
also designed the dome, completed 1585-90  
by *Giacomo della Porta* (1541-1604)  
and *Domenico Fontana* (1543-1607);
- 5 side cupolas added 1564, by *Vignola* (1507-73)
- 6 *Carlo Maderna* (1556-1629) lengthened nave to form a Latin cross & added the façade 1606-12



S. Spirito, Florence,  
1435 *Brunelleschi*  
(p.122)



S. Maria della Consolazione, 1508,  
*Bramante* & *Cola di Caprarola*

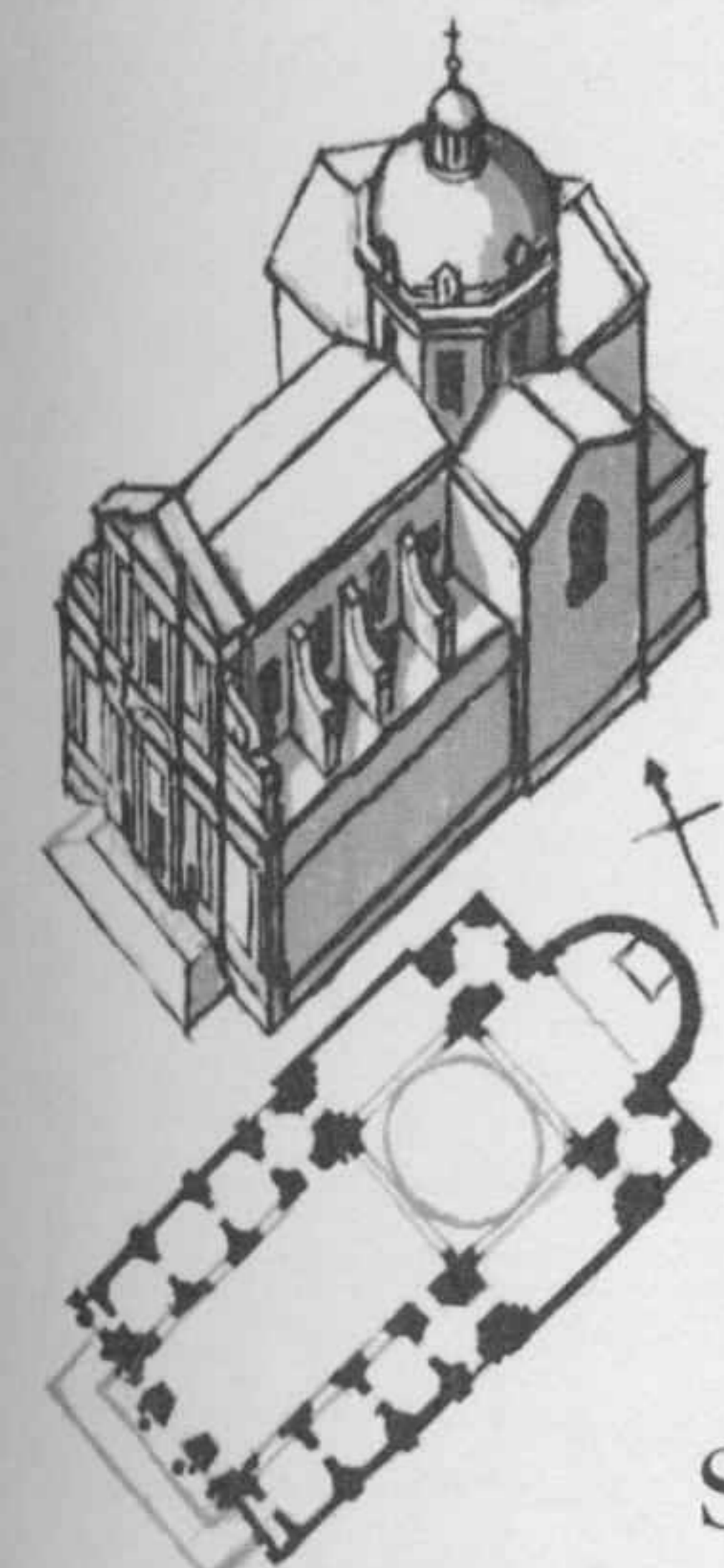


St Peter's, Rome, 1506-1612 (pp. 93, 124)

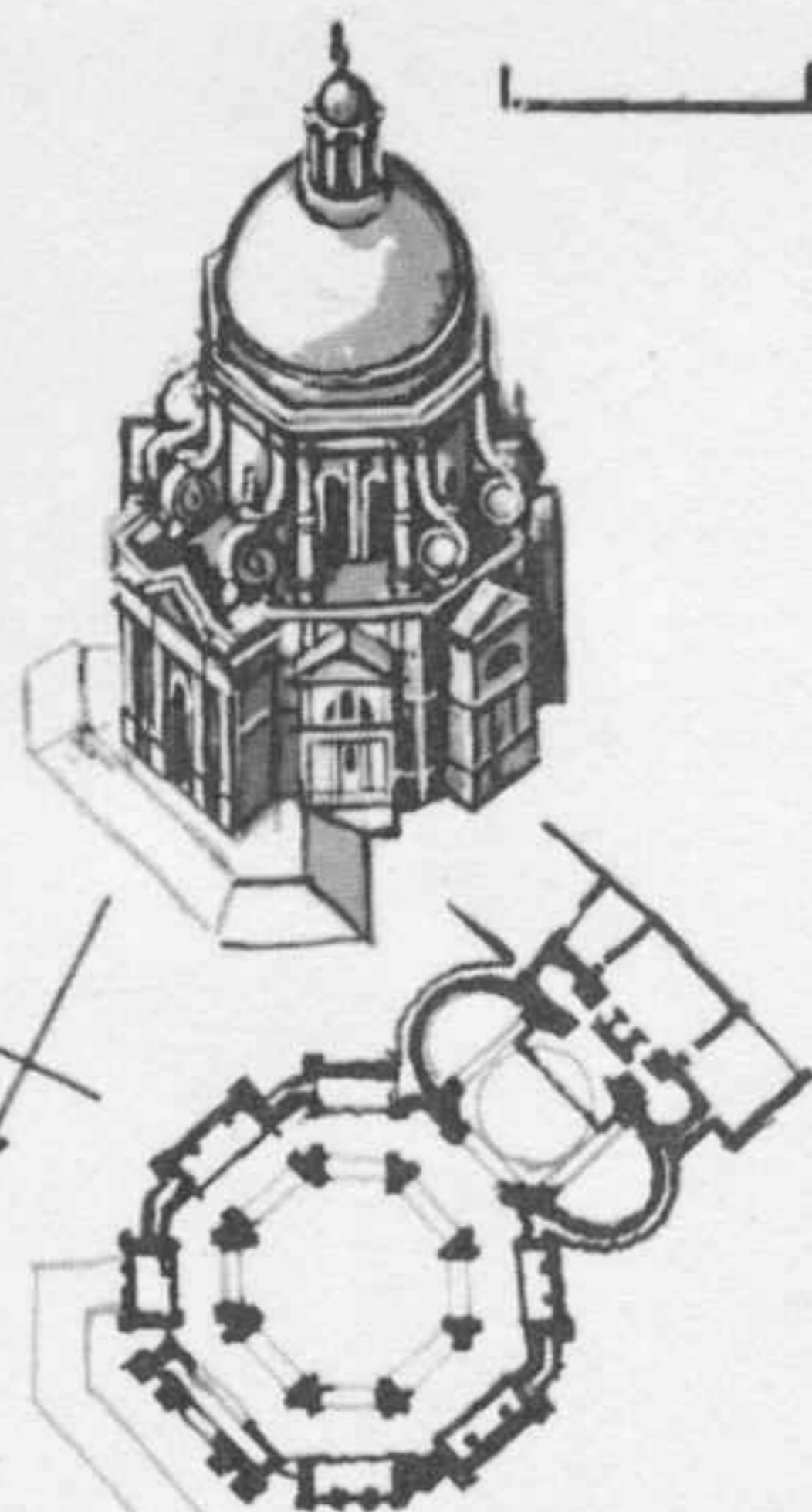
# PLANS & ELEVATIONS

plans and elevations  
to the same scale

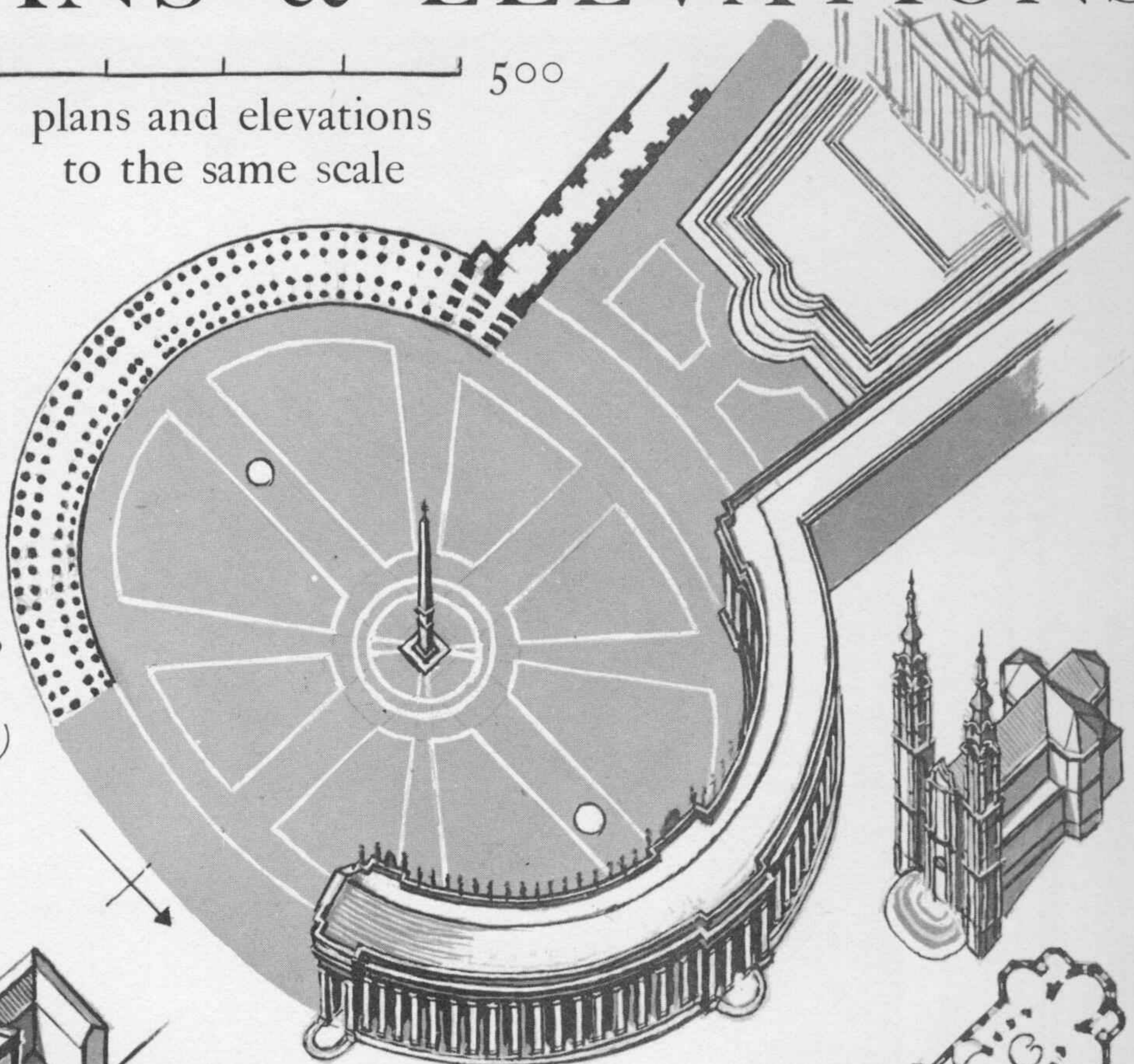
500



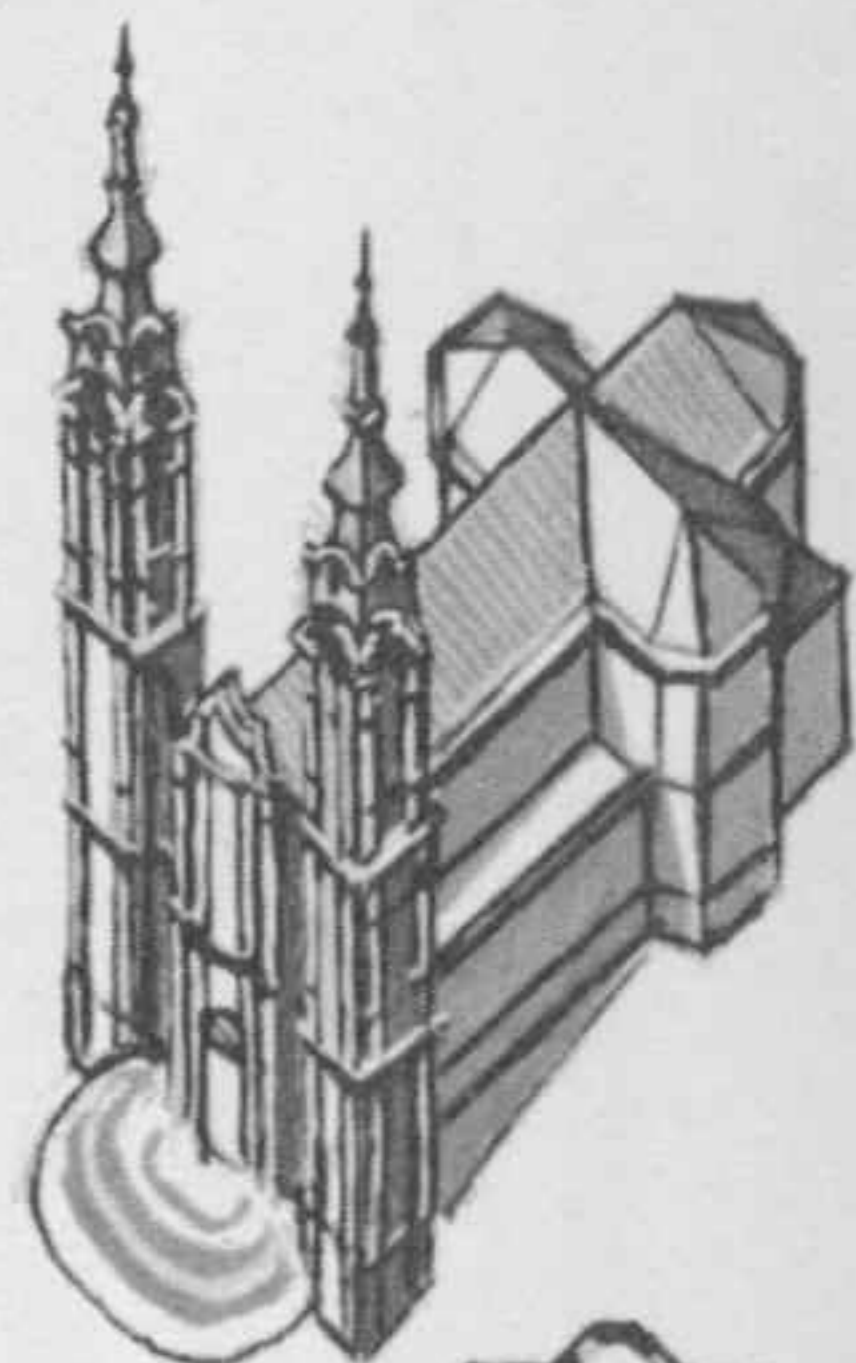
The Gesù,  
Rome,  
1568-75  
*Vignola*  
(1507-73)  
(pp. 120,  
122)



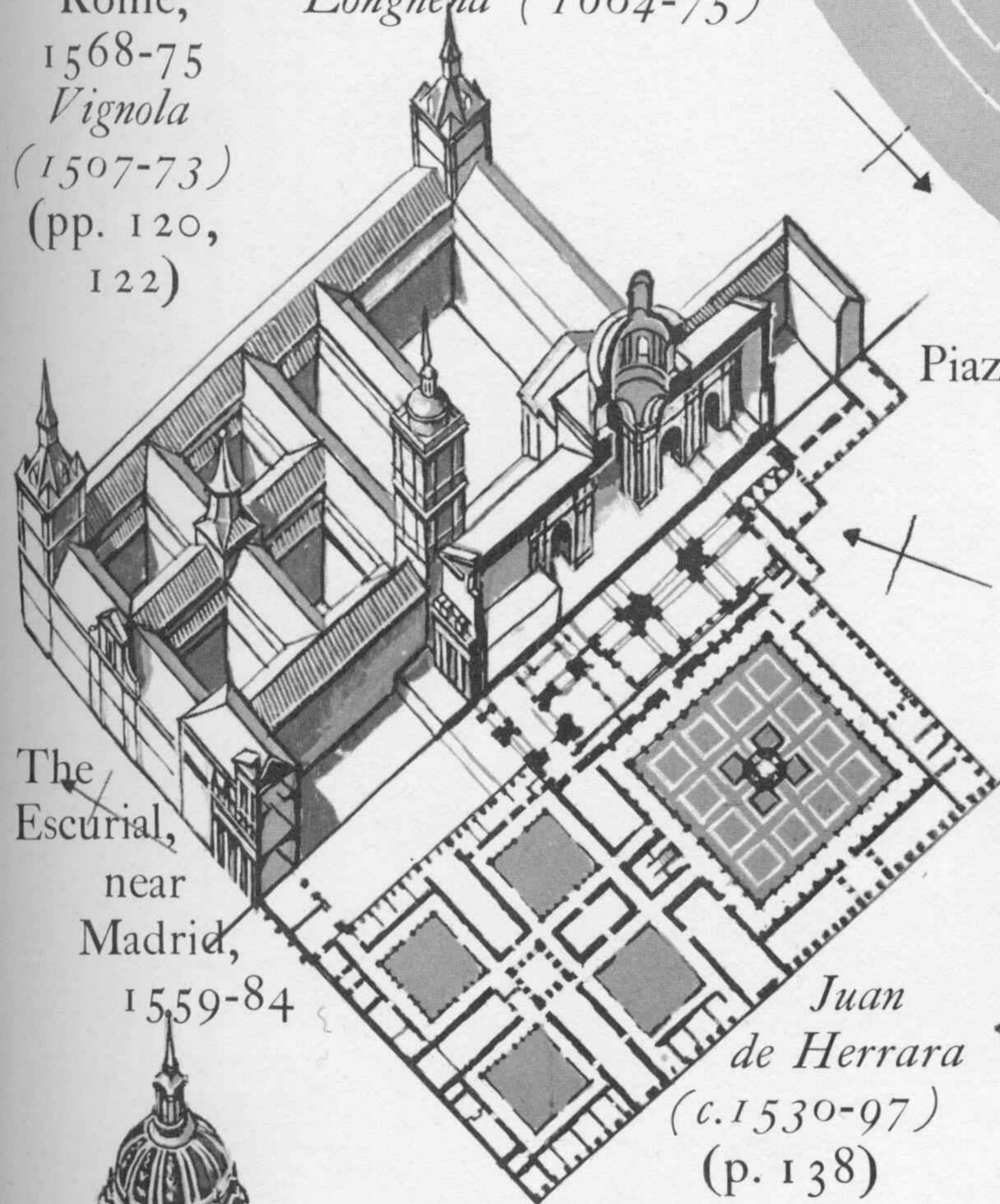
S. Maria della Salute,  
Venice, 1632  
*Longhena* (1604-75)



Piazza, St Peter's, Rome, 1655-67  
*Bernini* (1589-1680)

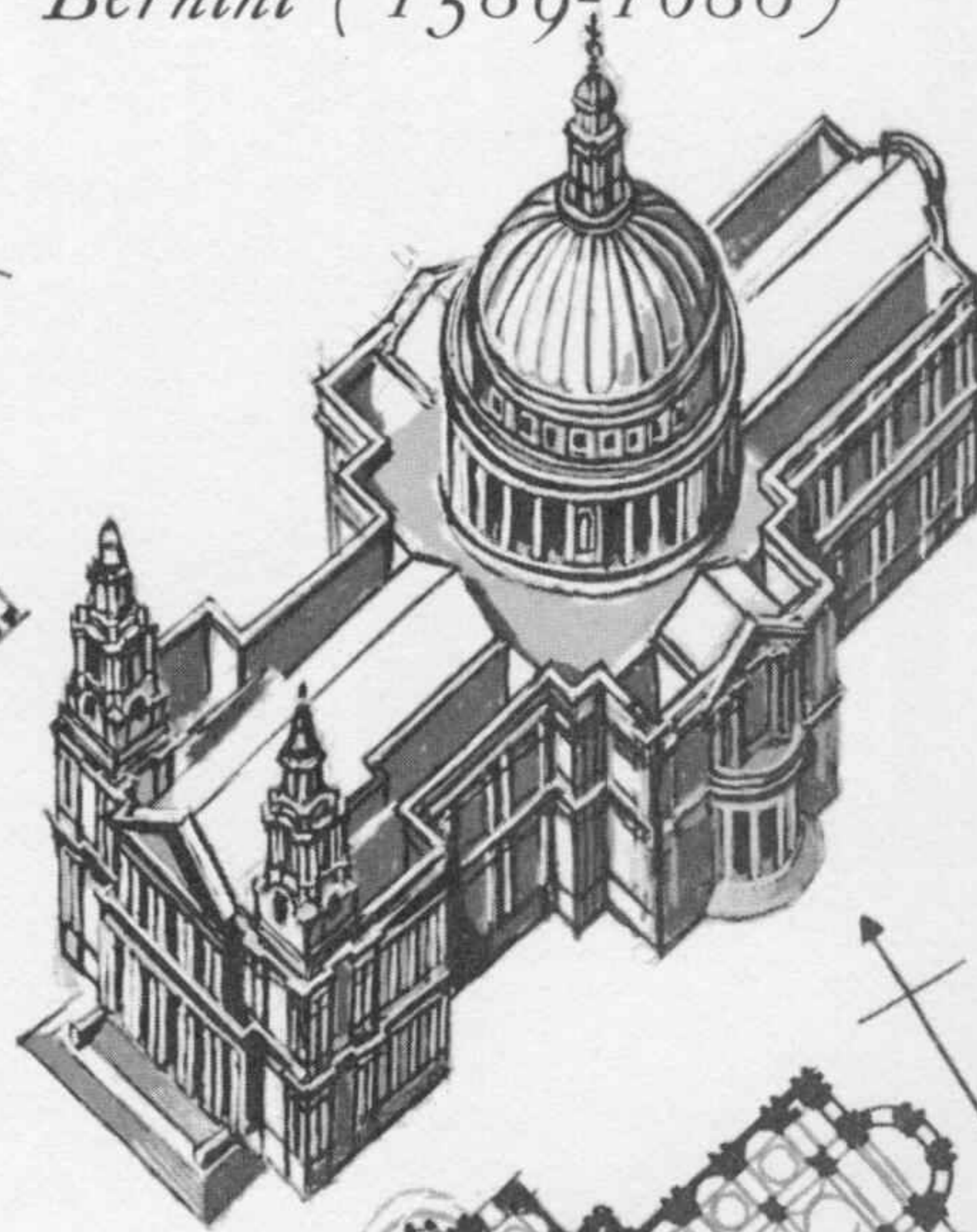


Vierzehnheiligen,  
S. Germany,  
1744-72 *Neumann*  
(1687-1753)  
(p. 137)

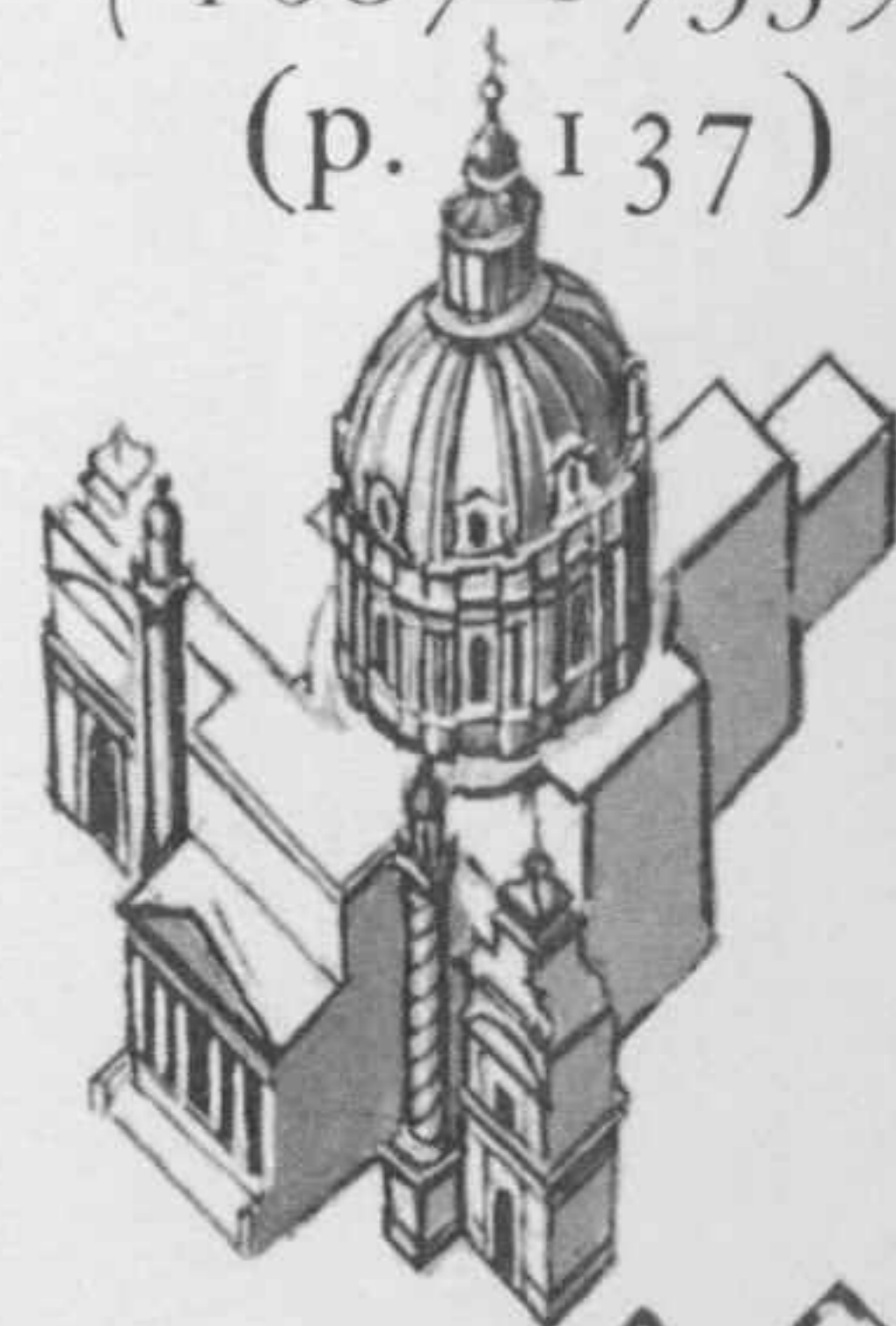


The Escorial,  
near  
Madrid,  
1559-84

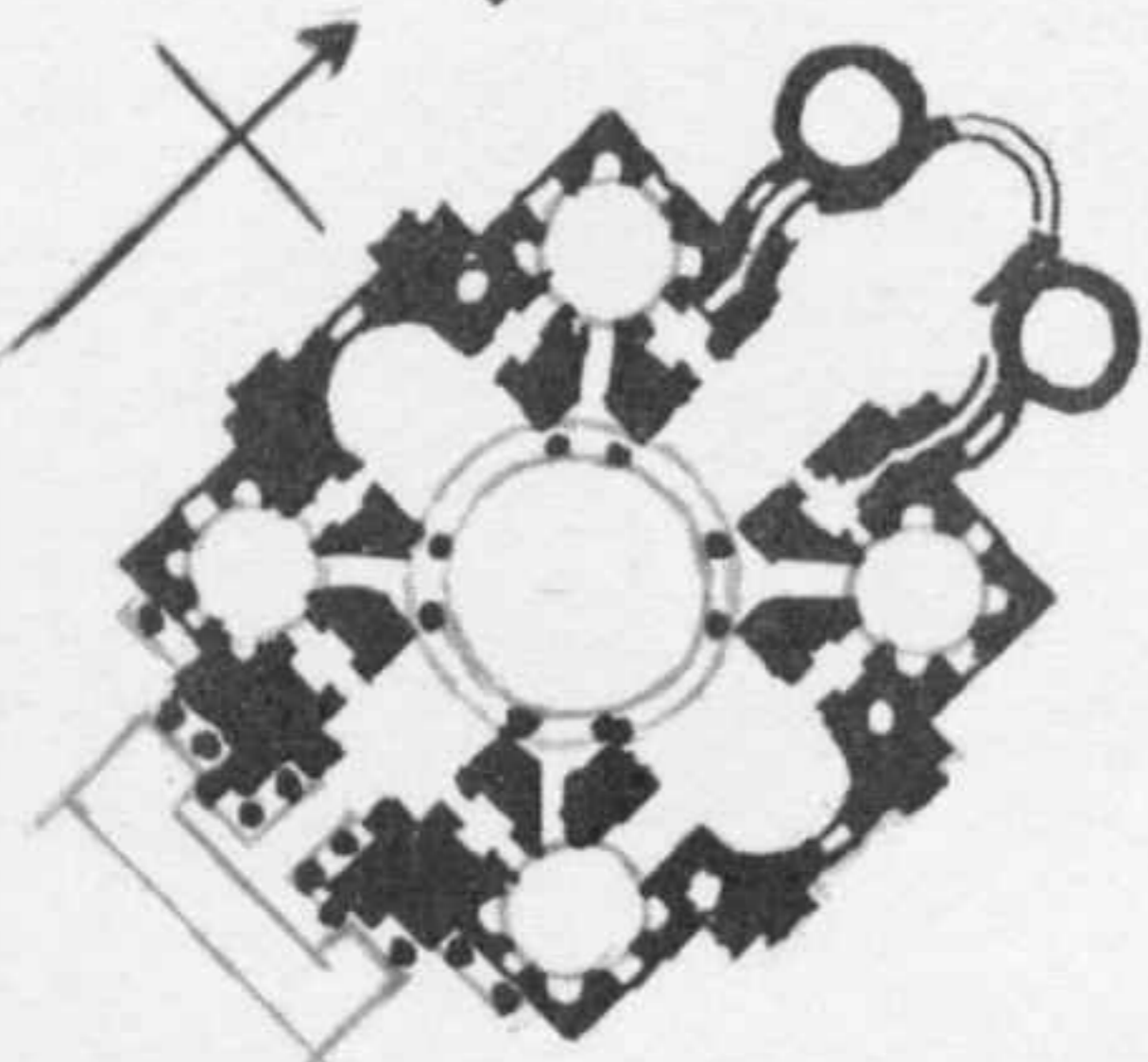
*Juan de Herrera*  
(c.1530-97)  
(p. 138)



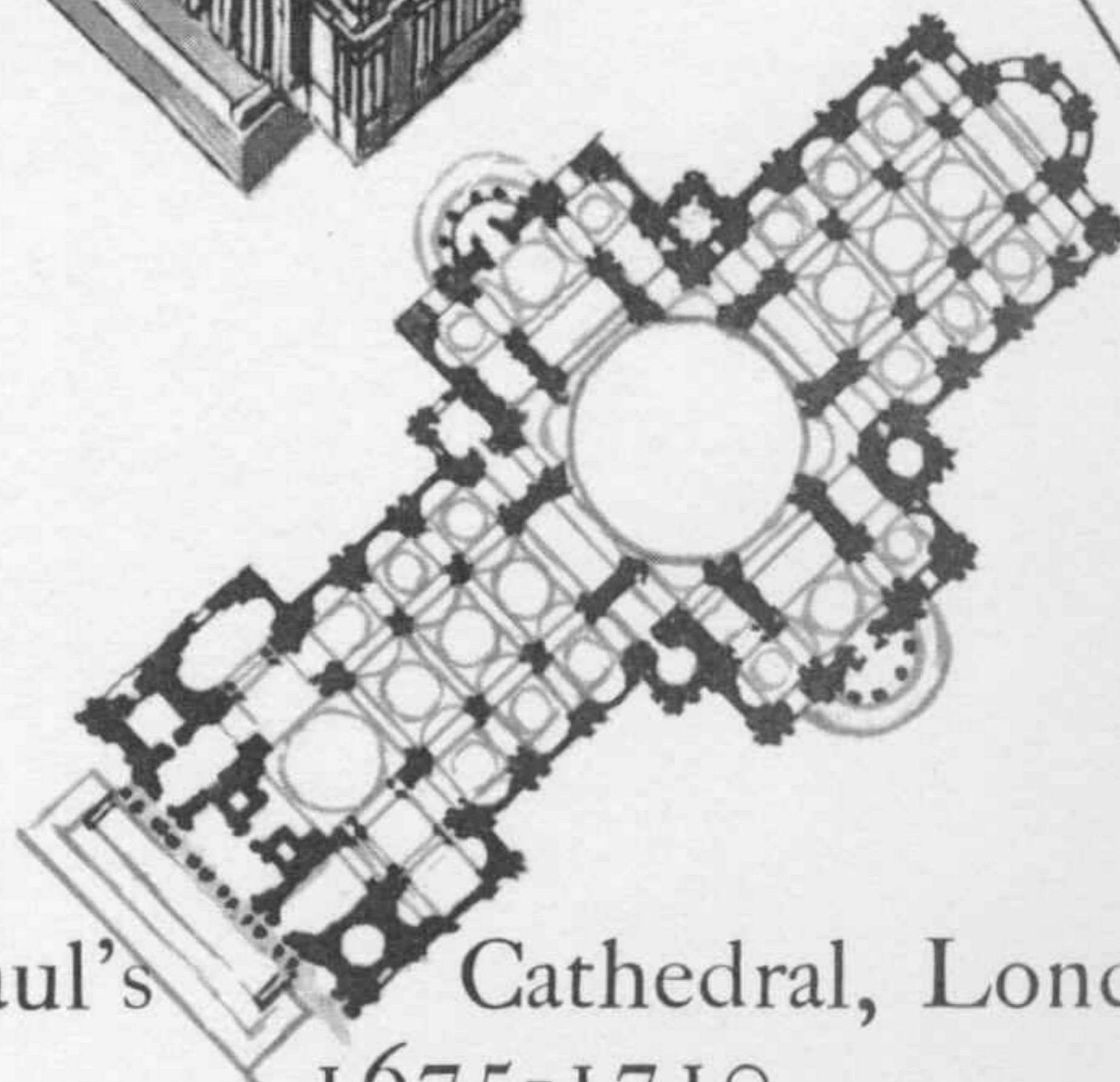
St Paul's Cathedral, London,  
1675-1710  
*Sir Christopher Wren* (1631-1723)  
(pp. 144-145)



Karlskirche,  
Vienna,  
1716-29  
*J. B. Fischer*  
*von Erlach*  
(1656-1725)



The Dome of the Invalides, Paris,  
1693-1706  
*J. H. Mansart*  
(1646-1708) (pp. 125, 131)



# RENAISSANCE - BAROQUE

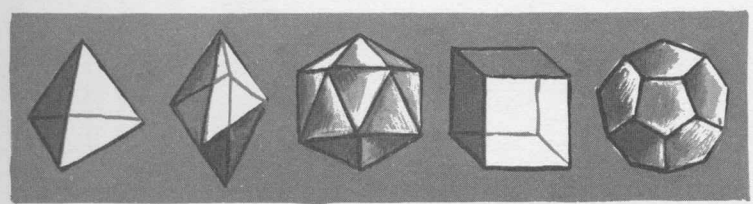
Sources of Italian architectural theory:

1. The study of Roman buildings.
2. The Platonic-Aristotelian description of God and the Universe as a perfect circle.
3. The Pythagorean, and Medieval, idea of Man as the microcosm of the Universe (the macrocosm).
4. The linking of Geometry and Music, two of the Seven Liberal Arts: 'Geometry makes visible the musical consonances' (Boethius, *De Musica*, c.500).

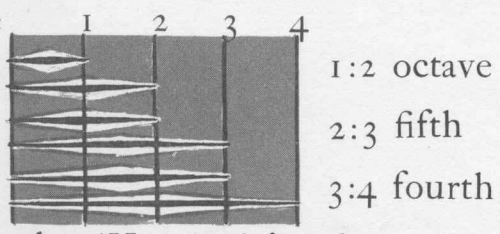
In Florence Cosimo de Medici (1389-1462) founded the Platonic Academy.

*The Timaeus*  
Plato  
427-347 B.C.

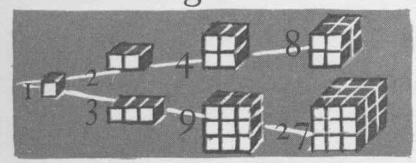
gives an account of the creation and geometrical form of the universe. He represents the four basic elements and the cosmos as:



these 'Platonic' bodies are the 5 regular solids. The elements of the cosmos, as well as its soul-substance & its motion, were created proportionate to musical ratios based on Pythagoras (582-c.507 B.C.) He 'regarded numbers as the elements of all things and the whole heaven as a numerical scale' (Aristotle), & found that tones could be measured by striking cords proportionate in length.



Plato gives the 'Harmonic' scale as:

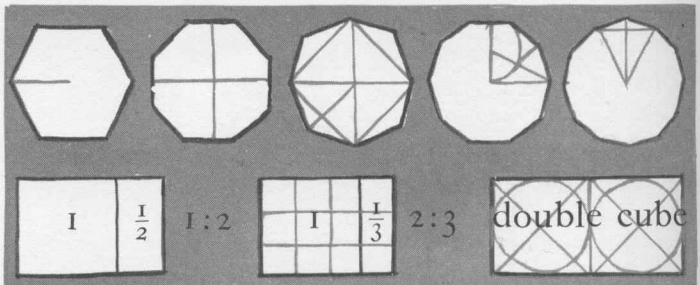


which contain the musical consonances  
1:2, 2:3, 3:4.

For Renaissance architect-theorists, churches based upon these axioms, would be microcosms of the universe of God: '... the little temples we make ought to resemble this very great one' (Palladio).

Marcus Vitruvius Pollio  
*The Ten Books on Architecture*  
Roman architect & engineer 1st century B.C.

Vitruvius  
(edited by Fra Giocondo)  
Venice, 1511

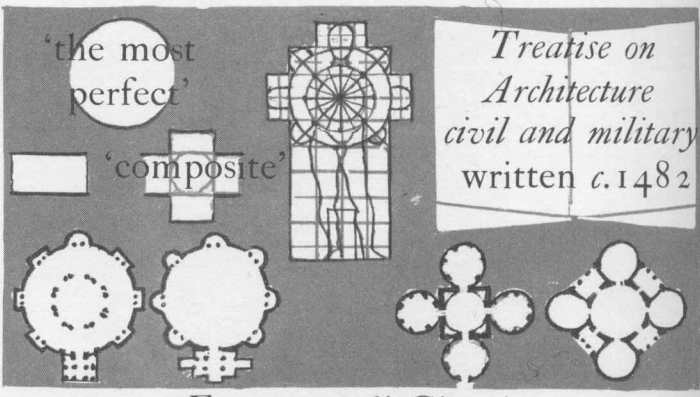


Ideal plans for churches (VII, 4)

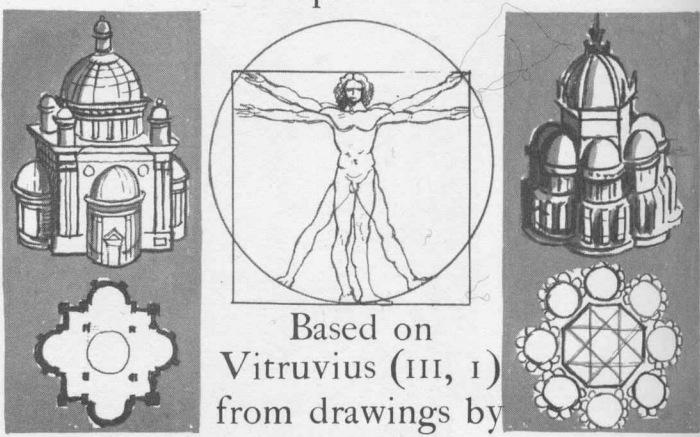
'Of all these numbers. . . the architects make very convenient use' (IX, 5)

*Ten Books on Architecture*  
Florence 1485  
England 1726

1404 — Leon Battista Alberti — 1472  
Florentine architect and theorist

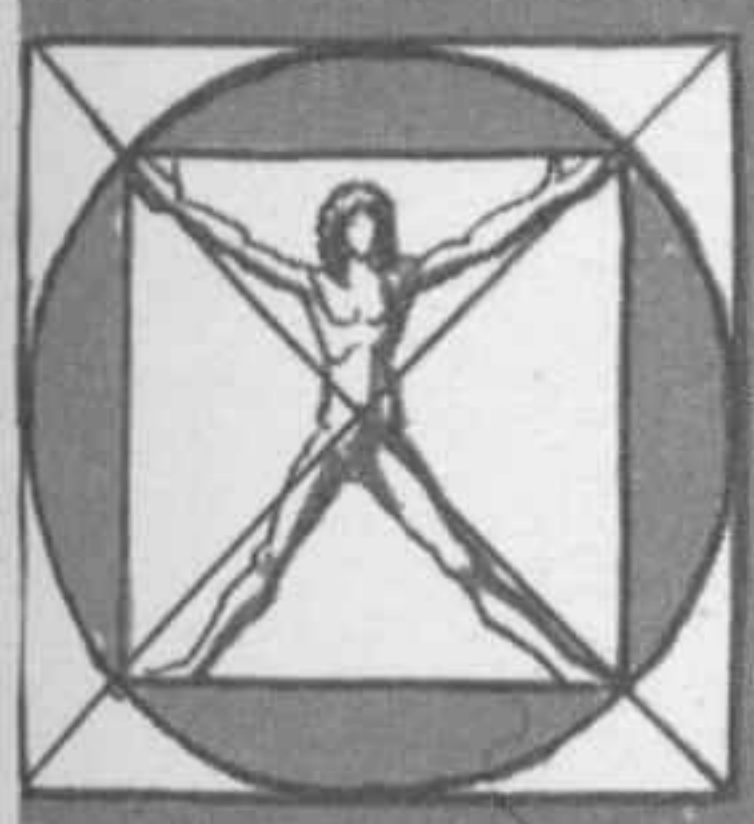


1439 — Francesco di Giorgio — 1502  
Sieneese sculptor and architect



1452 — Leonardo da Vinci — 1519

# THE DIVINE PROPORTIONS

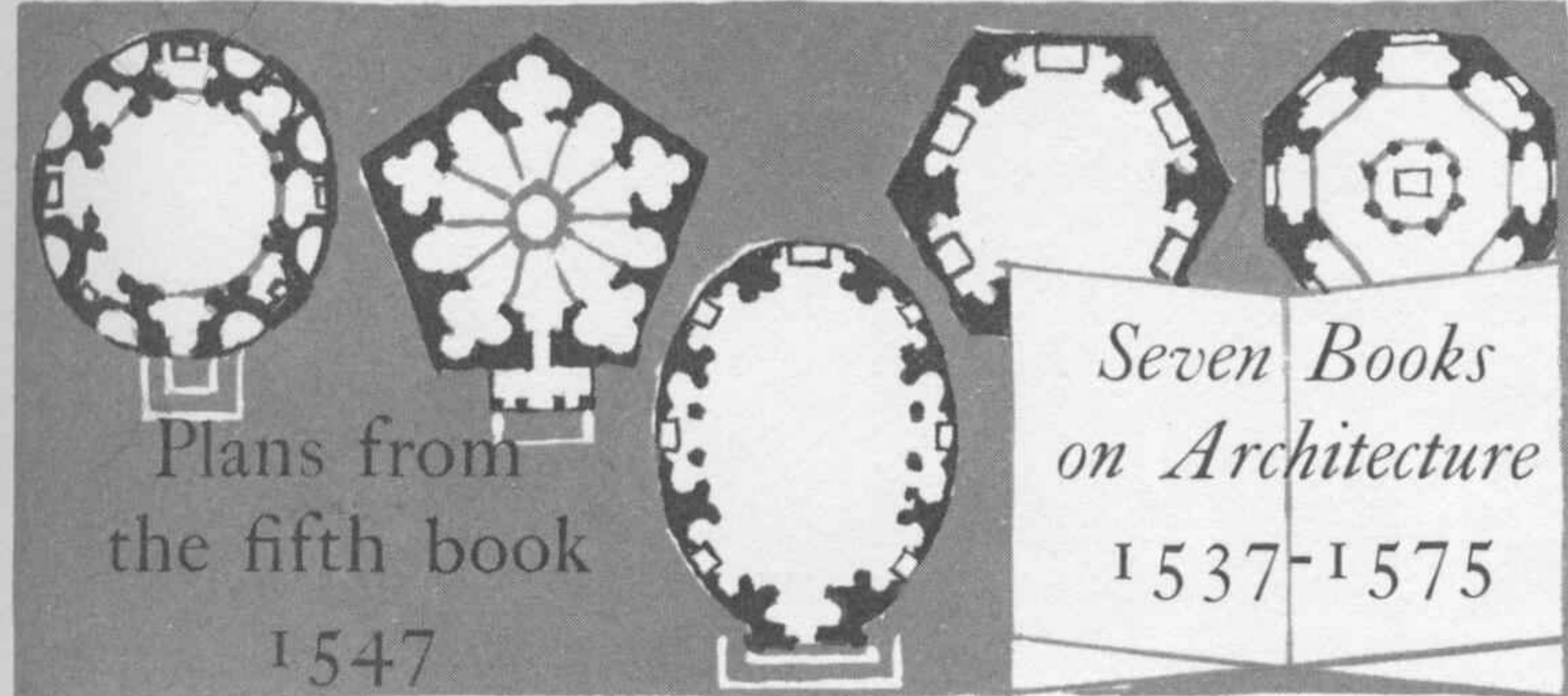


Vitruvius  
(edited by Cesarino),  
Como, 1521

Vitruvius  
(edited by Barbaro,  
illustrated by Palladio),  
Venice, 1556

*Architecture de Vitruve  
ou Art de bien bâtir  
mis en français*  
Jean Martin 1546

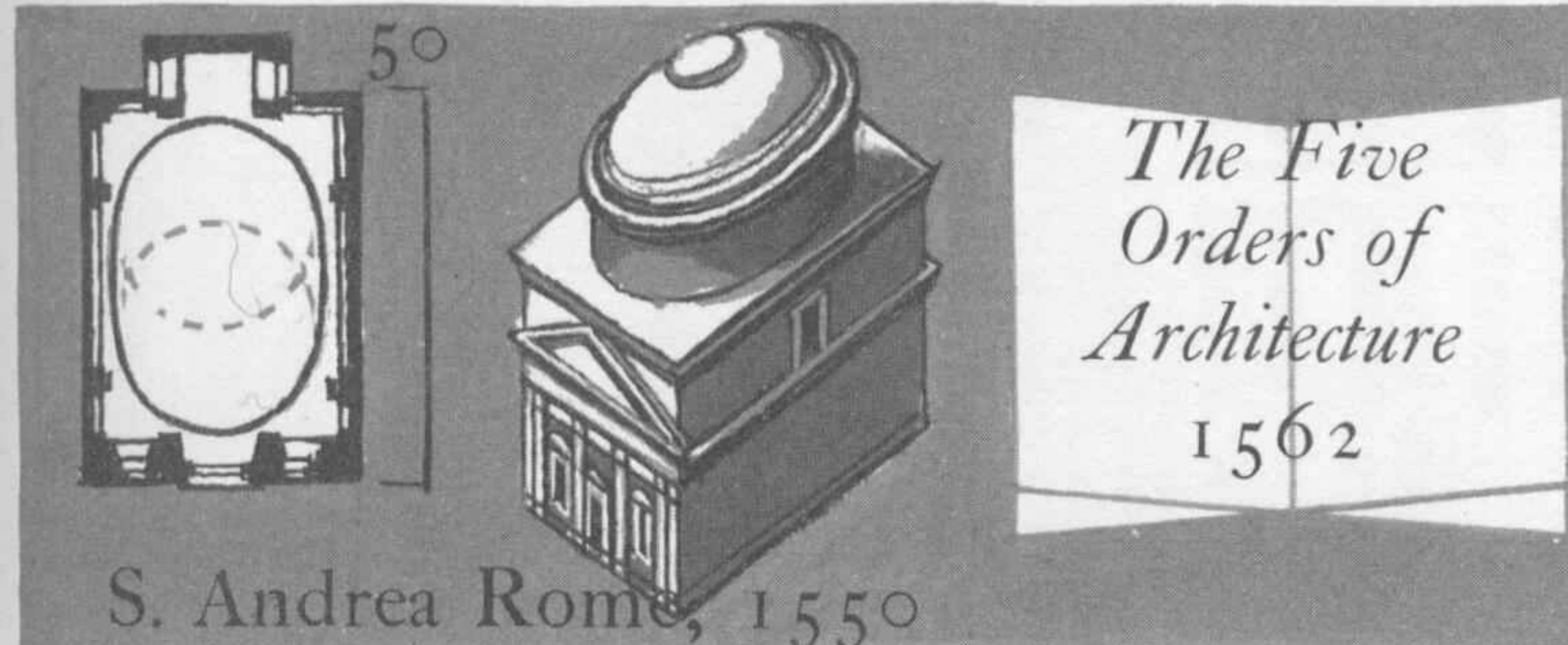
Vitruvius  
First English  
translation  
1692



Plans from  
the fifth book  
1547

*Seven Books  
on Architecture*  
1537-1575

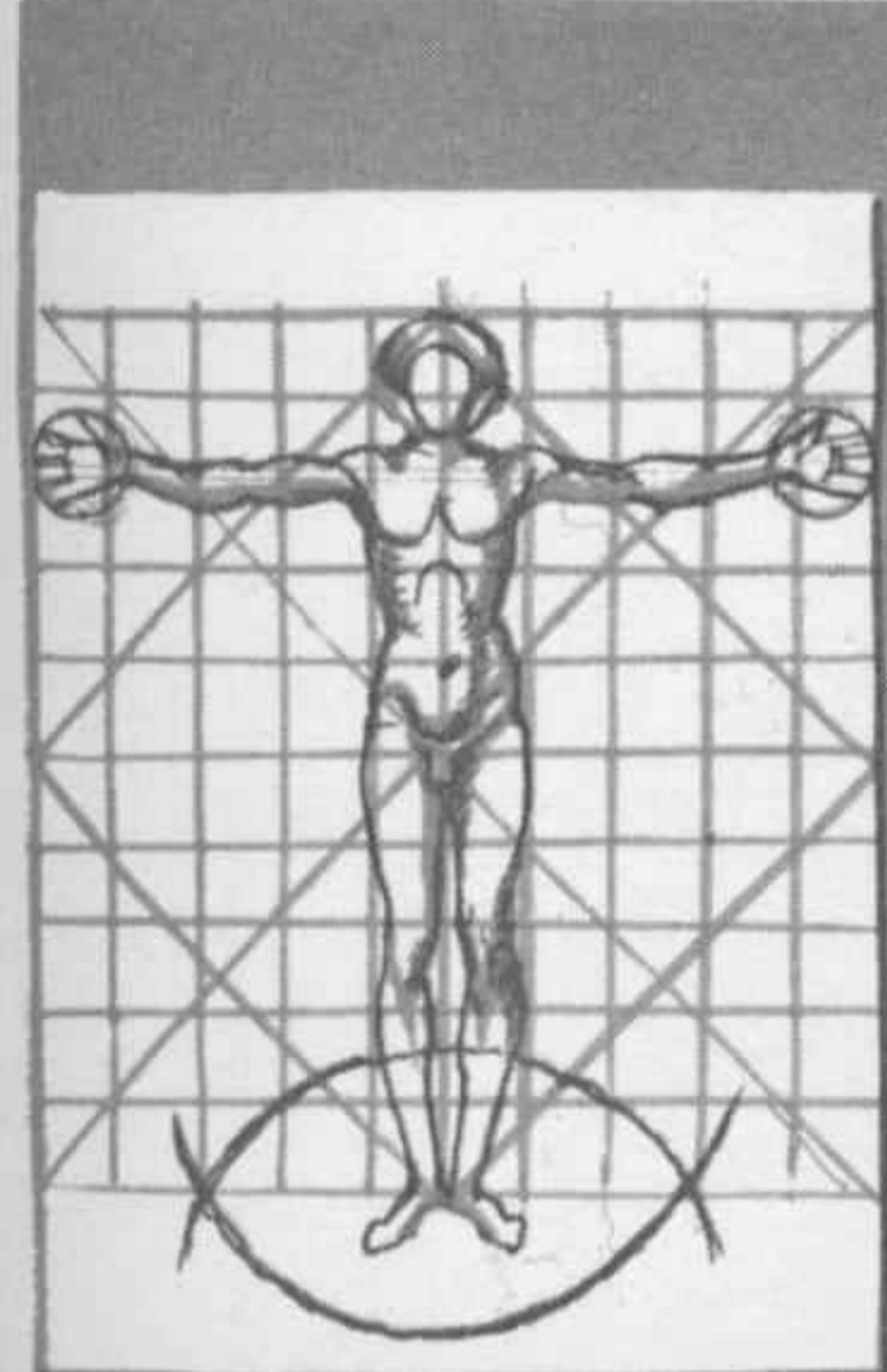
1475 — Sebastiano Serlio — 1554  
Born Bologna. Architect, worked in France



S. Andrea Rome, 1550

*The Five  
Orders of  
Architecture*  
1562

1507 — Giacomo Barozzo Da Vignola — 1573

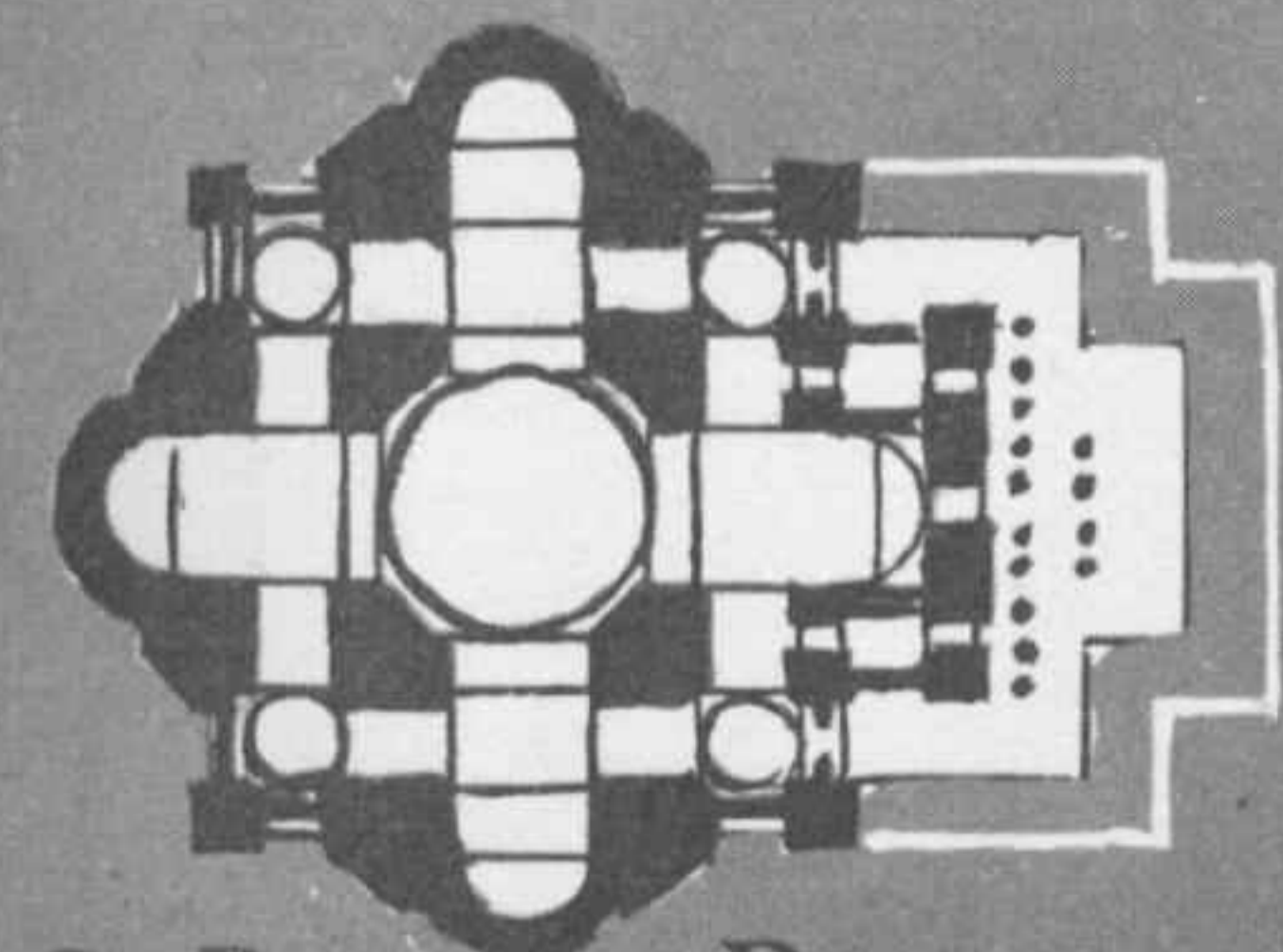


Michelangelo  
stated that  
a figure should  
be made  
'pyramidal,  
serpent-like  
and  
multiplied by  
one, two  
and three',



from  
Cesarino's  
Vitruvius 1521

and wrote in a letter:  
'... the architectural  
members derive from  
human members'.

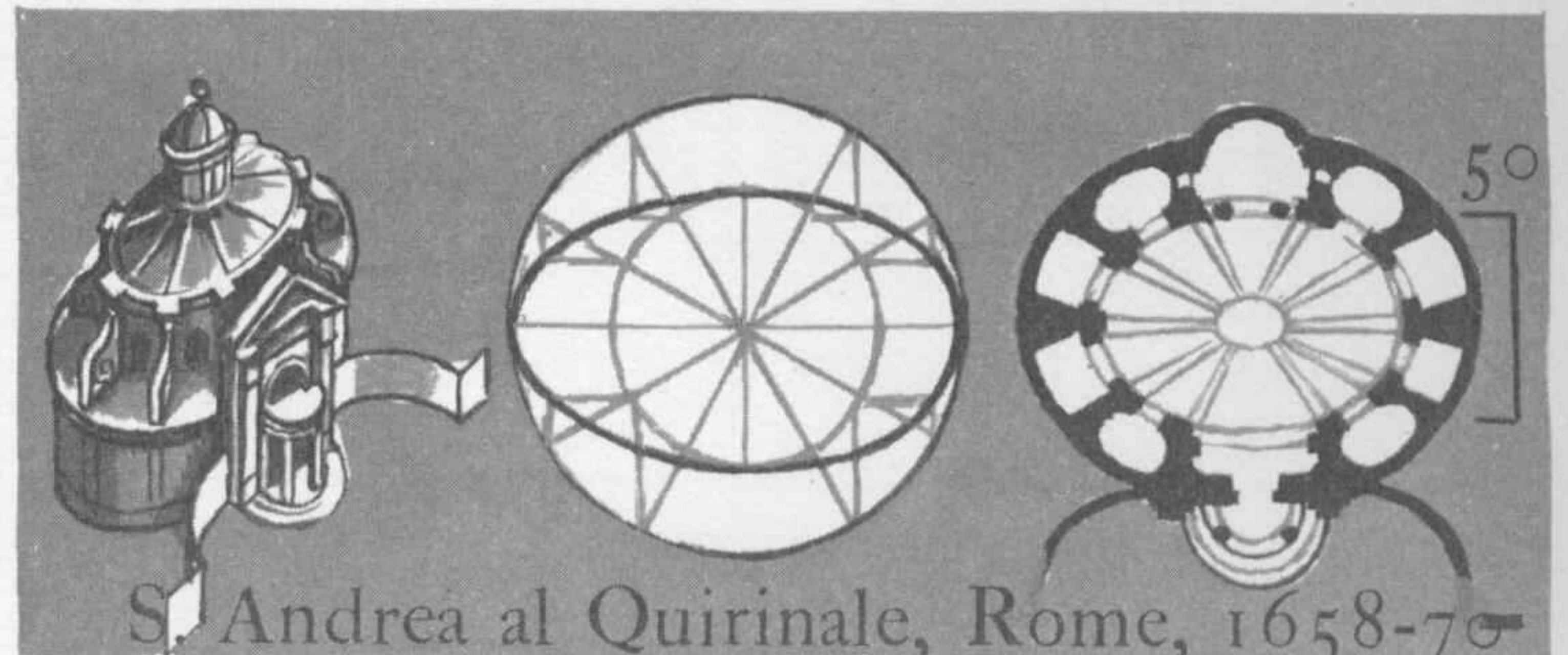


St Peter's, Rome, 1506

1475 — Michelangelo — 1564

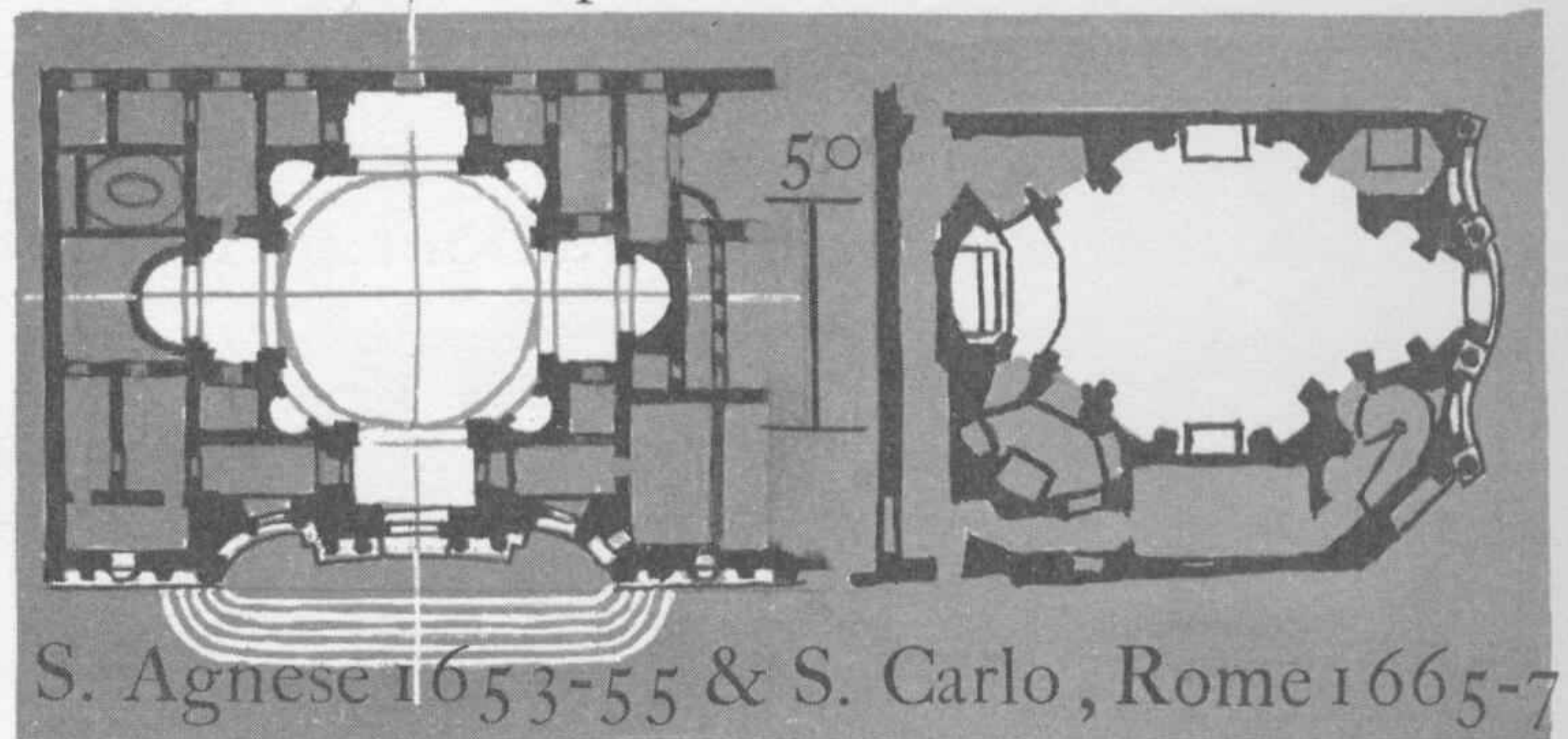
1508 — Andrea Palladio (pp. 128-9) — 1580

In Baroque churches musical ratios  
were resolved into an orchestration of visual  
forces comparable to the fugue, & measured  
by the eye and the mind of the beholder



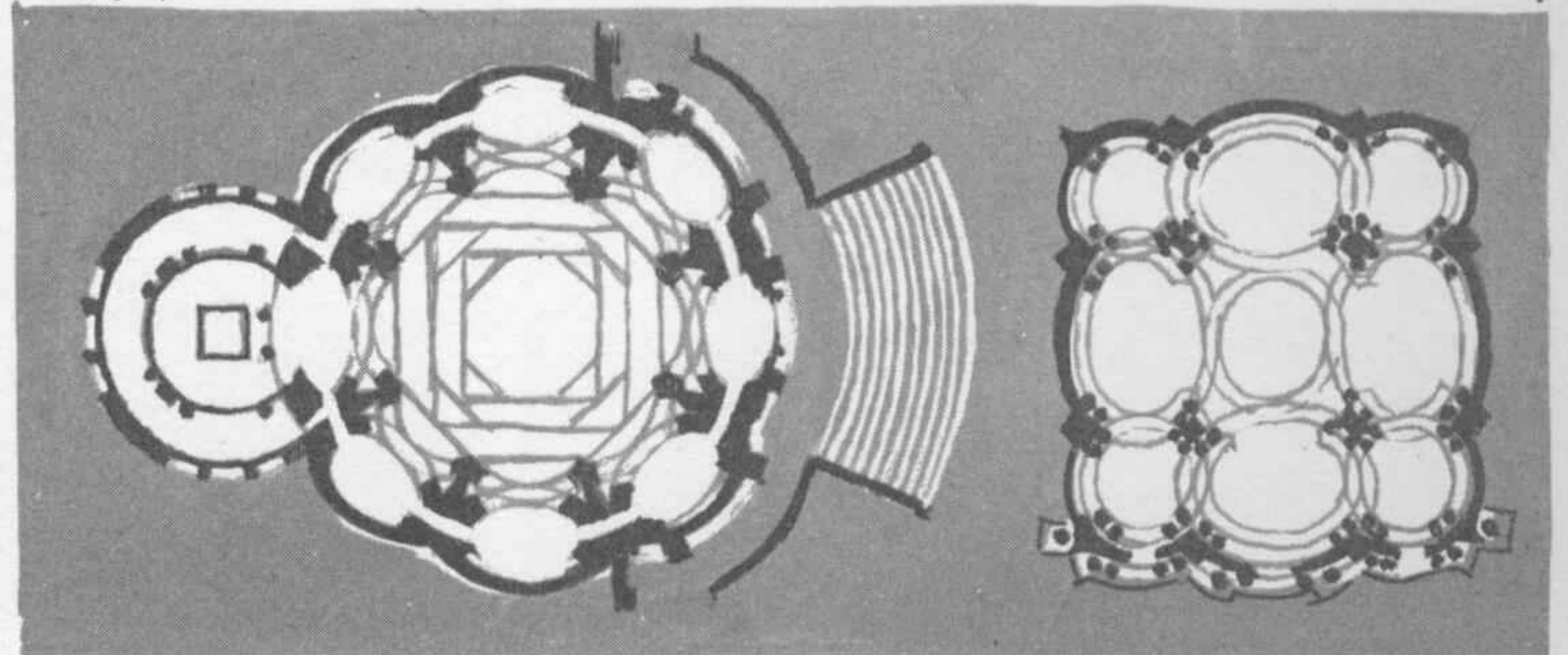
S. Andrea al Quirinale, Rome, 1658-70

1598 — Giovanni Lorenzo Bernini — 1680  
sculptor and architect

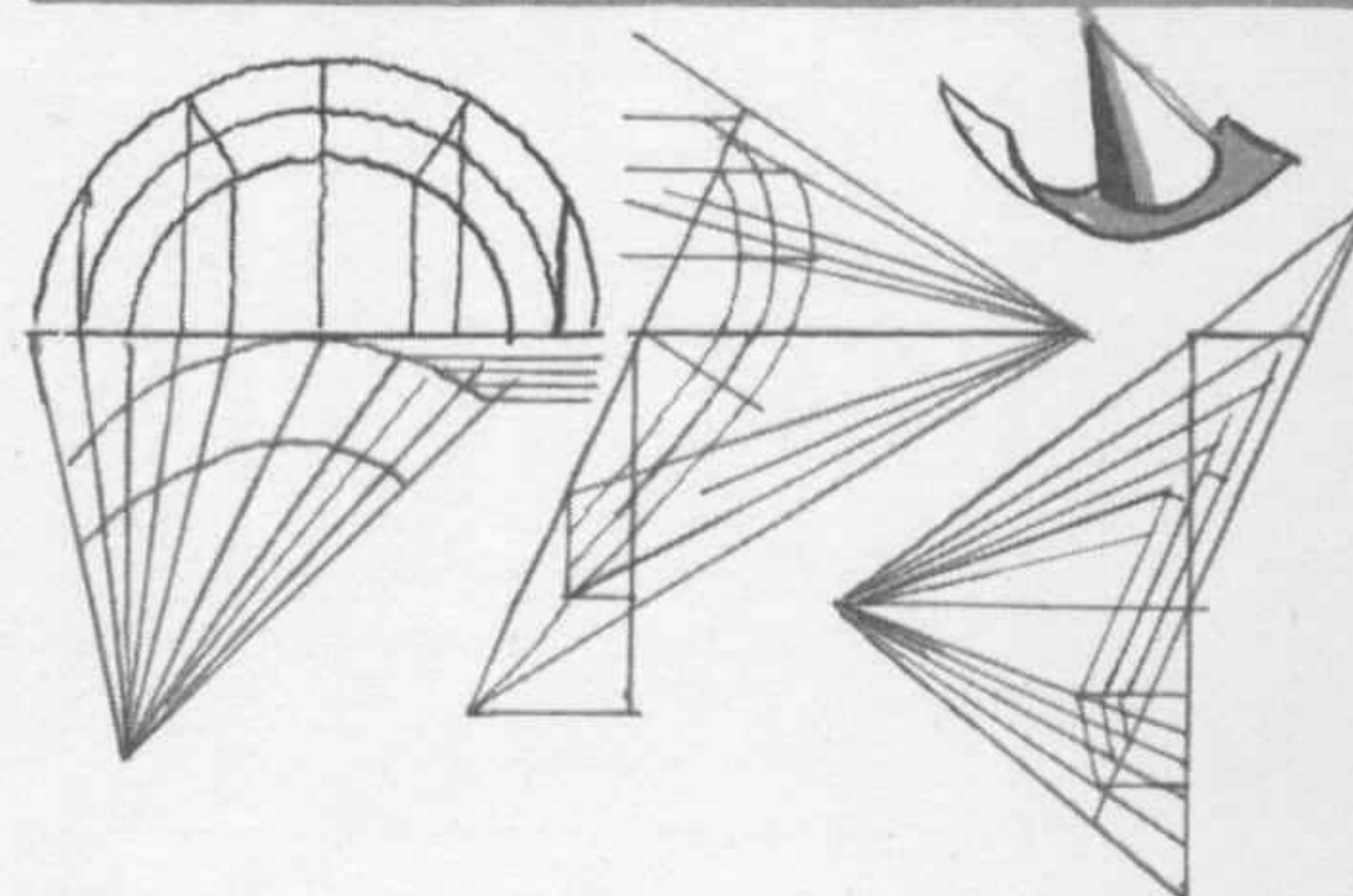


S. Agnese 1653-55 & S. Carlo, Rome 1665-7

1599 — Francesco Borromini — 1667



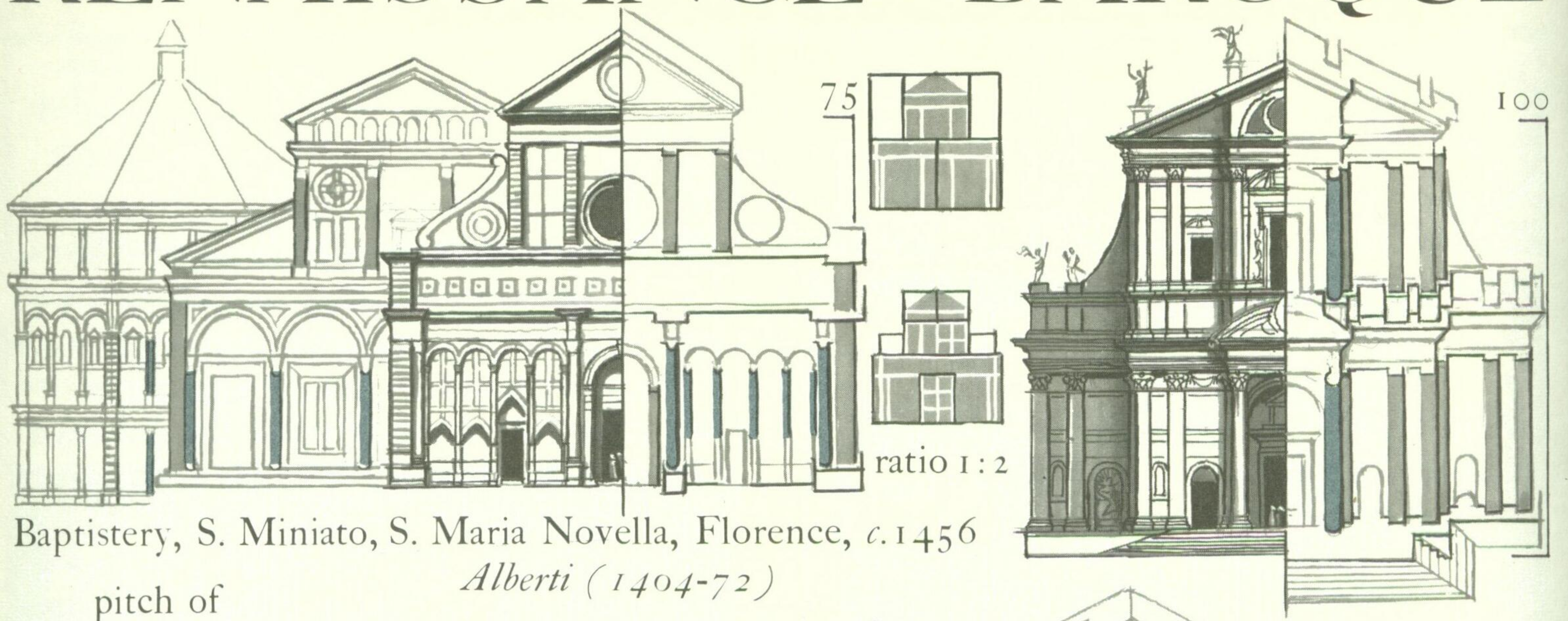
designs from



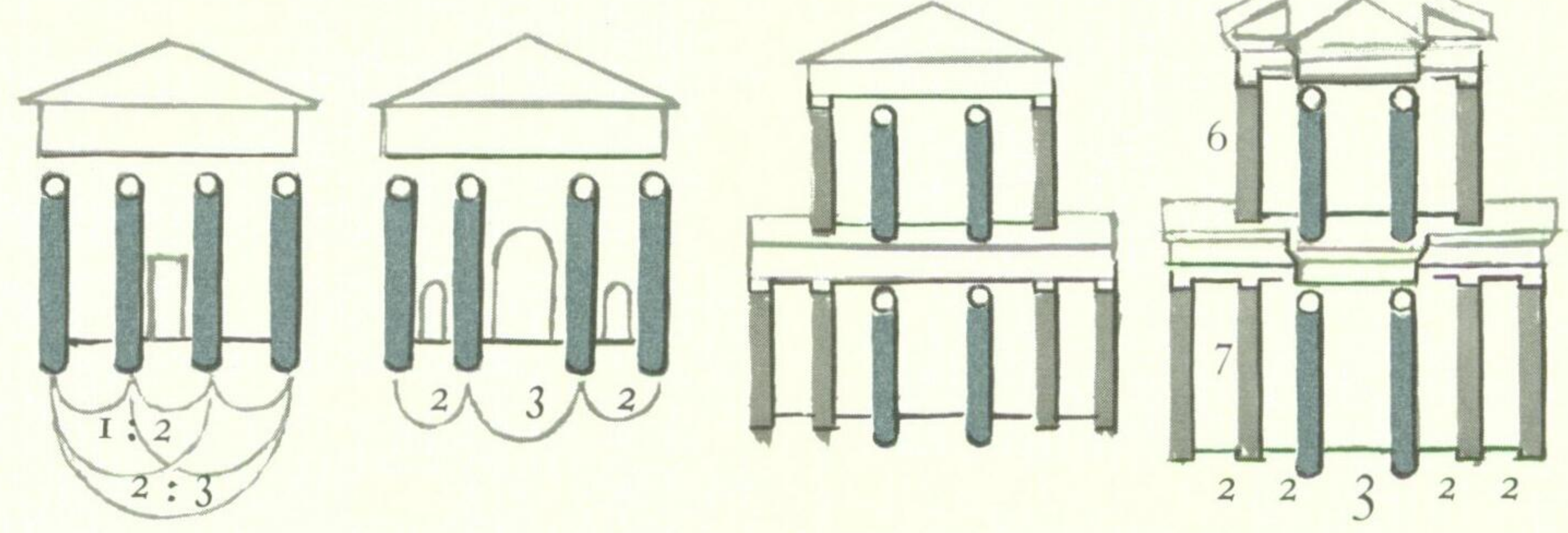
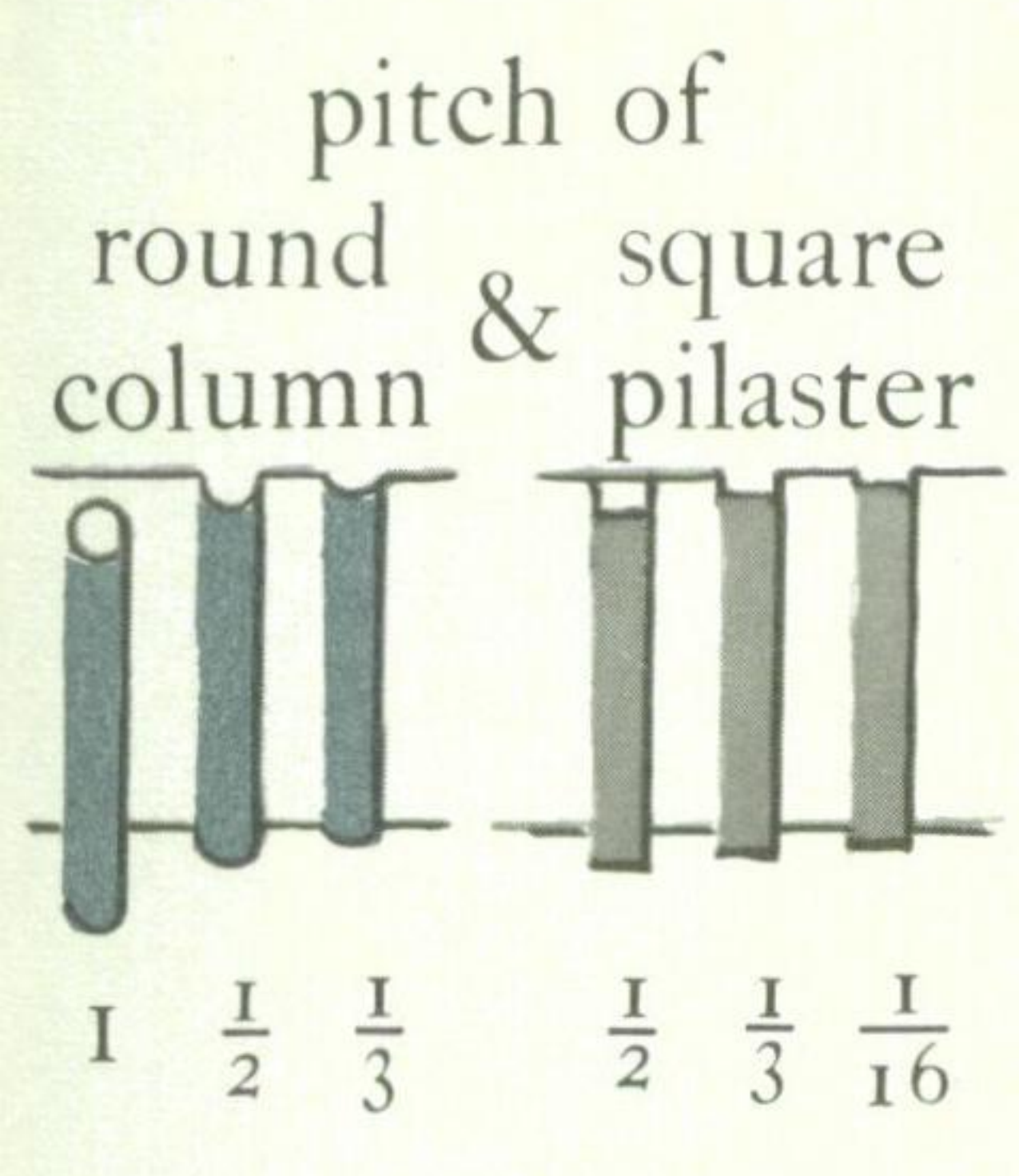
*Dell'  
Architettura  
civile*  
Turin 1737

1624 — Guarino Guarini — 1683  
mathematician & architect, mostly at Turin

# RENAISSANCE - BAROQUE

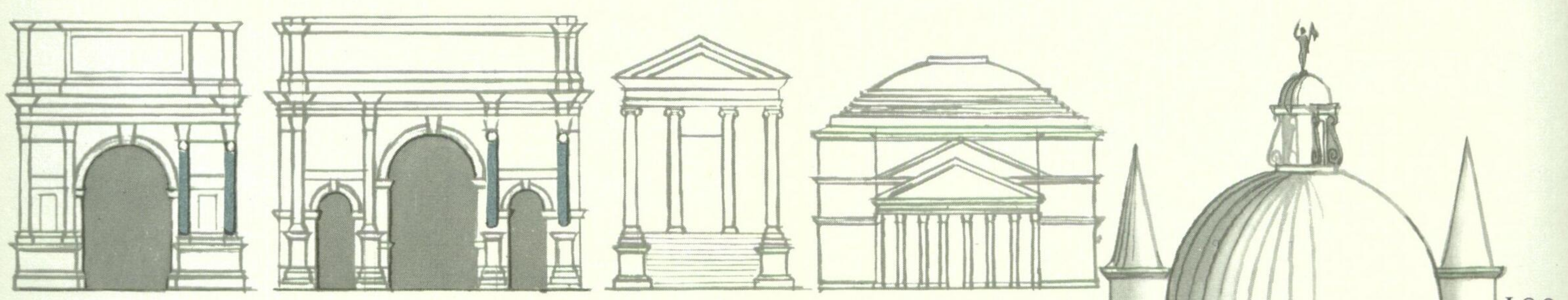


Baptistery, S. Miniato, S. Maria Novella, Florence, c.1456  
*Alberti (1404-72)*

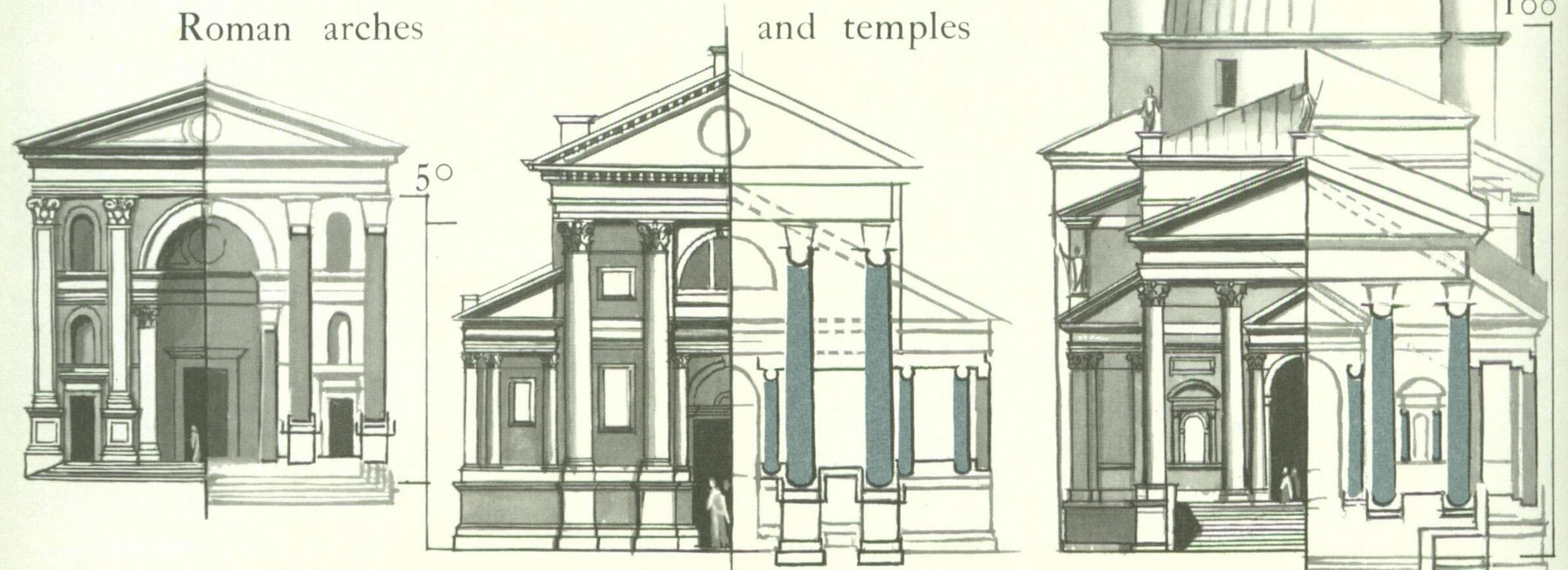


The Gesù, Rome, 1568-75  
*Vignola (1507-73)*  
(p.122)

Arrangement & permutations of columns & pilasters to compose a visual 'overture'

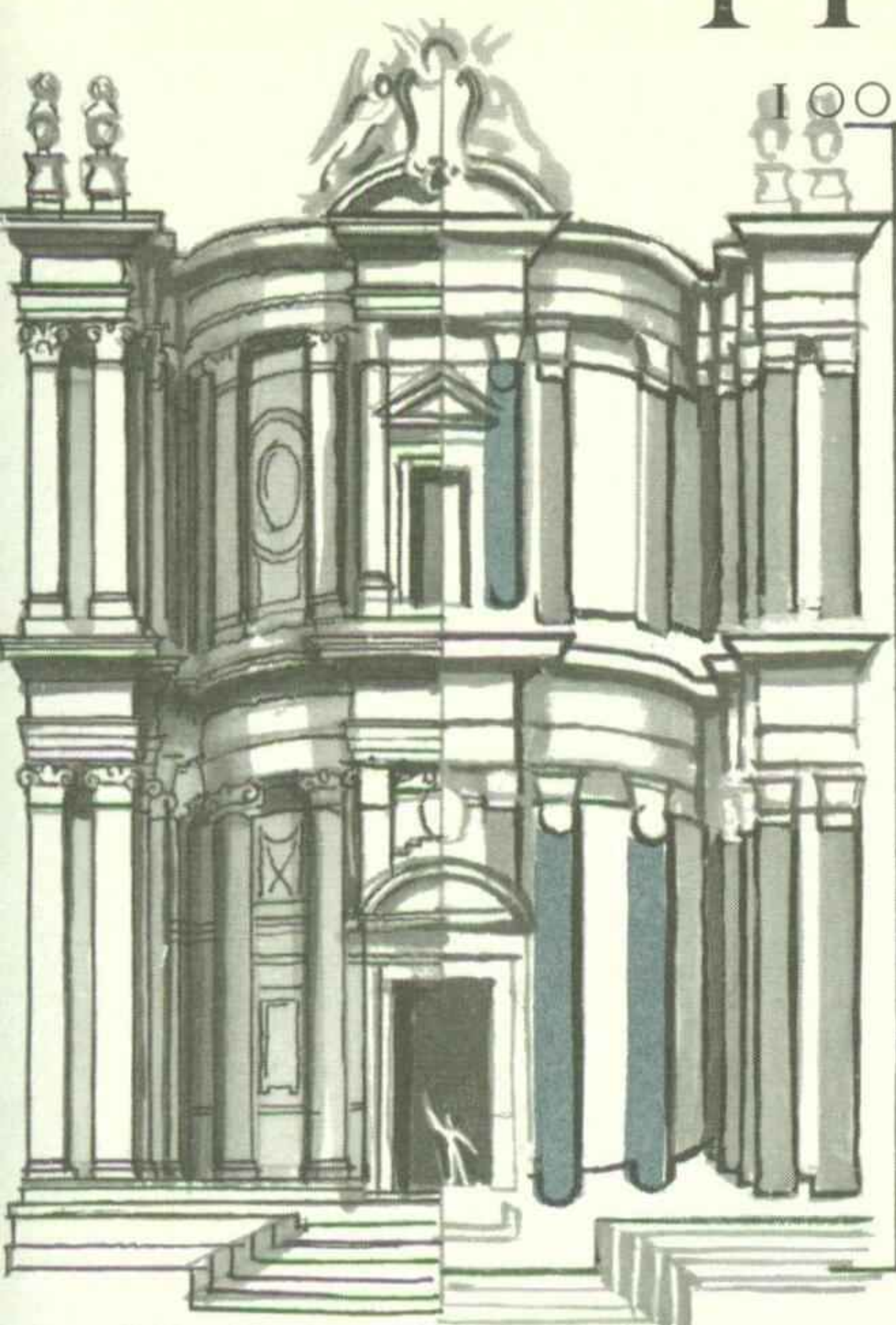


Roman arches and temples

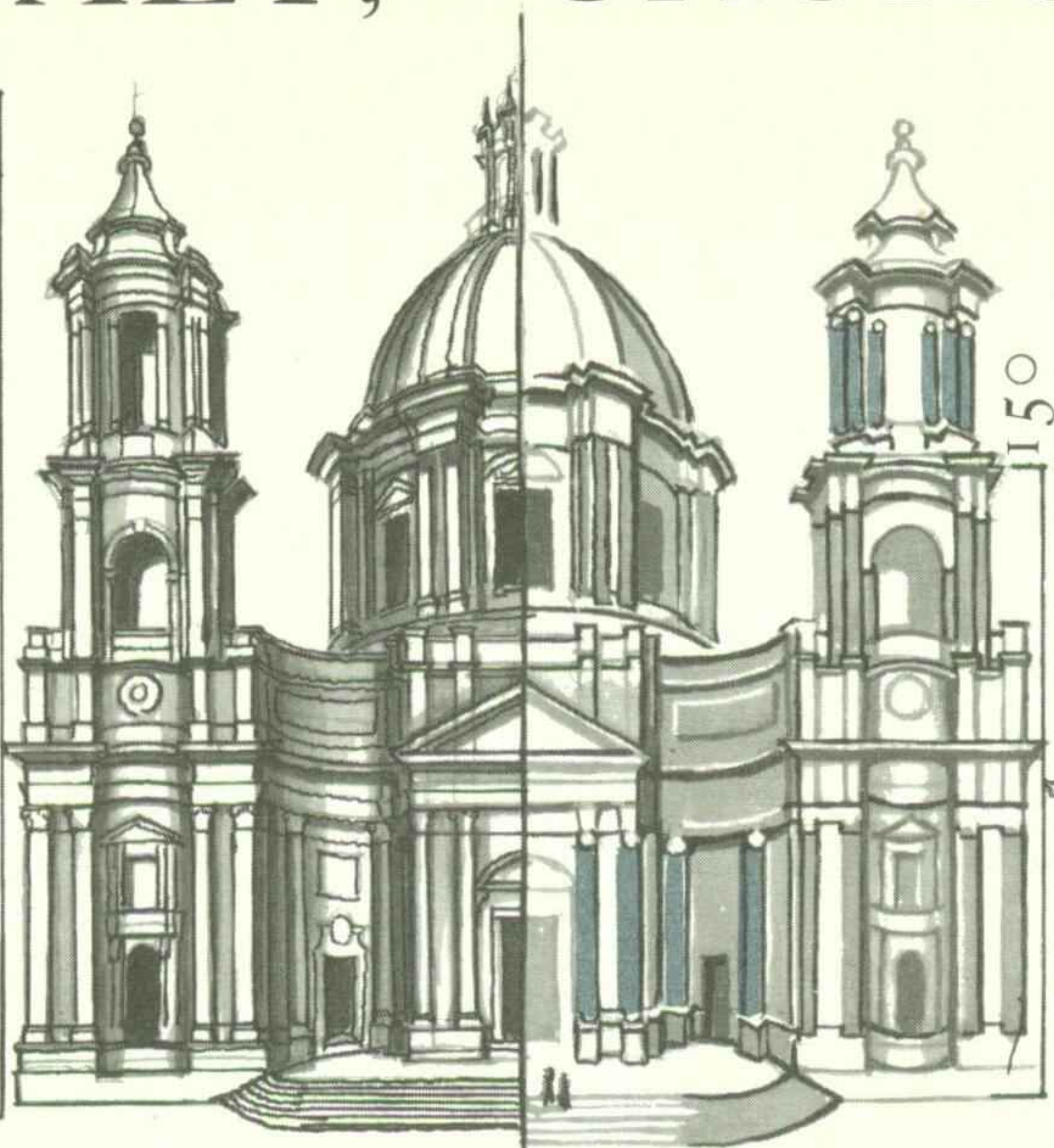


S. Andrea, Mantua, 1470 *Alberti (p.122)* S. Francesco della Vigna, Venice, 1562  
Il Redentore, Venice, 1576-92 *Andrea Palladio (1508-1580)*

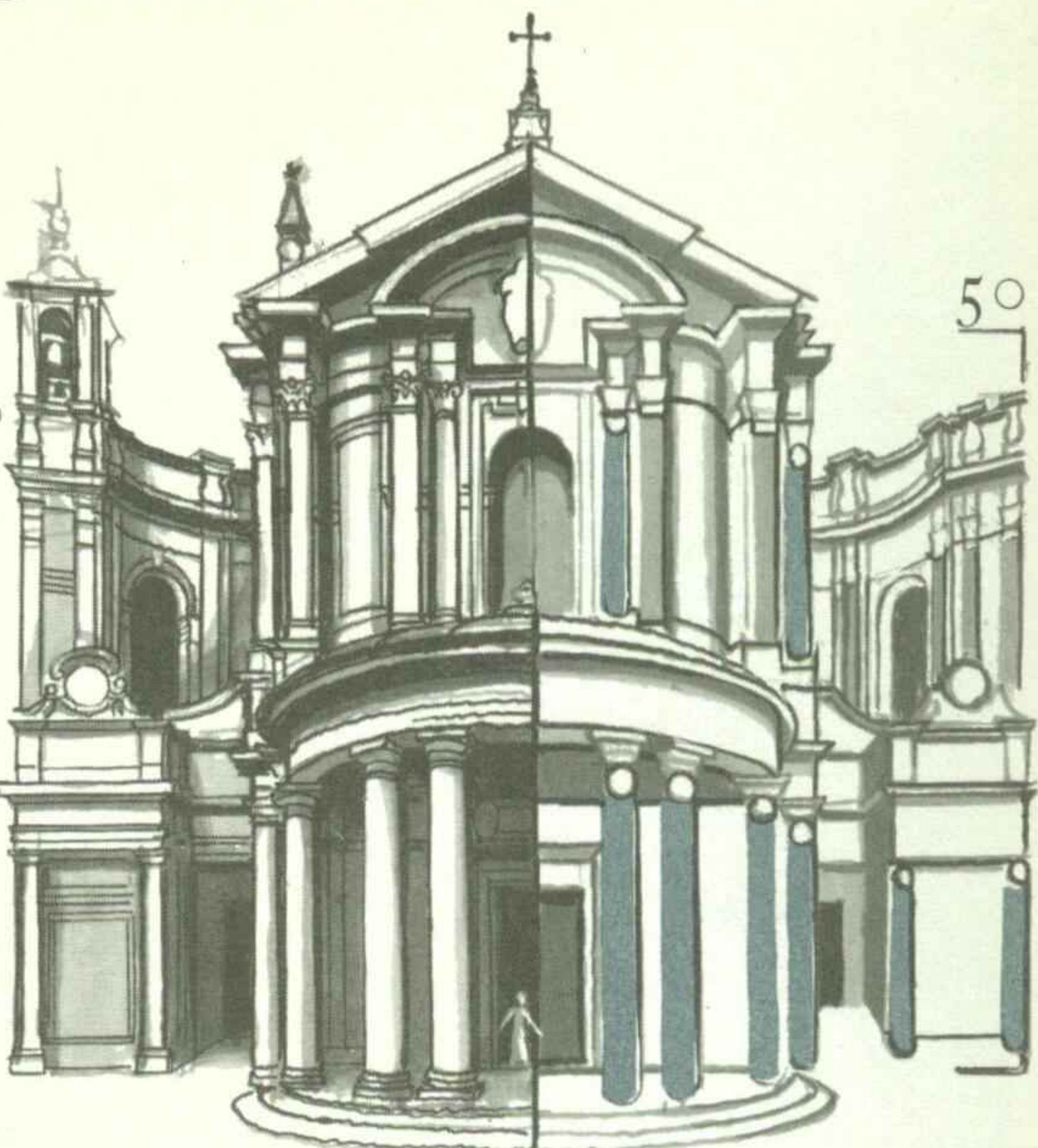
# ITALY, CHURCH FACADES



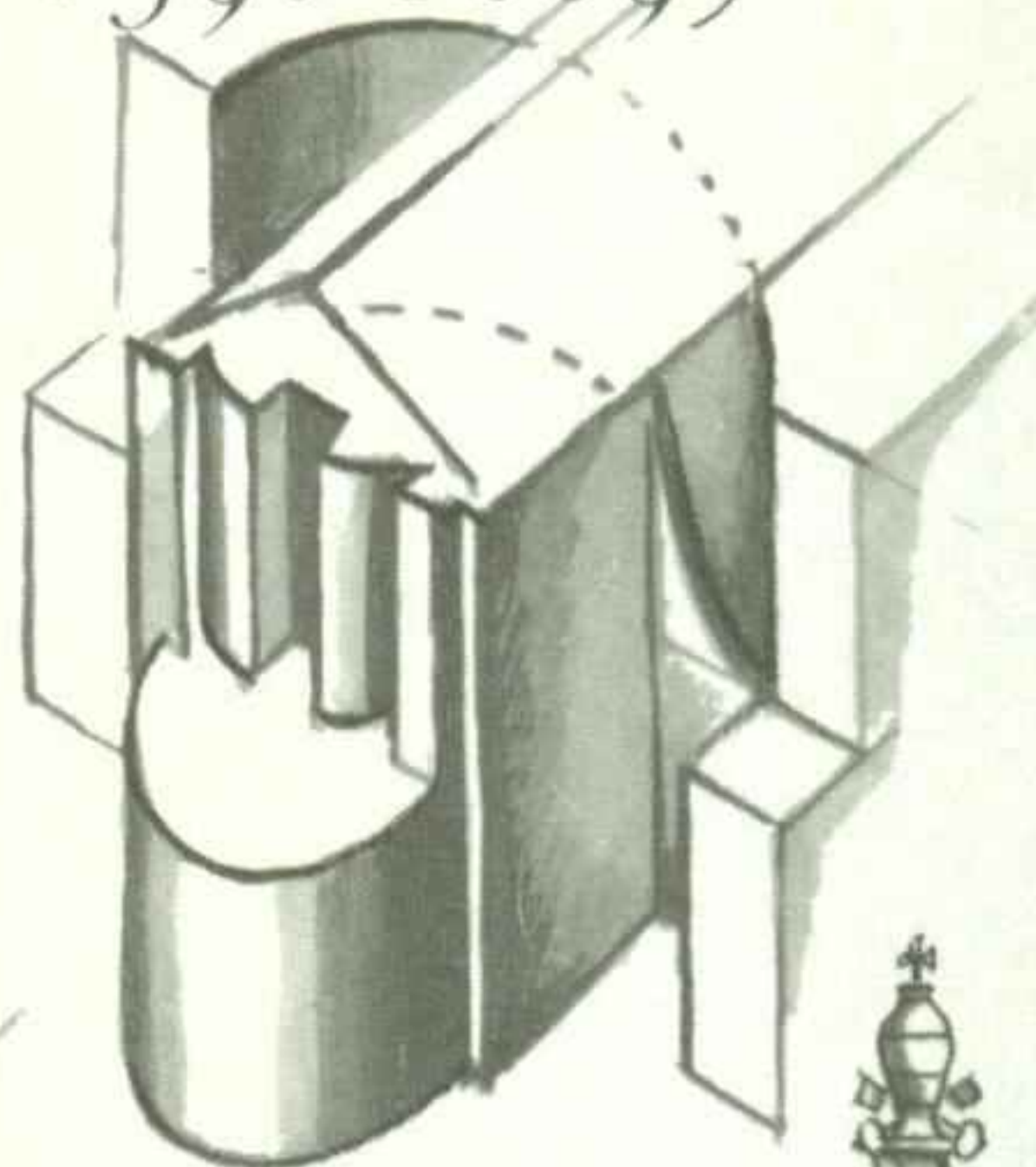
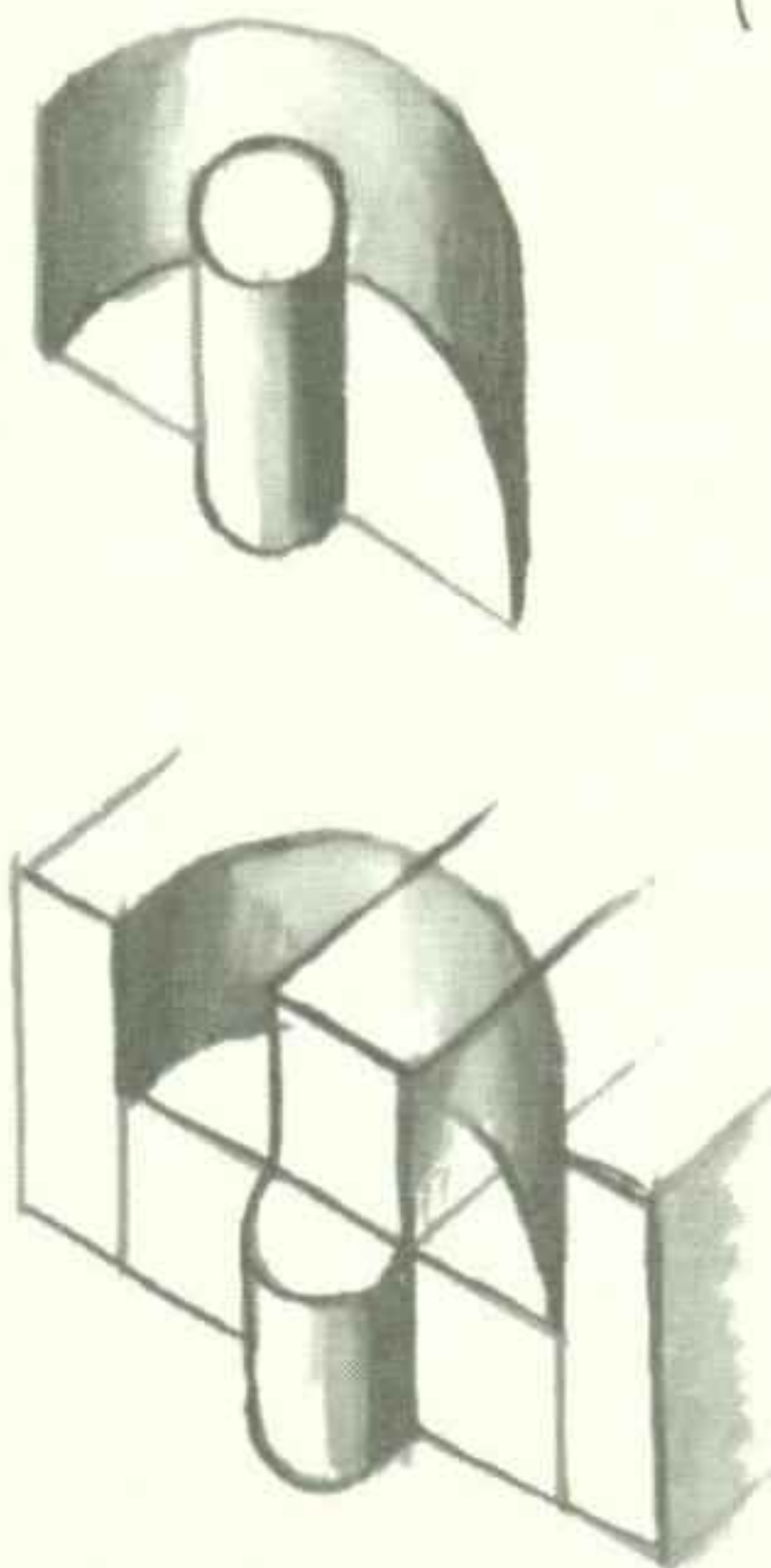
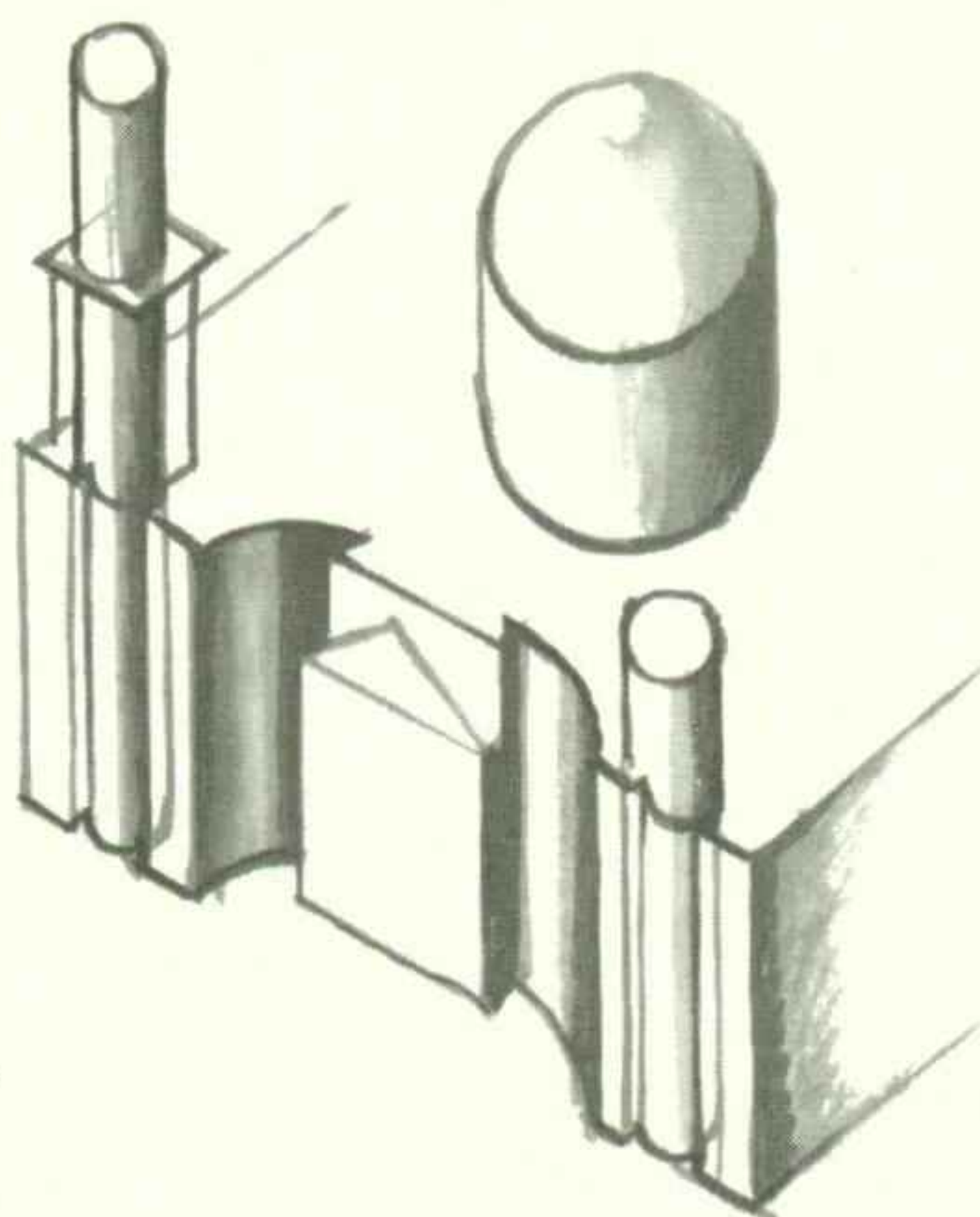
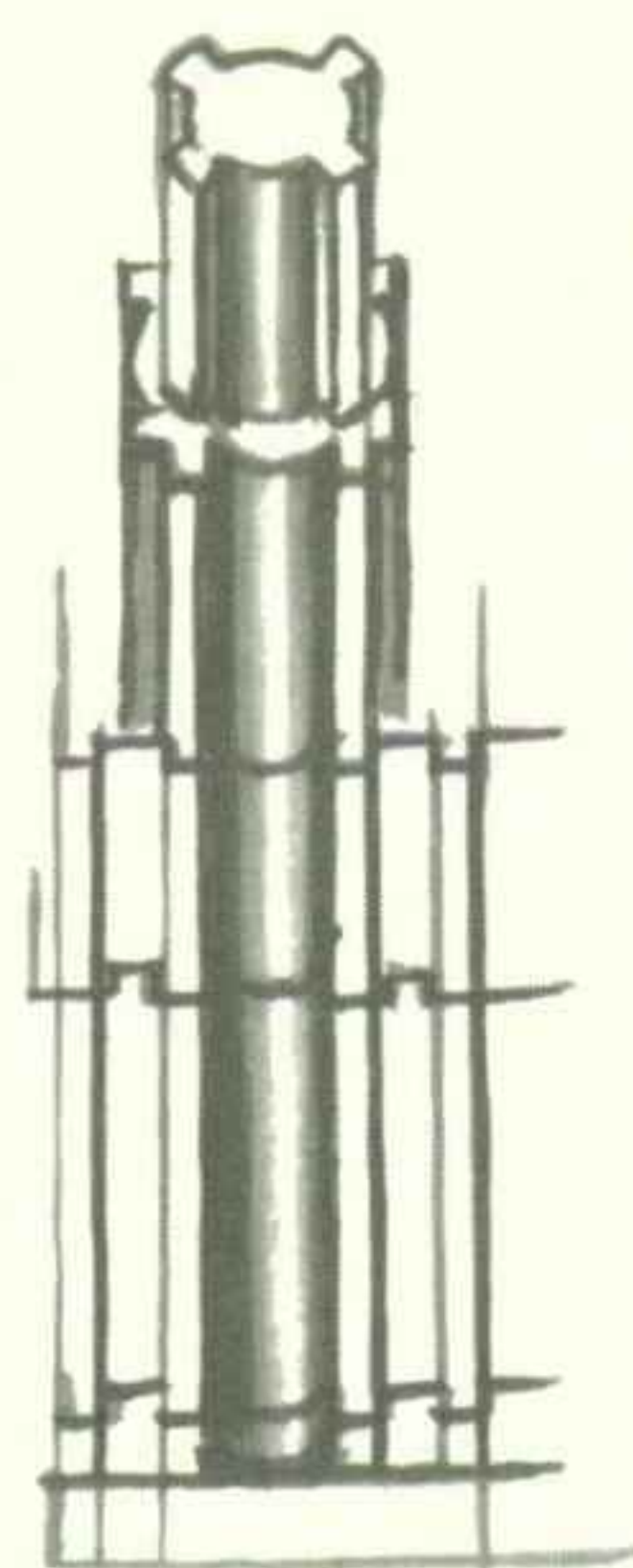
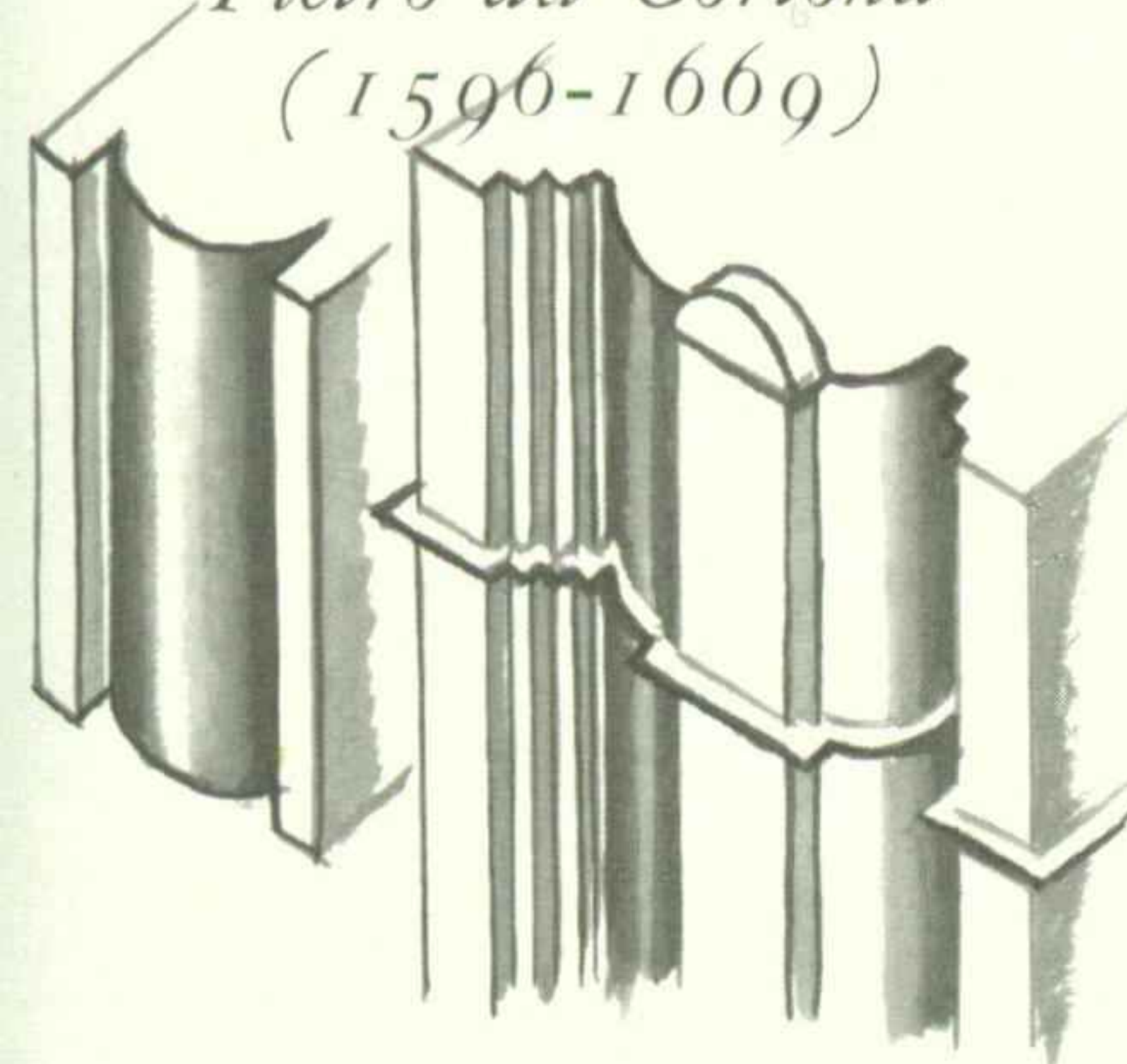
SS. Martina e Luca,  
Rome, 1635-50  
*Pietro da Cortona*  
(1596-1669)



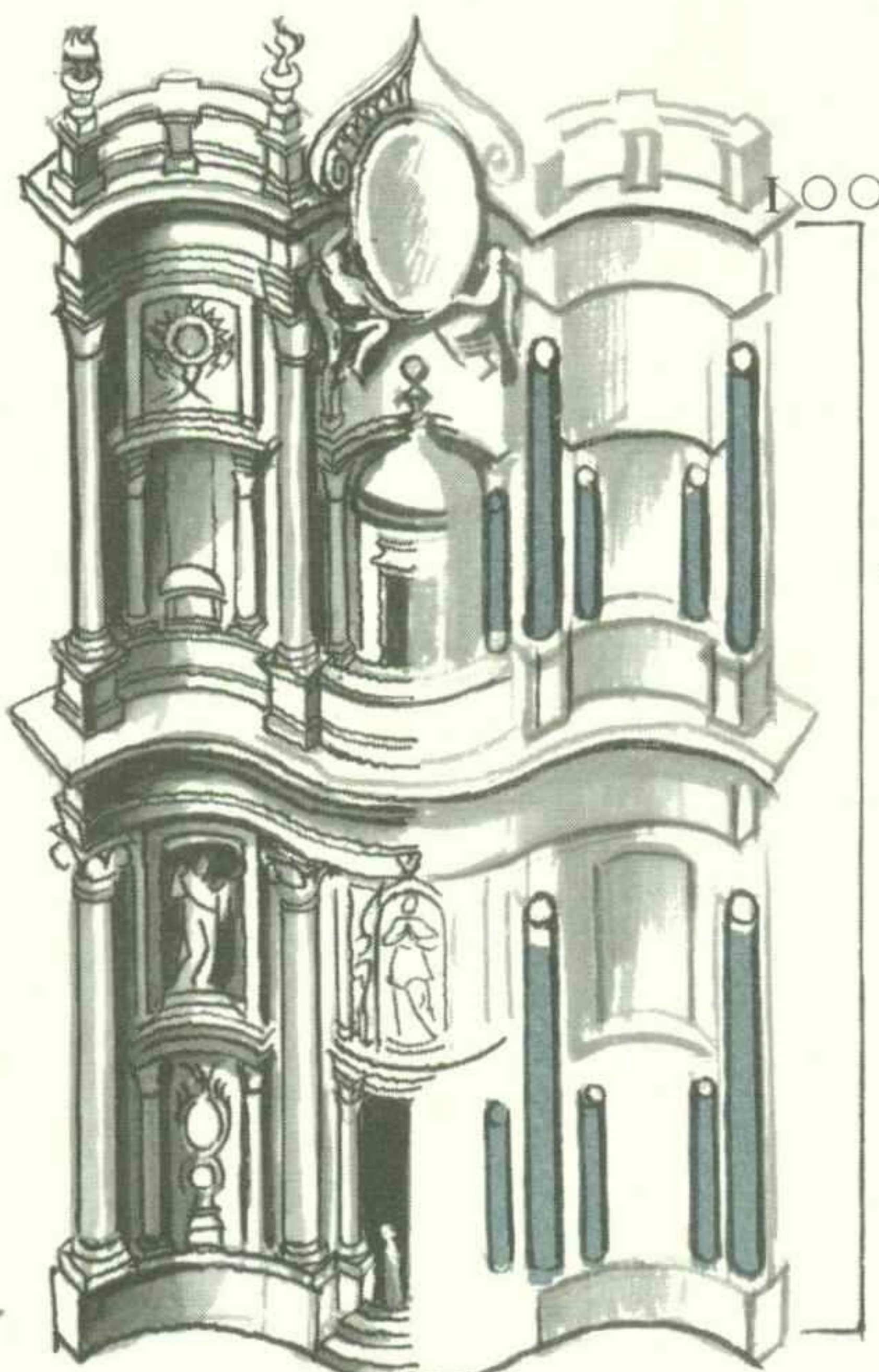
S. Agnese in Piazza Navona,  
Rome, 1653-55  
*Francesco Borromini* (1599-1667)



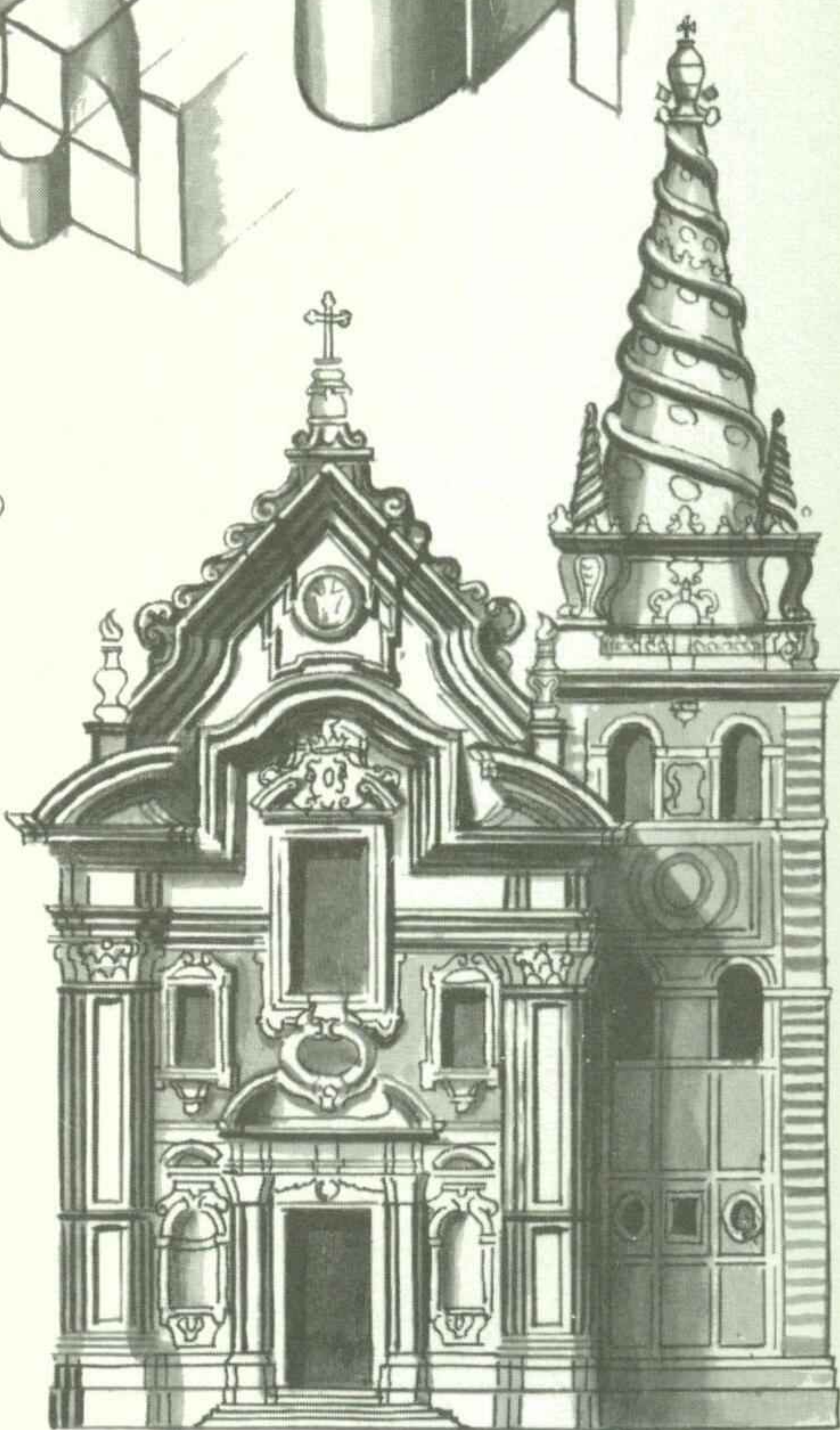
S. Maria della Pace,  
Rome, 1656-57  
*Pietro da Cortona*  
(1596-1669)



S. Susanna, Rome, 1597-1603  
*Carlo Maderna* (1556-1629)

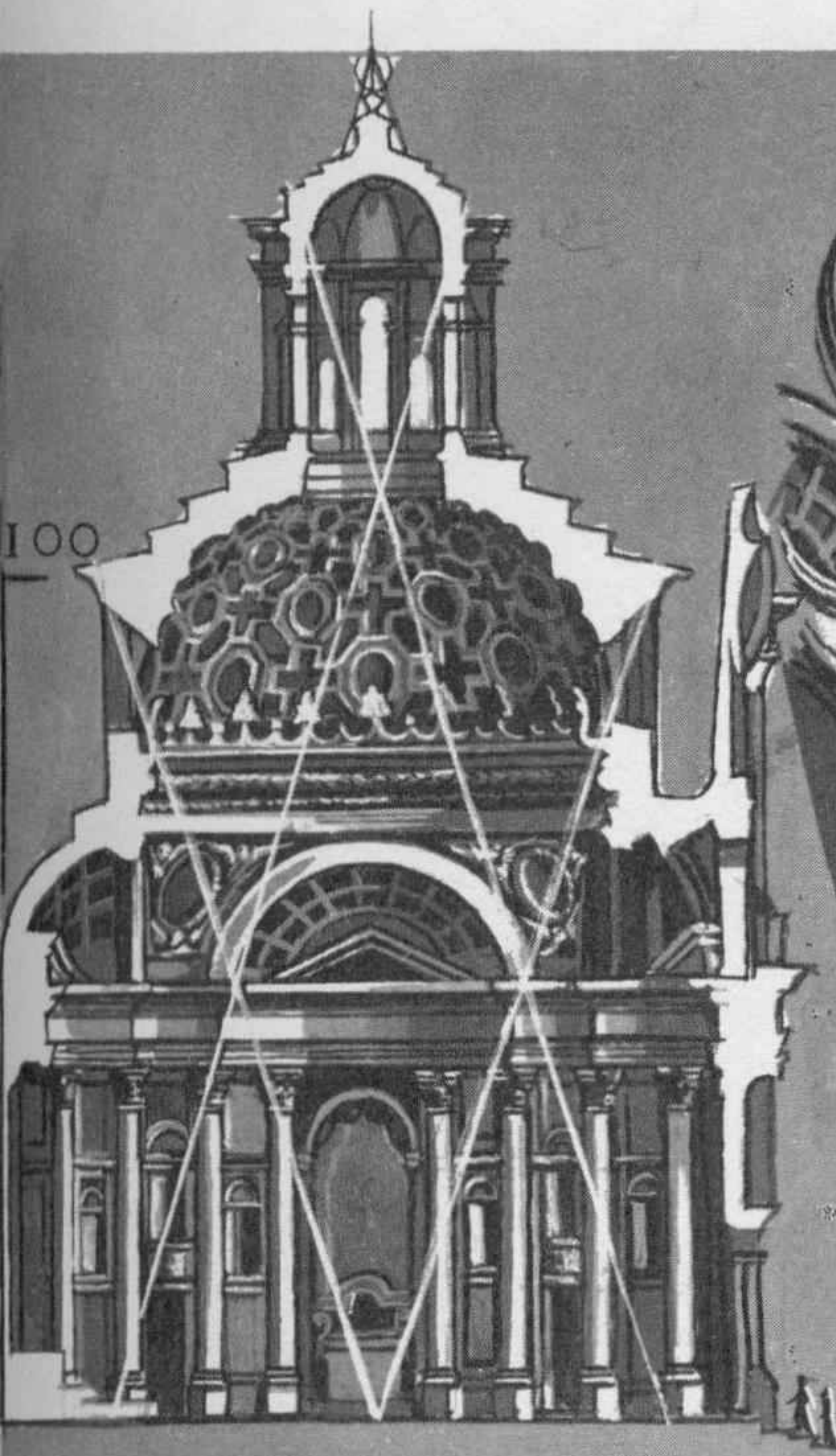


S. Carlo, Rome, 1665-7  
*Borromini* (p. 123)

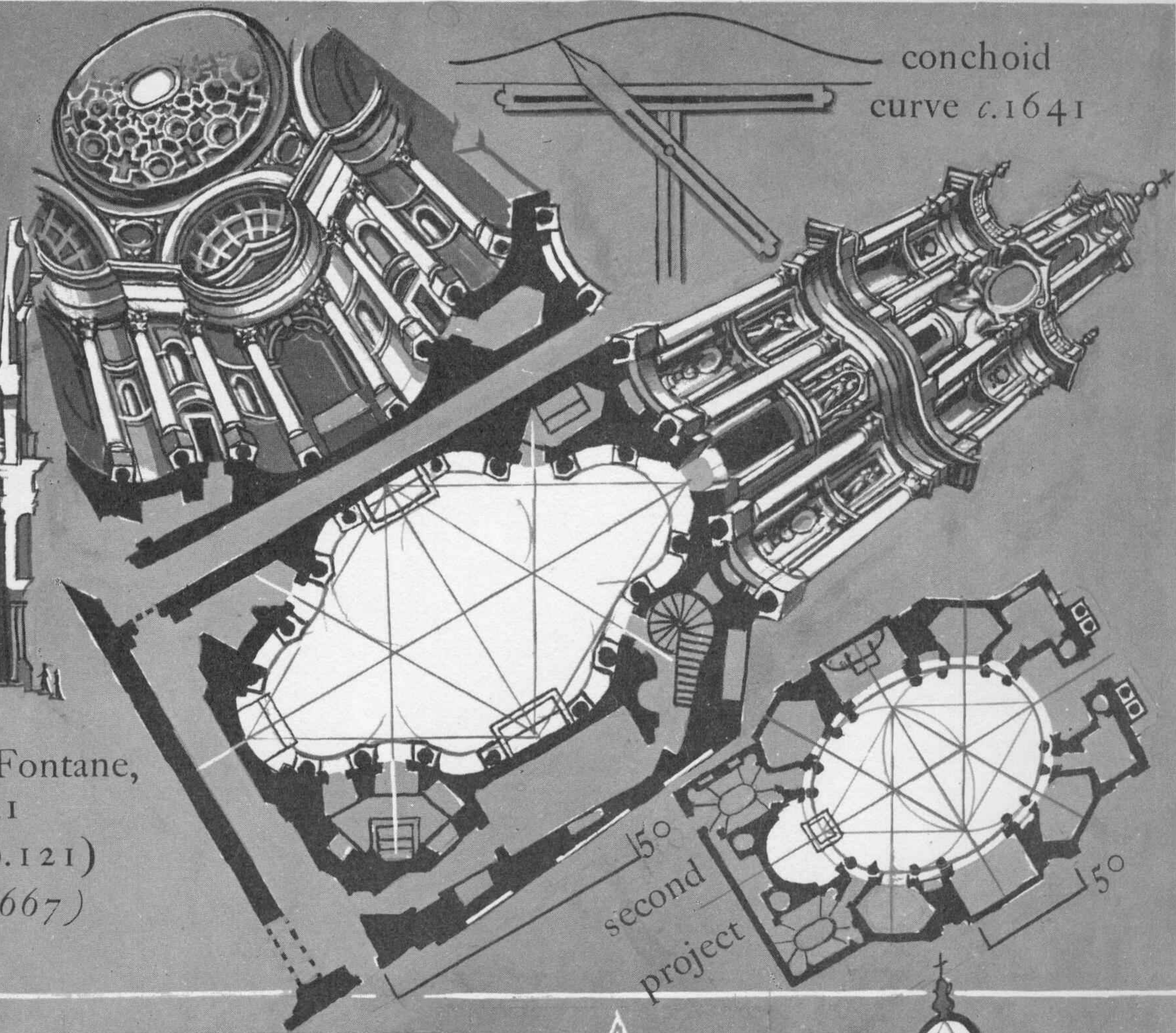


S. Gregorio, Messina, 1660  
*Guarini* (1624-1683)

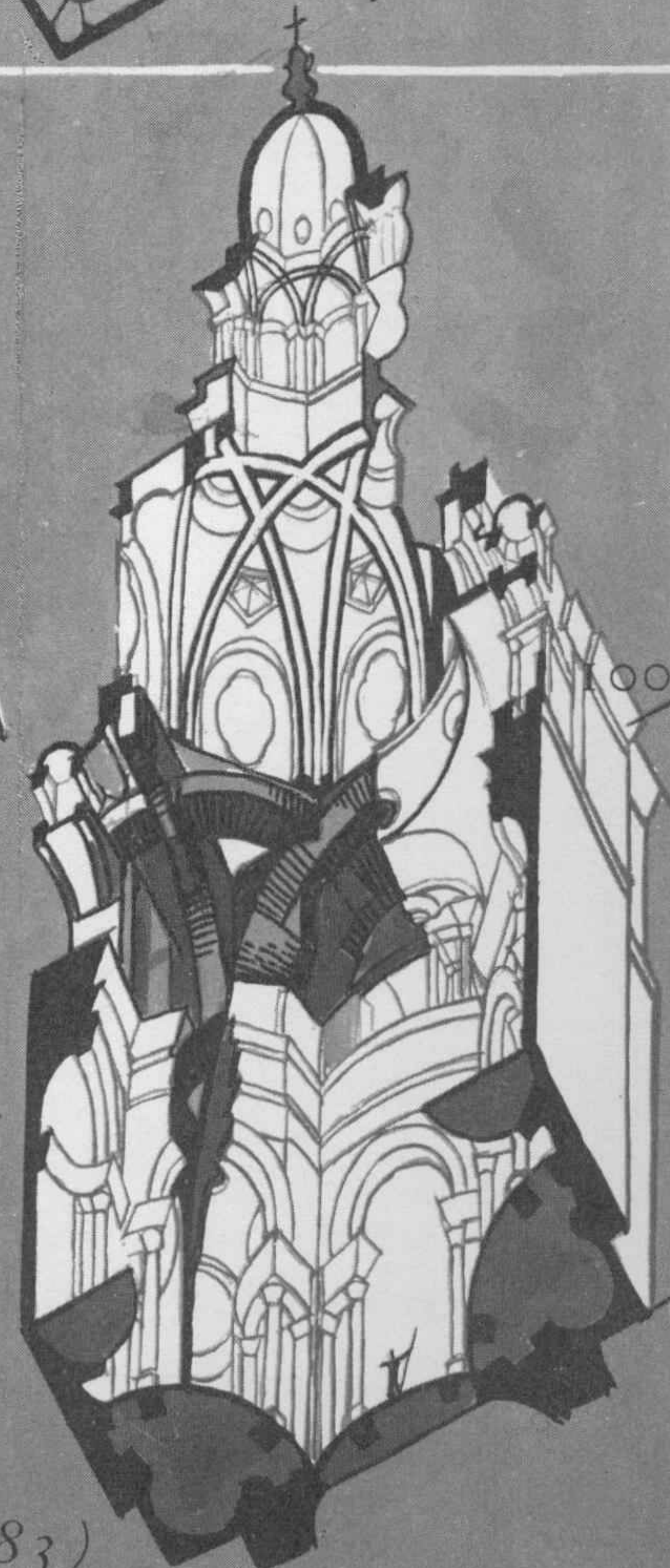
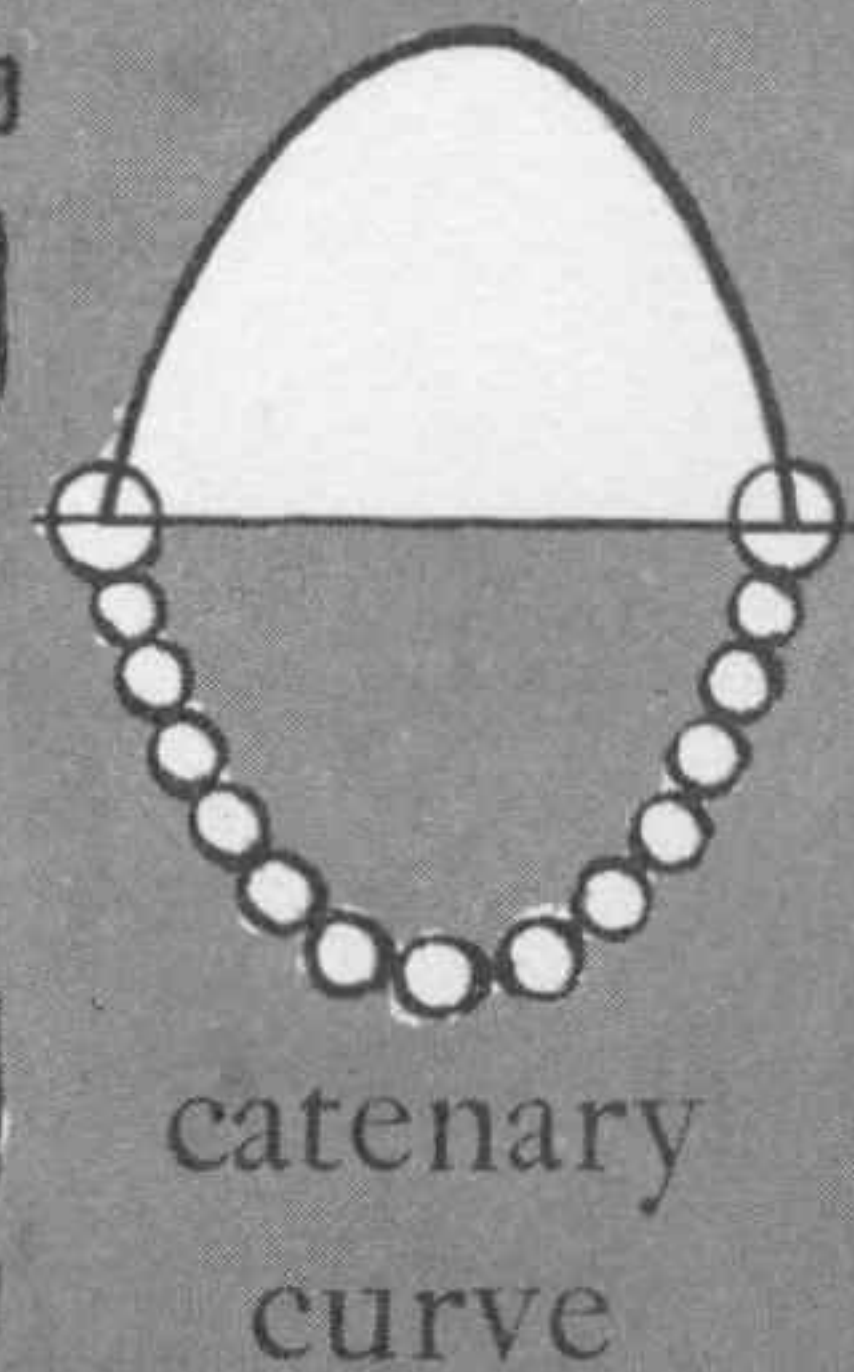
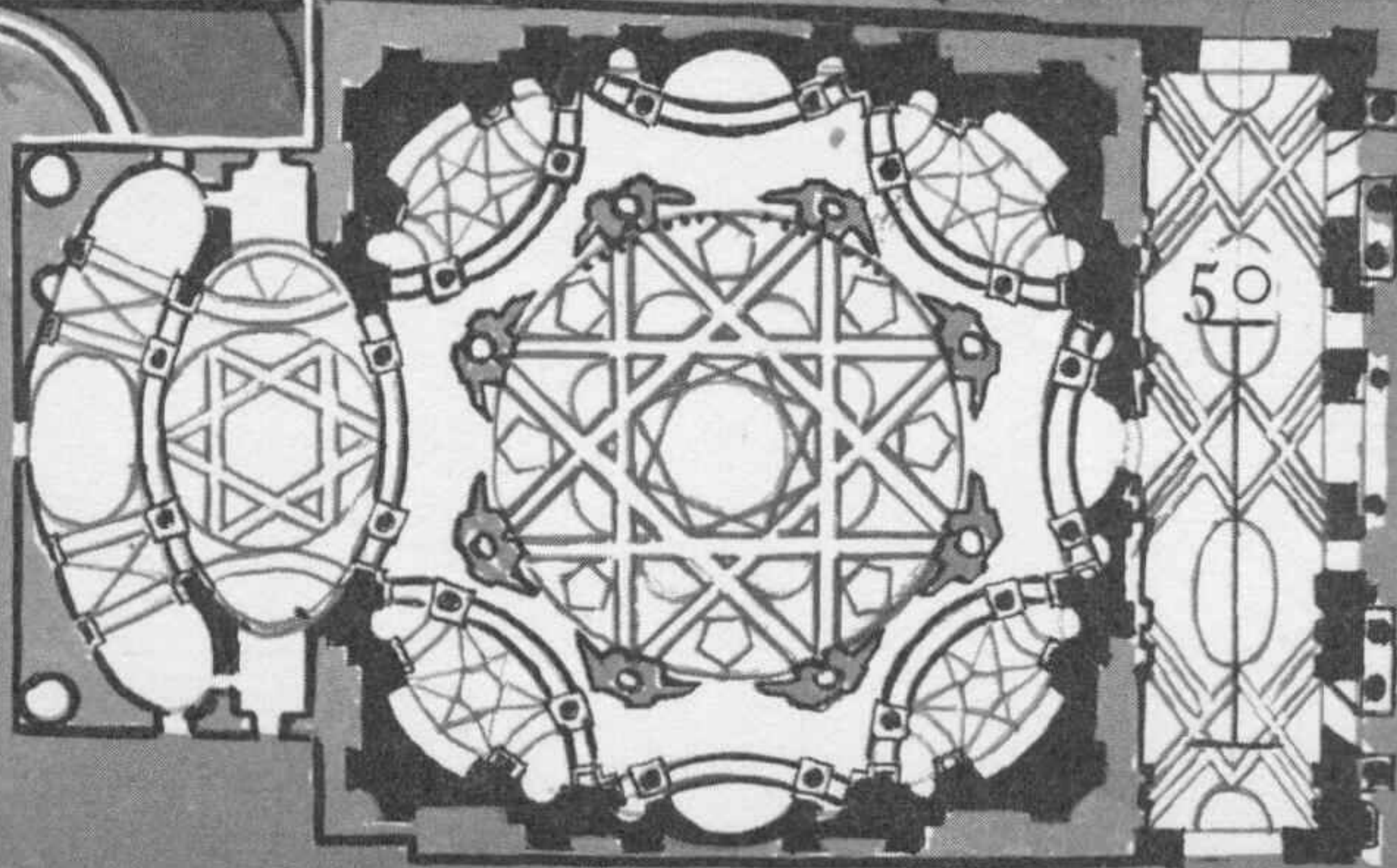
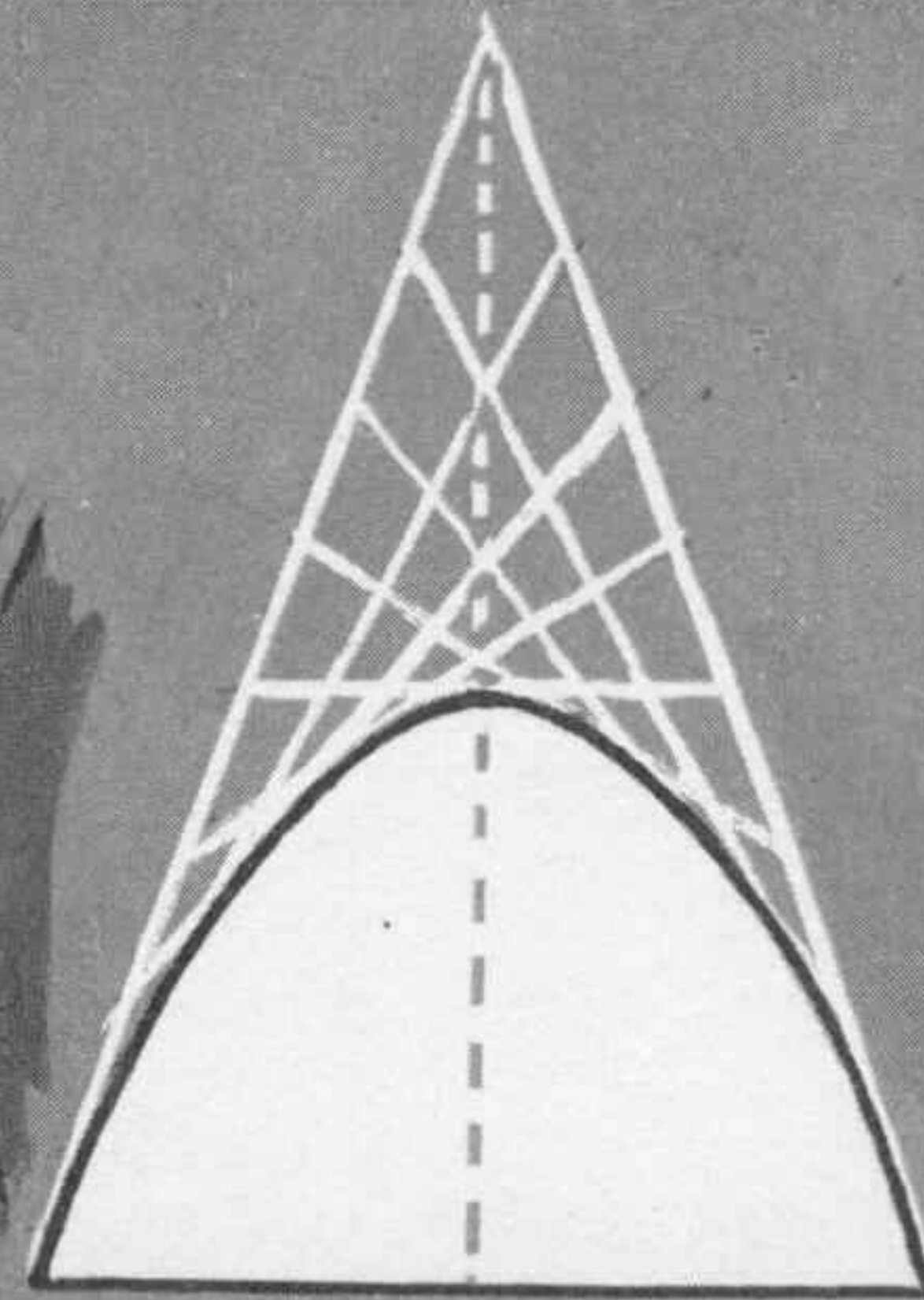
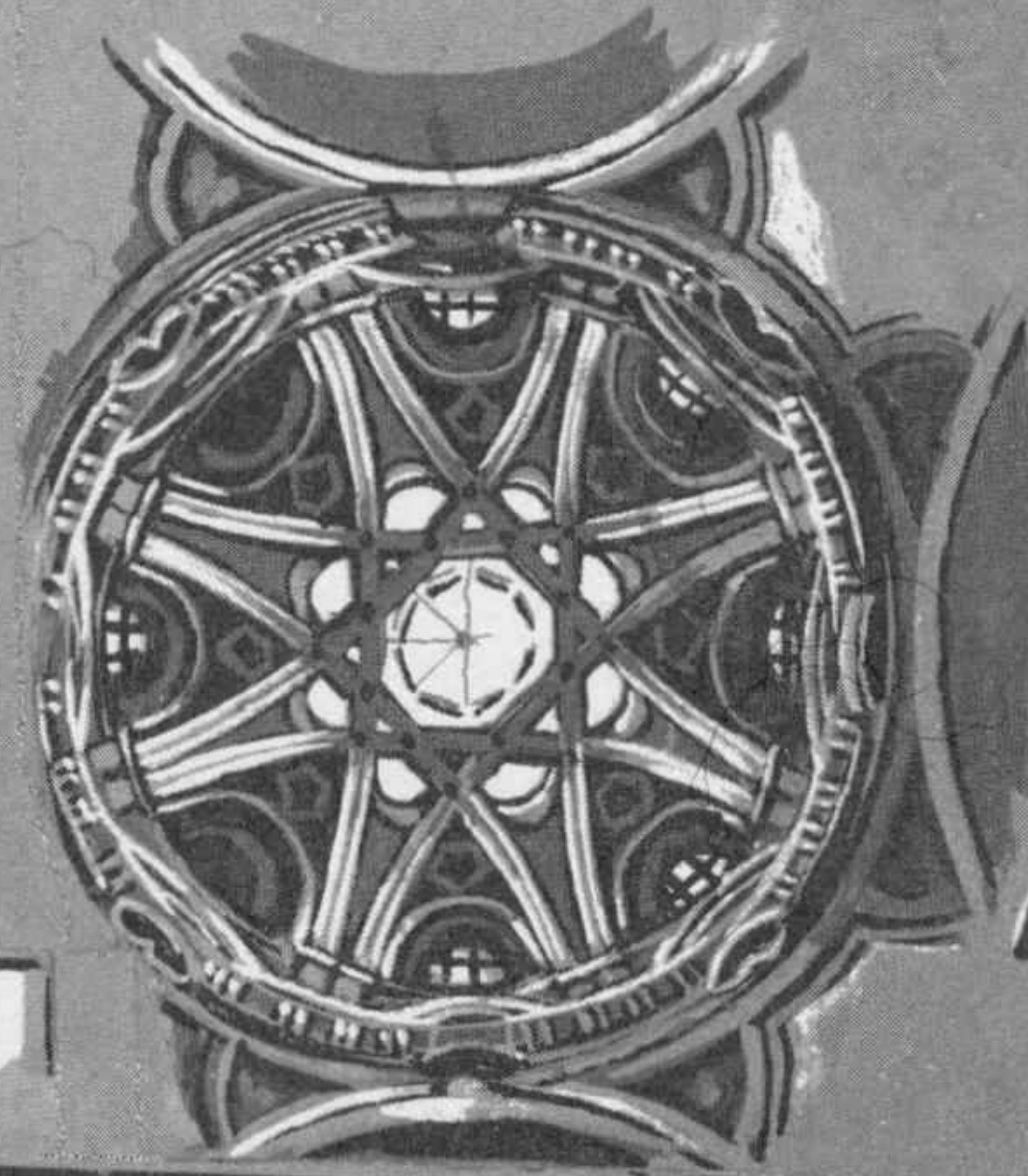
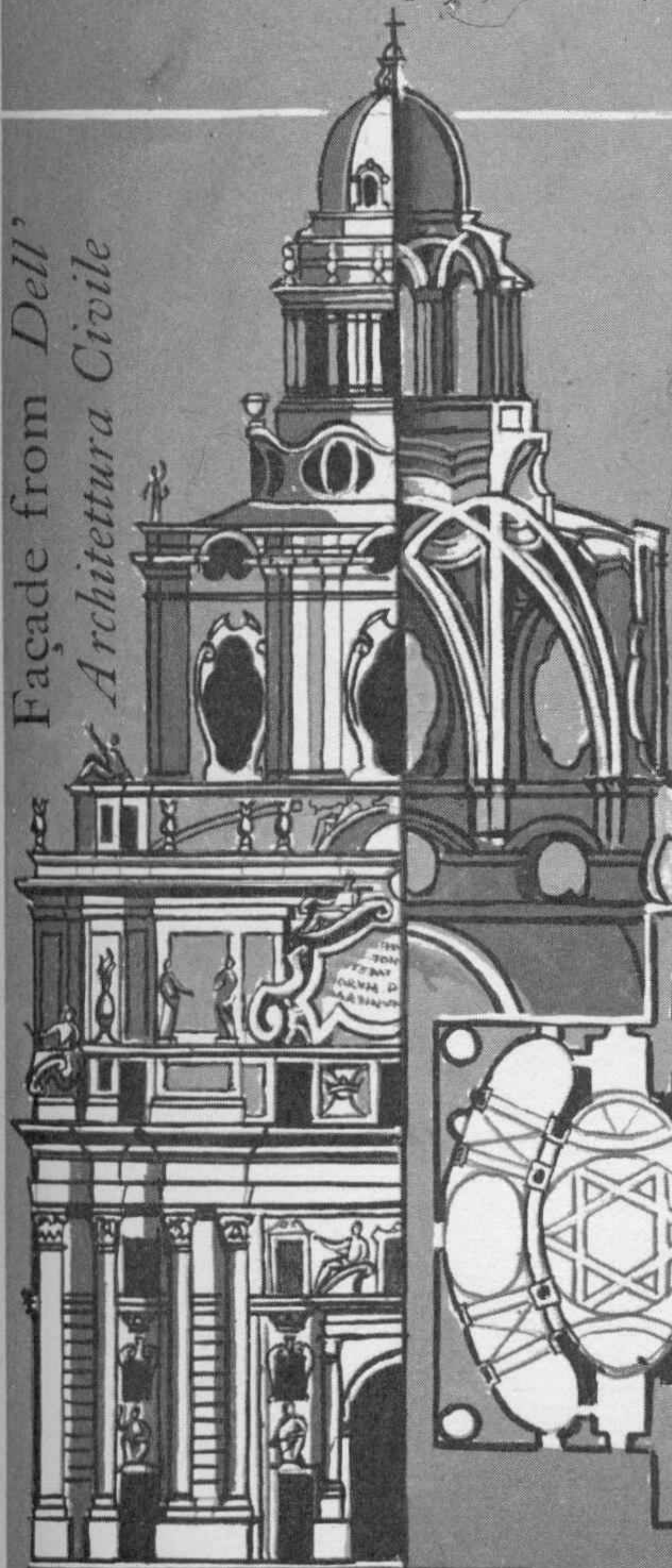
# ITALY, CHURCHES



S. Carlo alle Quattro Fontane,  
Rome, 1638-41  
(Façade 1662-67, p.121)  
*Borromini (1599-1667)*

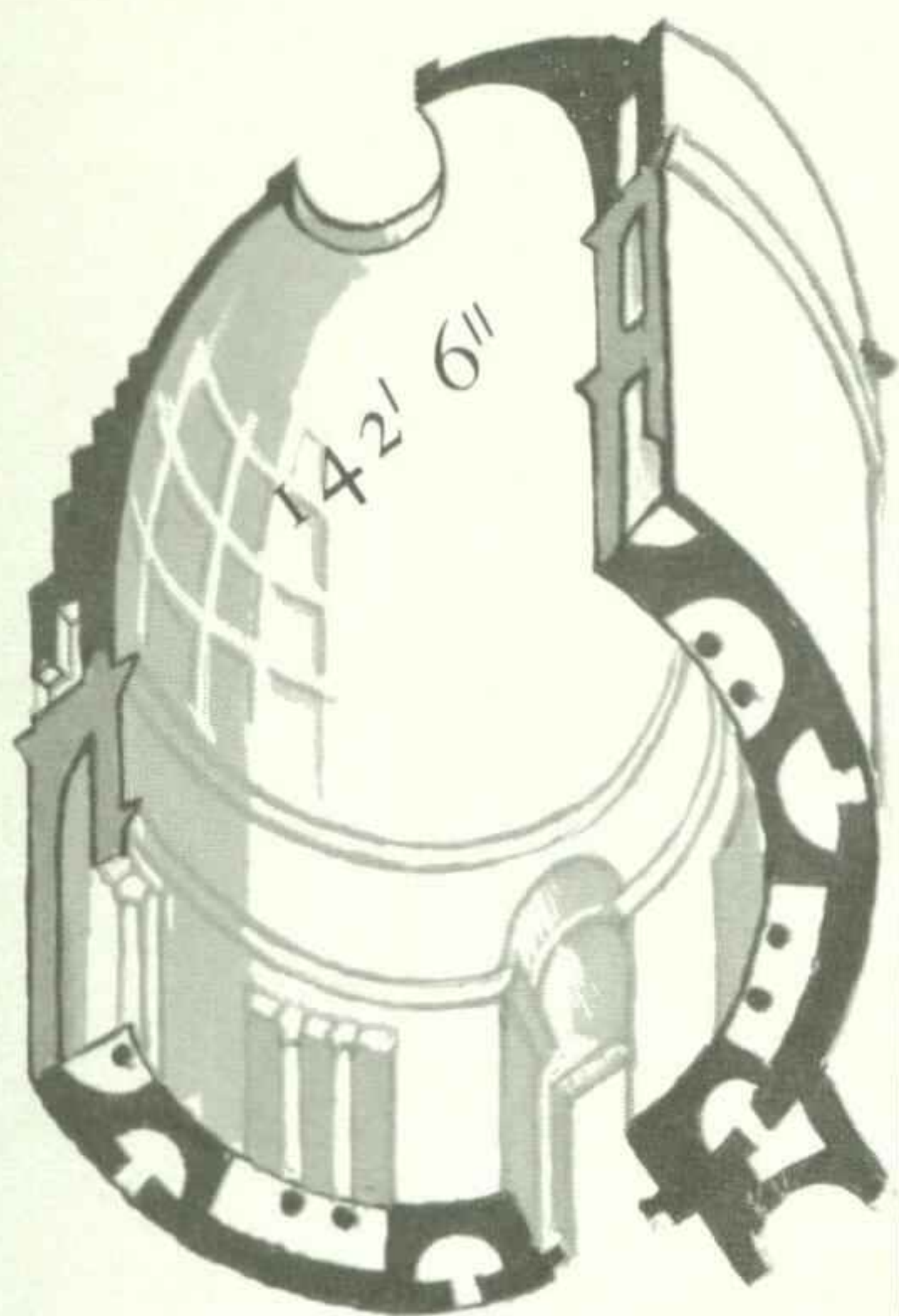


Façade from *Dell' Architettura Civile*

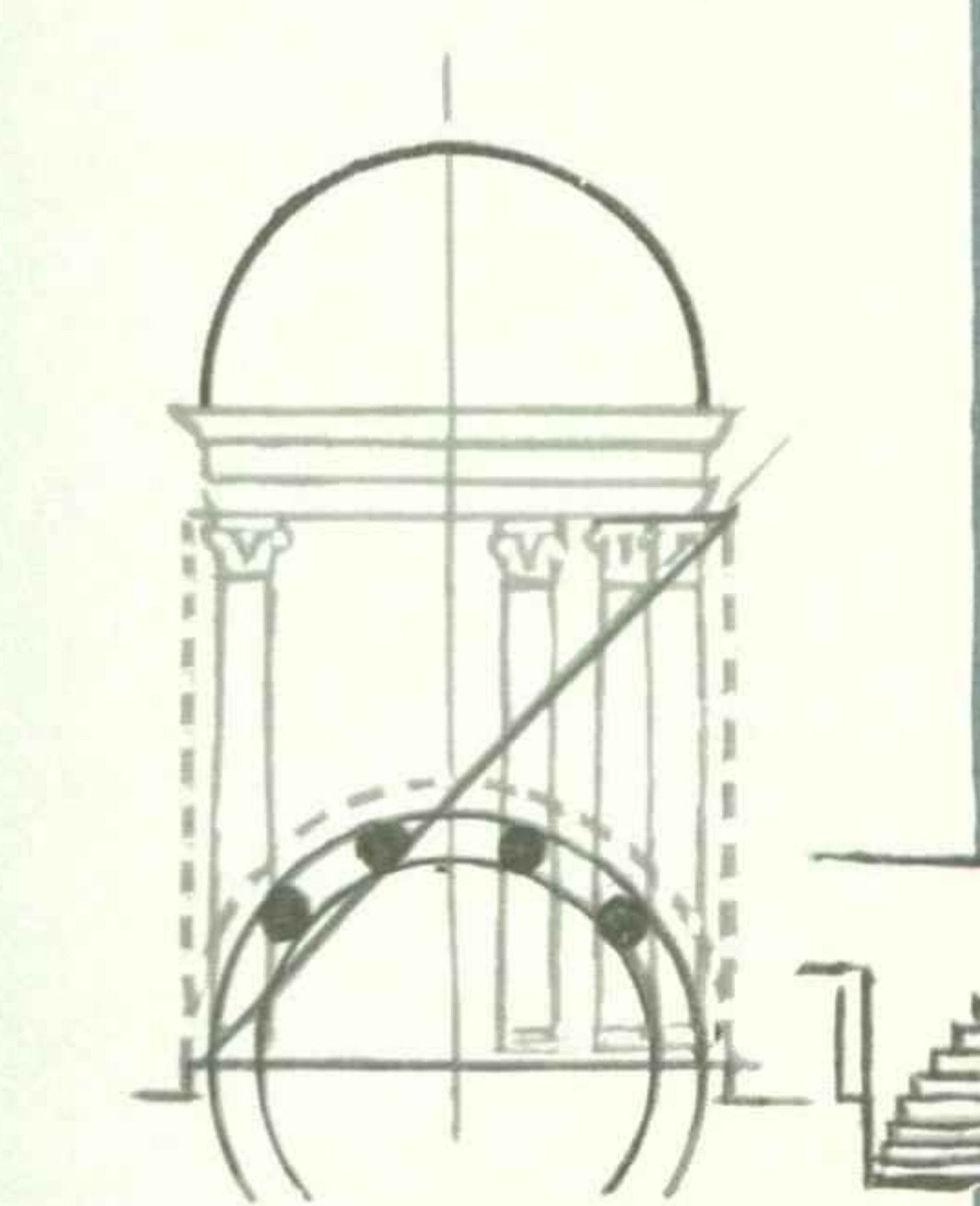
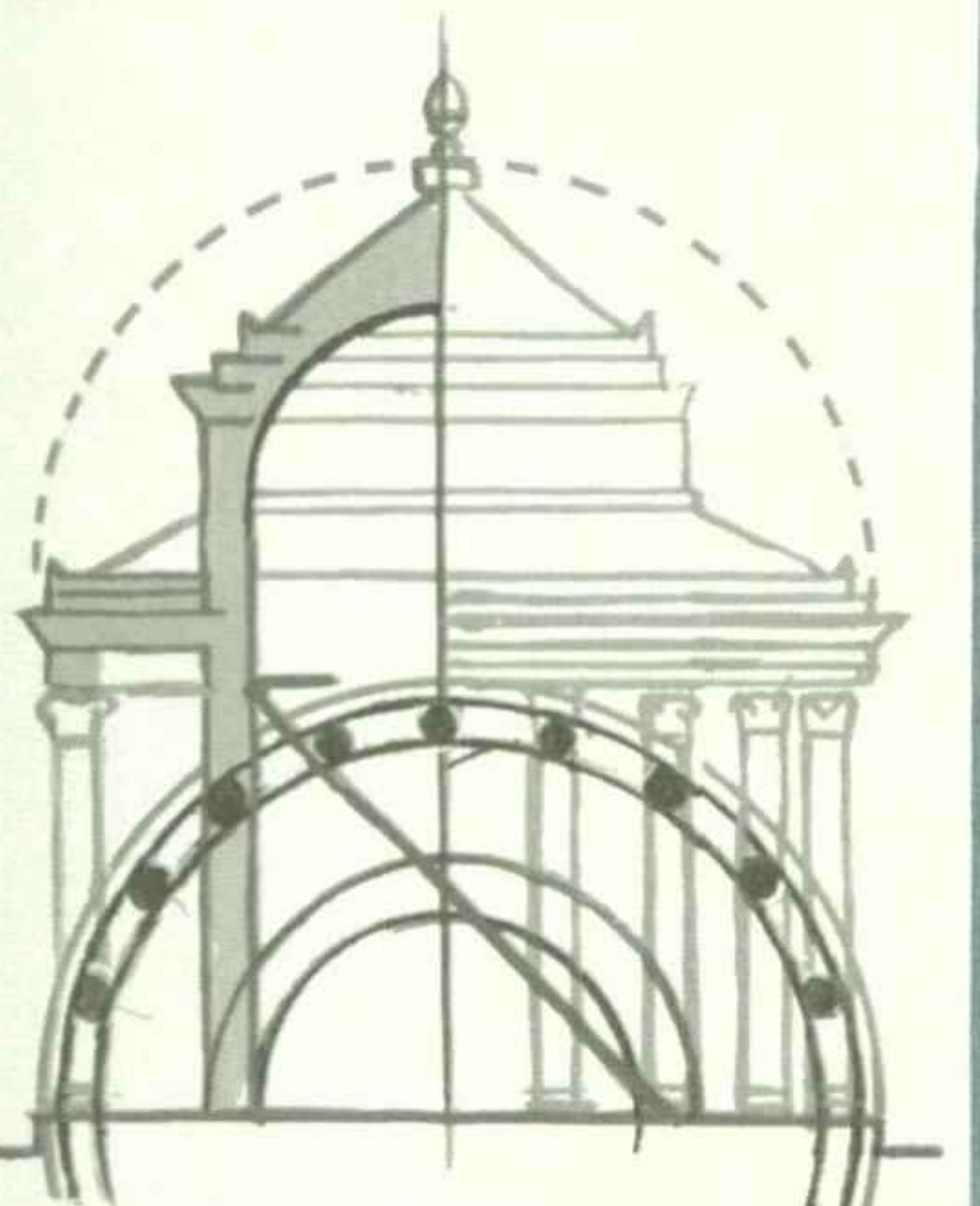


S. Lorenzo, Turin, 1668-87 *Guarini (1624-83)*

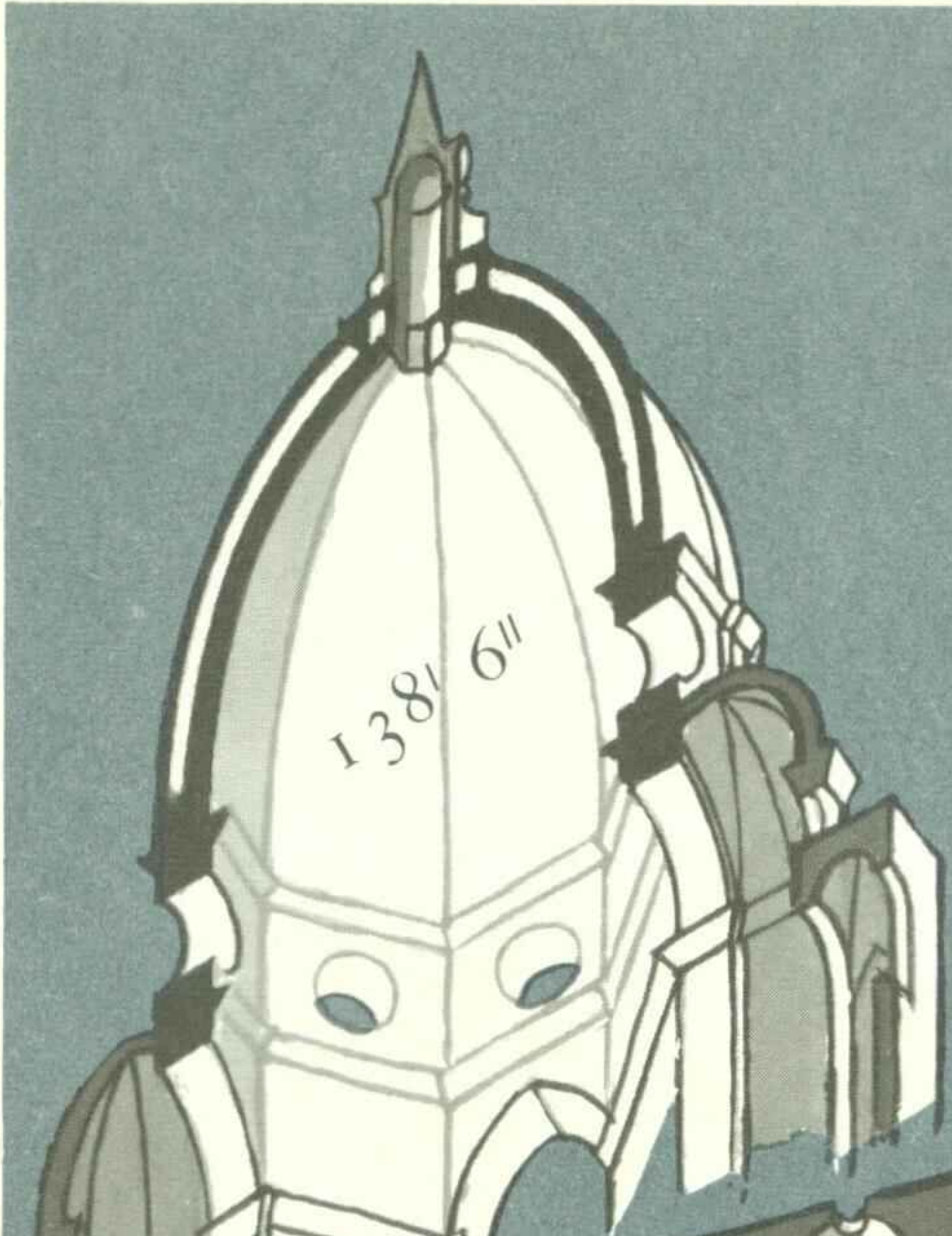
# RENAISSANCE - BAROQUE



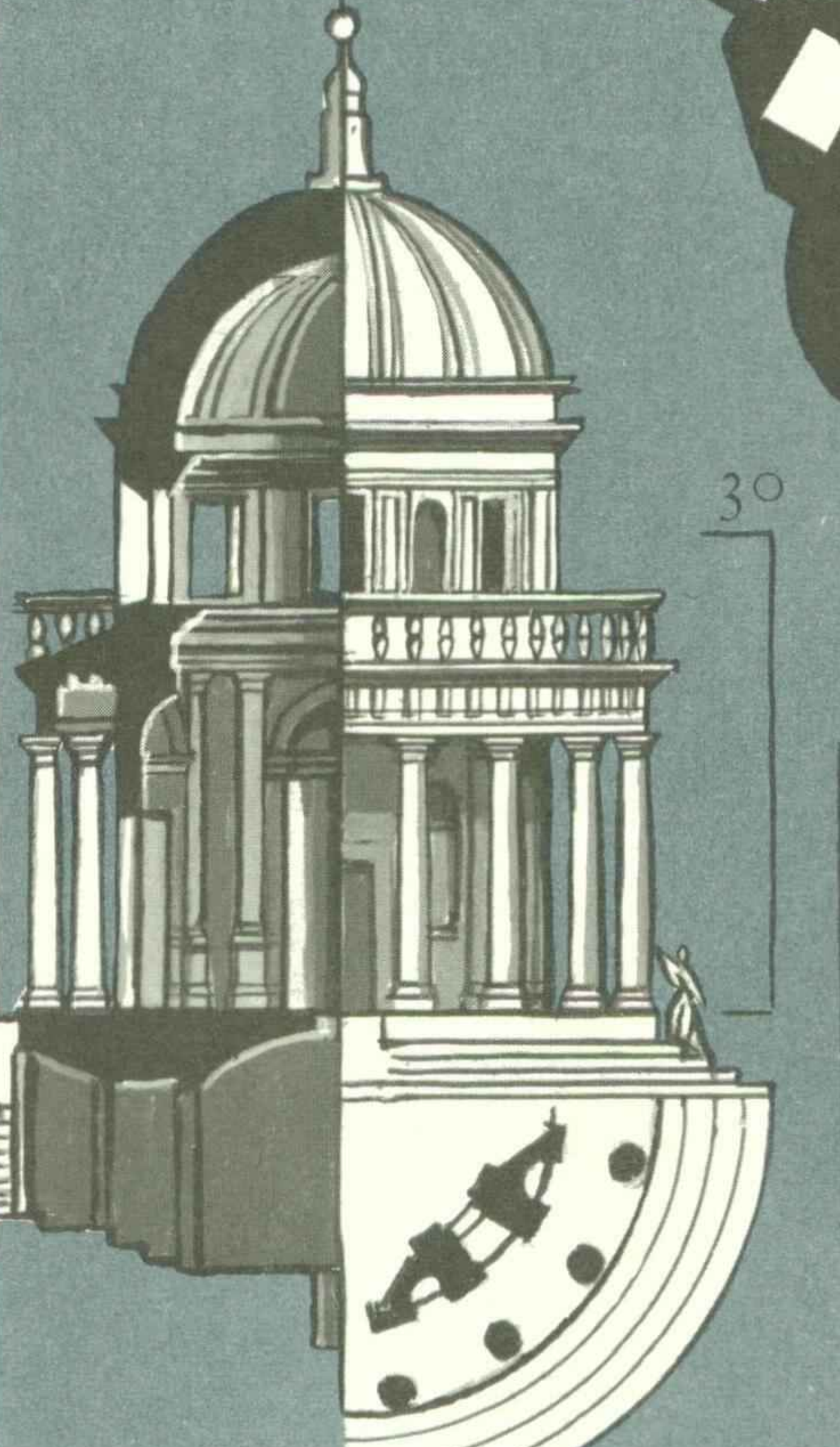
The Pantheon,  
Rome, A.D. 120-124



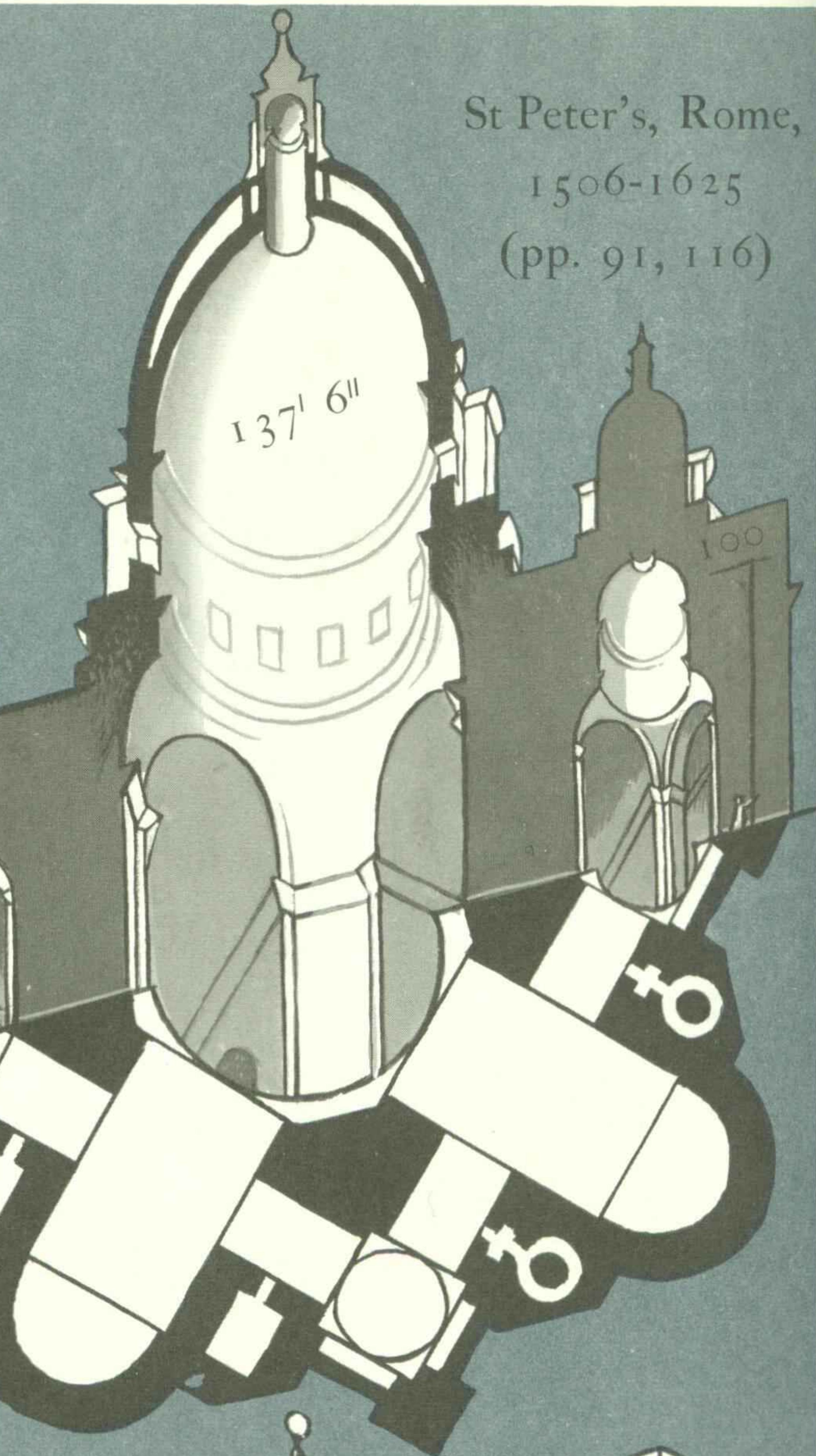
Circular temples,  
Vitruvius (IV, 9)



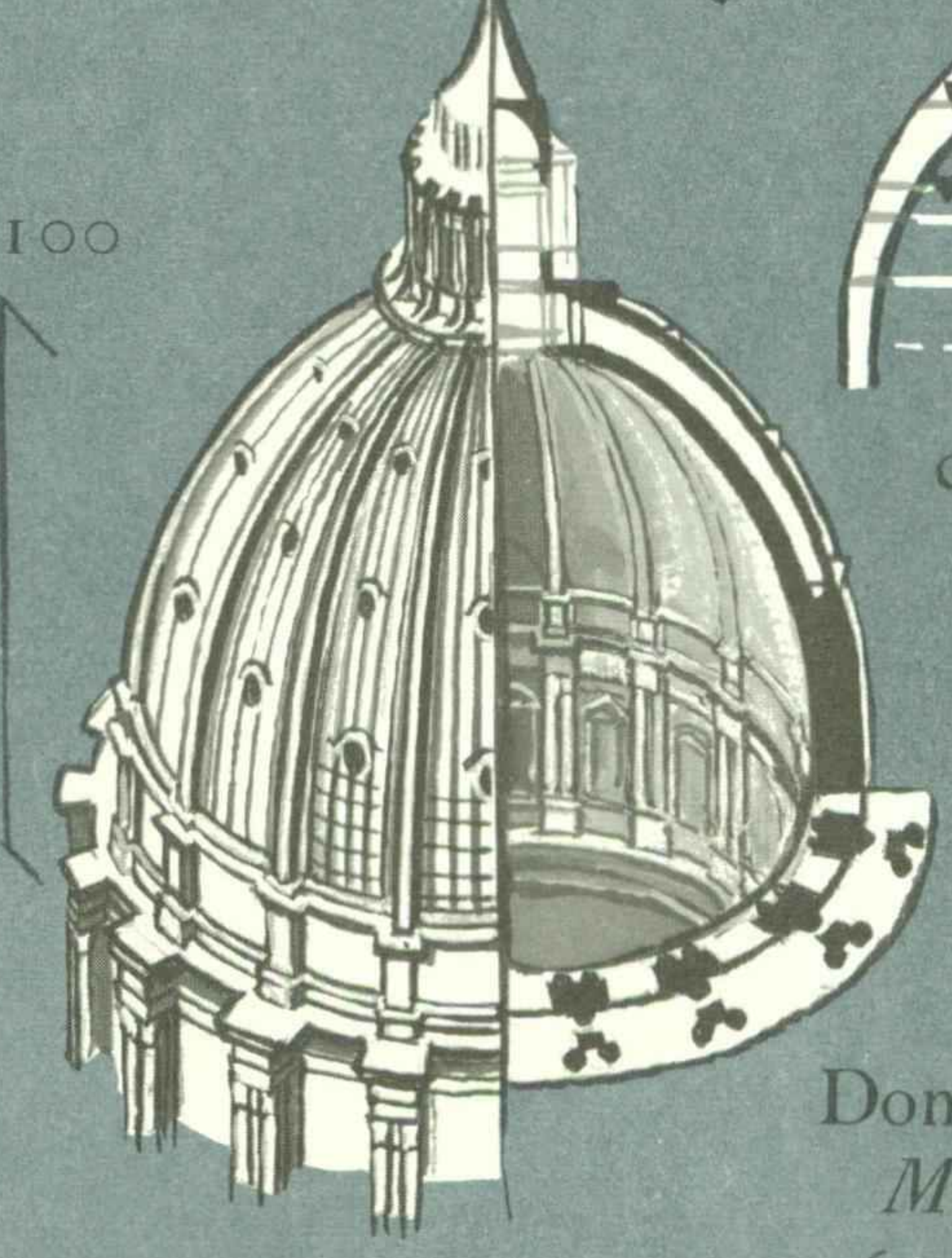
Florence  
Cathedral:  
dome, 1420-34  
*Brunelleschi*  
(1377-1446)  
(pp. 91, 109, 116)



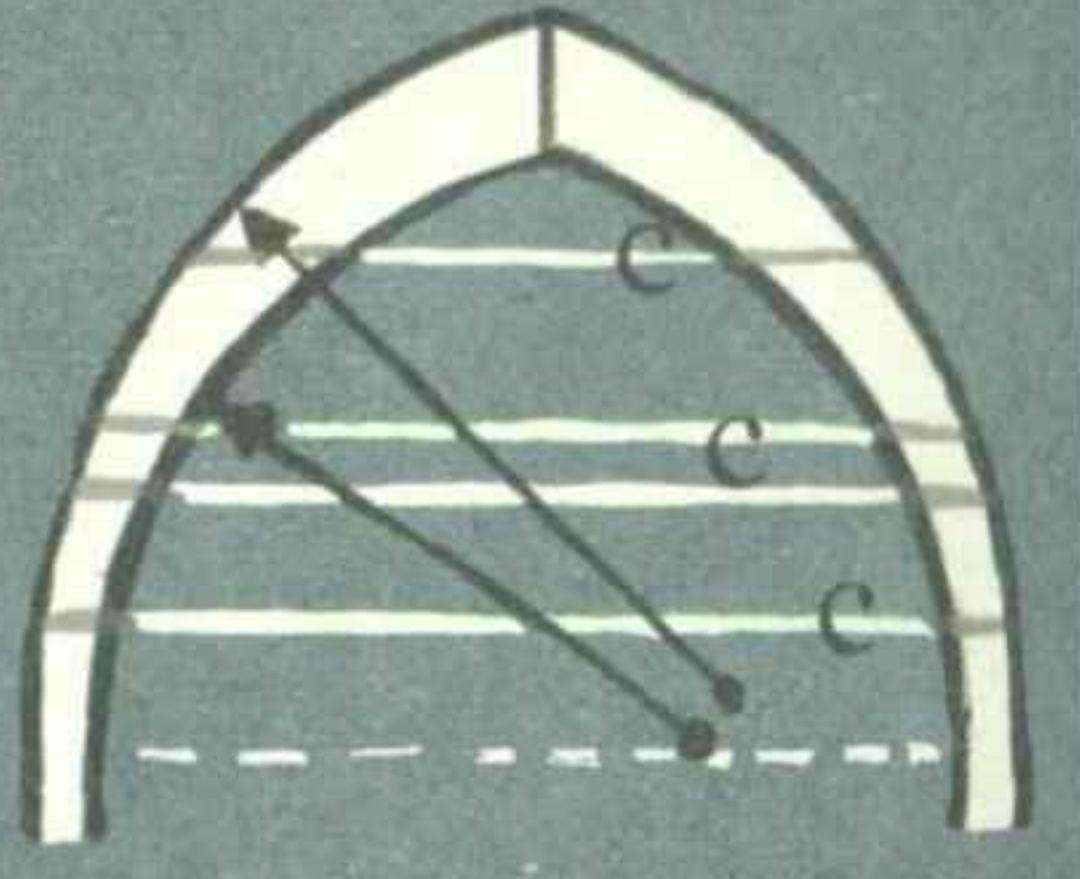
Tempietto, S. Pietro in  
Montorio, Rome, 1502-10  
*Bramante* (1444-1514)



St Peter's, Rome,  
1506-1625  
(pp. 91, 116)



Dome 1564-90  
*Michelangelo*  
(1475-1564)

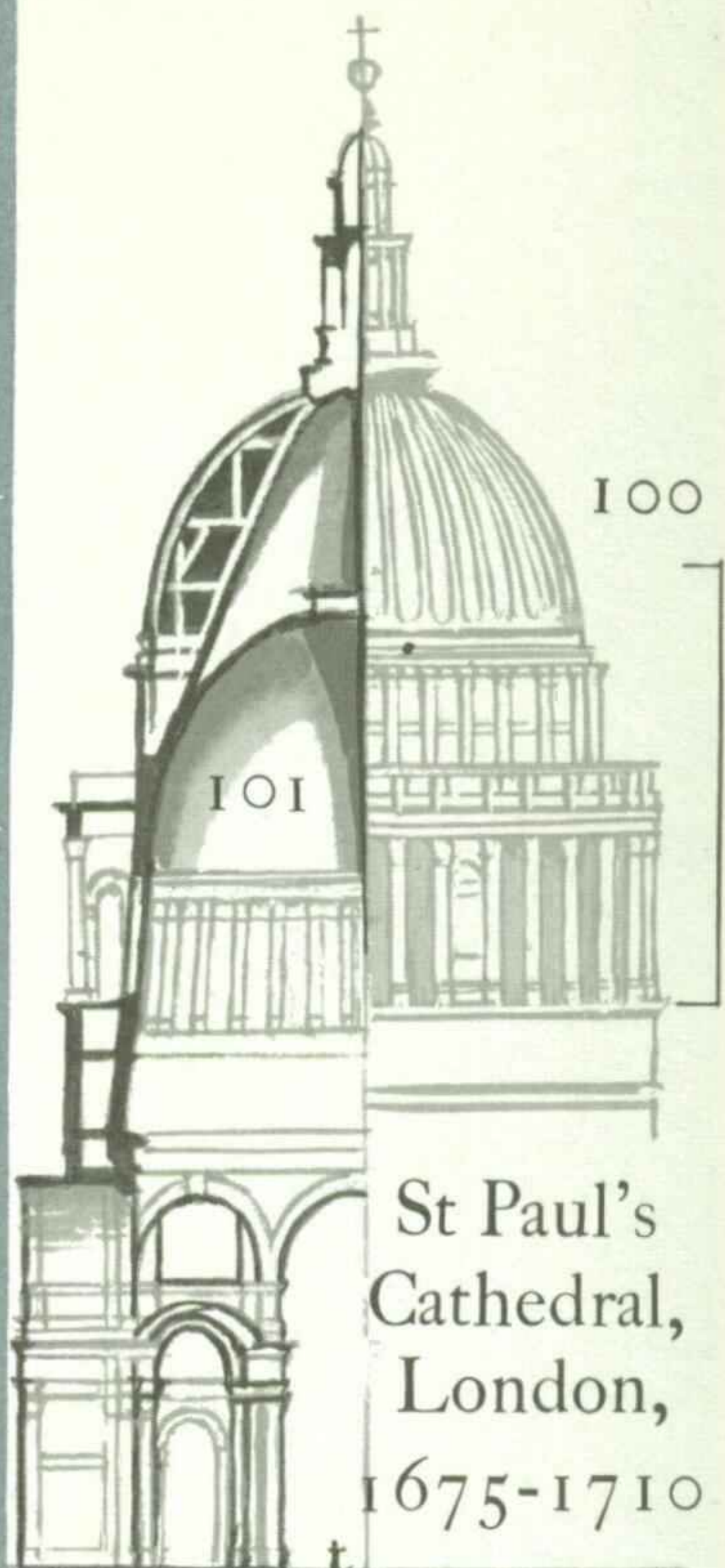
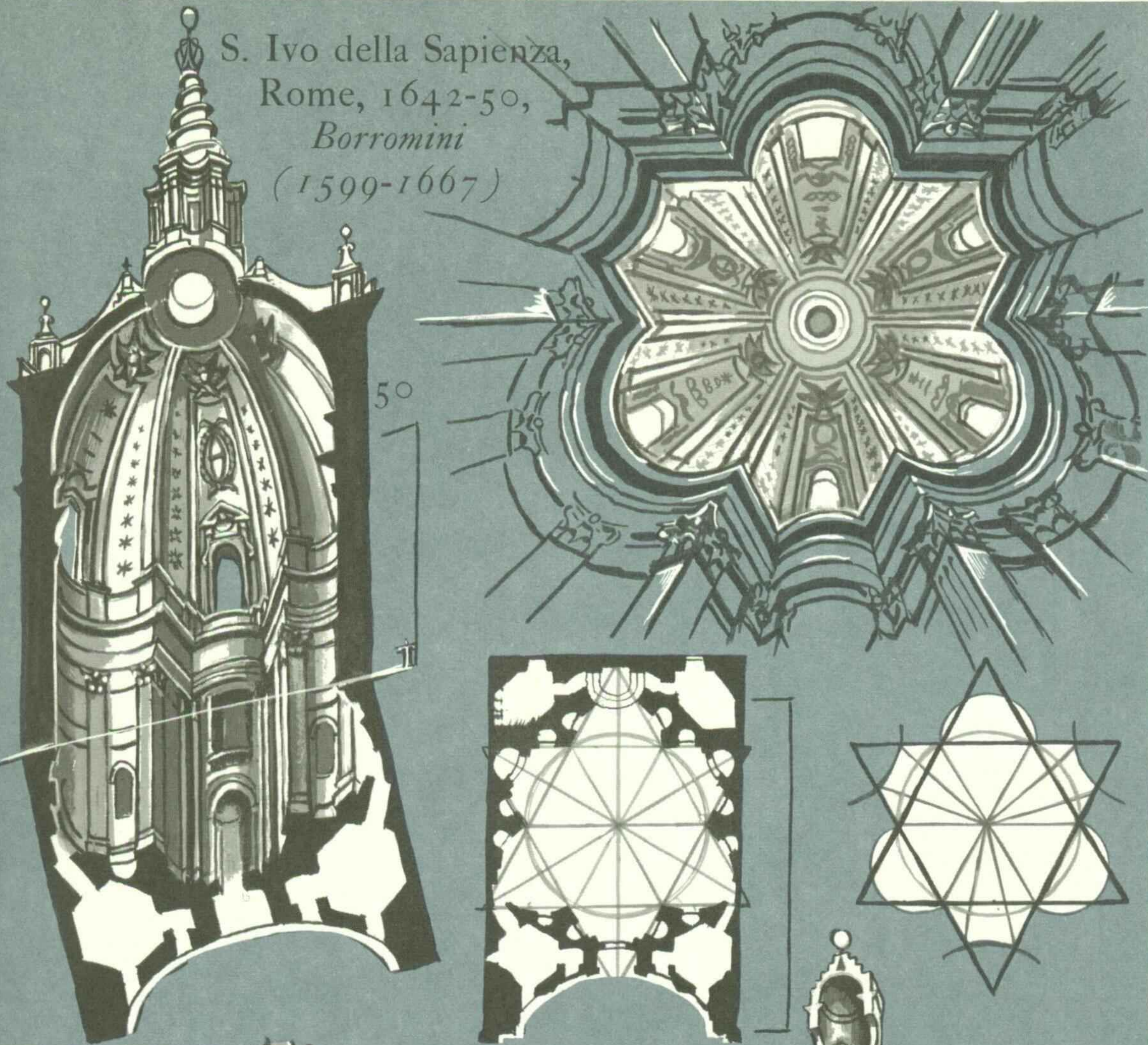


c. chains



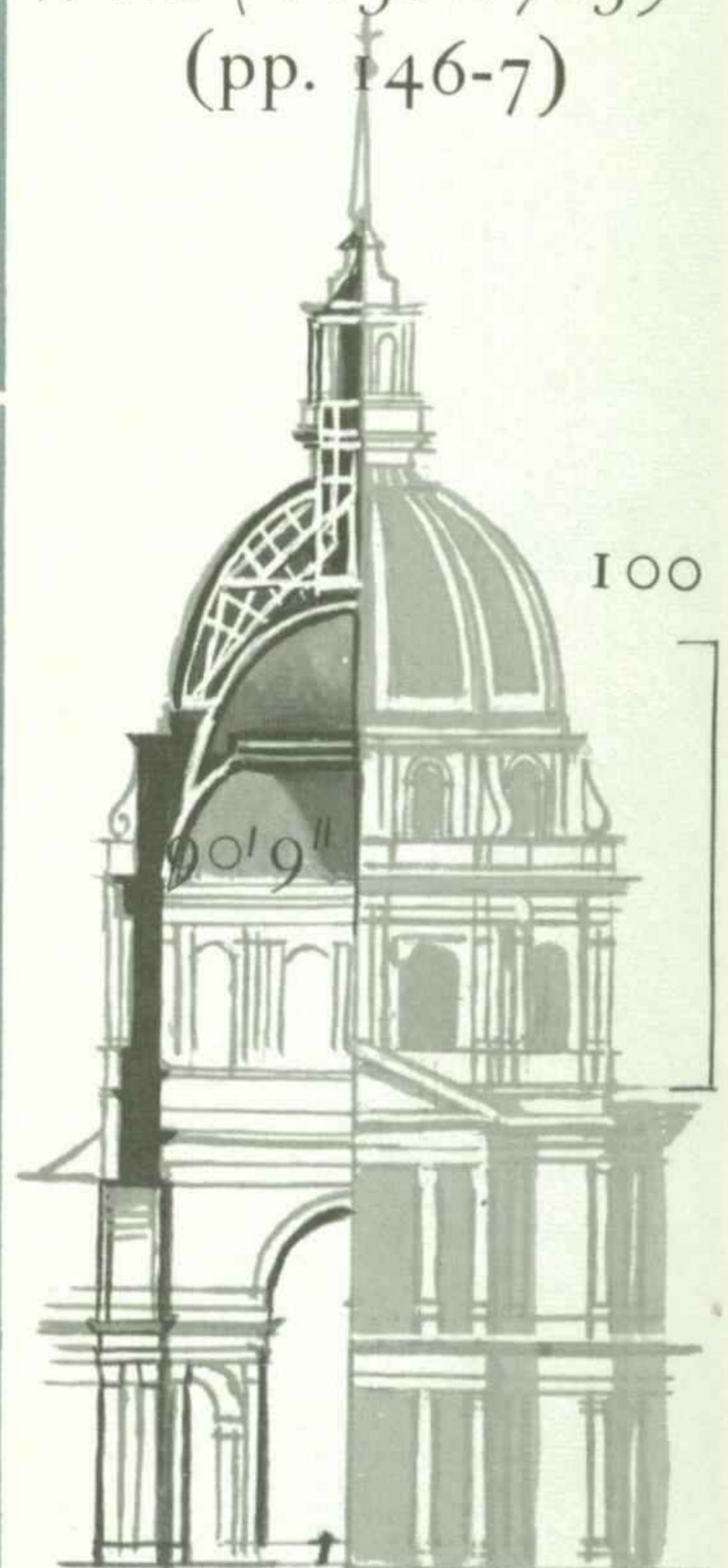
# ITALY, DOMES

S. Ivo della Sapienza,  
Rome, 1642-50,  
*Borromini*  
(1599-1667)

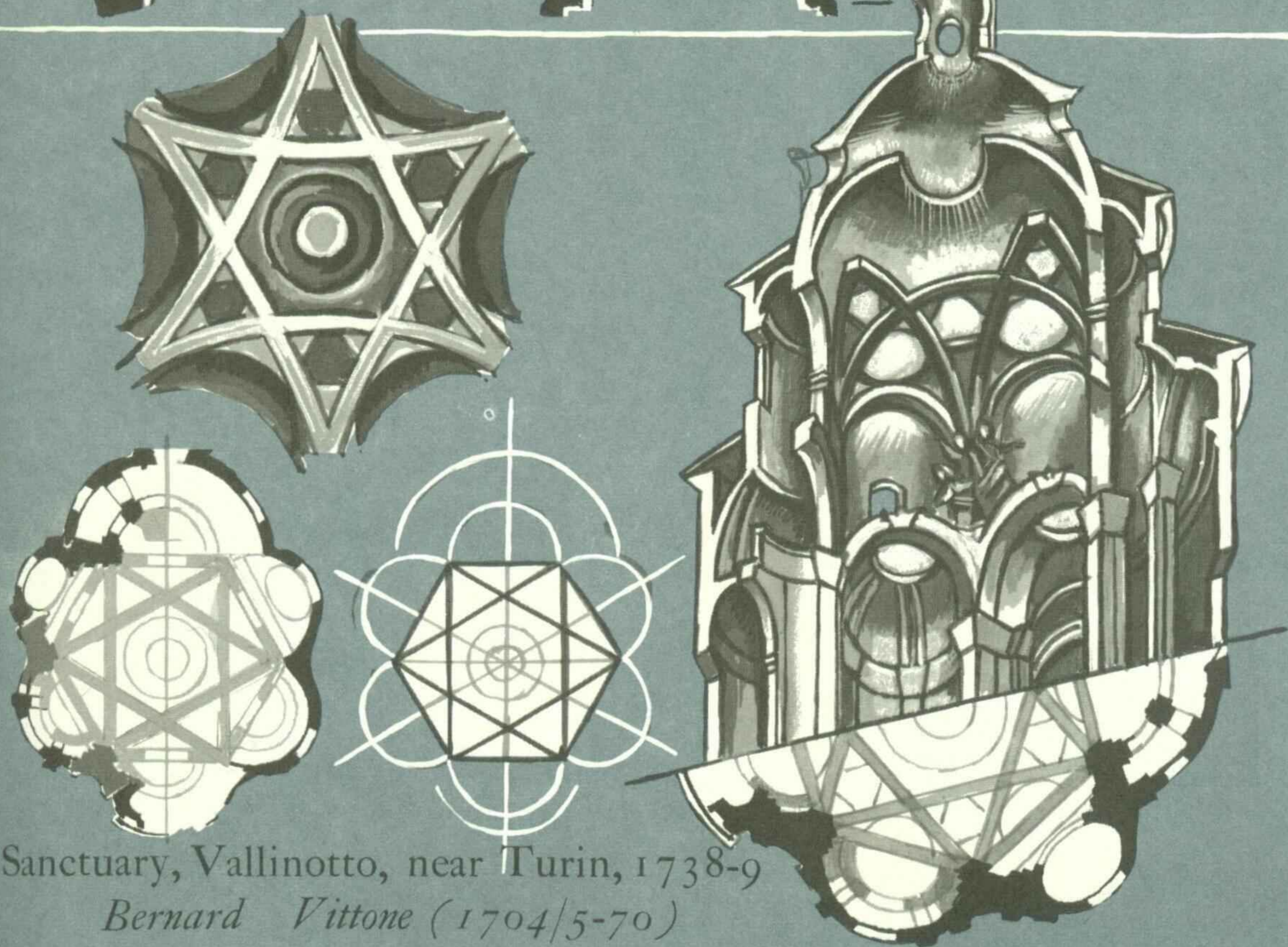


St Paul's  
Cathedral,  
London,  
1675-1710

*Wren* (1631-1723)  
(pp. 146-7)

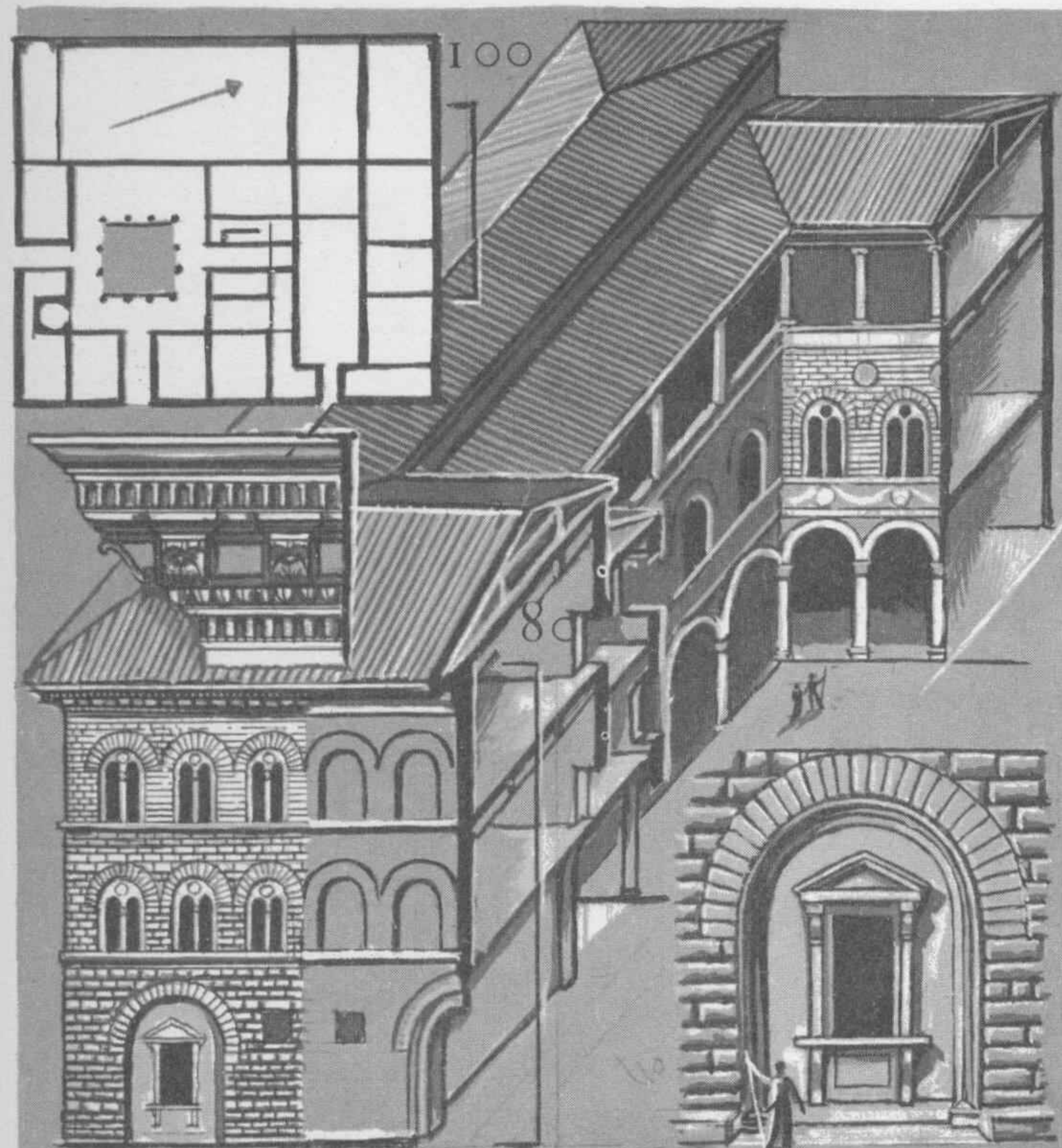


The Dome of the  
Invalides, Paris,  
1693-1706 *Jules  
Hardouin-Mansart*  
(1646-1708)  
(p. 131)

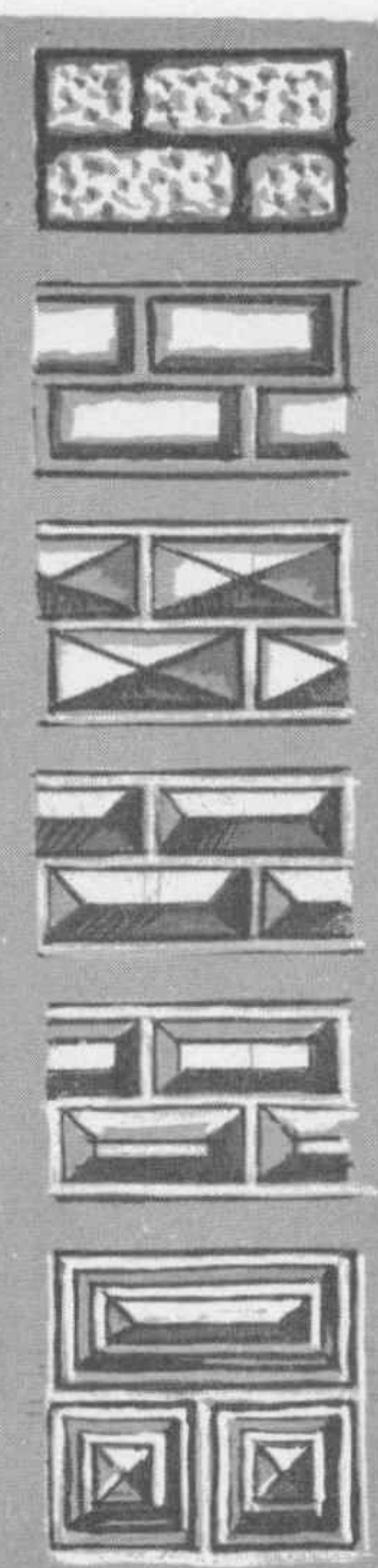


Sanctuary, Vallinotto, near Turin, 1738-9  
*Bernard Vittone* (1704/5-70)

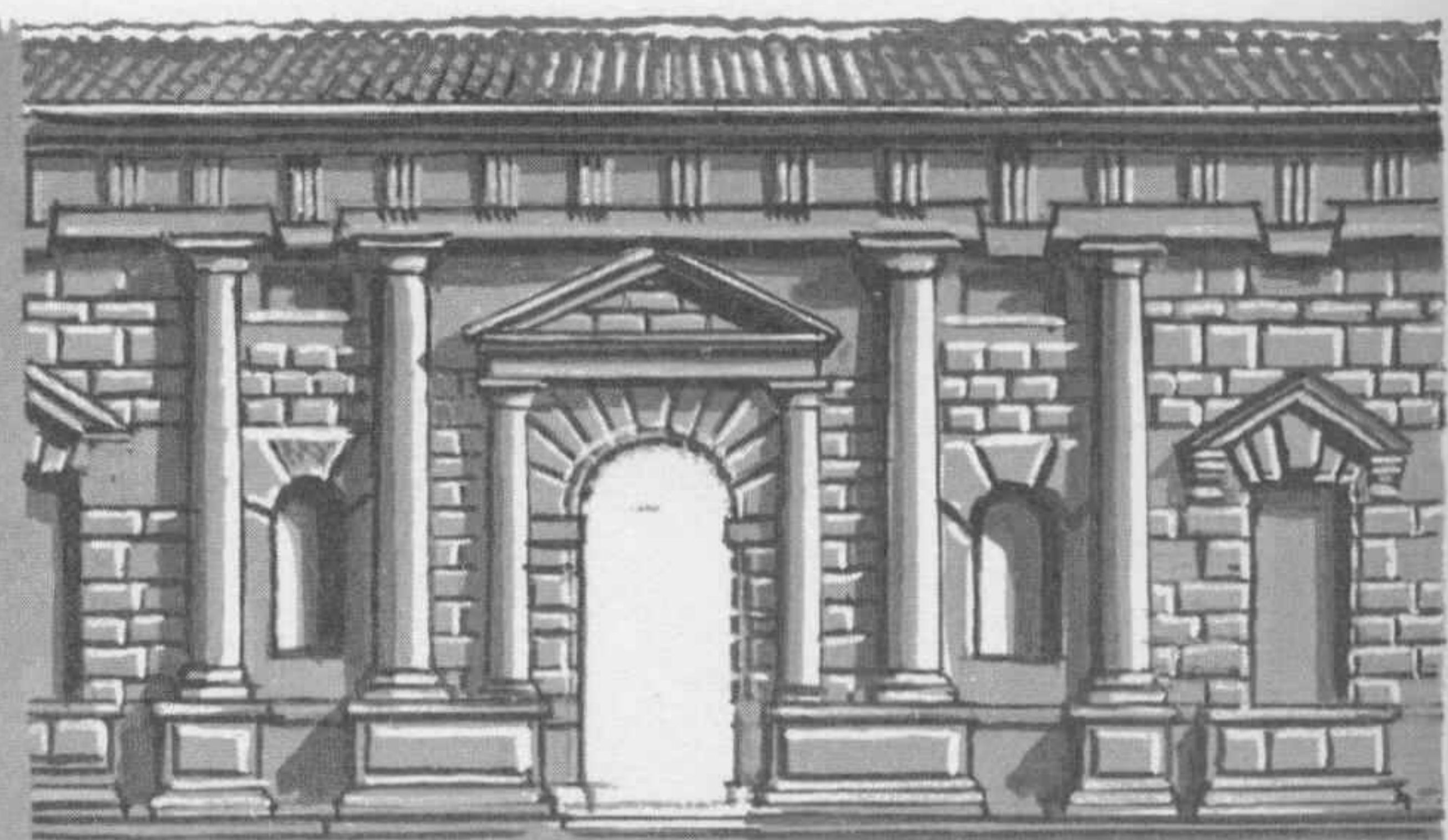
# RENAISSANCE - BAROQUE



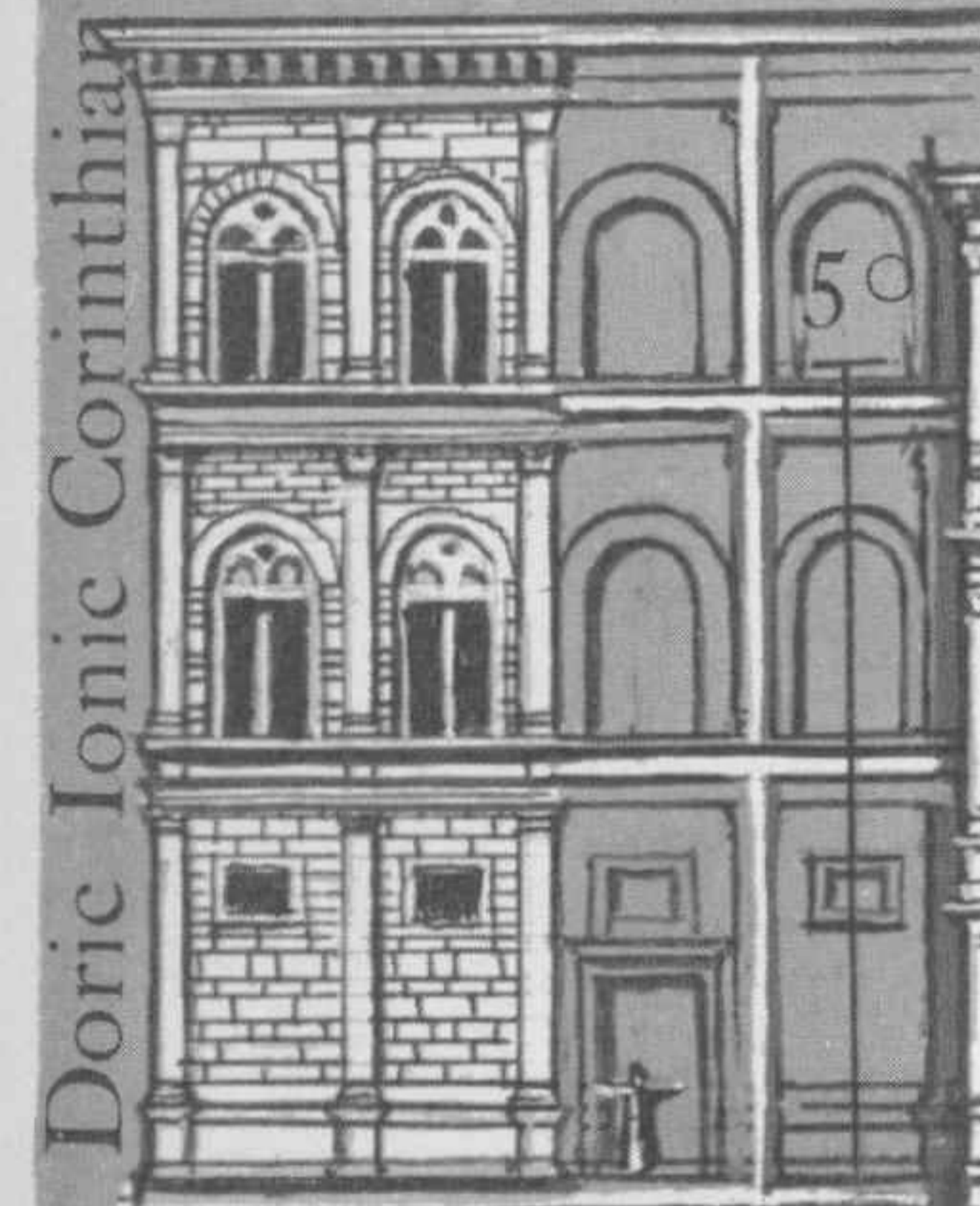
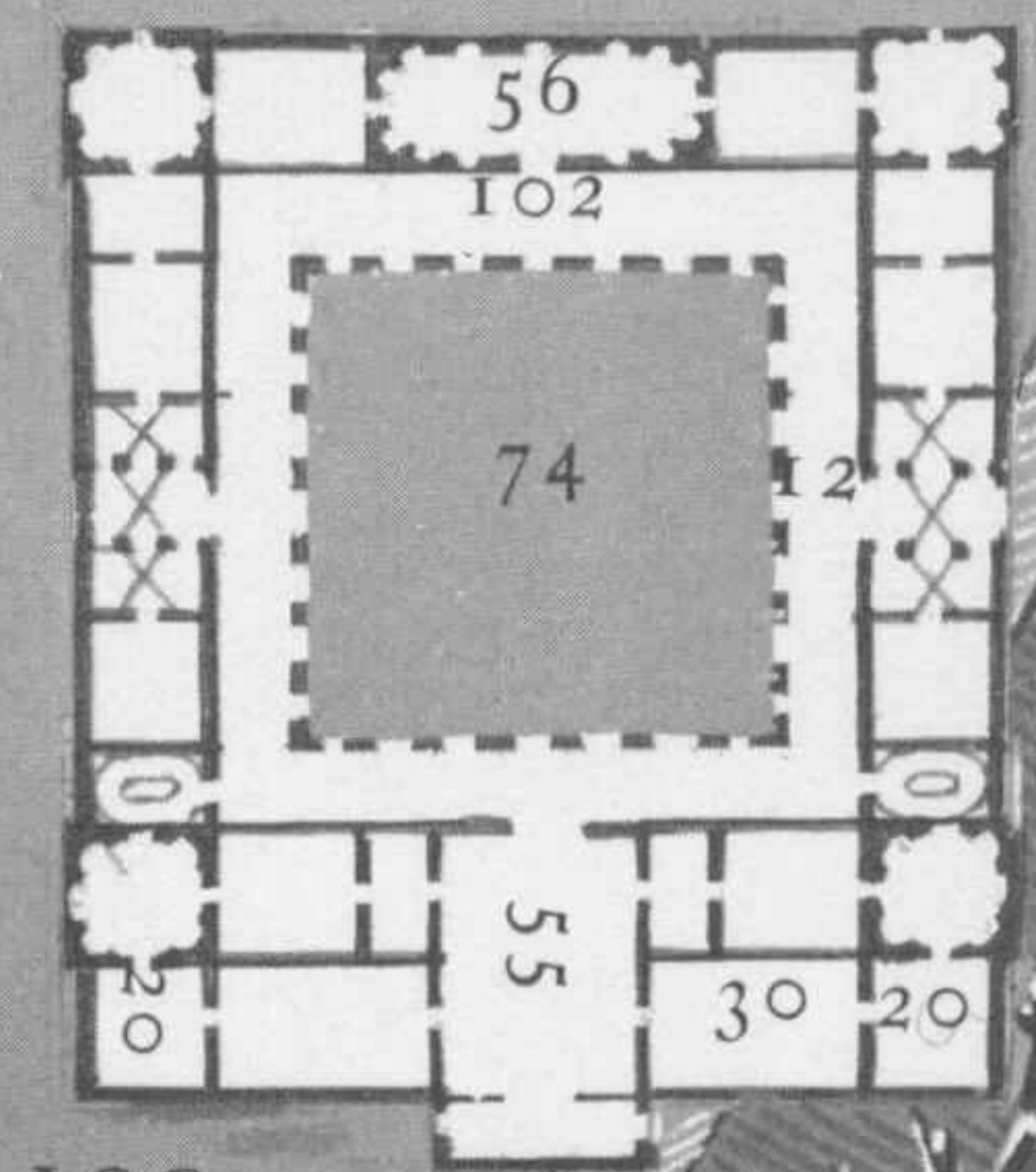
Palazzo Medici-Riccardi, Florence, 1430  
*Michelozzo (1397-1473)*



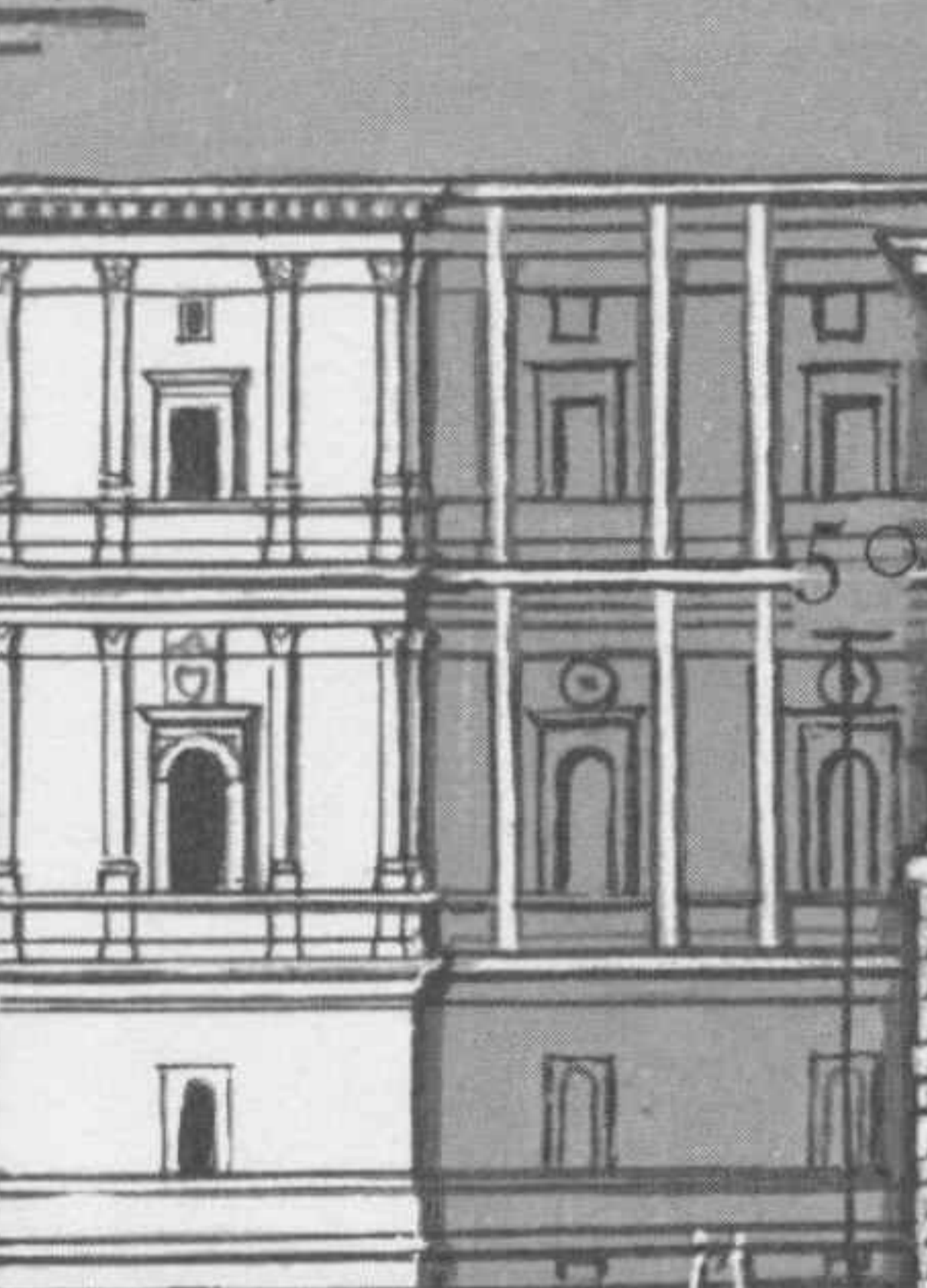
rusticated masonry after *Serlio*



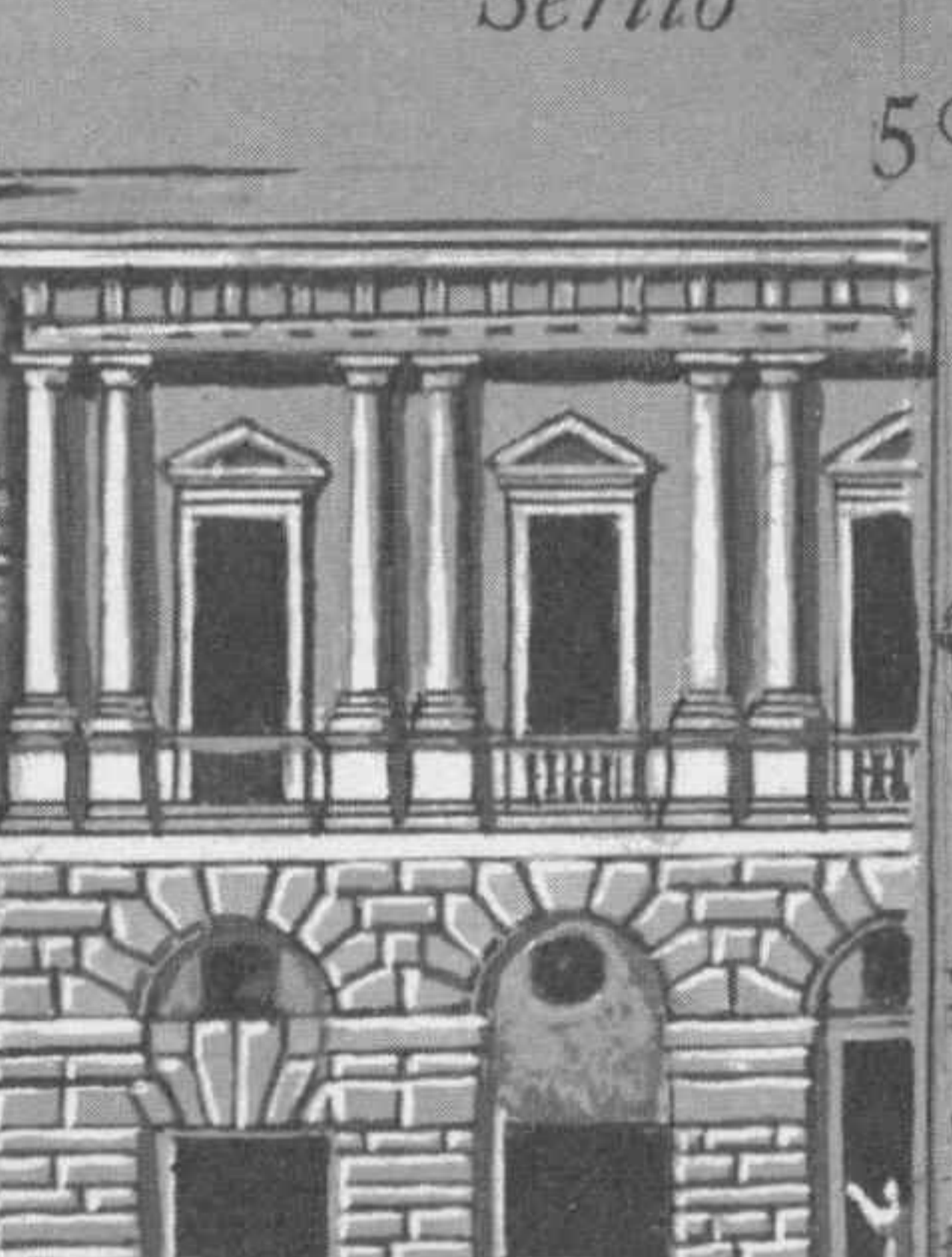
Palazzo del Tè, Mantua, 1526-35  
*Giulio Romano (1492-1546)*



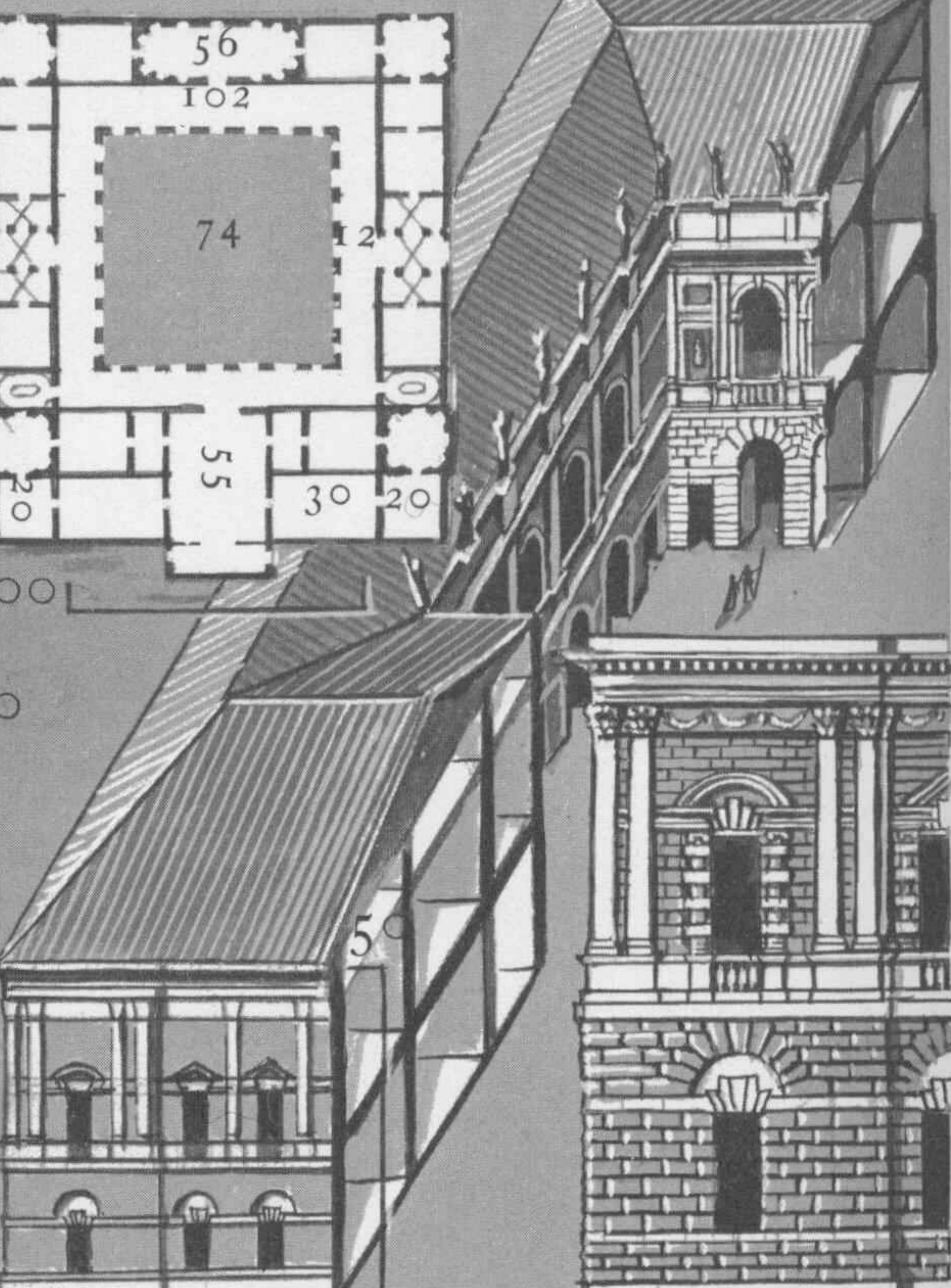
Palazzo Rucellai, Florence, 1451  
*Alberti (1404-72)*



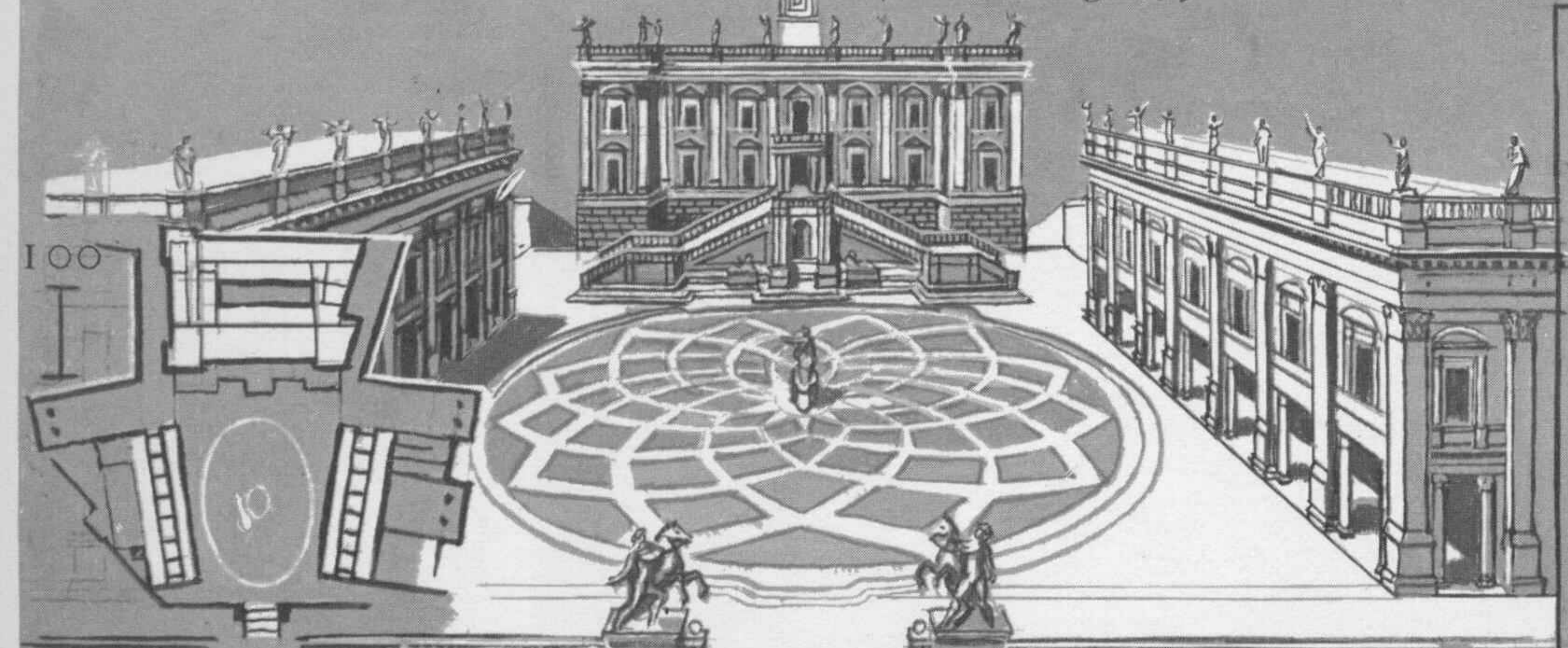
Cancelleria, Rome, 1495-1505  
*Bramante (1444-1514)*



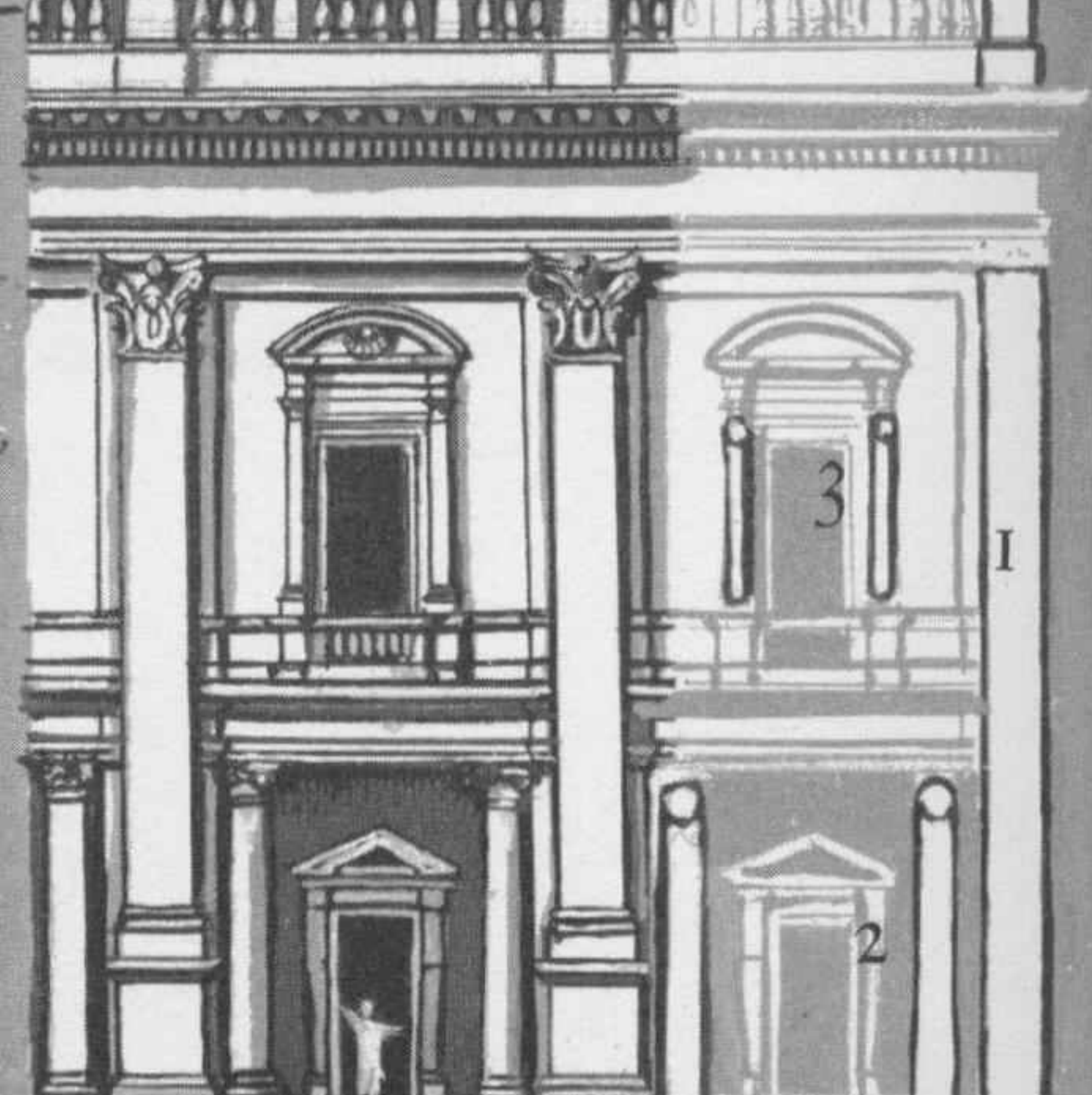
House of Raphael, Rome c.1512



Palazzo Thiene, Vicenza, 1556-58  
*Andrea Palladio (1508-1580)*

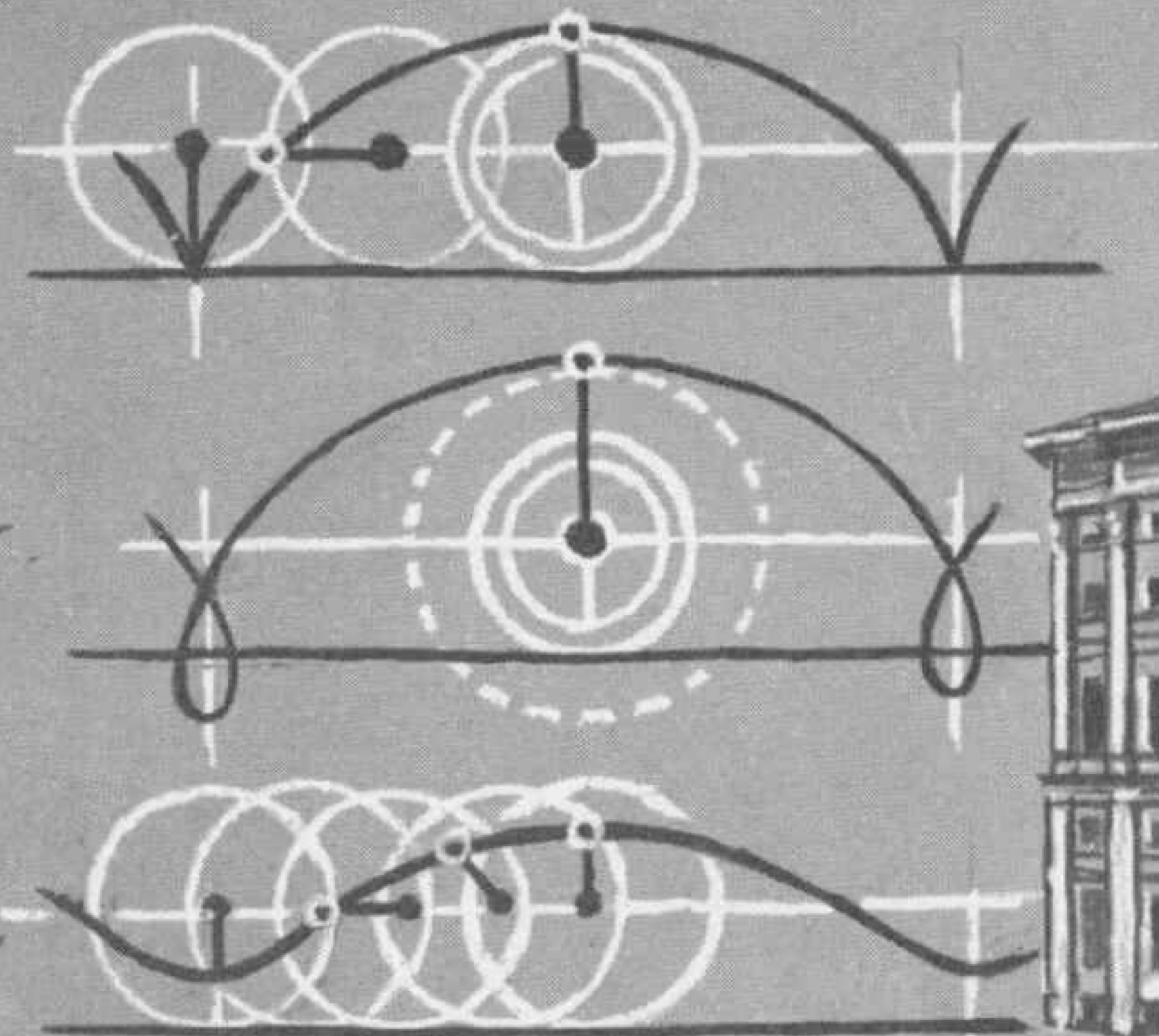
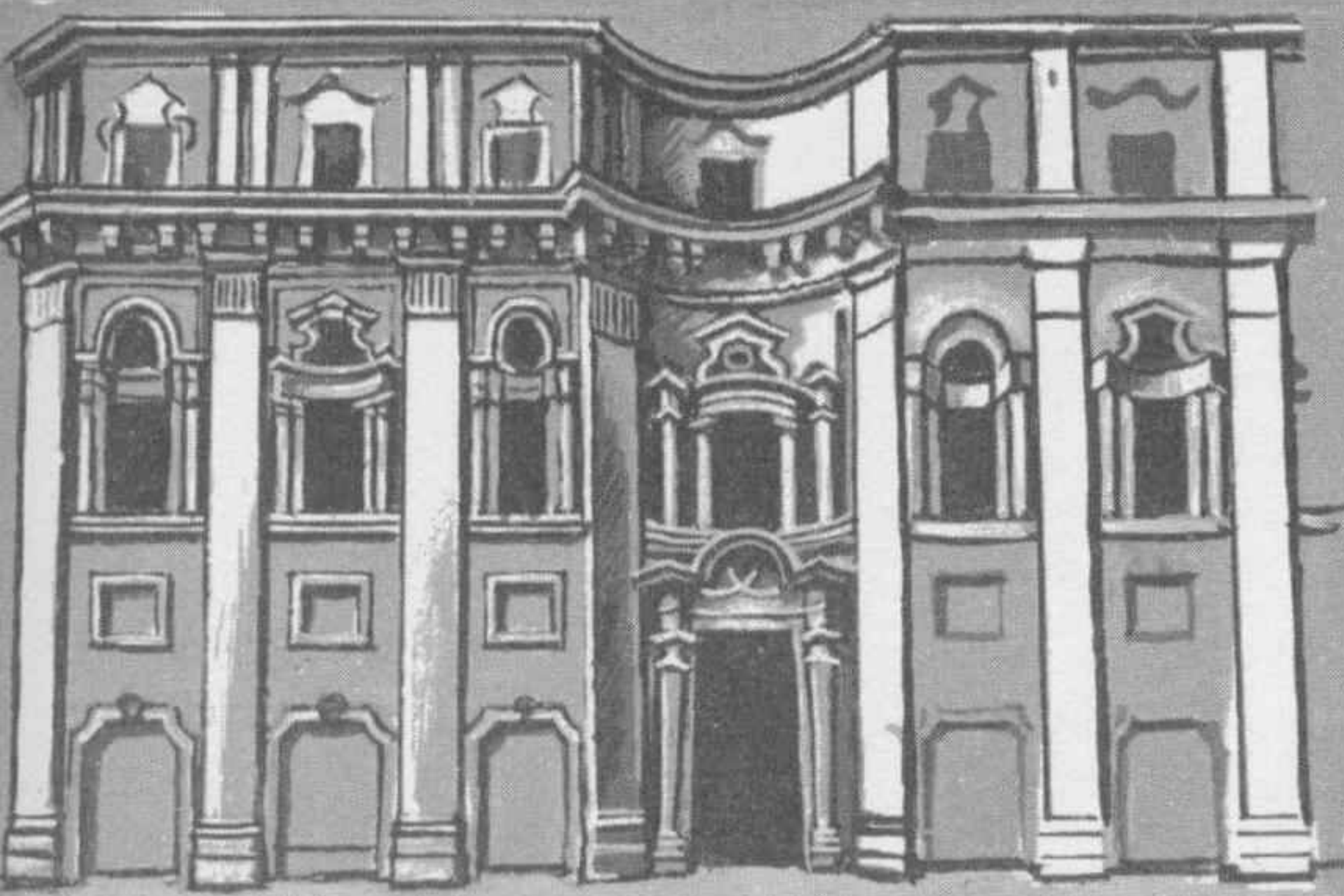


The Capitol, Rome, 1540-1644, *Michelangelo (1475-1564)*

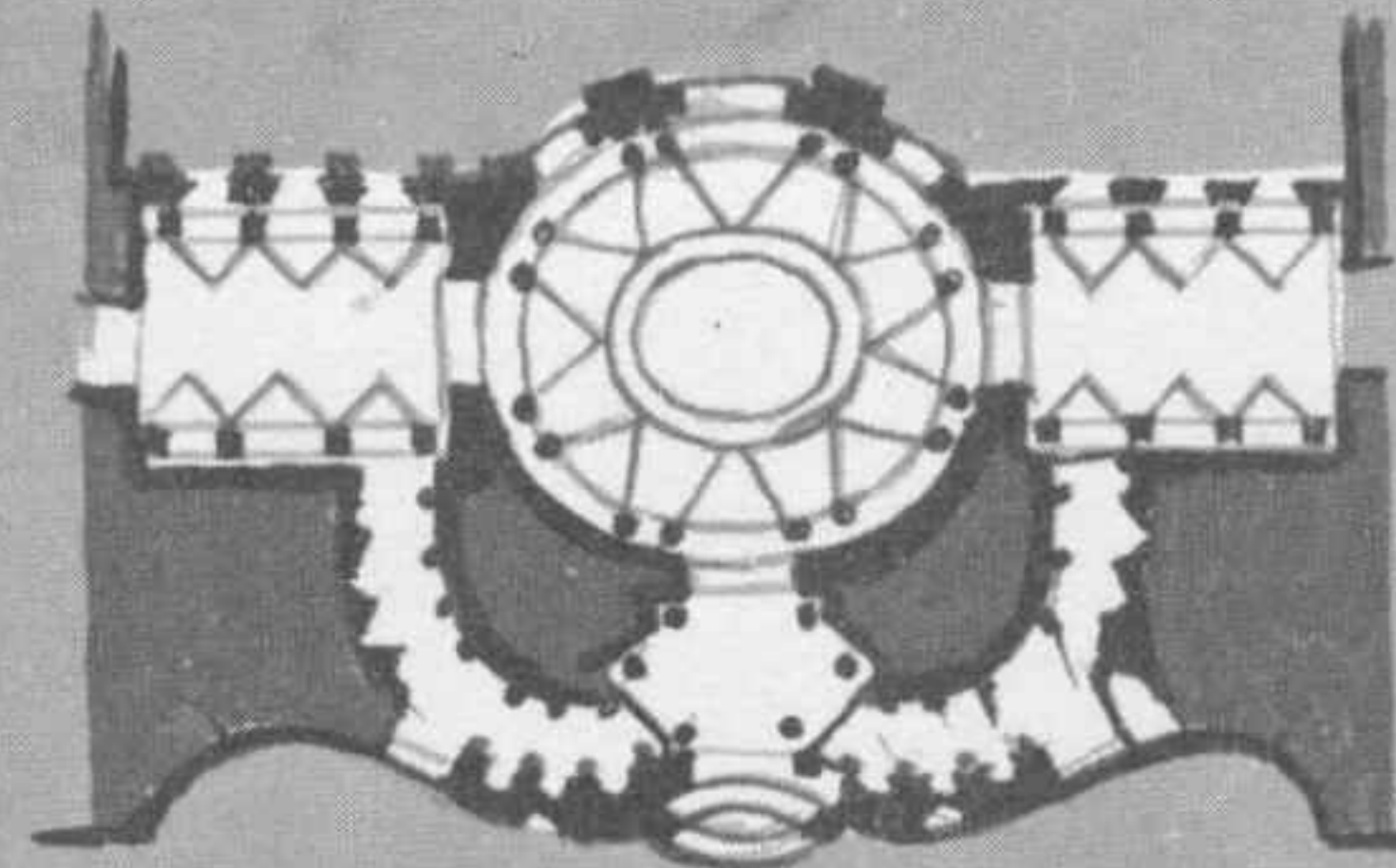
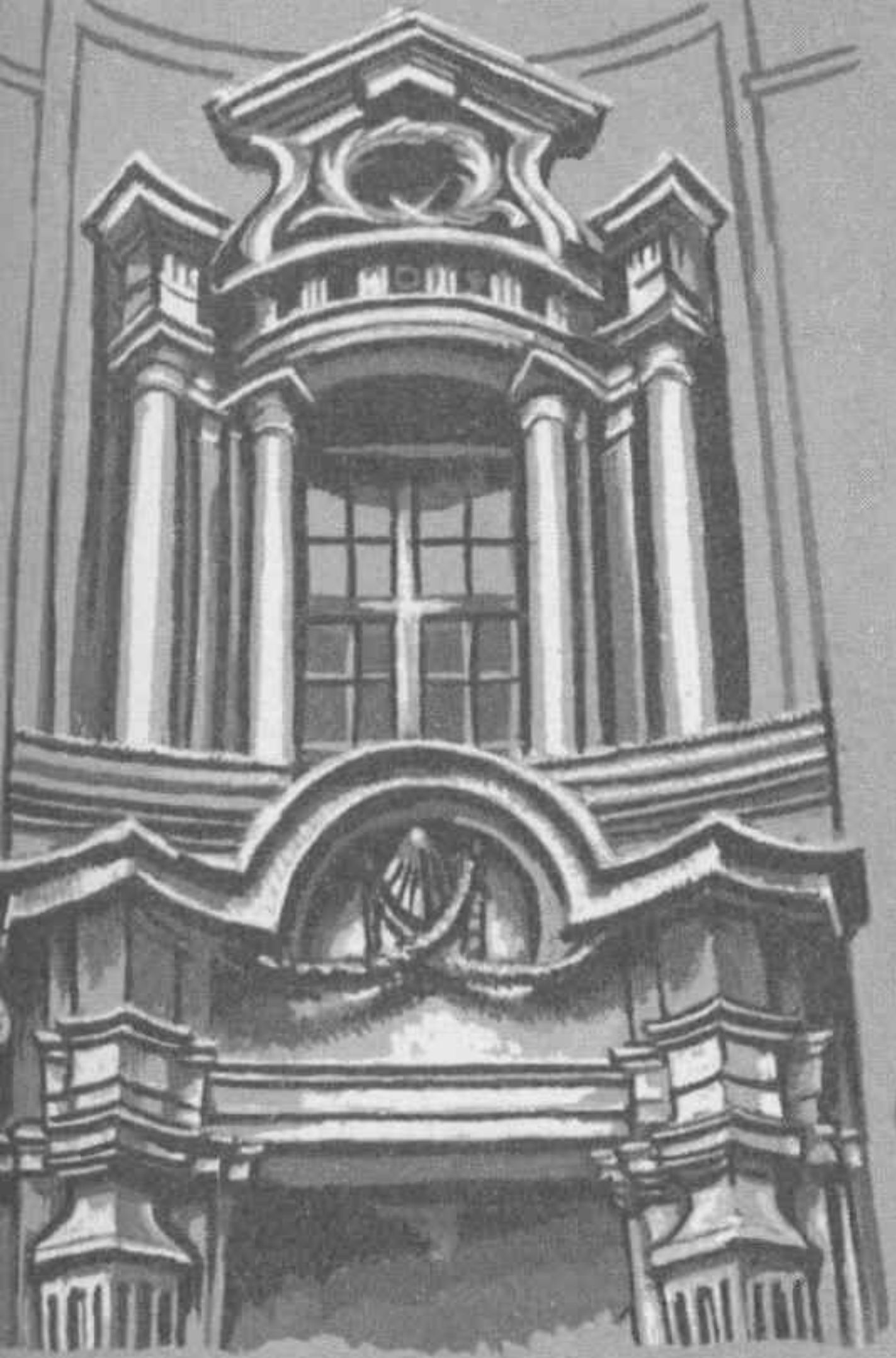
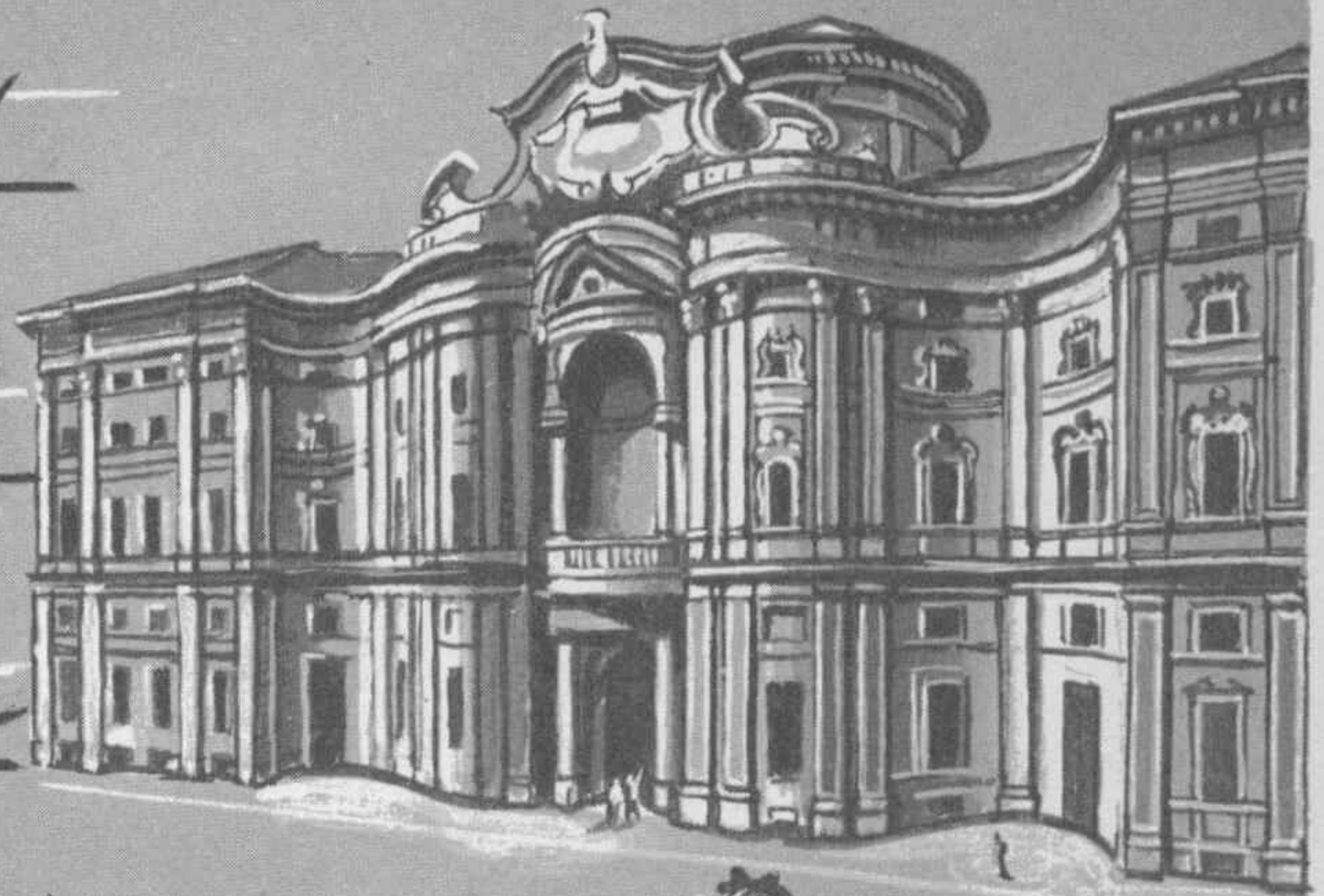


The 'Colossal' Order

# ITALY, PALACES

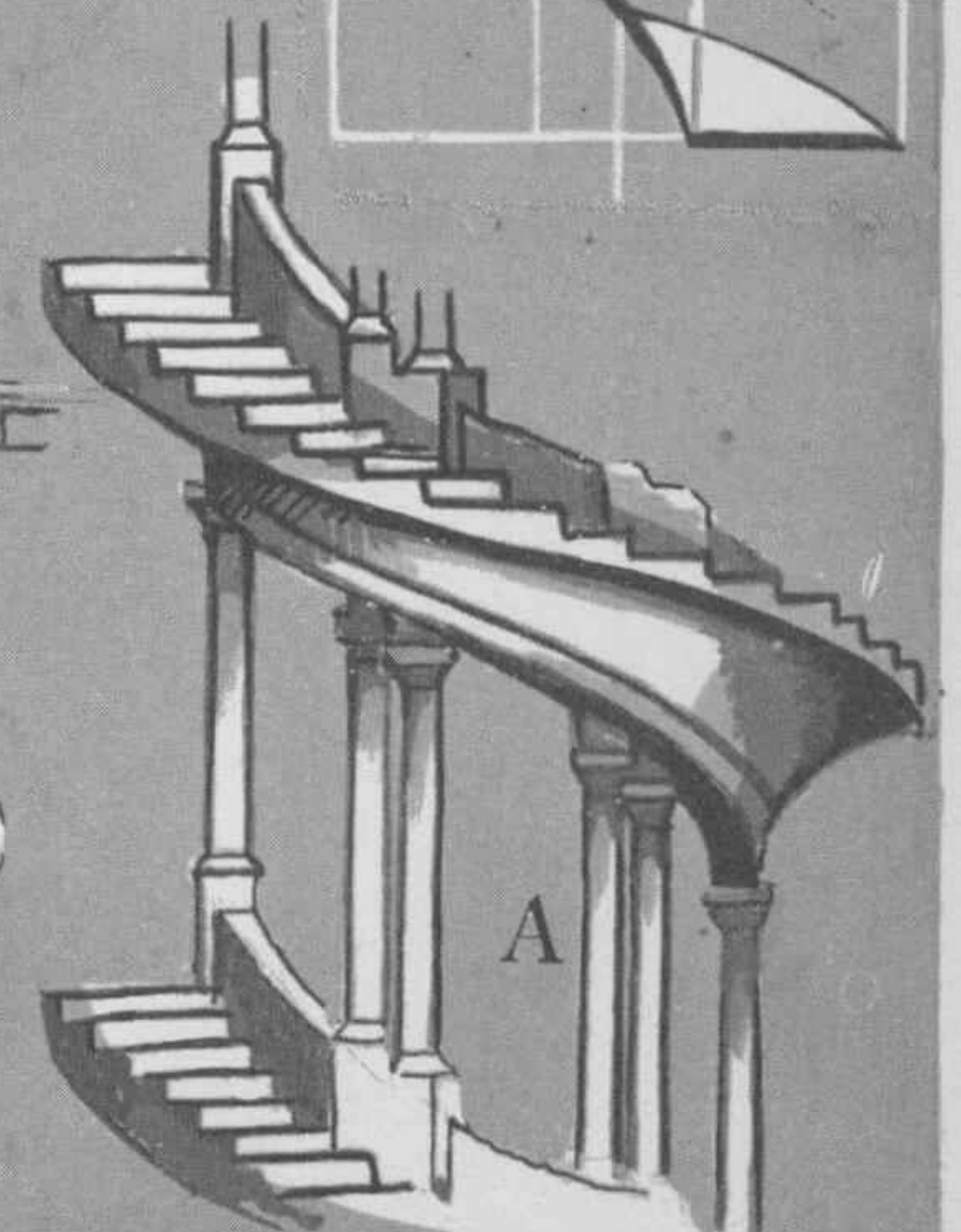
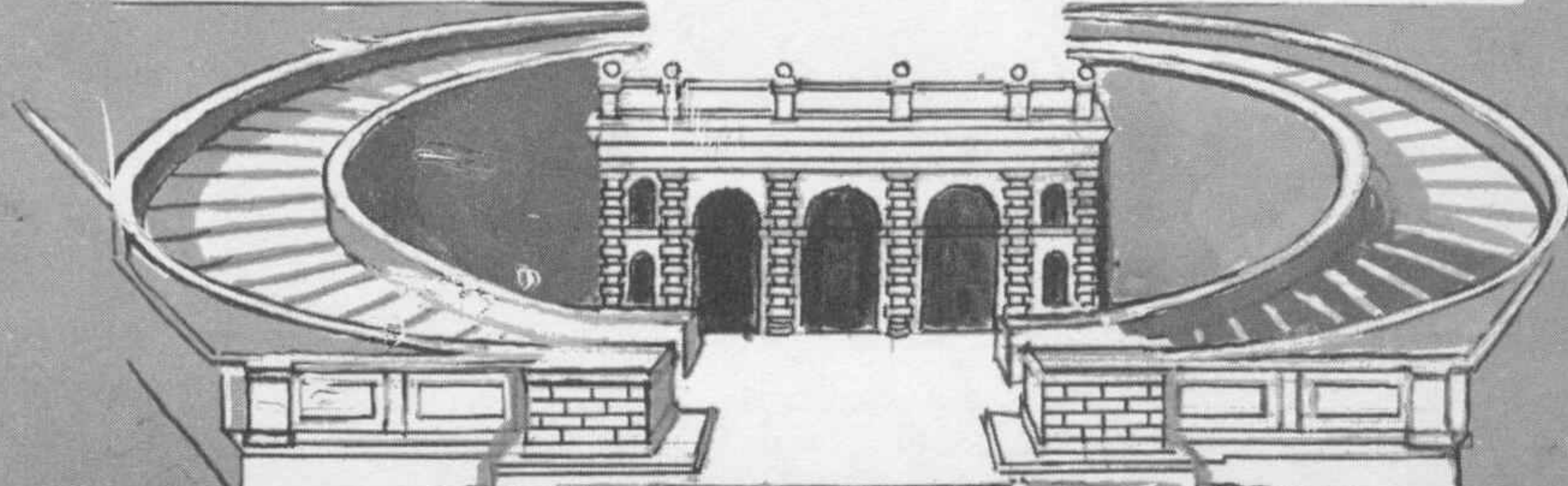
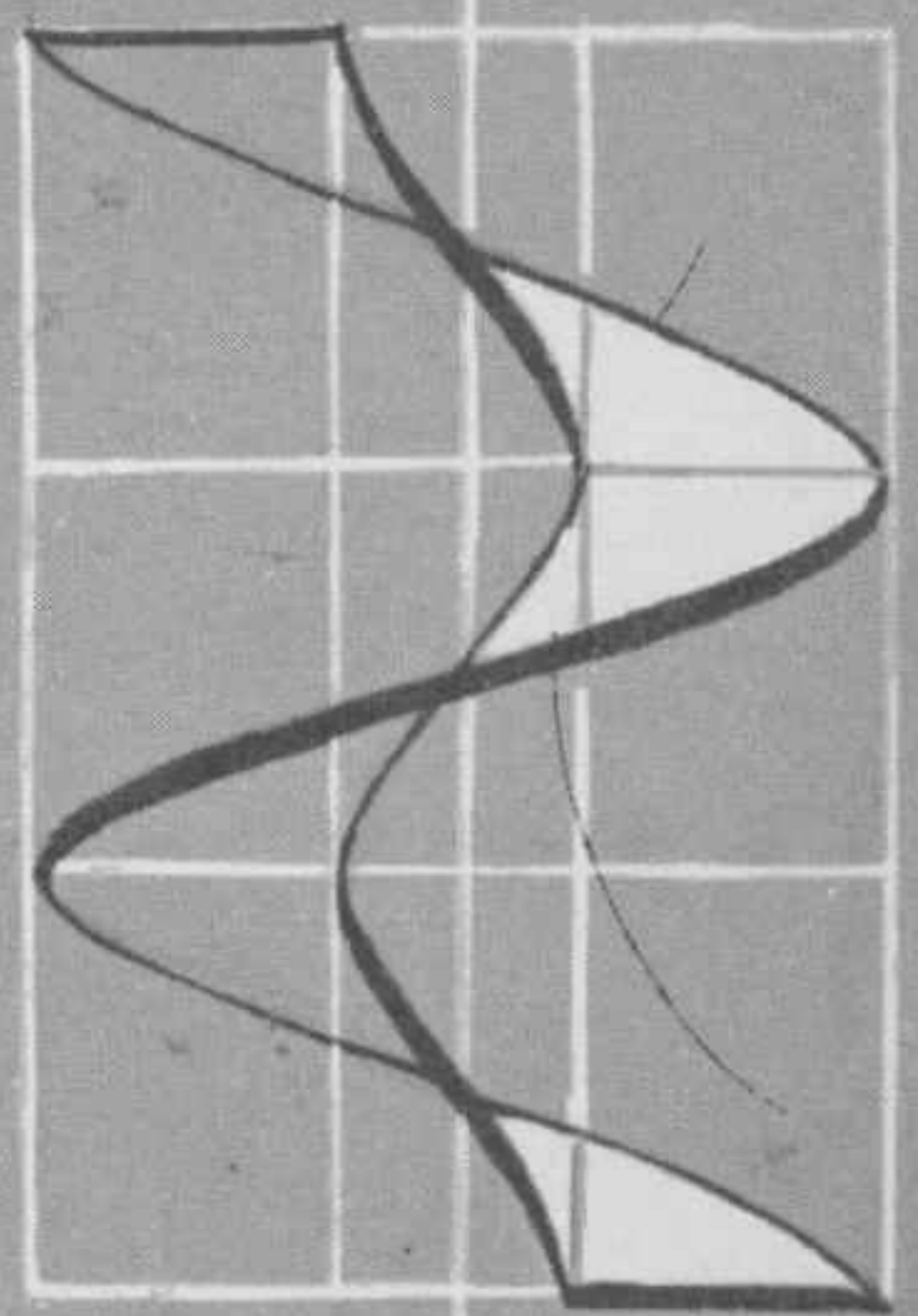
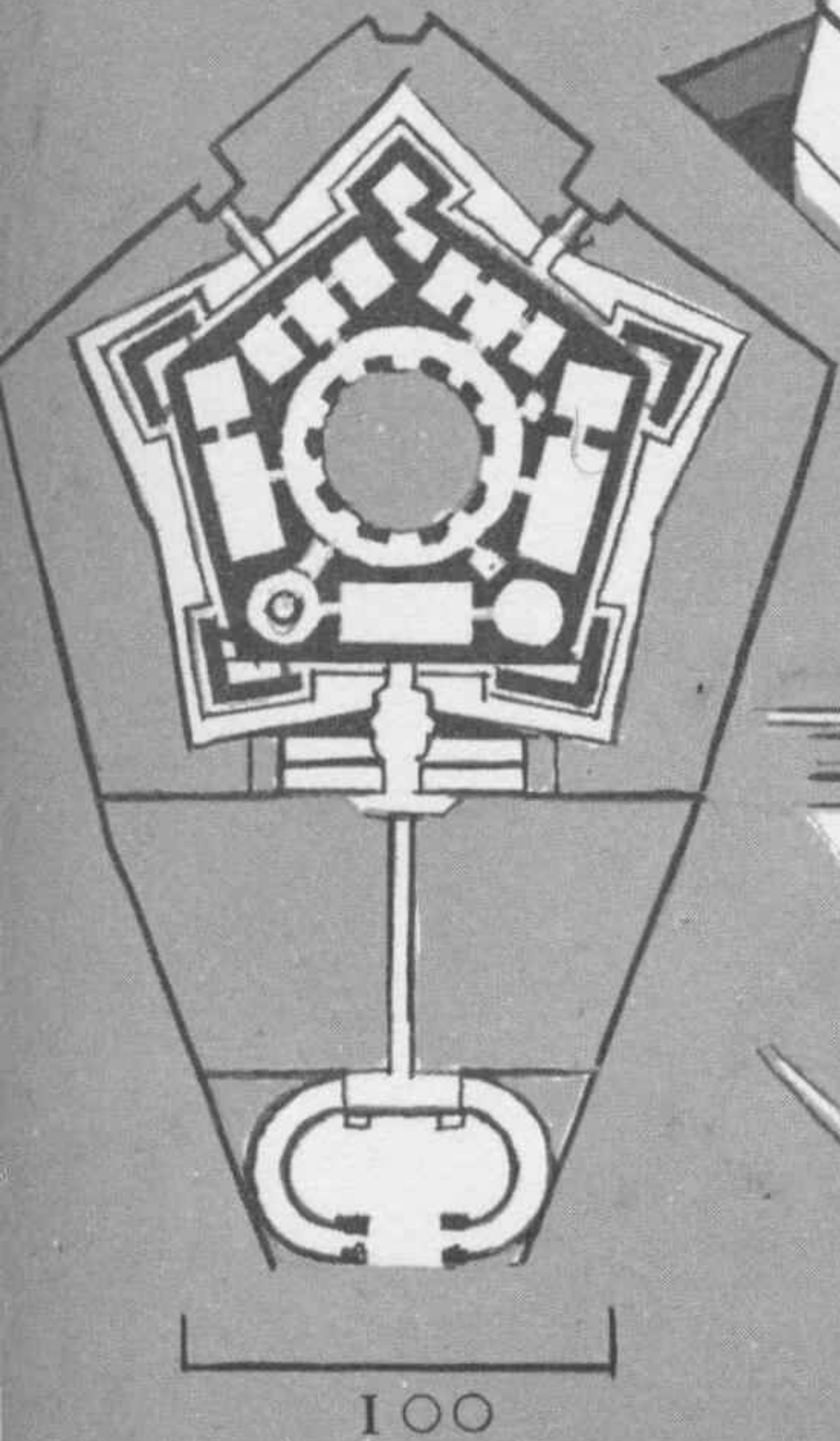
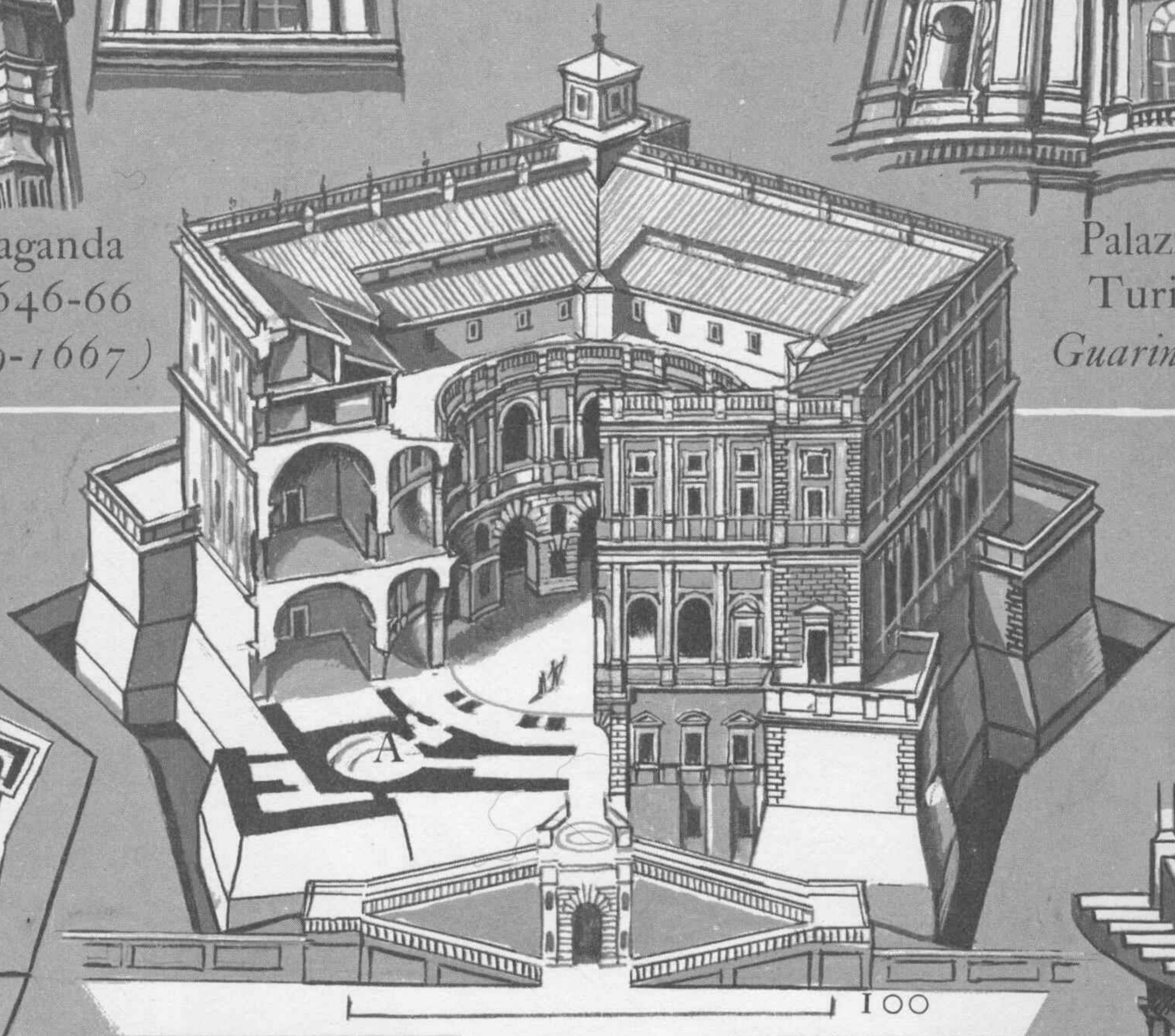


cycloidal curves  
*Pascal (1623-1662)*



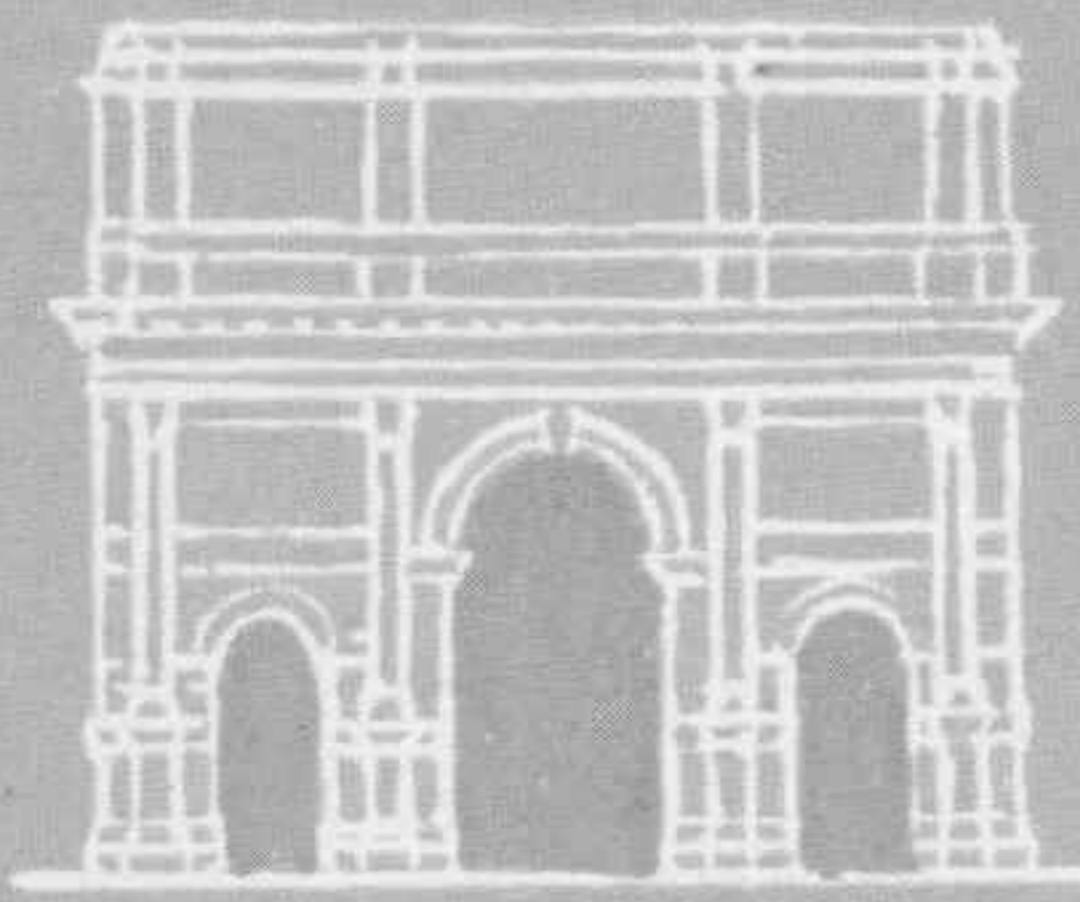
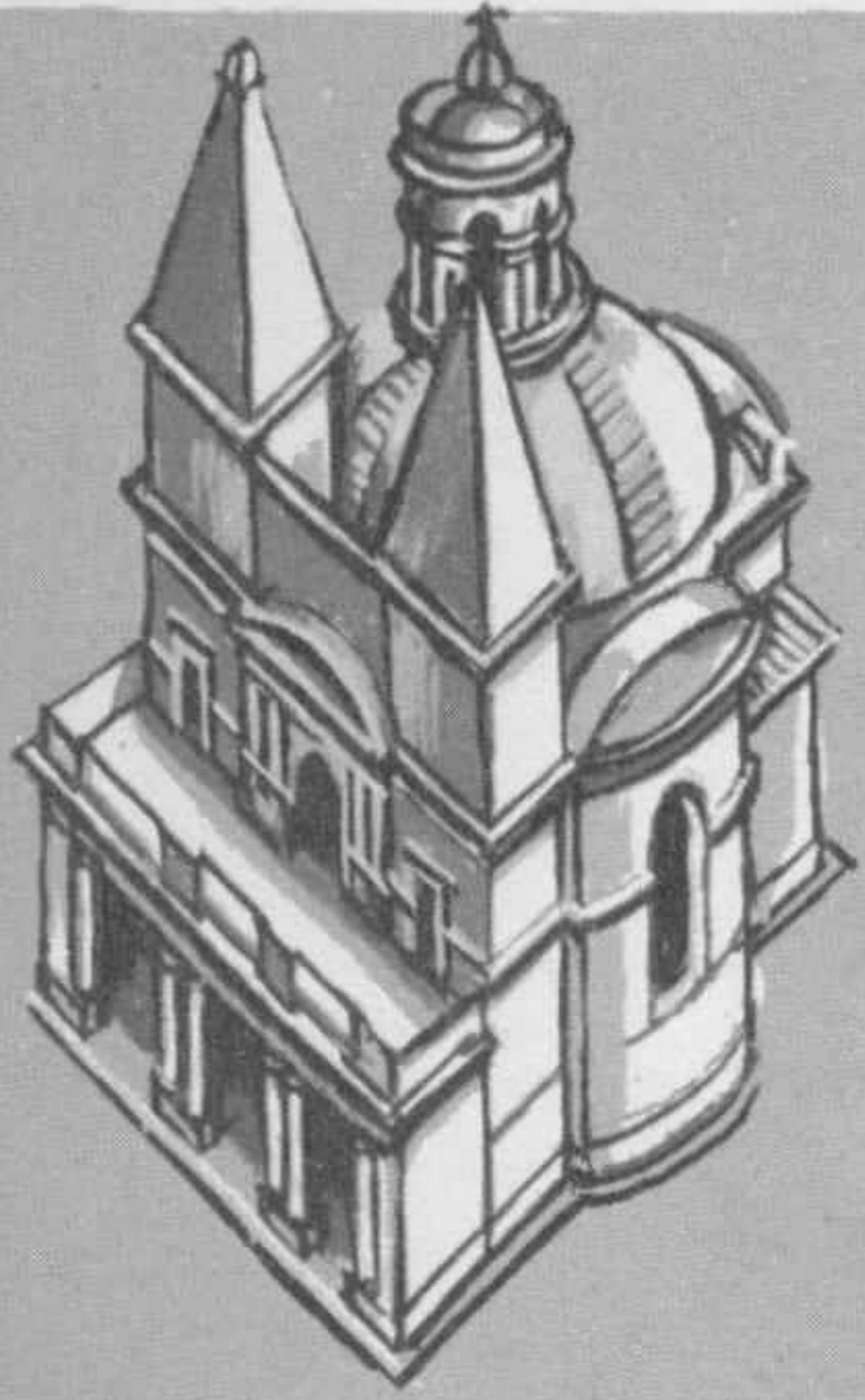
Collegio Propaganda Fide, Rome 1646-66  
*Borromini (1599-1667)*

Palazzo Carignano, Turin, c.1678-80  
*Guarini (1624-1683)*

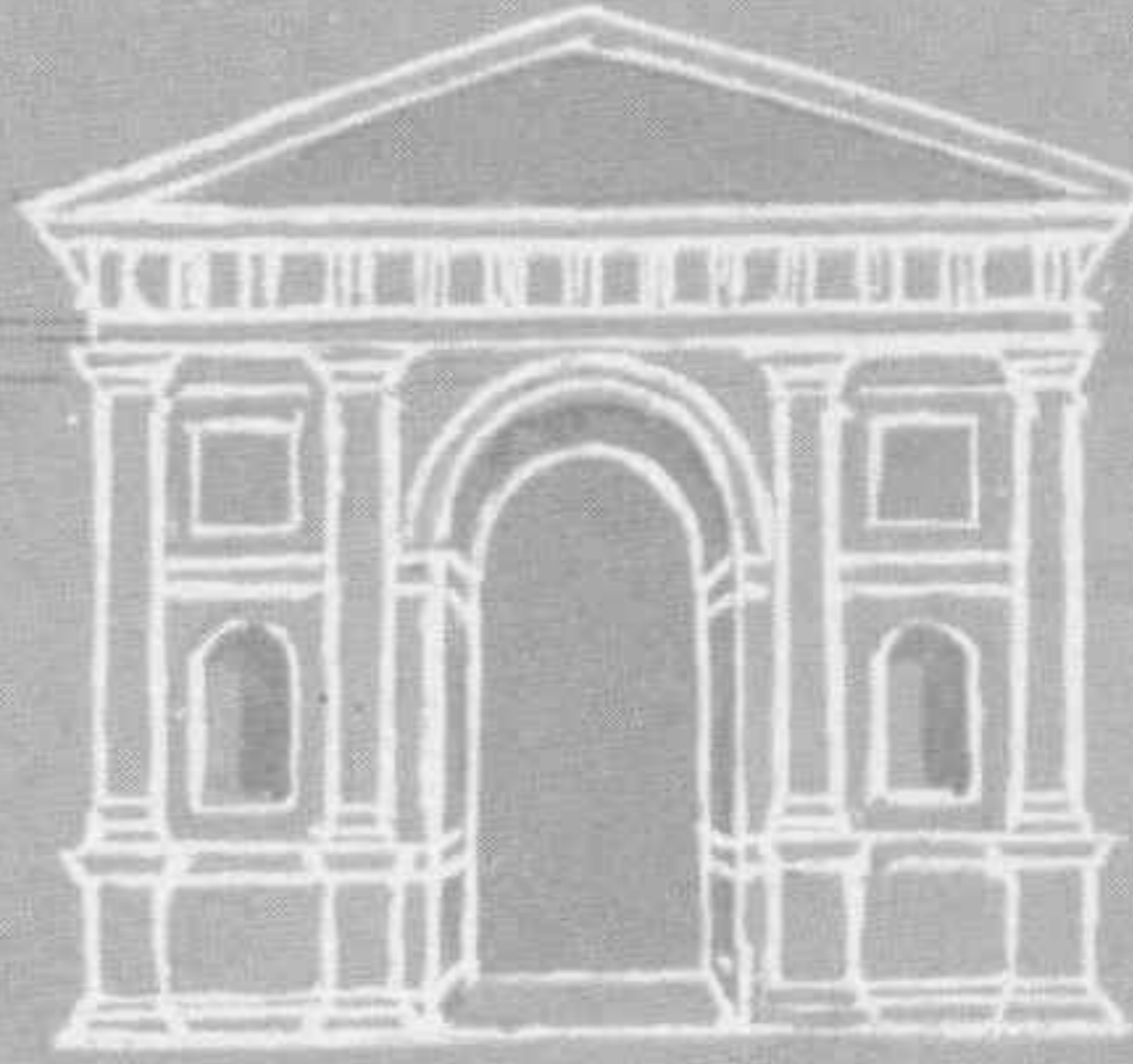


Palazzo Farnese, Caprarola, 1559-1564 *Giacomo Barozzi da Vignola (1507-1573)*

# RENAISSANCE - BAROQUE

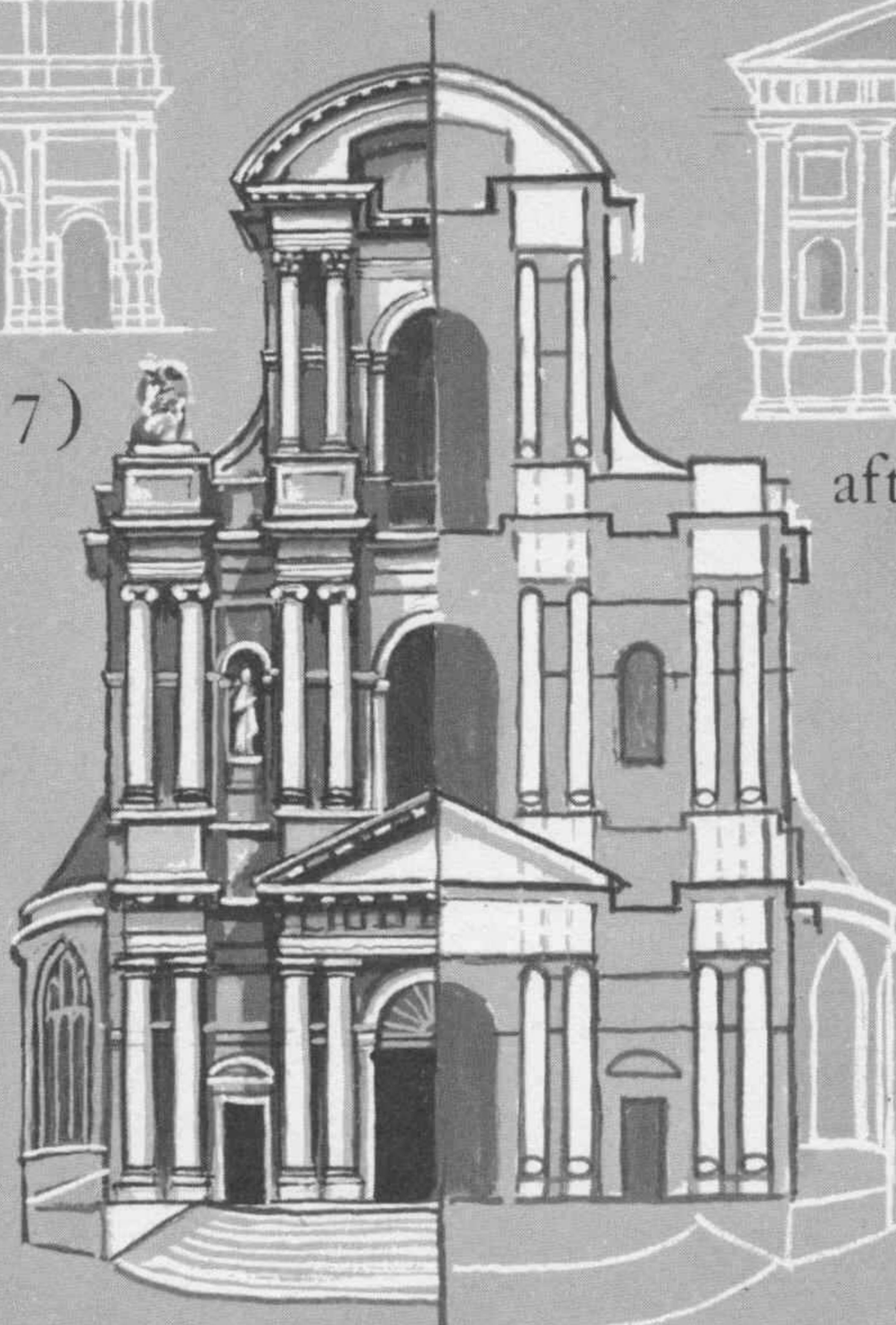


(p. 117)



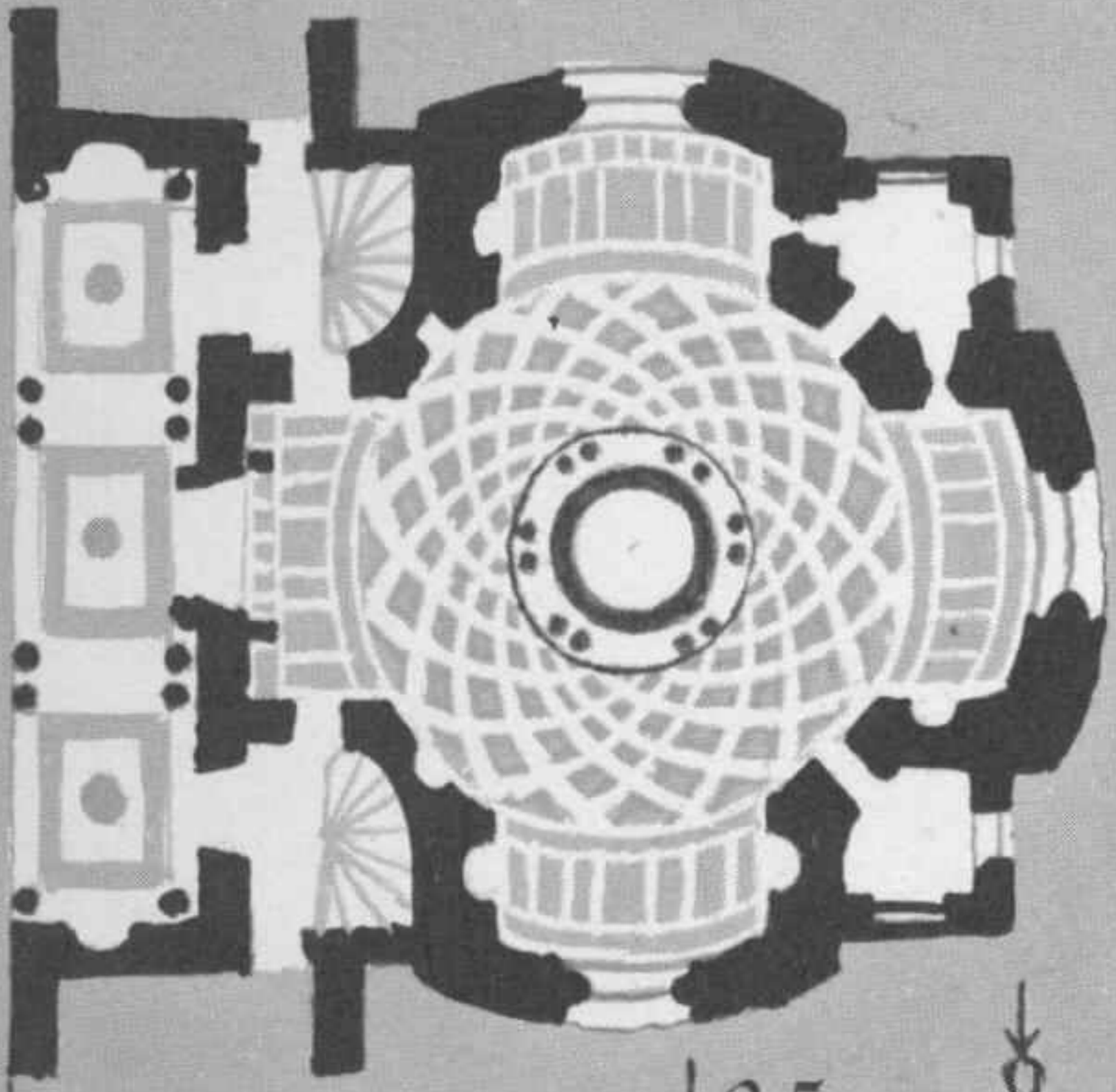
after Serlio  
1537

150

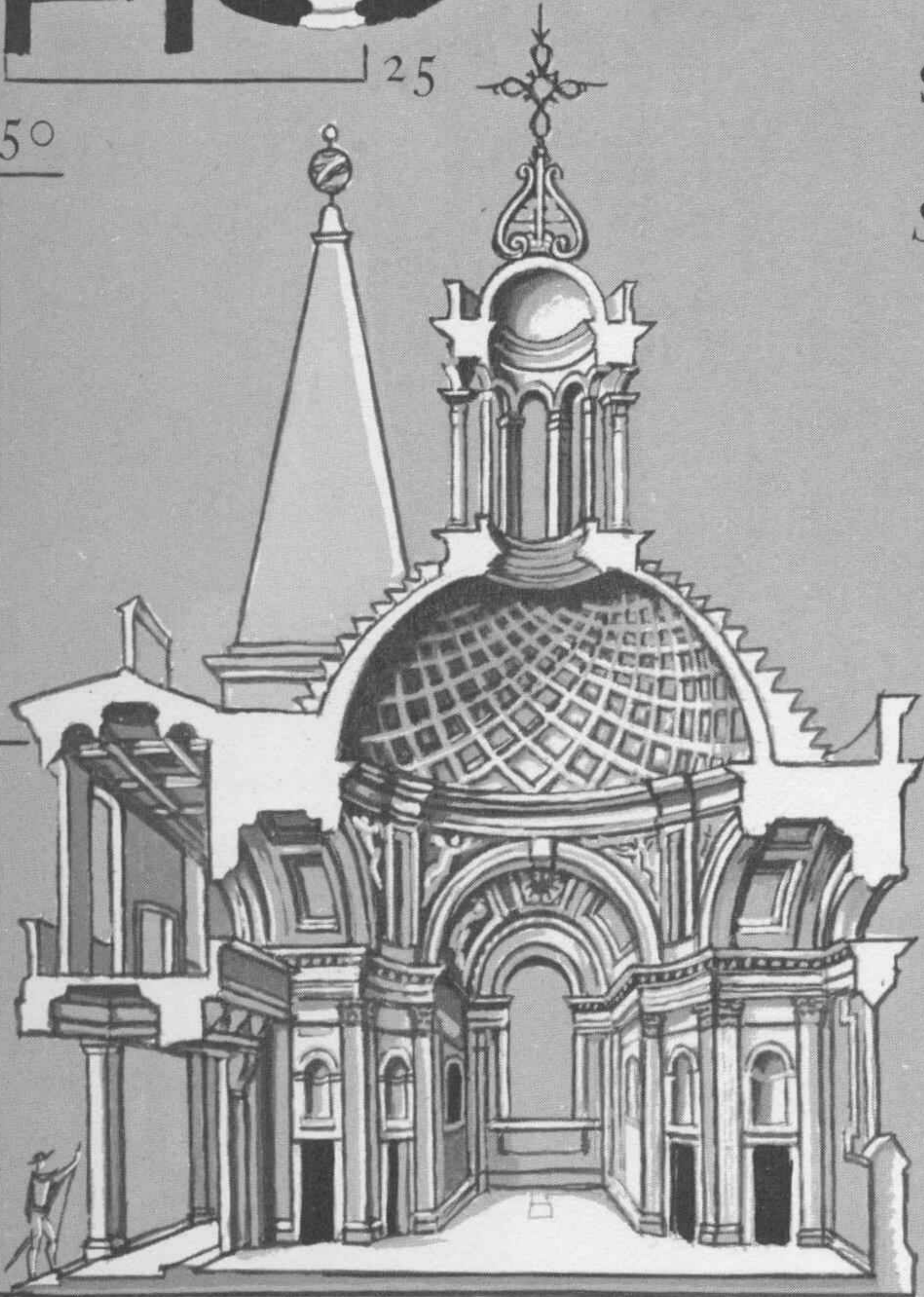


50

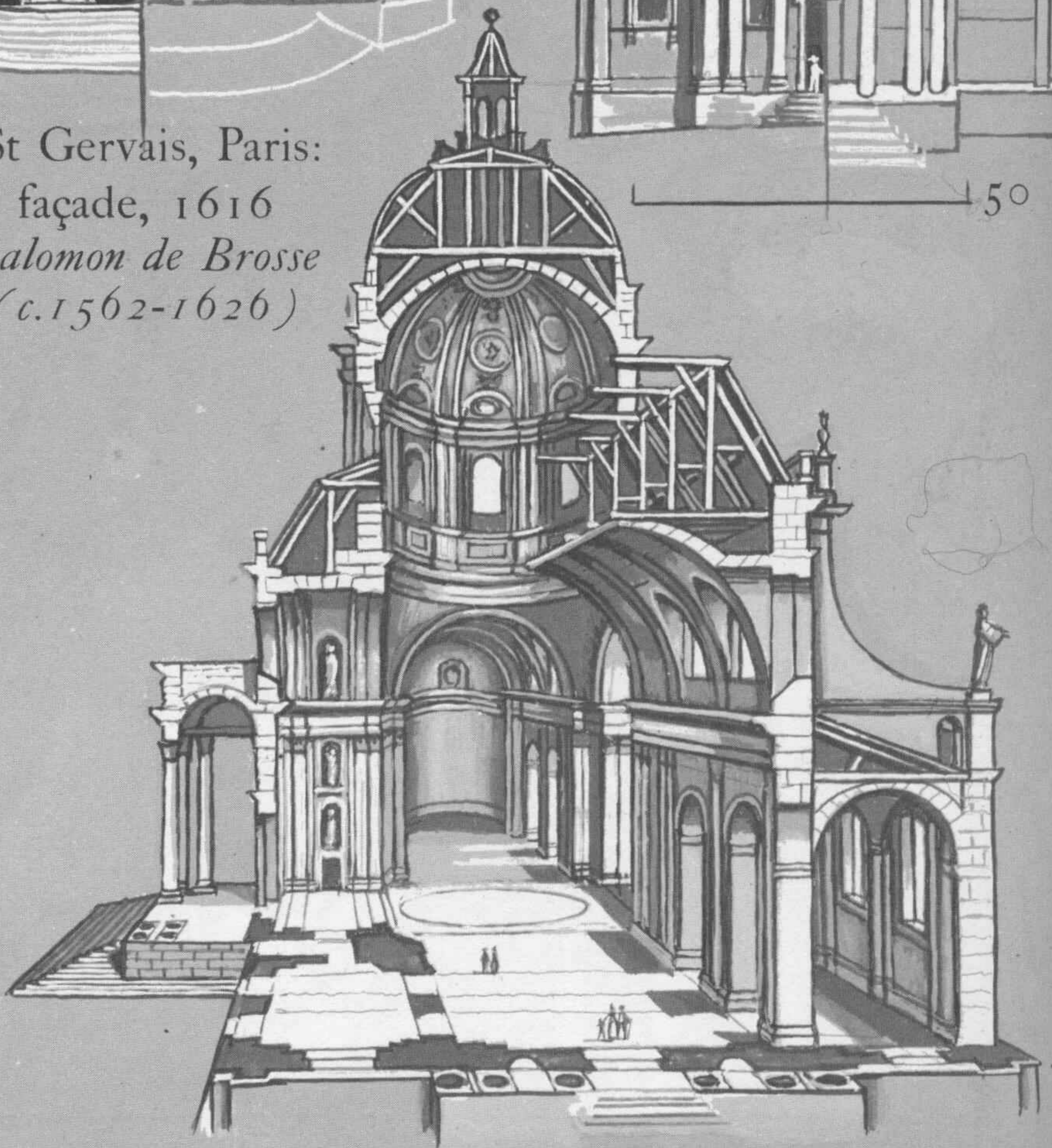
St Gervais, Paris:  
façade, 1616  
Salomon de Brosse  
(c. 1562-1626)



25



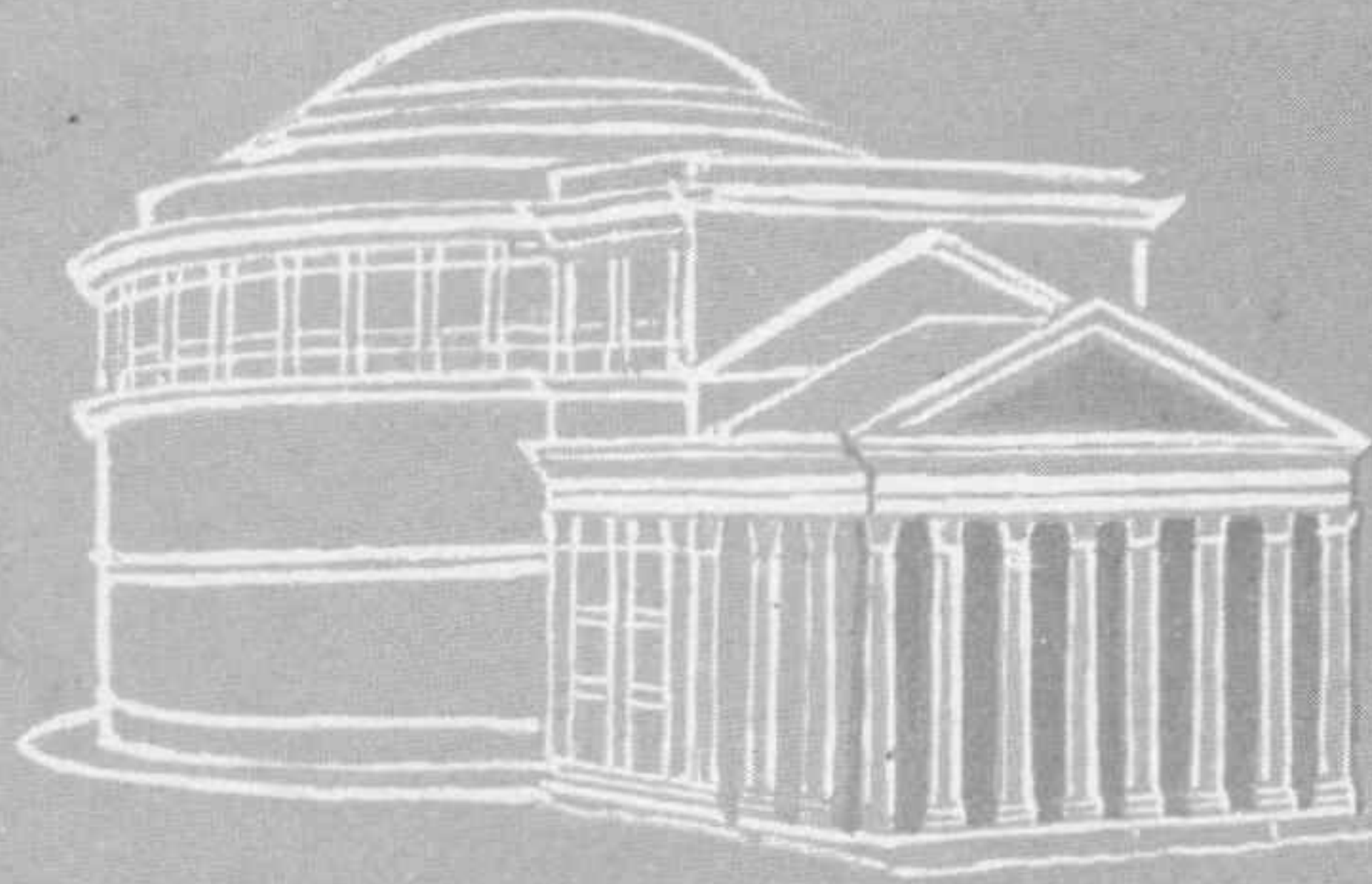
Château d'Anet: chapel, 1549-53  
Philibert de l'Orme (c. 1510-1570)



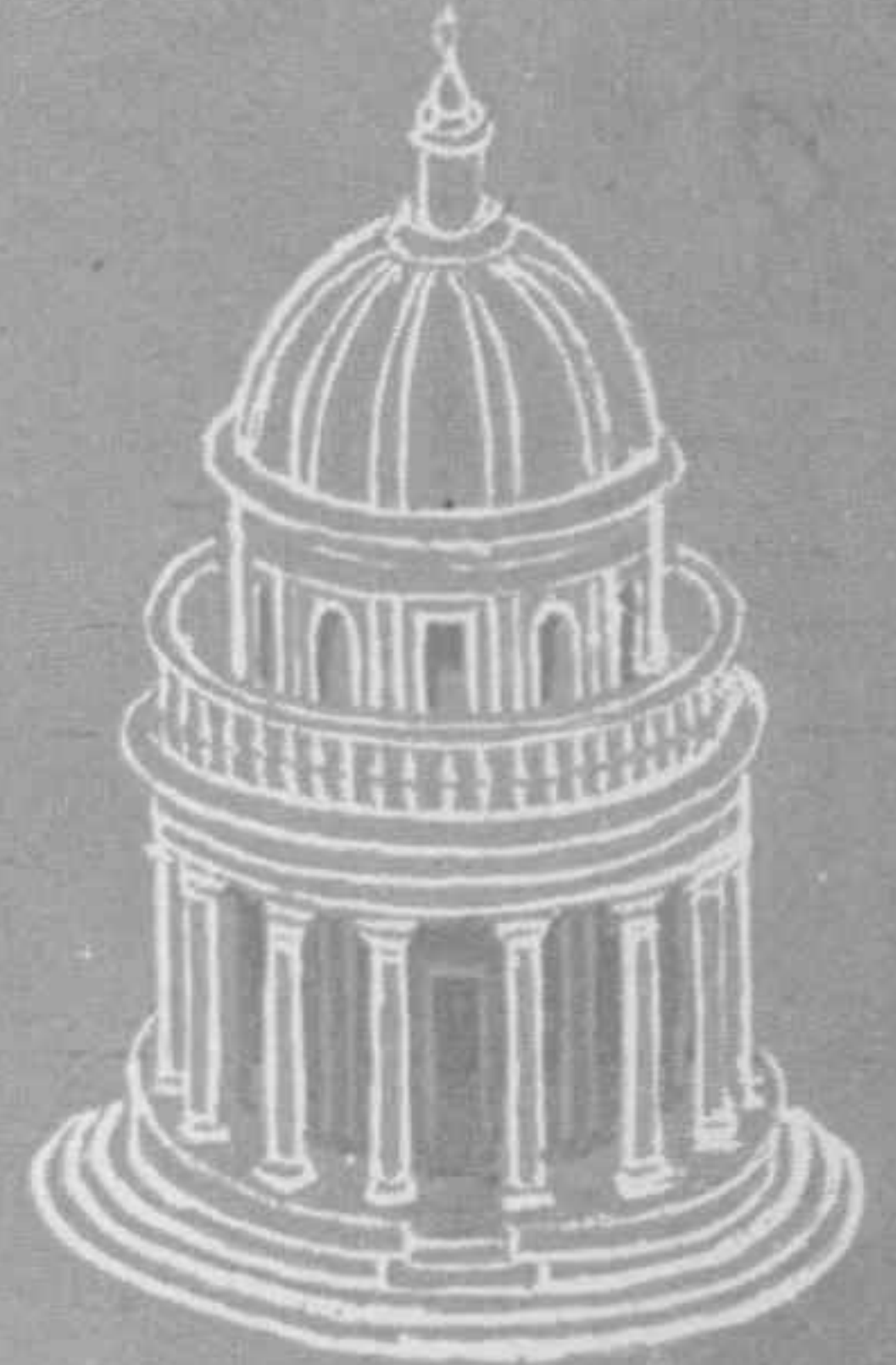
Church of the Sorbonne, Paris, c. 1635  
Jacques Lemercier (c. 1580/5-1654)

The Italian campaigns of the French Kings, Charles VIII (1483-98), Louis XII (1498-1515) and Francis I (1515-47), failed in their aims; instead France was invaded by the ideas and the arts of the Italian Renaissance.

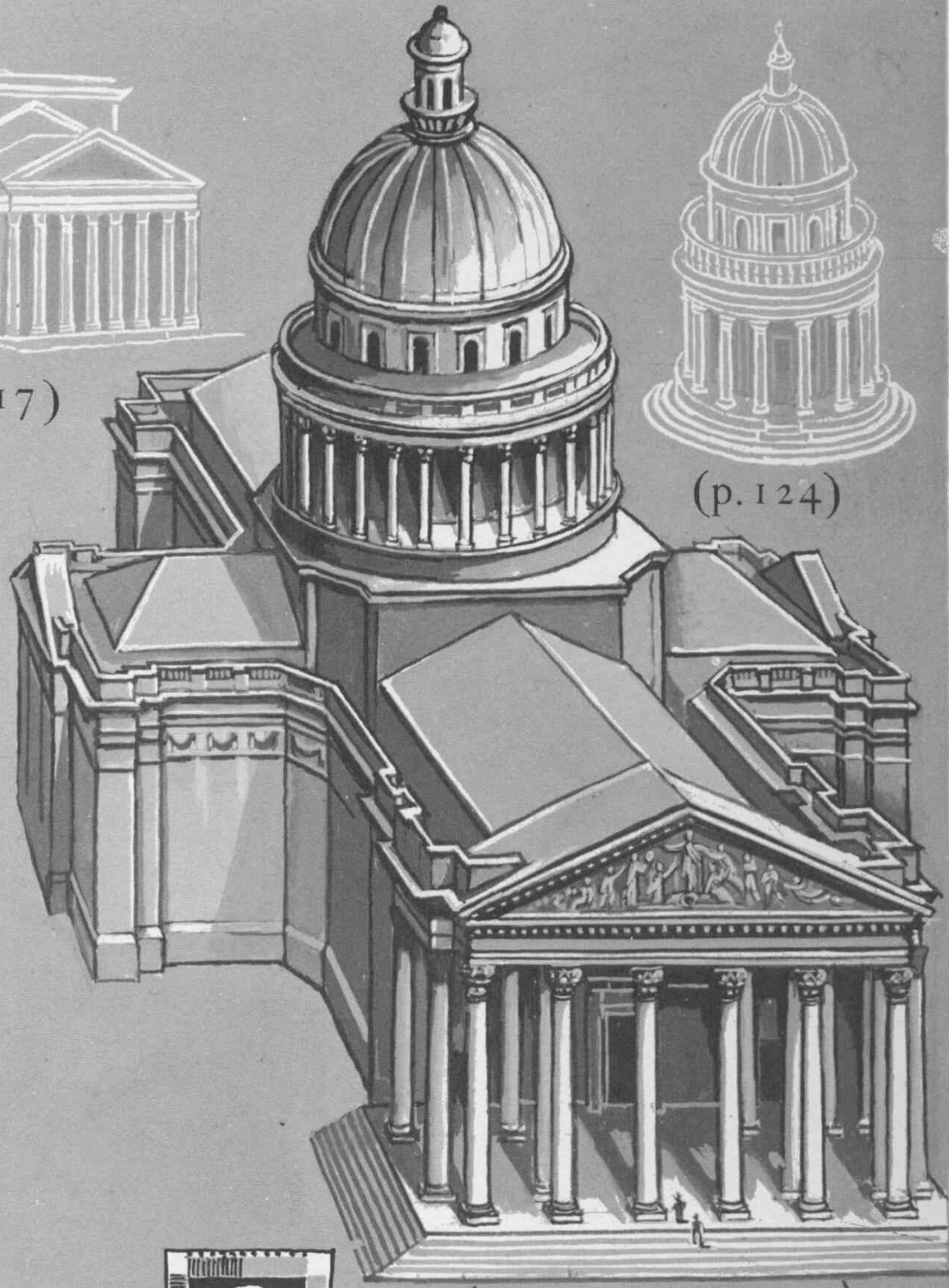
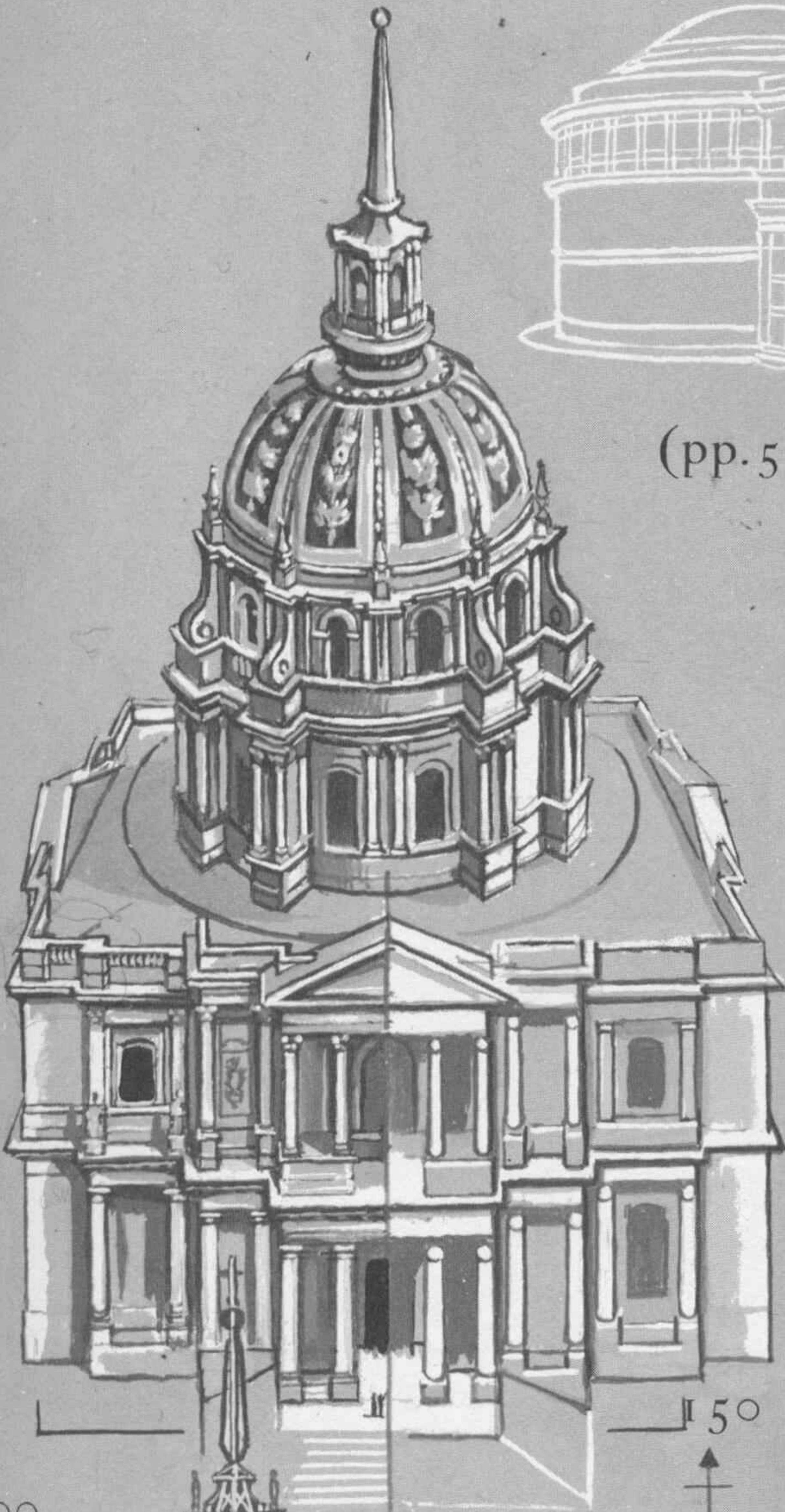
# FRANCE, CHURCHES



(pp. 56, 117)



(p. 124)

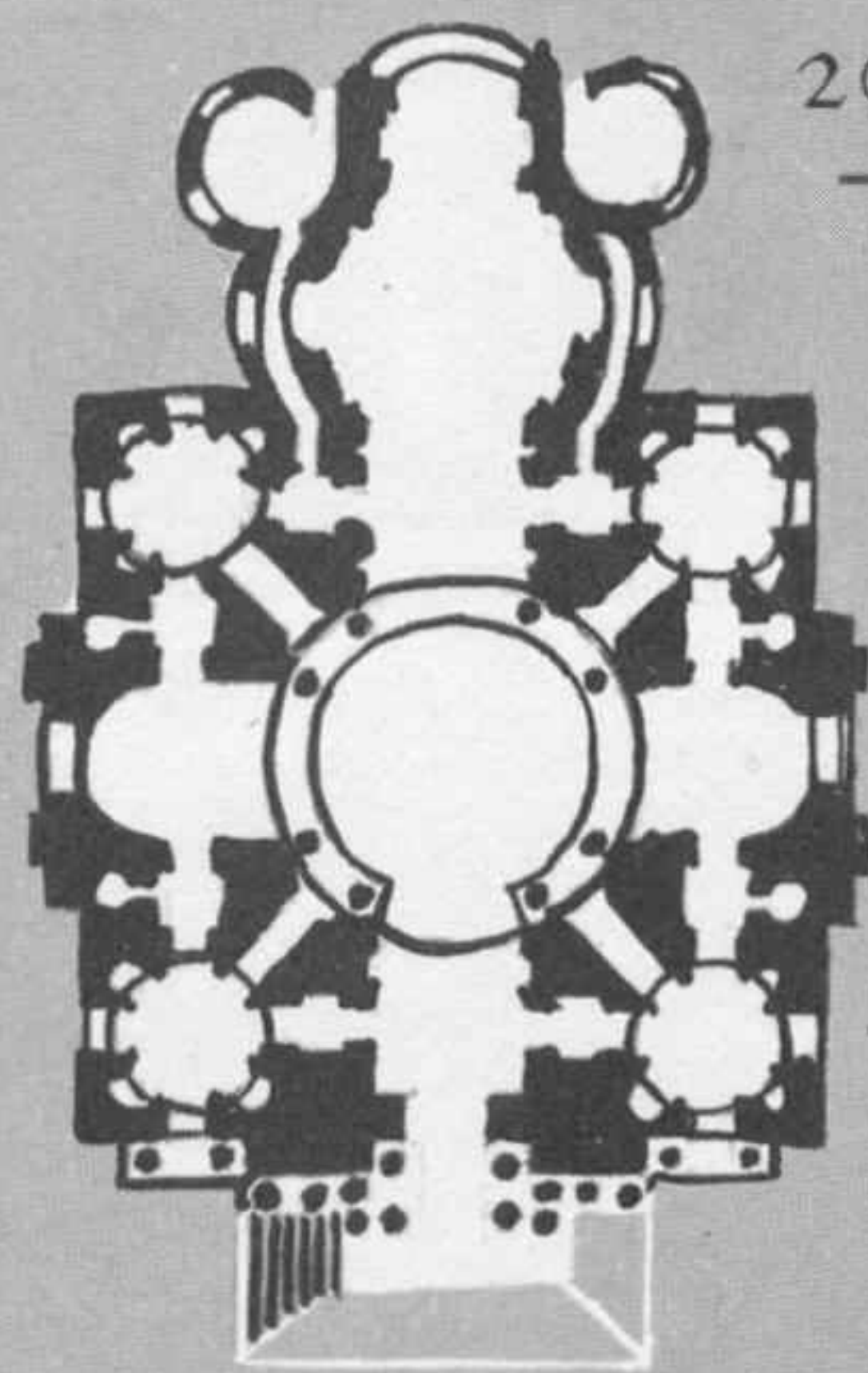


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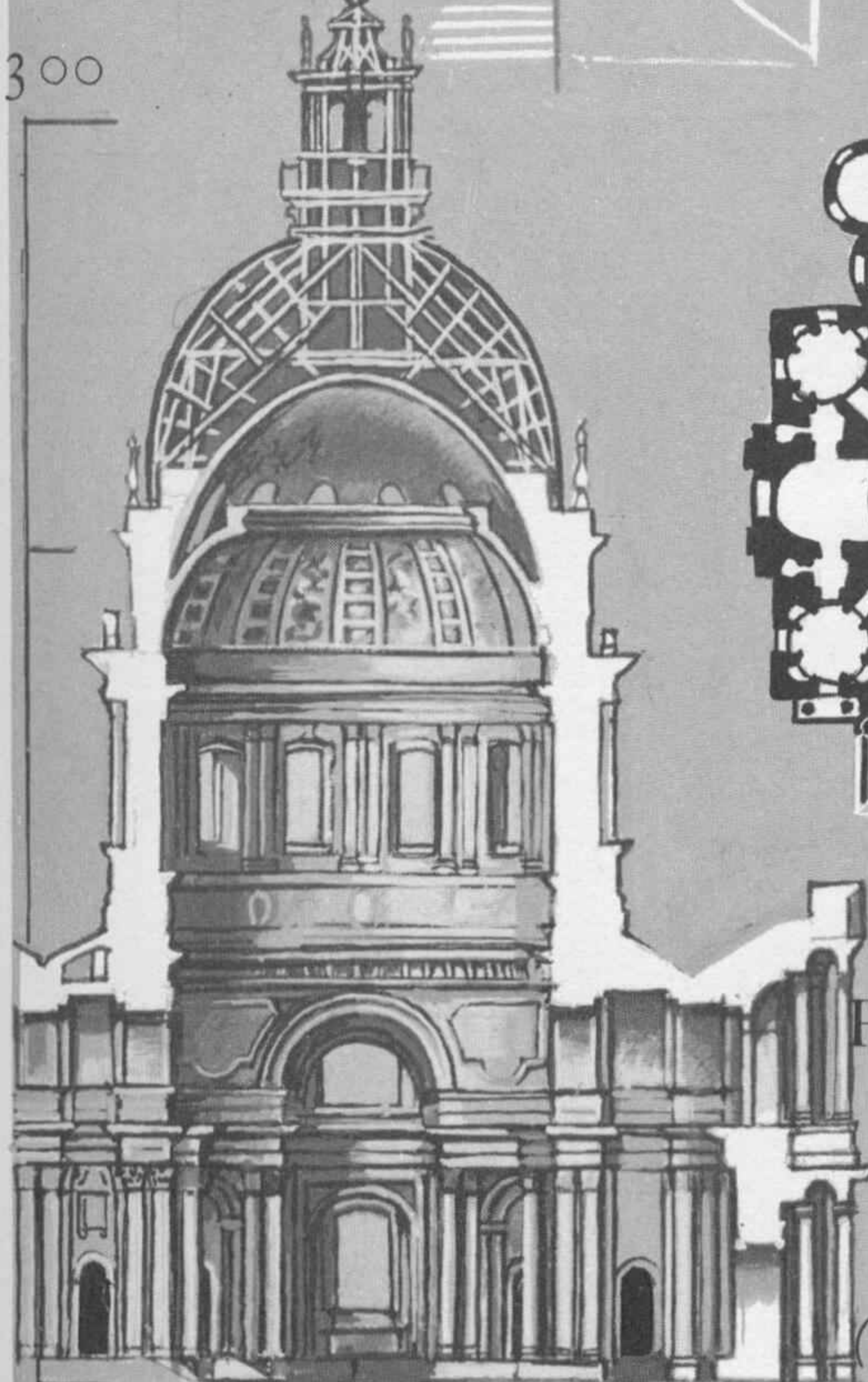
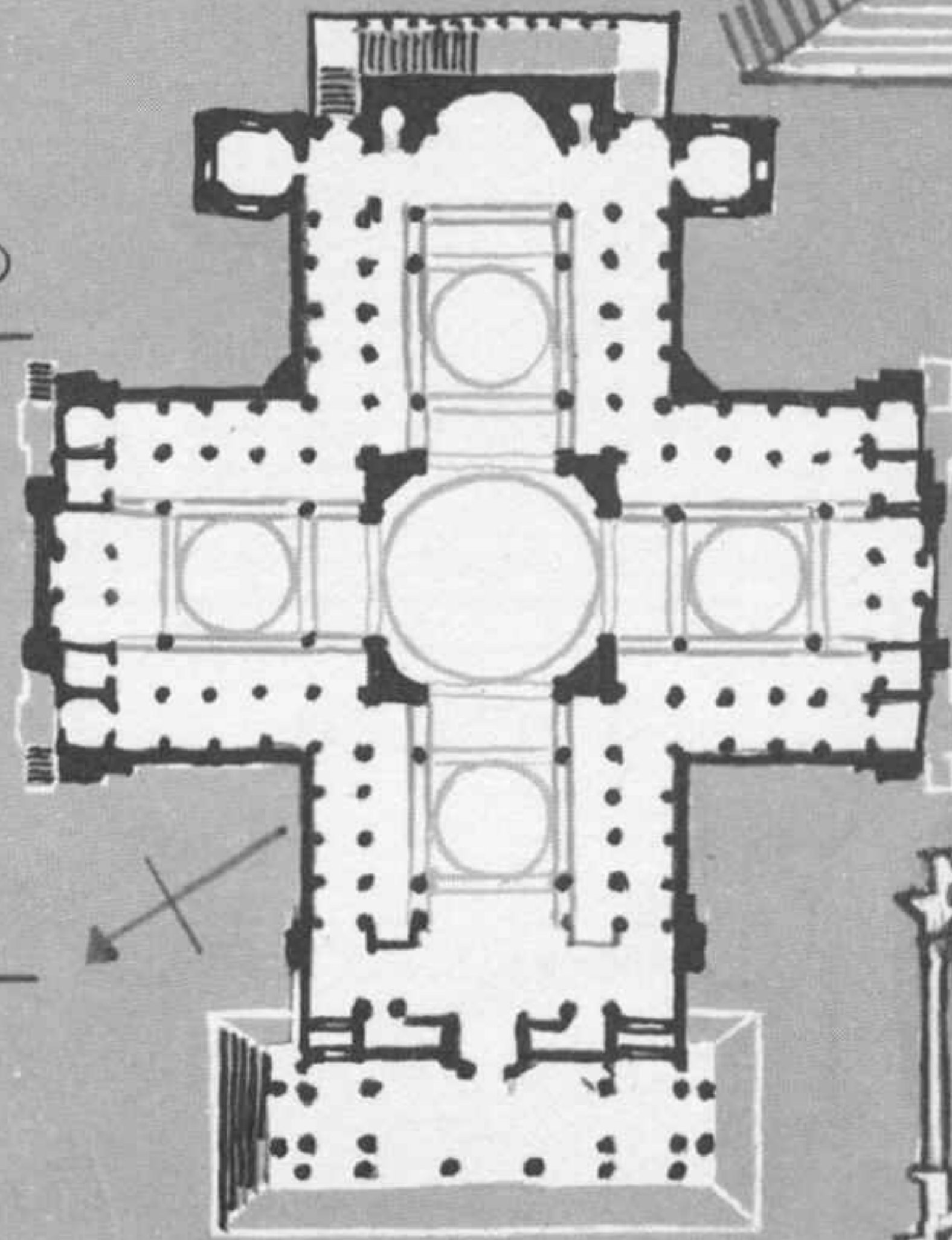
150

100

300

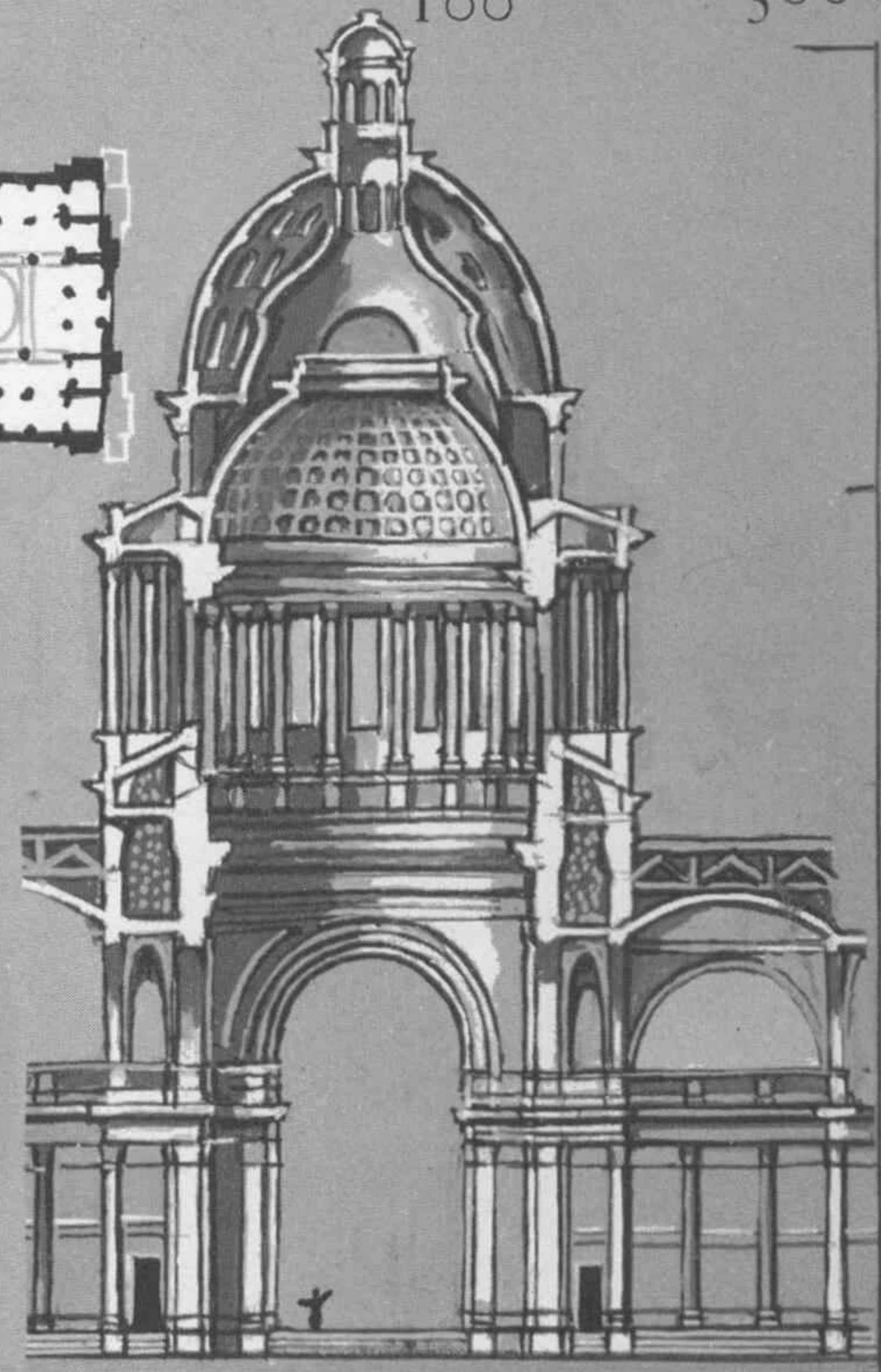


200

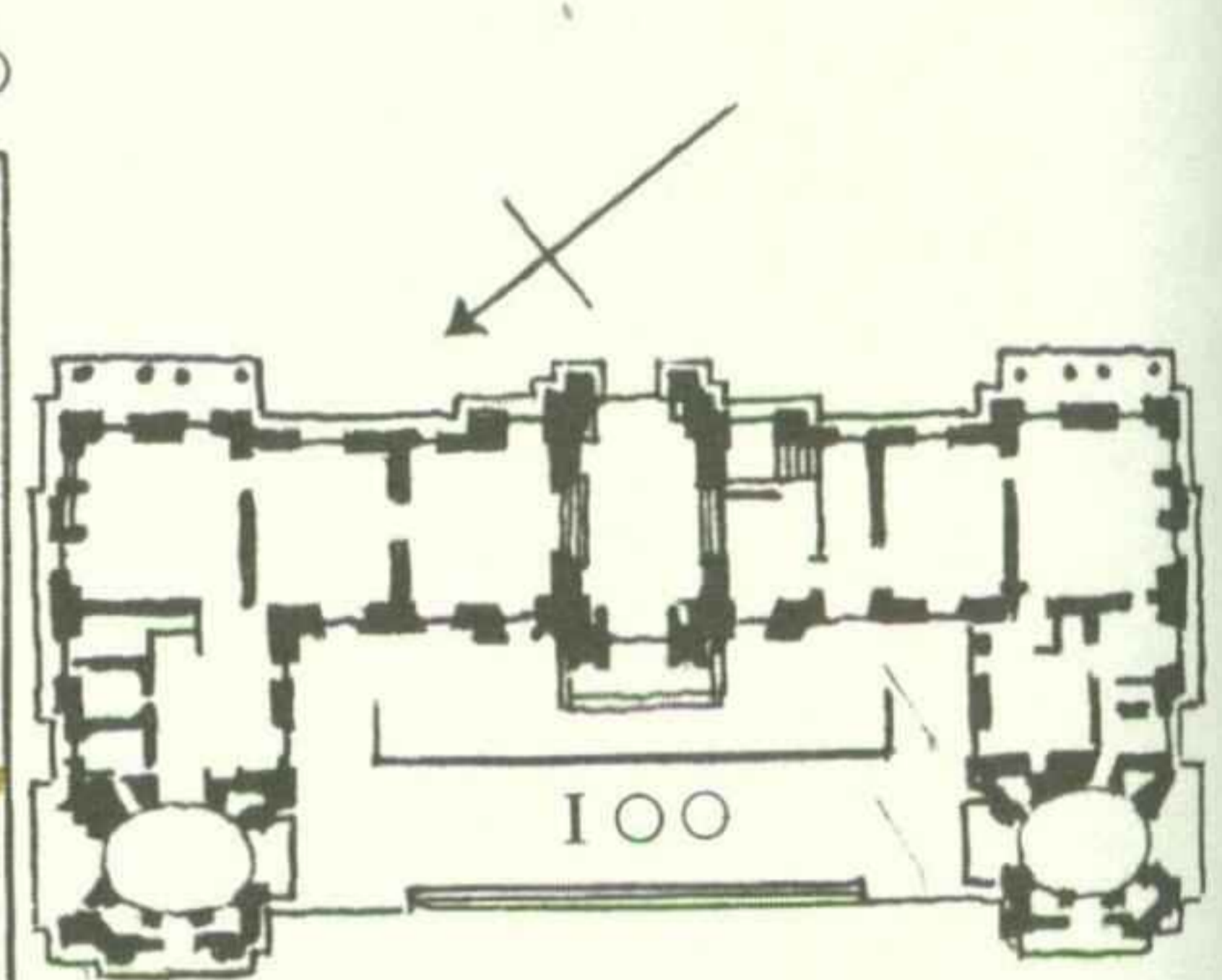
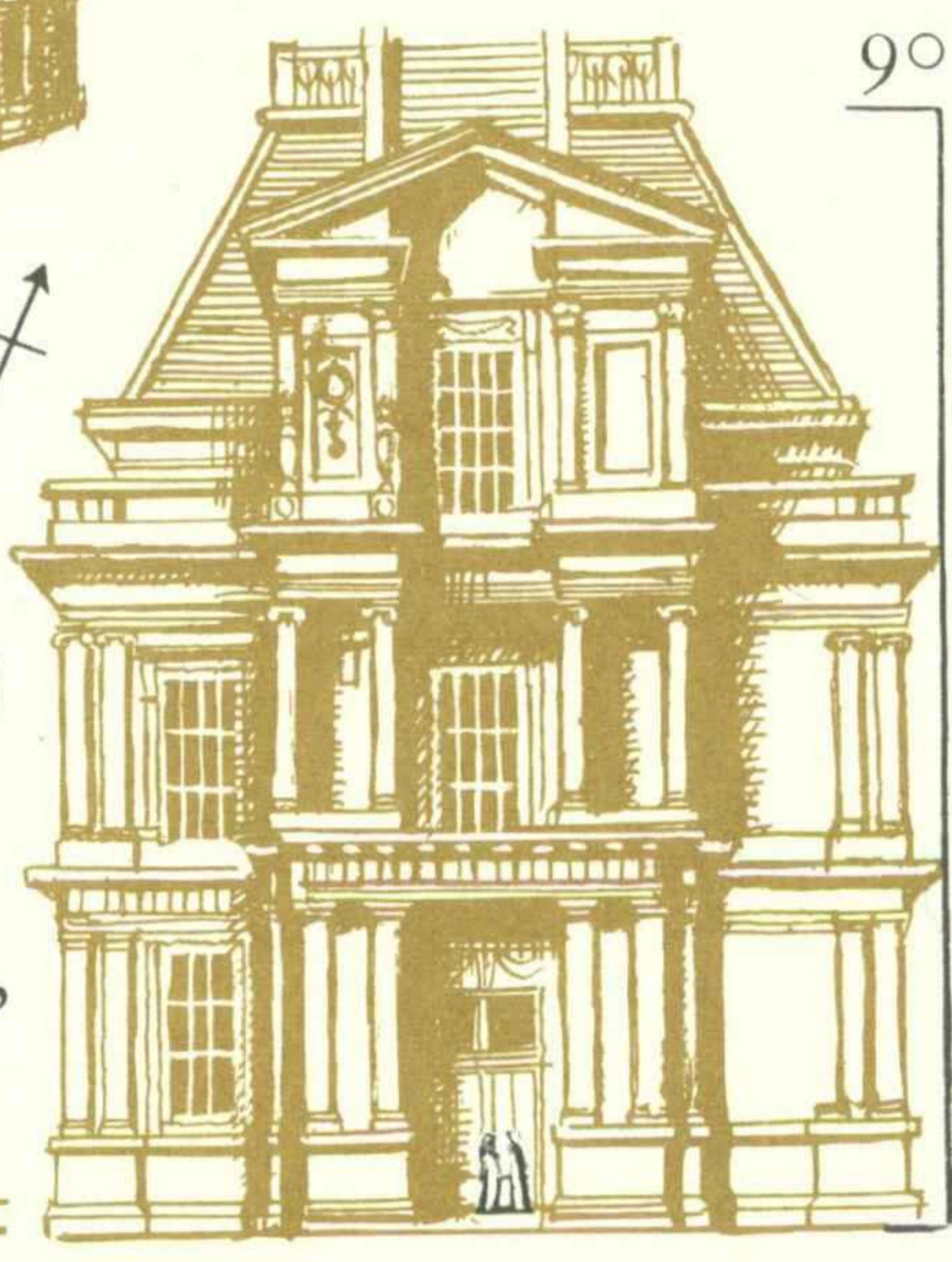
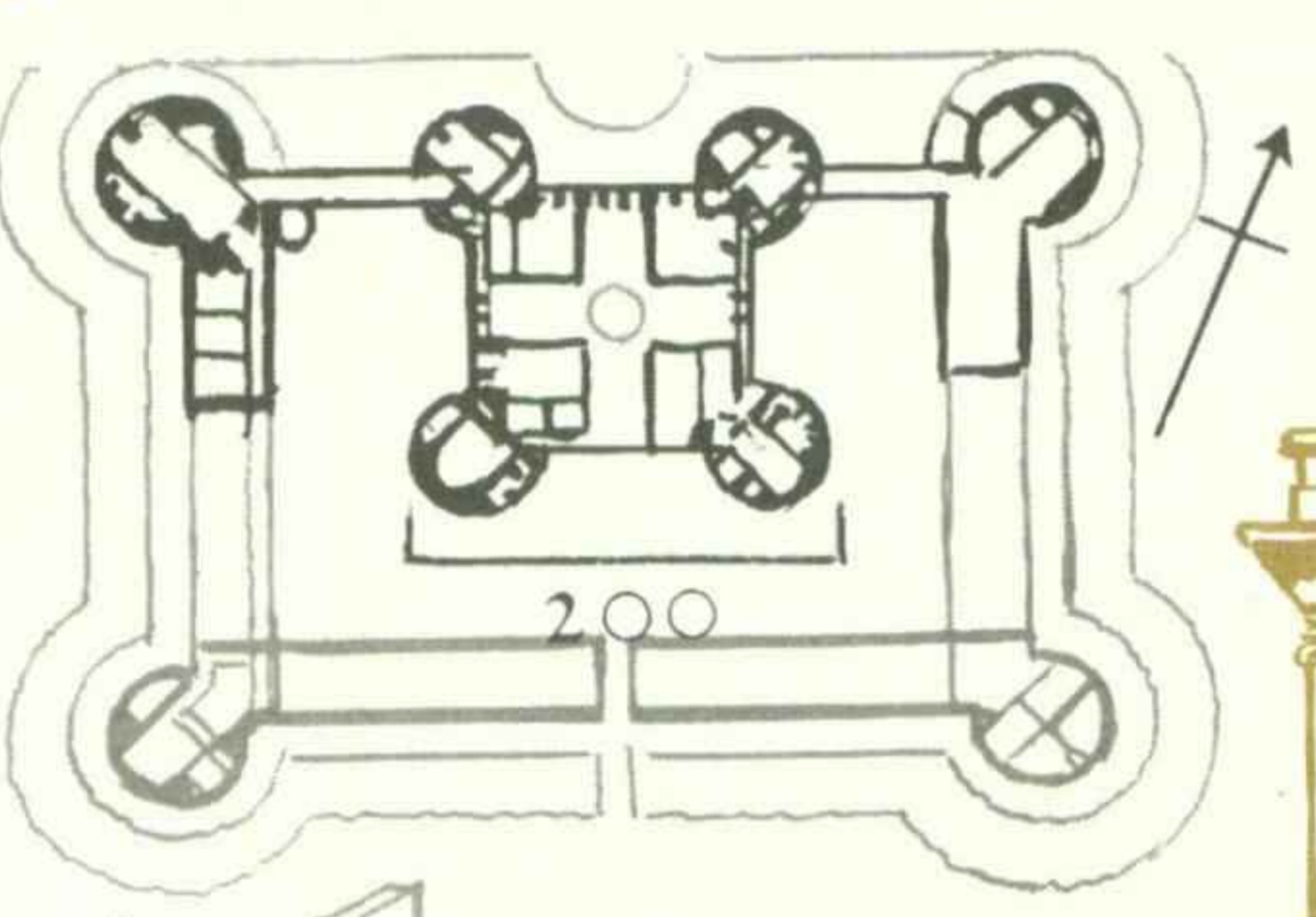
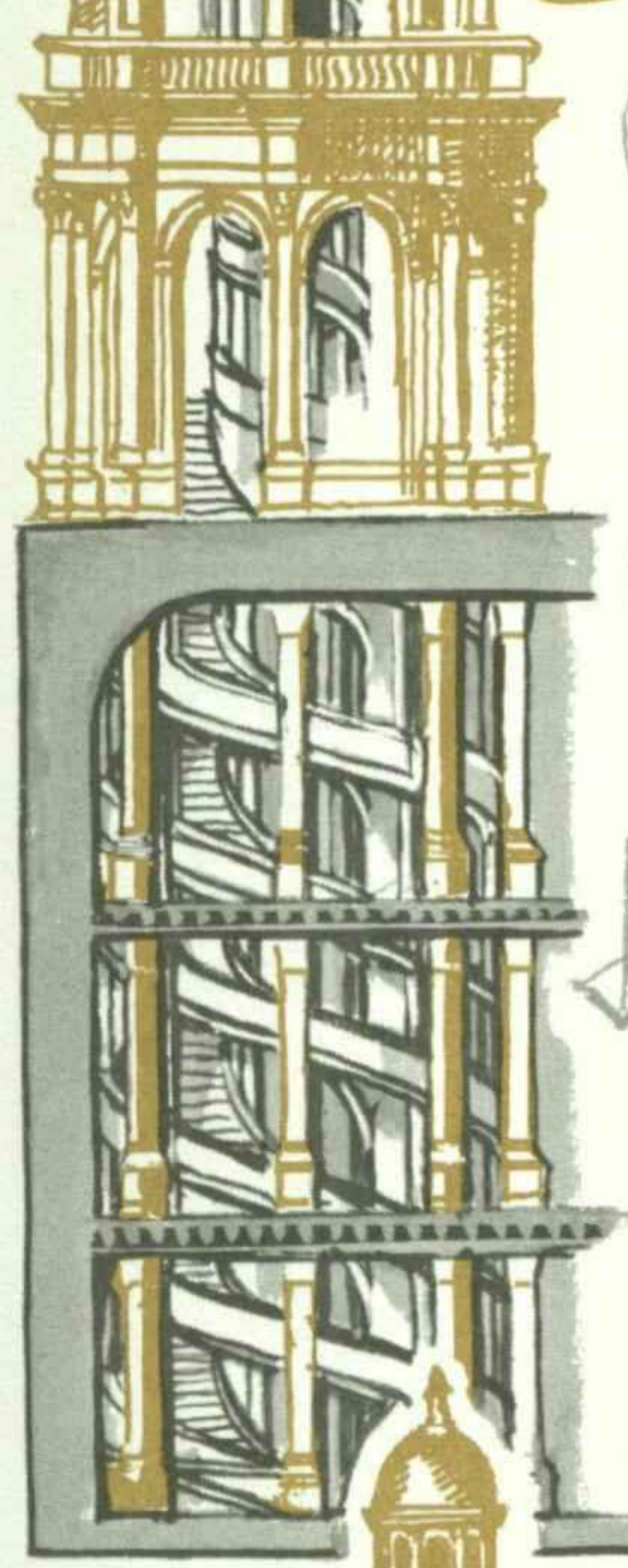


Church of the Invalides, Paris, 1680-91  
*Jules Hardouin Mansart*  
(1646-1708)

Panthéon (St G<sup>é</sup>neviève), Paris, 1764-90  
*Jacques-Germain Soufflot*  
(1713-80)



# RENAISSANCE-BAROQUE

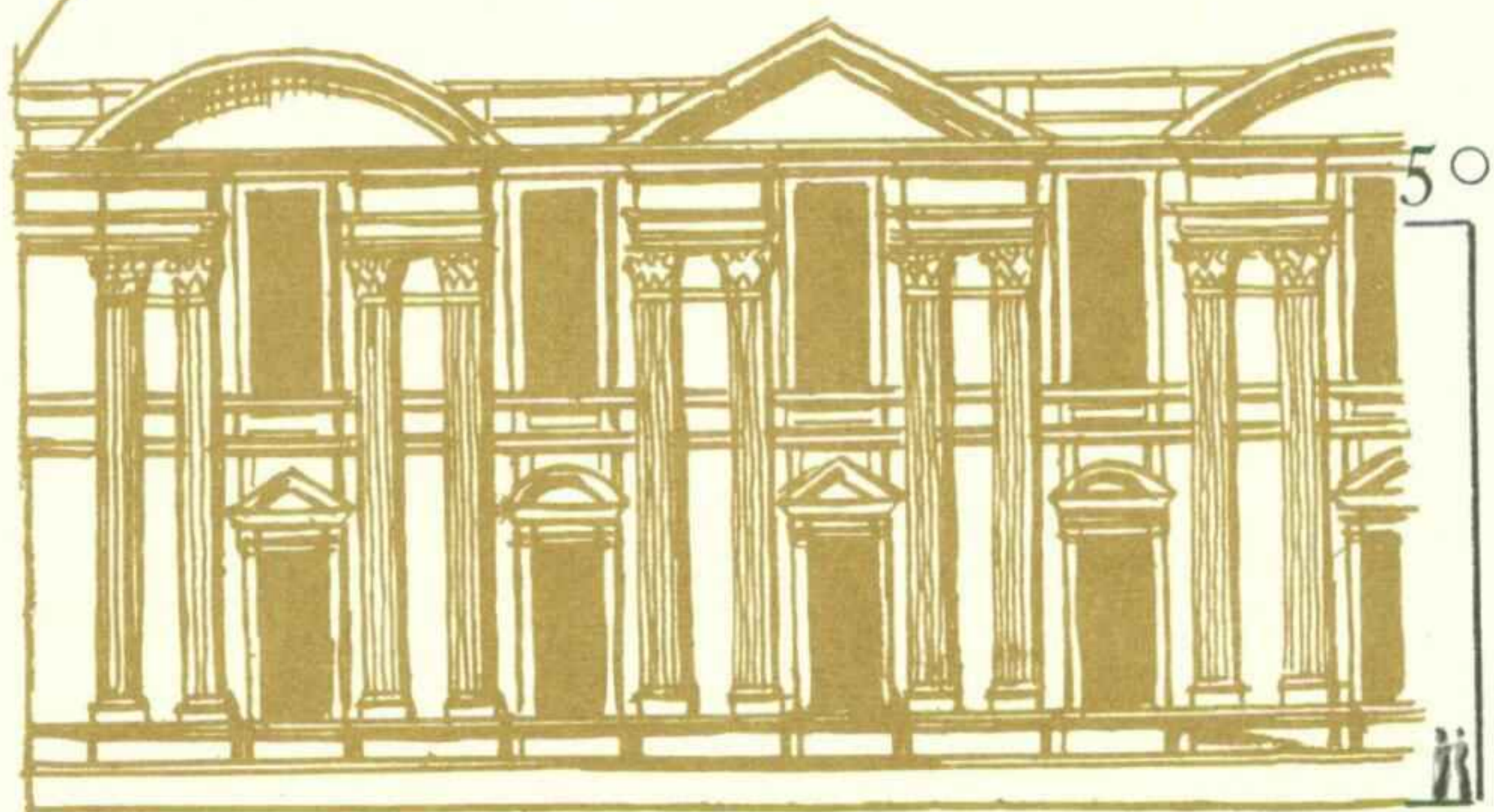


Château de Chambord, 1519-1547

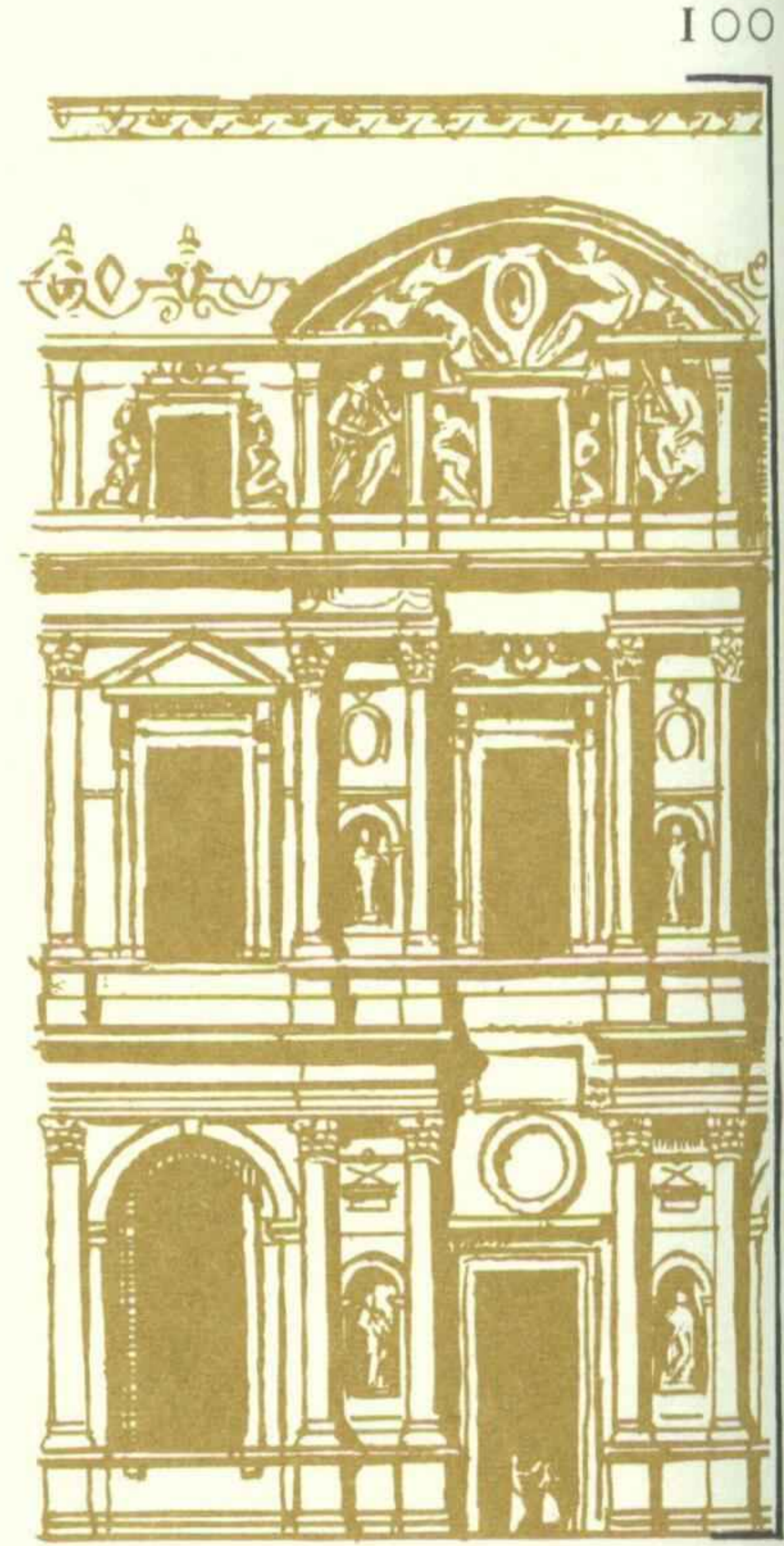
Château de Maisons, 1642-46  
François Mansart (1598-1666)



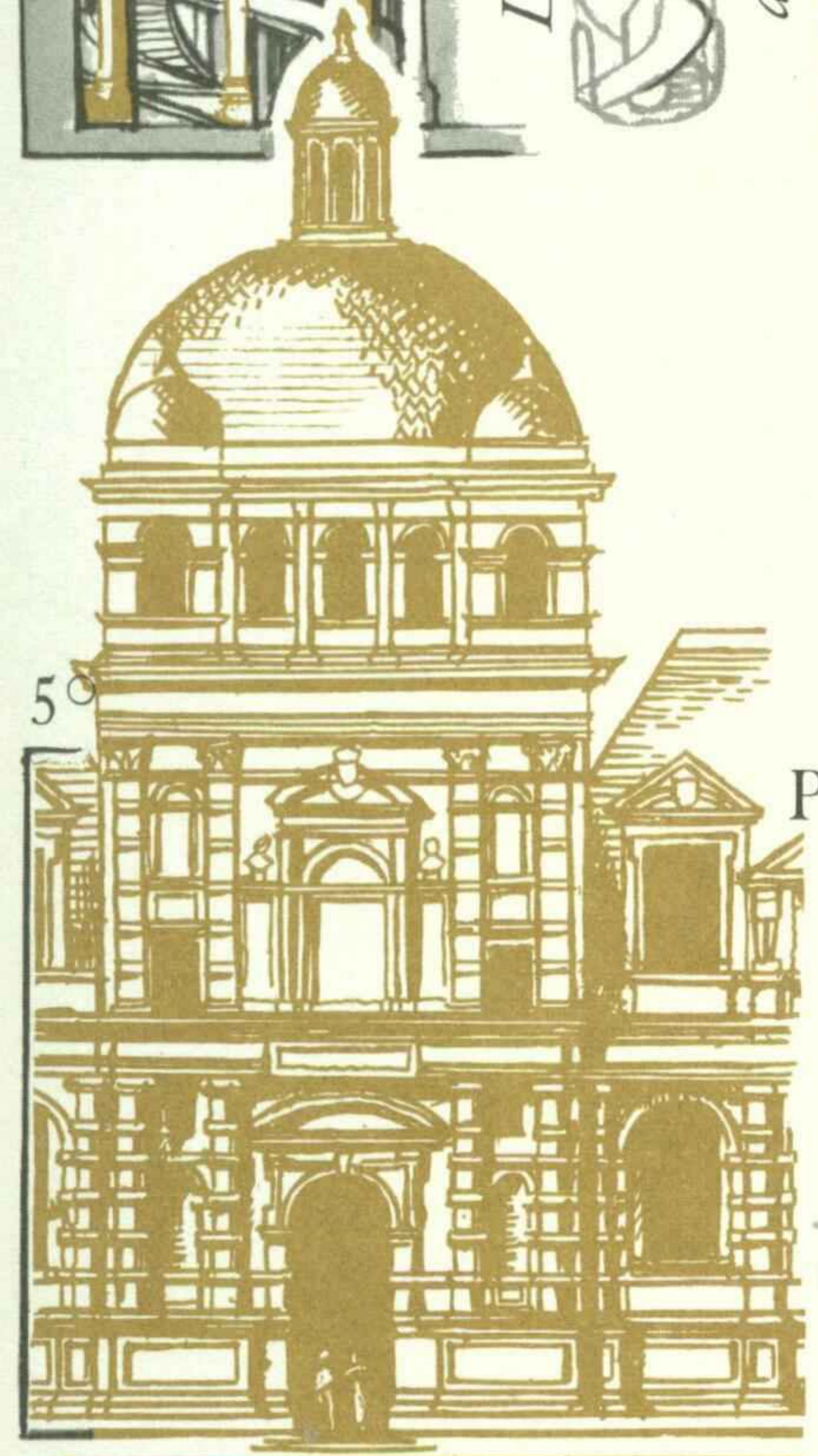
Leonardo da Vinci



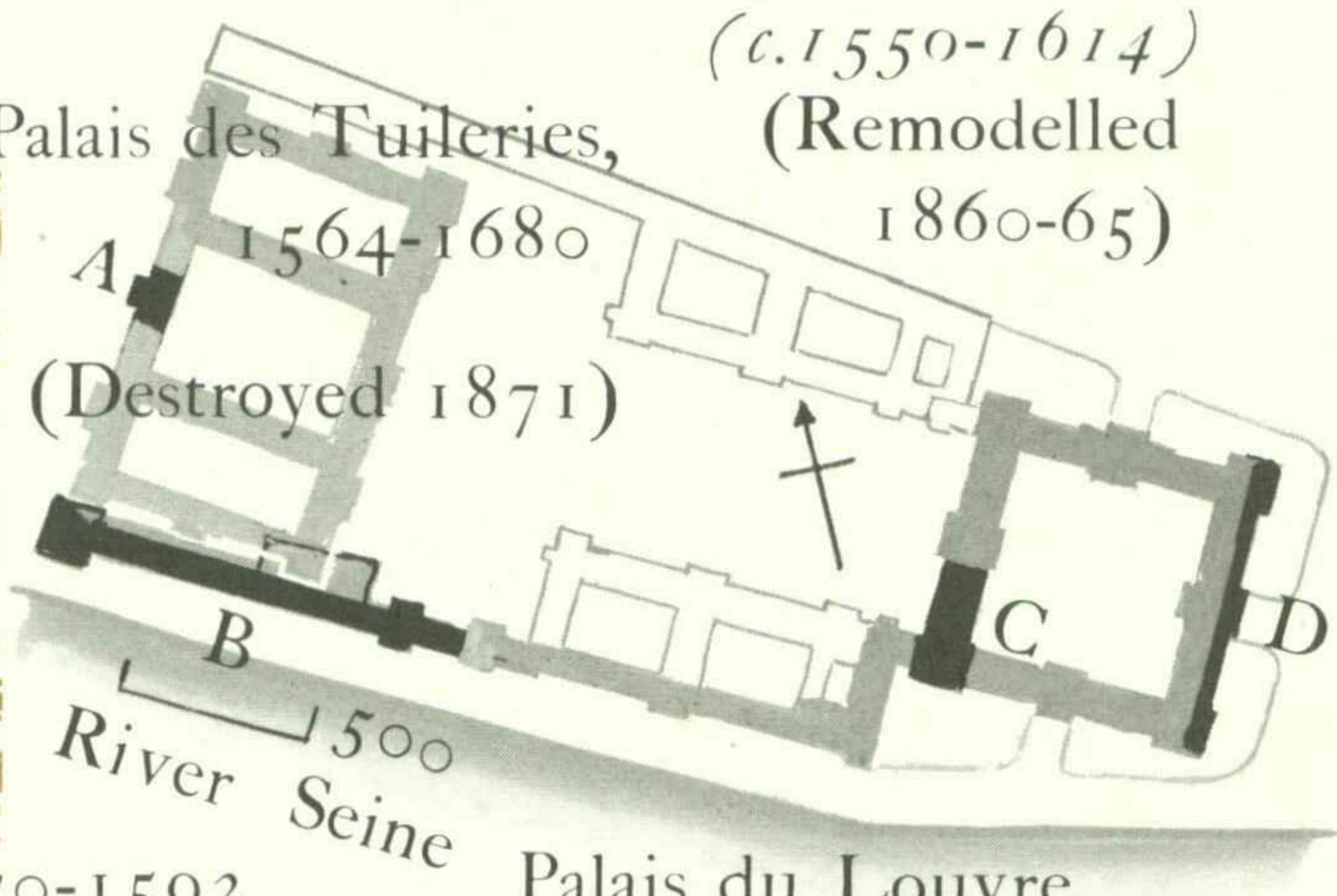
B. 1600-09 Jacques du Cerceau (c.1550-1614) (Remodelled 1860-65)



C. Course du Vieux Louvre, begun 1546  
Pierre Lescot (c.1510-78)



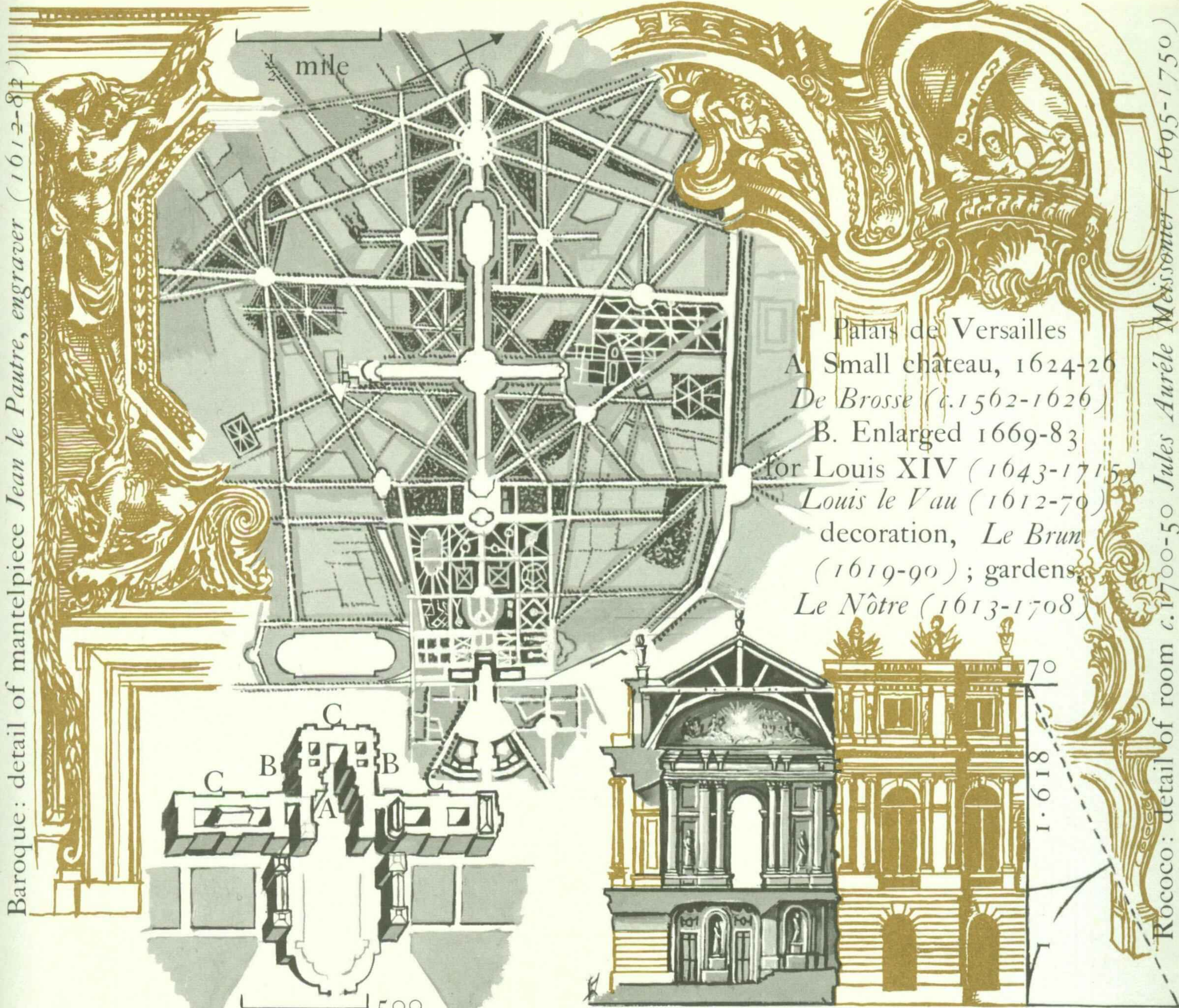
A. Central pavilion, 1570-1592  
Philibert de l'Orme (c.1515-1570)



Palais du Louvre, Paris, 1546-1878

A. Central pavilion, 1570-1592  
Philibert de l'Orme (c.1515-1570)

# FRANCE, CHÂTEAU TO PALACE



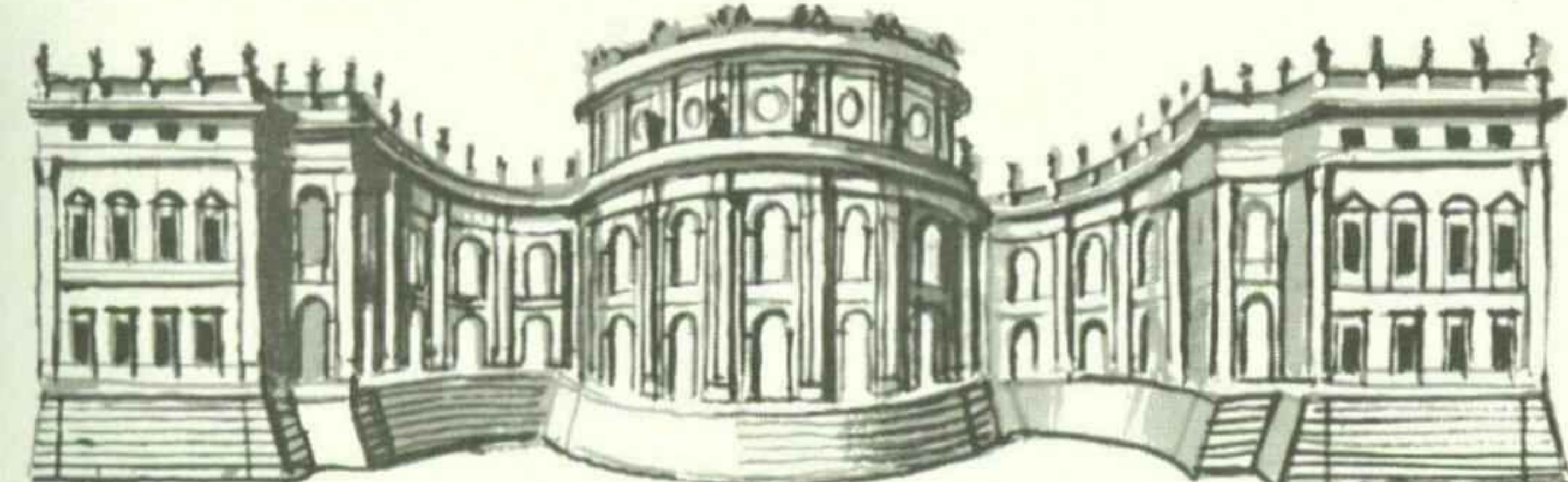
Baroque: detail of mantelpiece Jean le Pautre, engraver (1612-84)

Rococo: detail of room c.1700-50 Jules Aurèle Meissonnier (1695-1750)

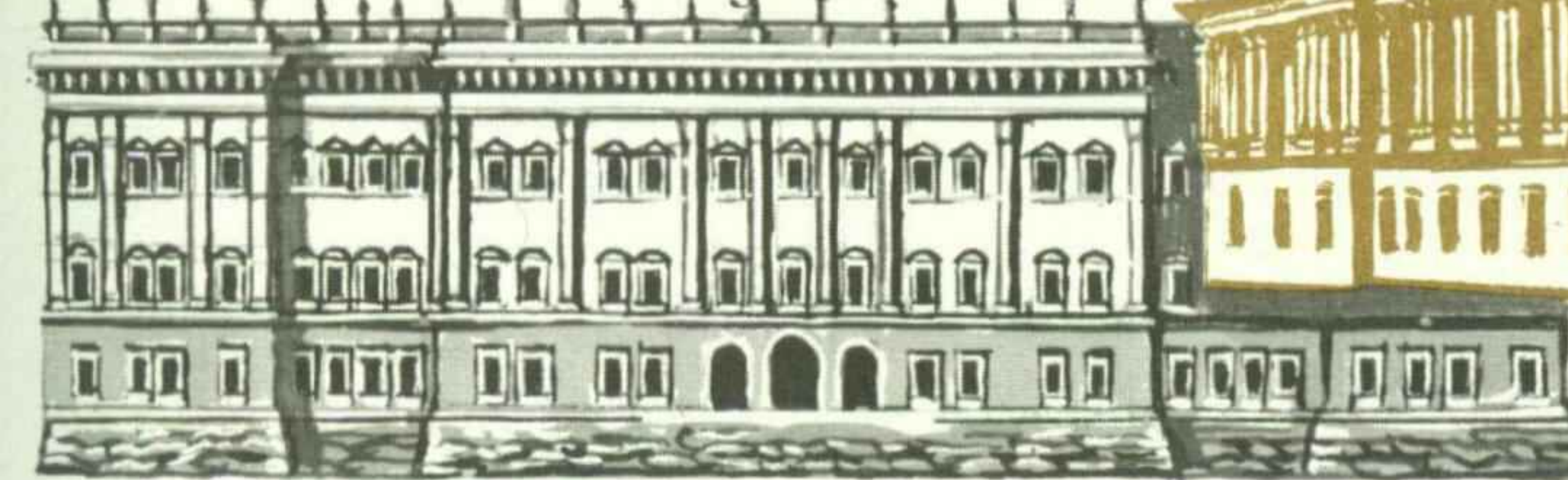
Palais de Versailles  
 A. Small château, 1624-26  
*De Brosse* (c.1562-1626)  
 B. Enlarged 1669-83  
 for Louis XIV (1643-1715)  
*Louis le Vau* (1612-70)  
 decoration, *Le Brun*  
 (1619-90); gardens  
*Le Nôtre* (1613-1708)

C. Galerie des Glaces, & Façade  
 1679-82 *J. H. Mansart*  
 (1646-1708)

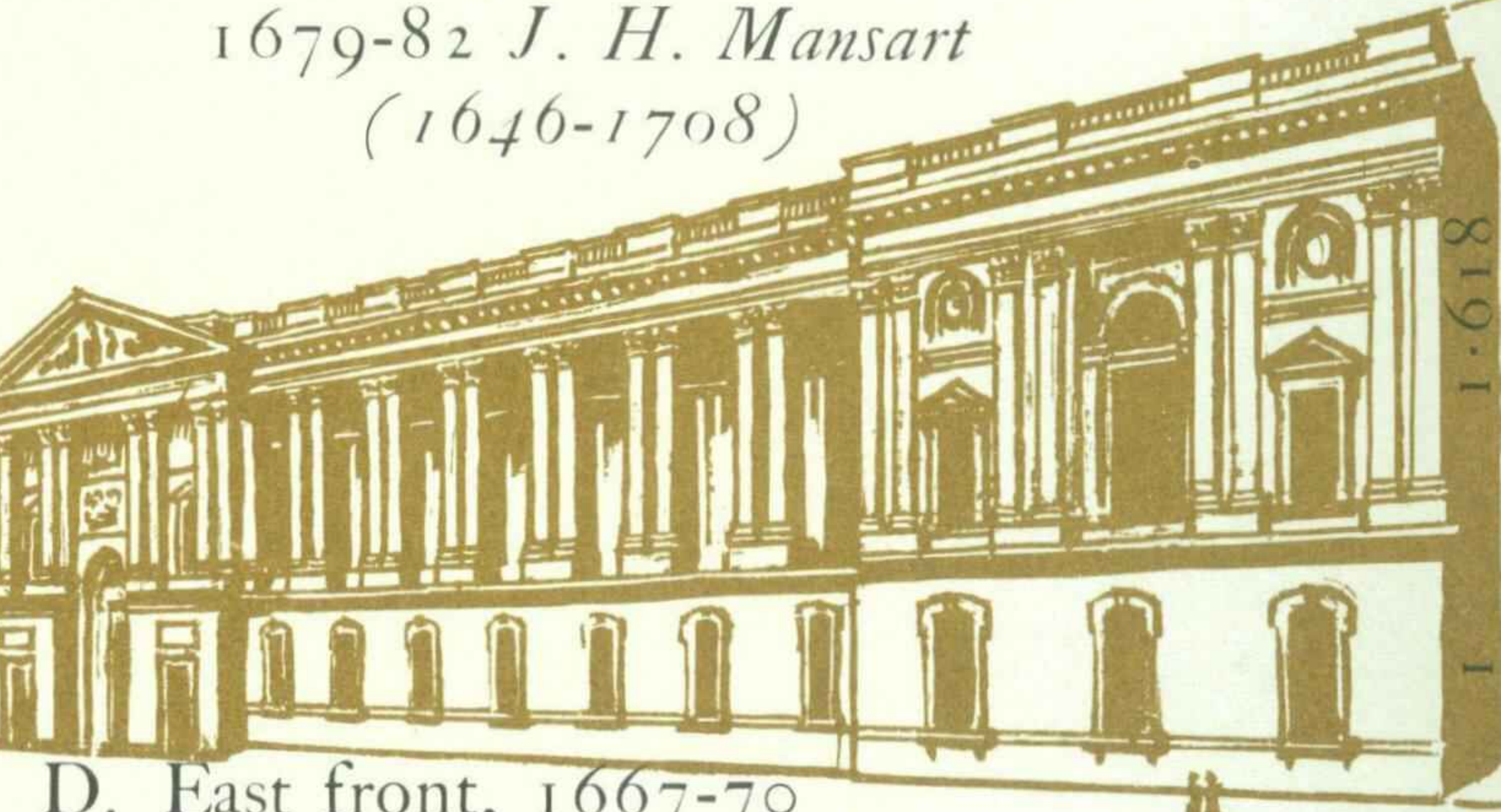
95



First project and



final project made by *Bernini* (1598-1680)  
 in Paris, 1665 for the East Front of the Louvre



D. East front, 1667-70

*Claude Perrault* (1613-88),  
*Louis Le Vau* (1612-88) &  
*Charles Le Brun* (1619-90)

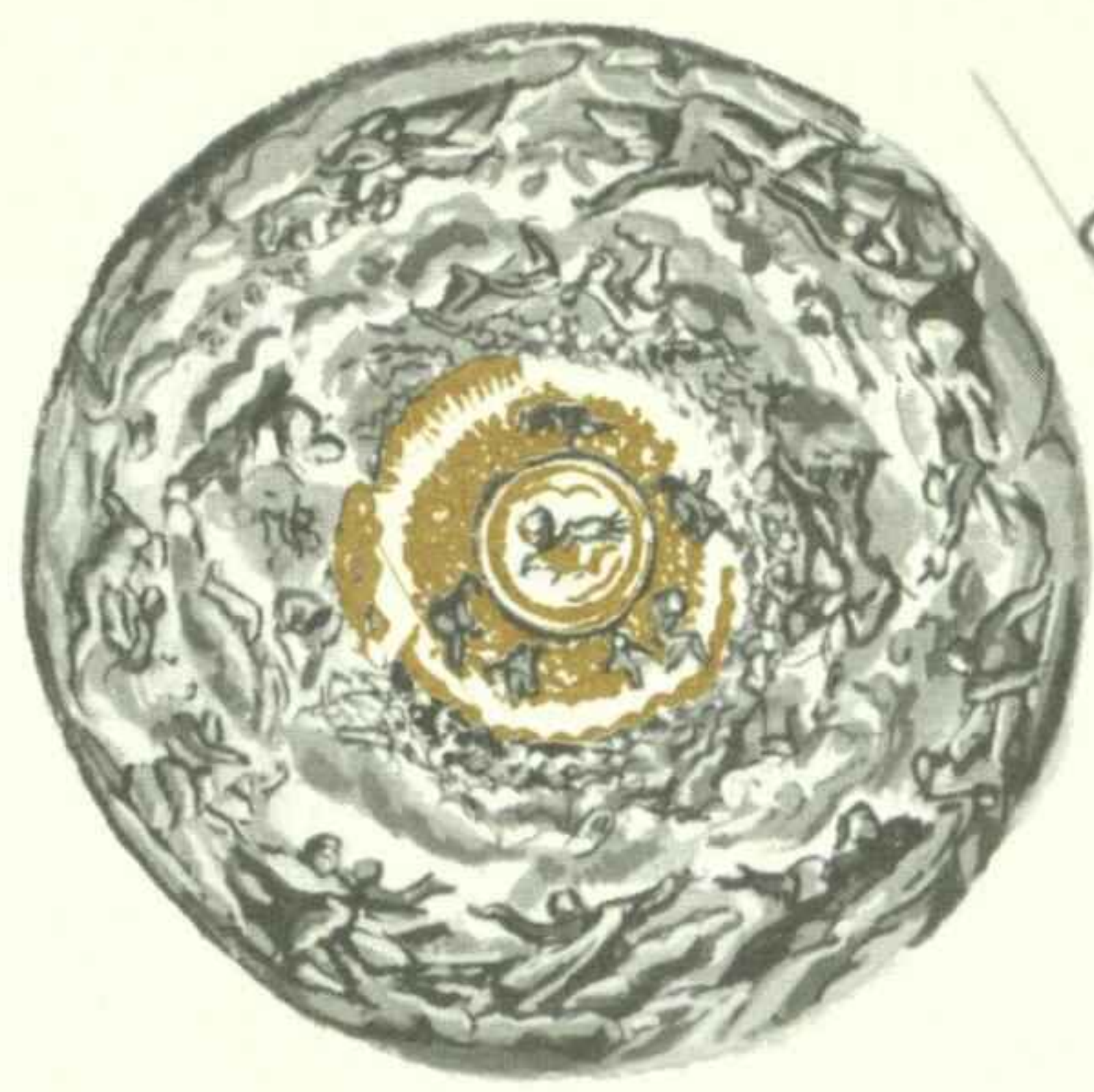
1.618

# RENAISSANCE - BAROQUE



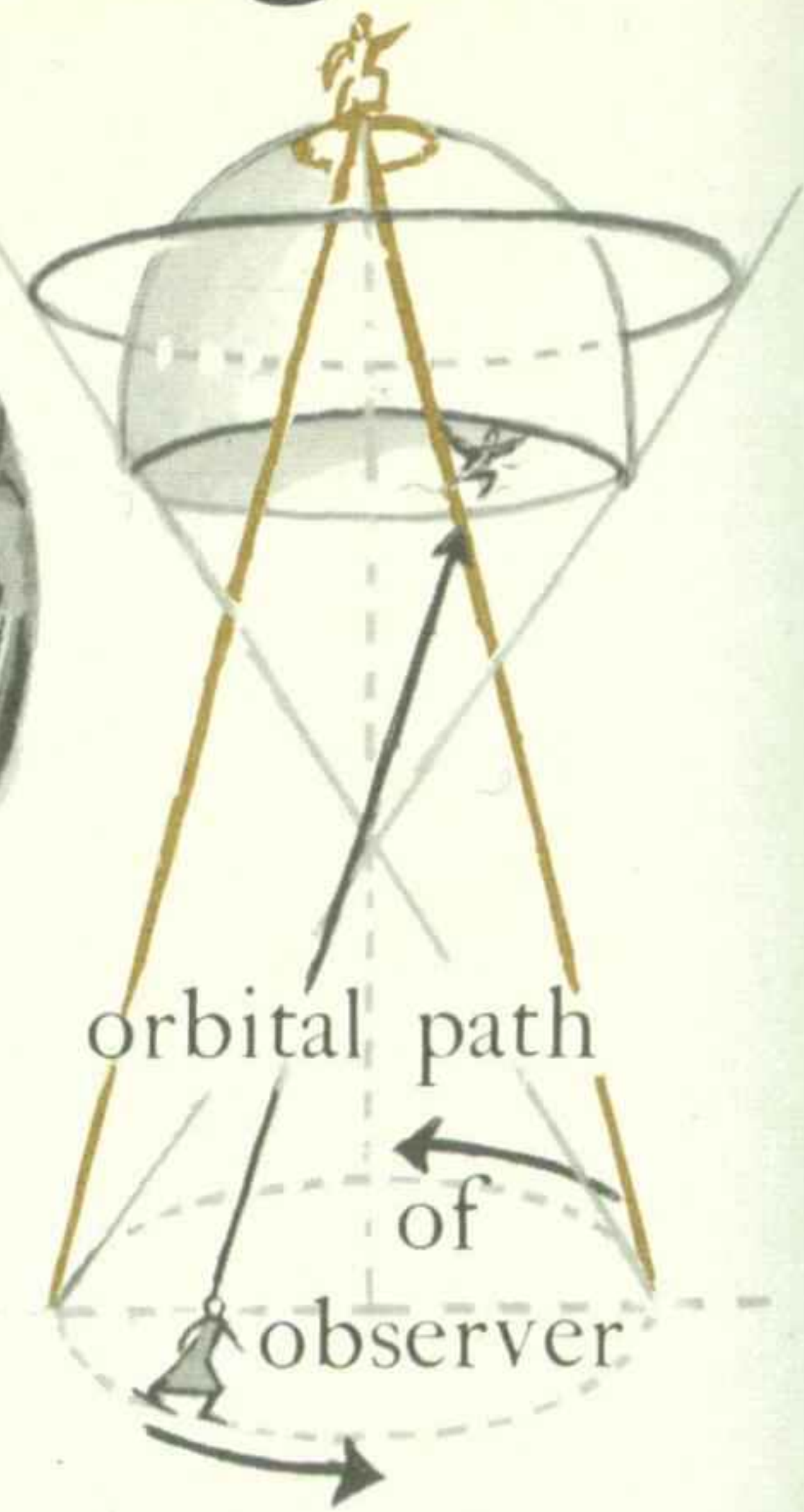
The Gesù, Rome, 1668-83 (p.122): fresco and stucco figures on nave vault, 1674-79, 'Adoration of the Name of Jesus'

*Giovanni Battista Gaulli (1639-1709)*



S. Andrea in Valle, Rome, 1591-1623: fresco in dome, 'The Virgin in Glory'

*Giovanni Lanfranco (1582-1647)*

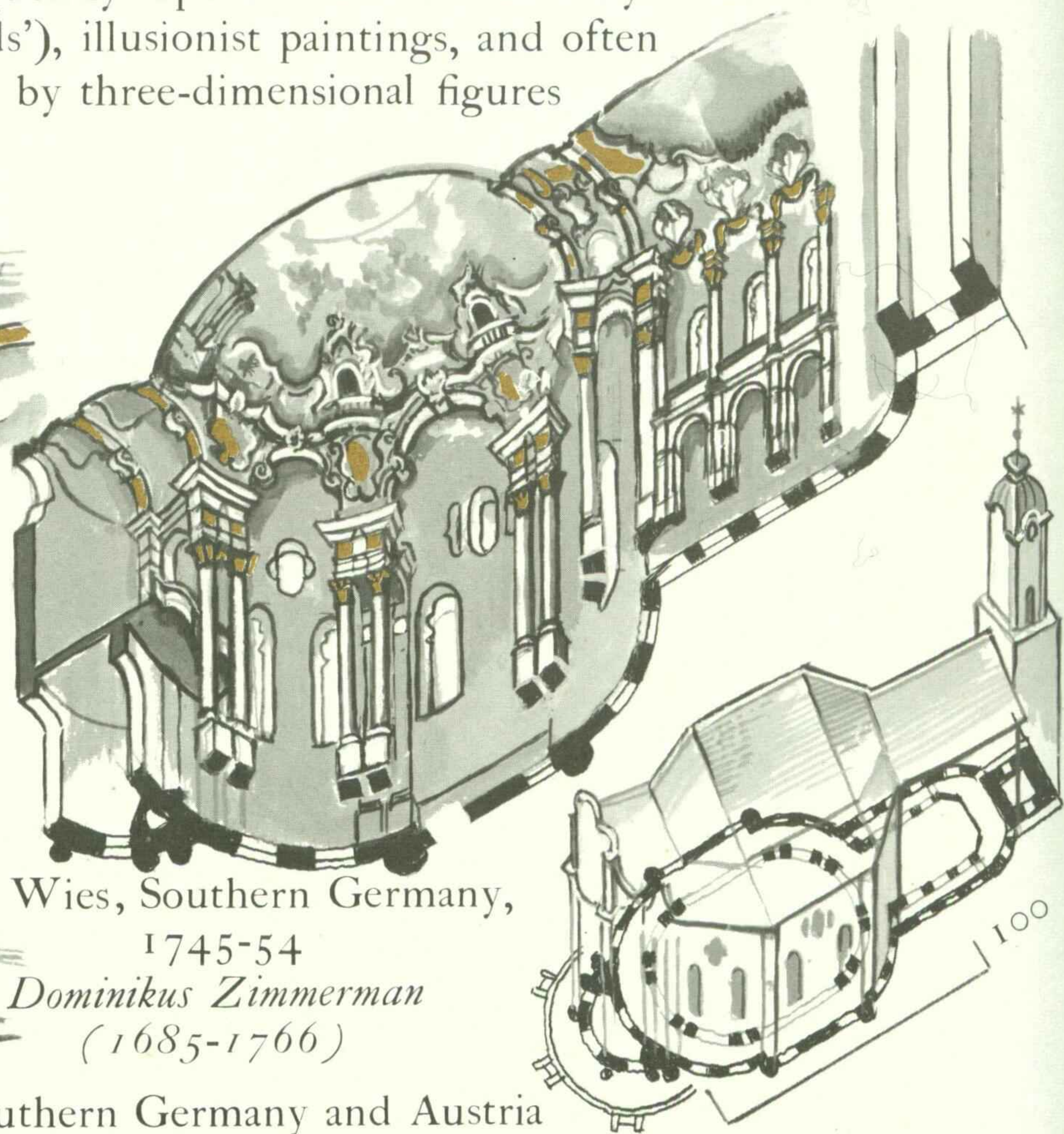


## Italian Baroque churches

Vaults, domes and apses were frequently 'opened out' to heaven by means of *sotto in su* (Italian: 'from below upwards'), illusionist paintings, and often reinforced by three-dimensional figures



Die Wies, Southern Germany, 1745-54  
*Dominikus Zimmermann (1685-1766)*

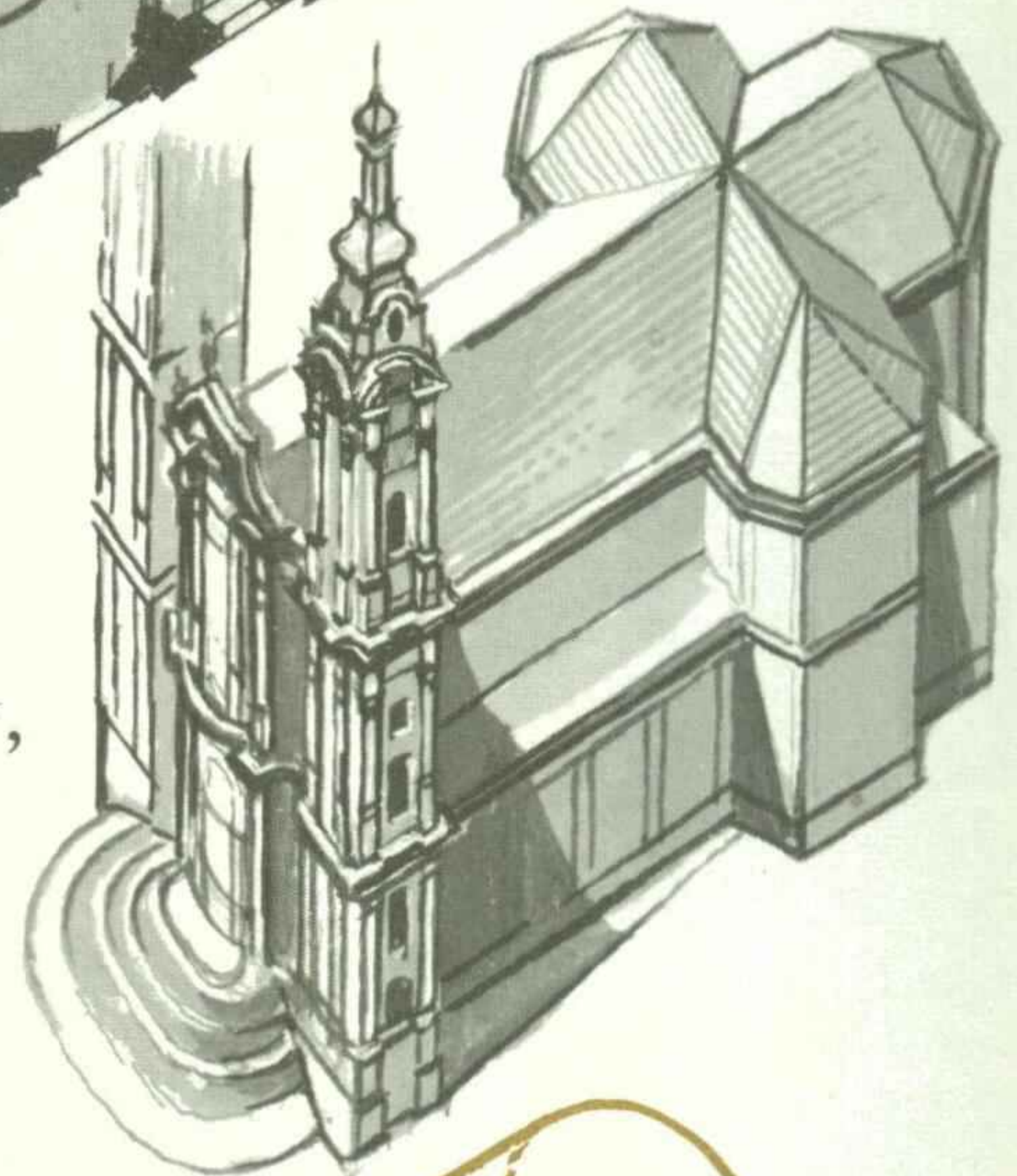
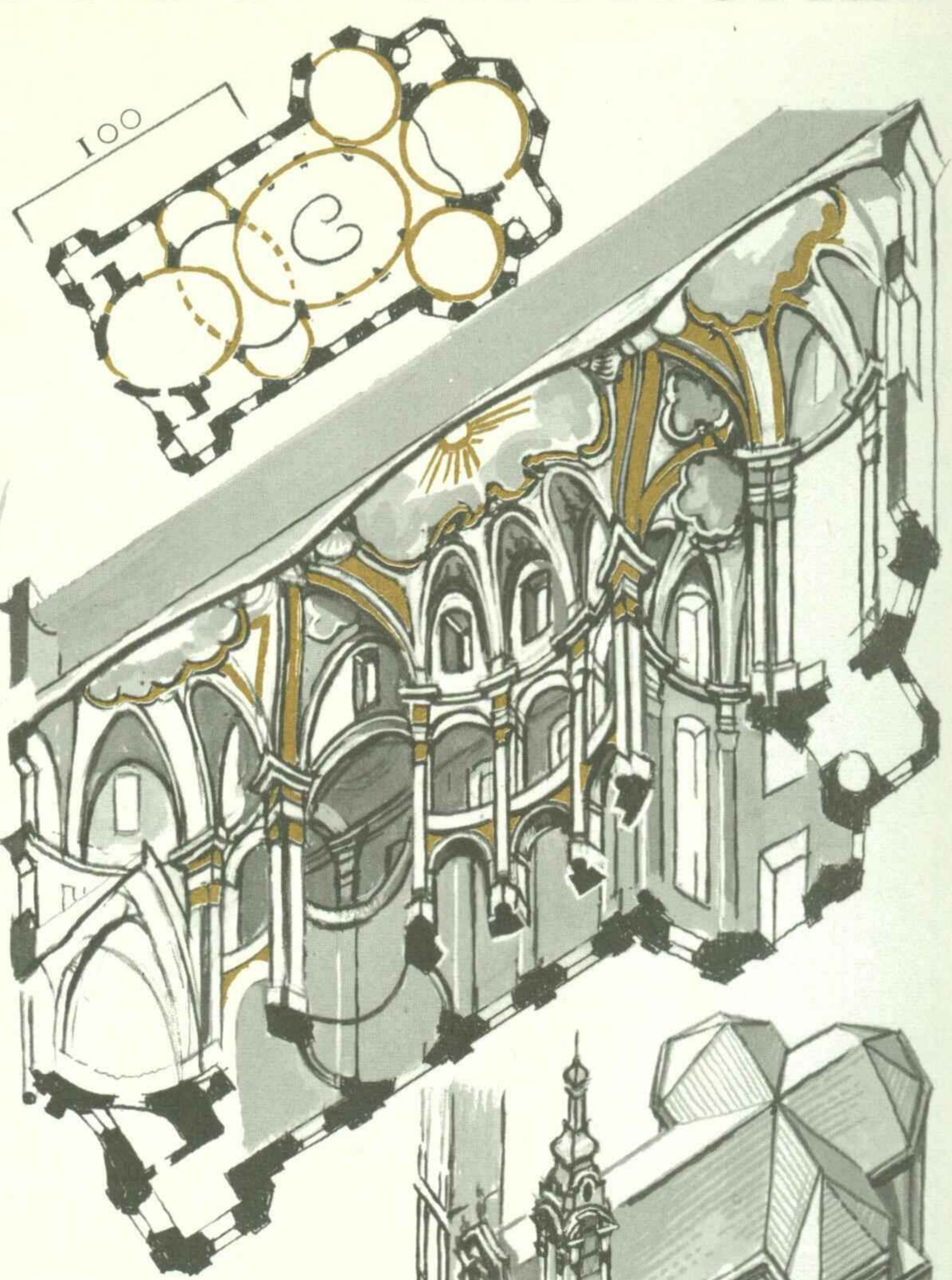


In Southern Germany and Austria many Jesuit Baroque churches were built in the style of the Gesù (p.122).

The Thirty Years' War (1618-48) was followed by a resurgence of church-building in which all the arts—architecture, sculpture, painting and music—were fused into Rococo.



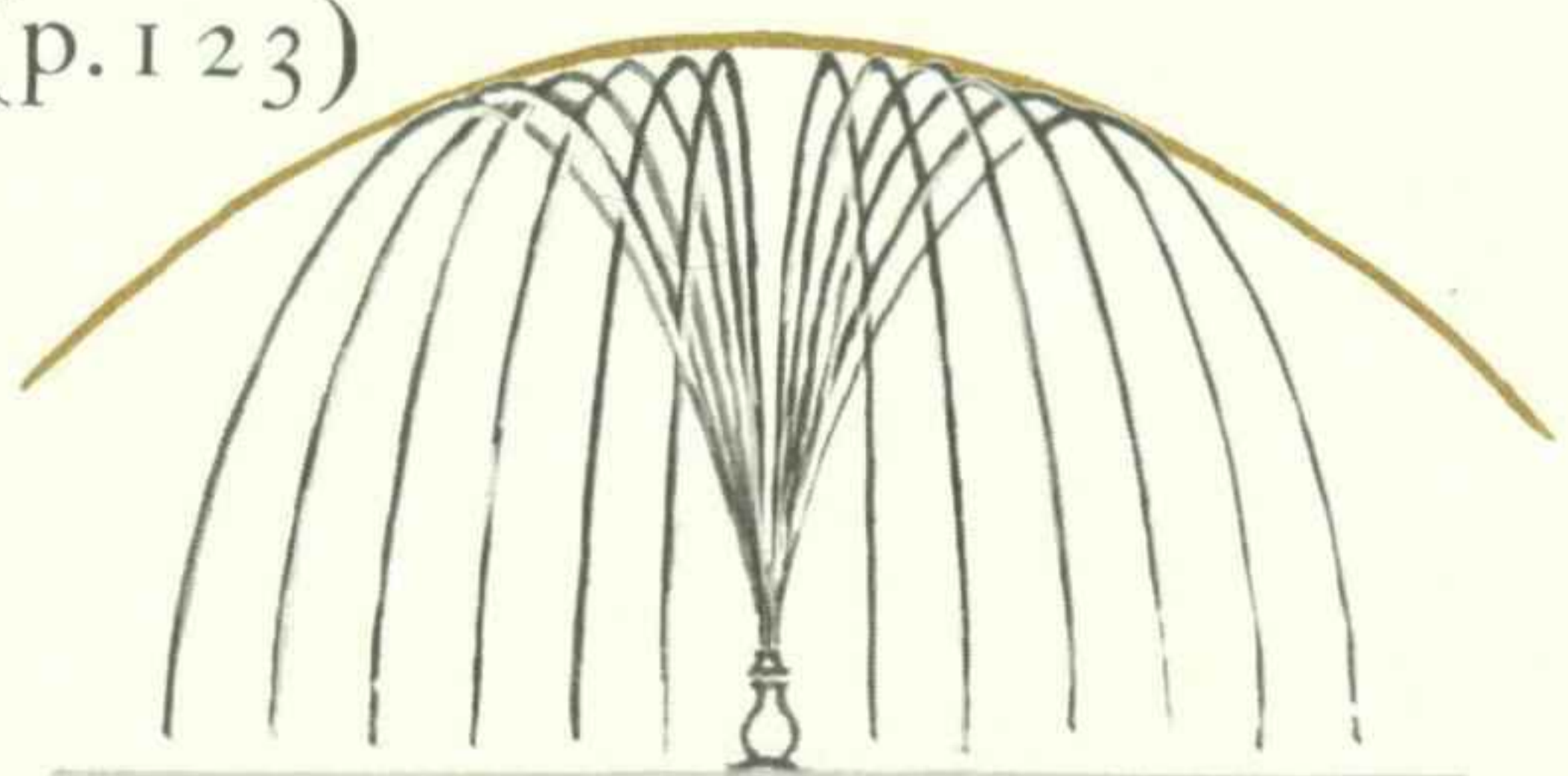
# GERMANY, ROCOCO CHURCHES



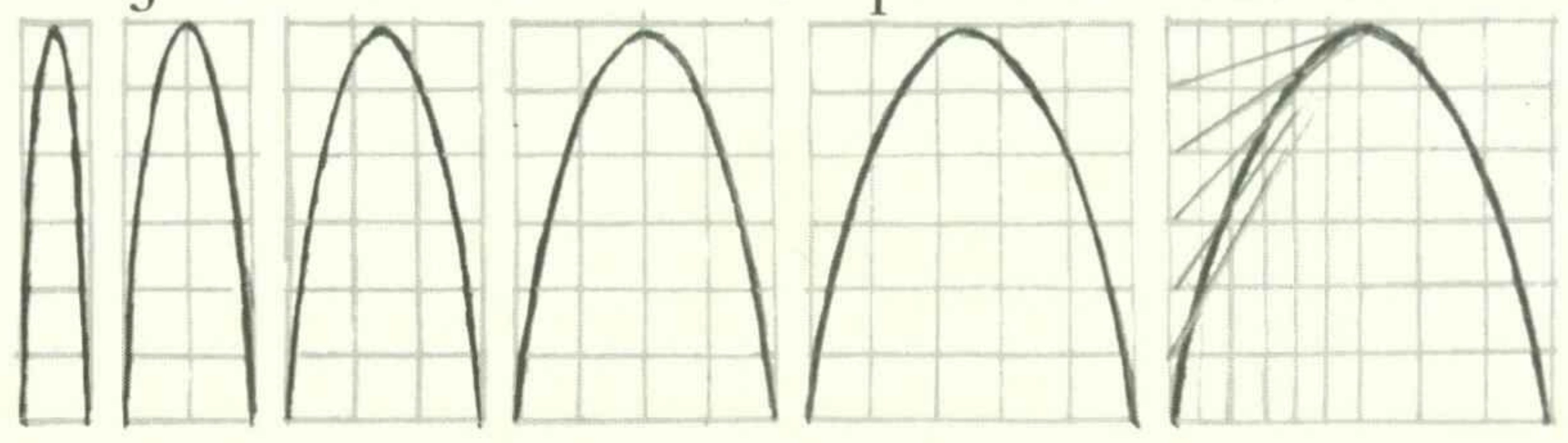
Vierzehnheiligen, Southern Germany, 1744-72

Balthasar Neumann (1687-1753),

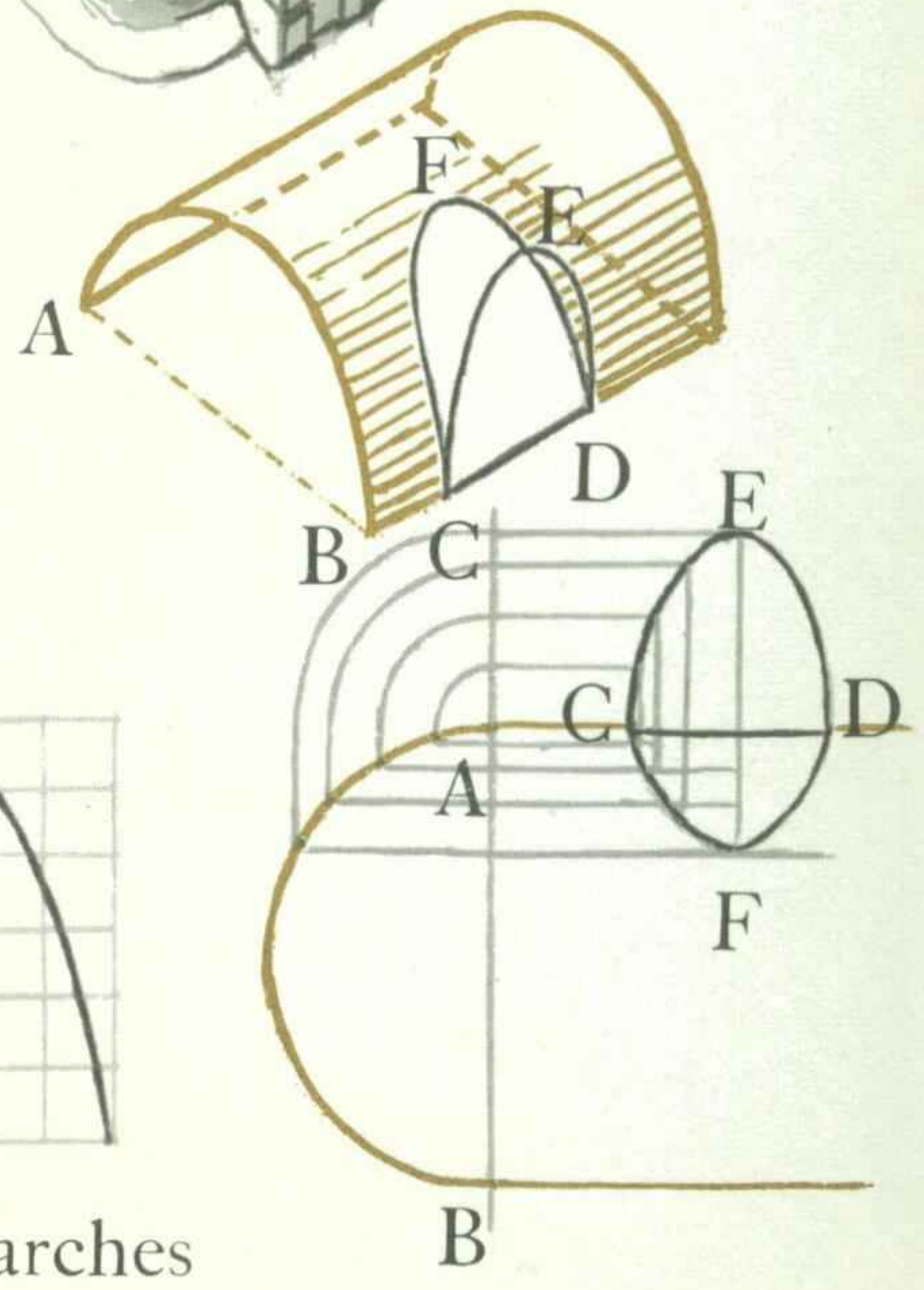
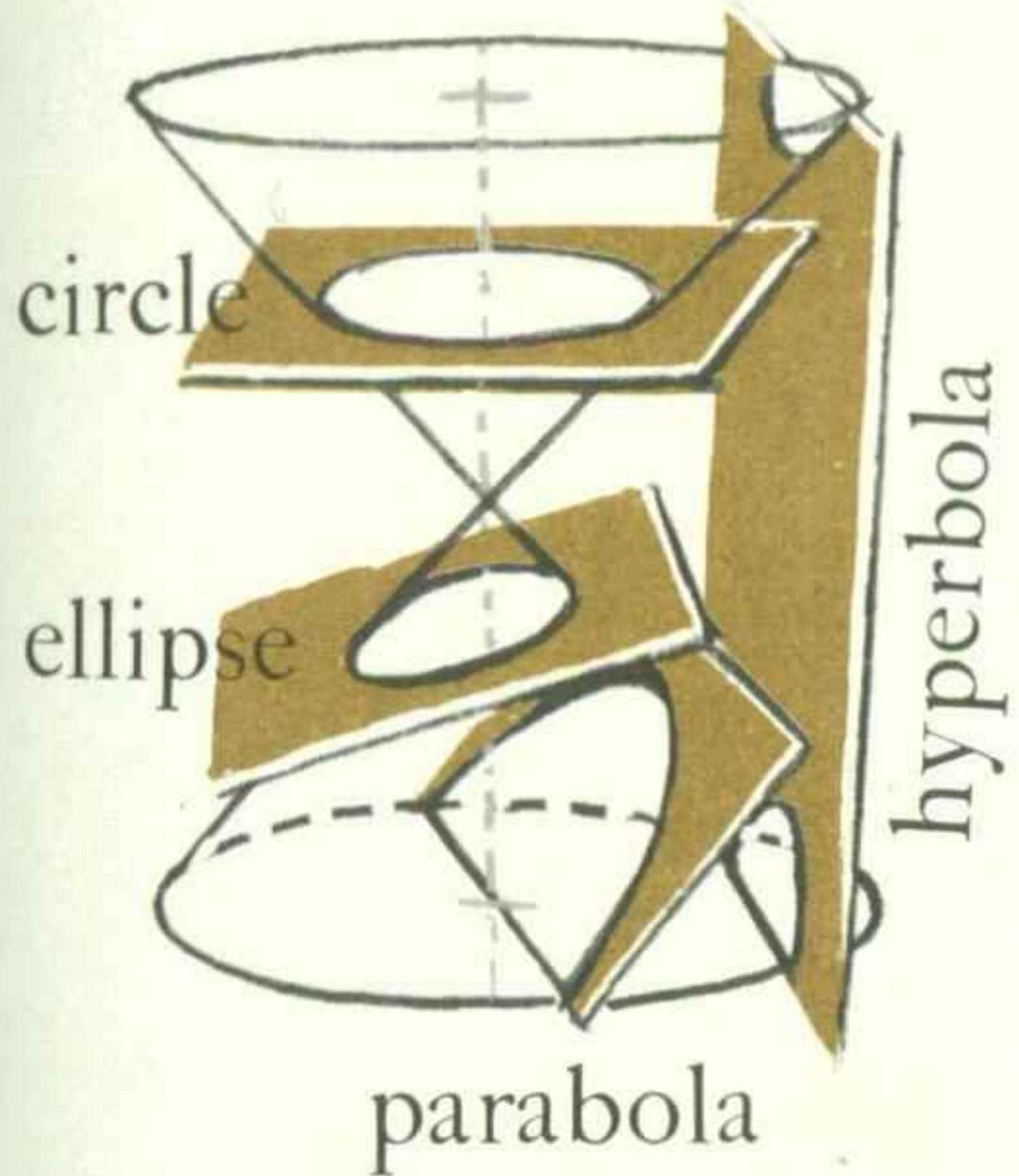
architect, mathematician, military engineer, town-planner, designer of fountains, bell-caster; possessed Guarini's *dell' Architettura Civile*, 1737 (p.123)



jets of water describe parabolic curves

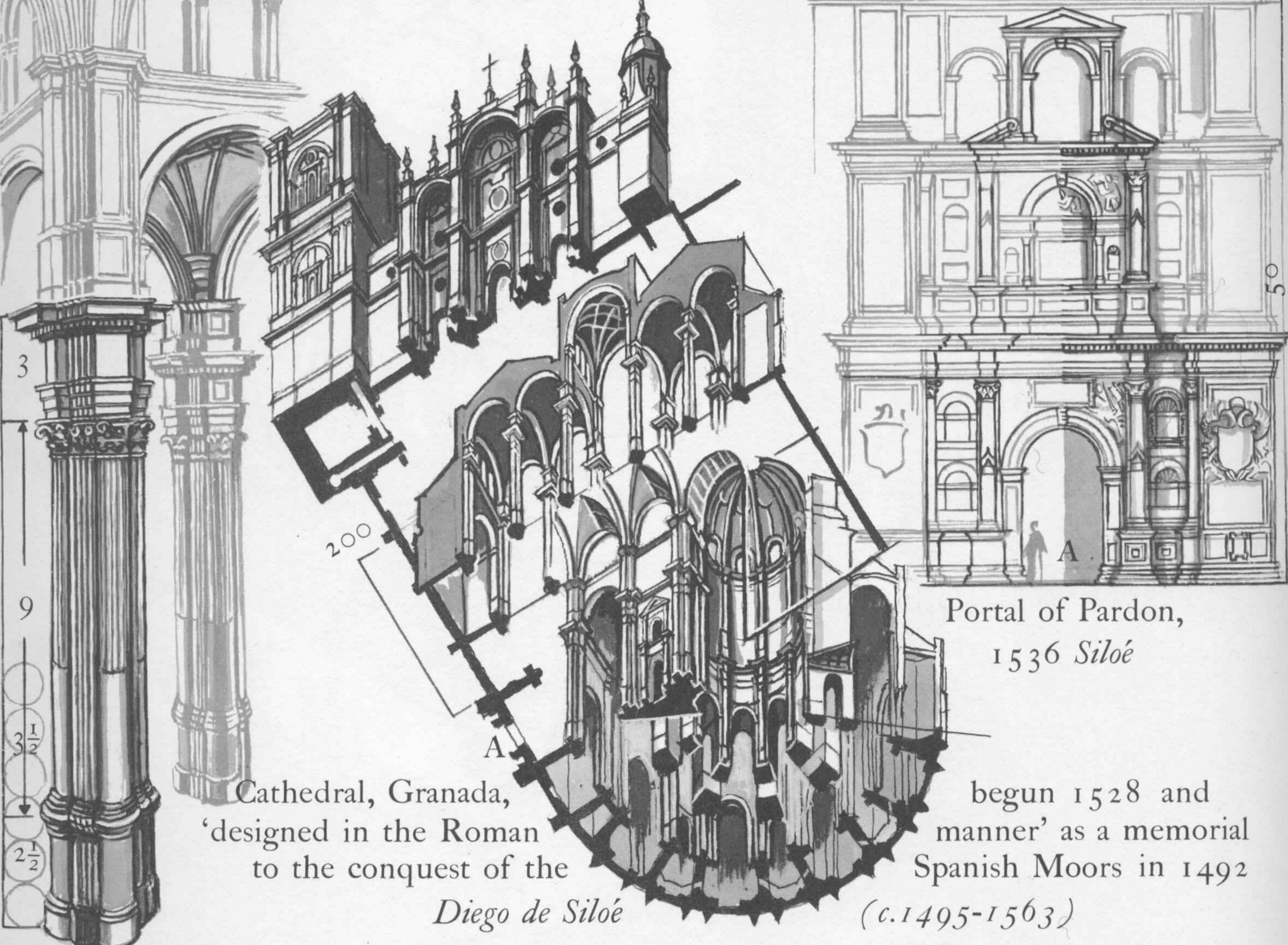


parabolic, forward tilted, three-dimensional arches



# RENAISSANCE-BAROQUE

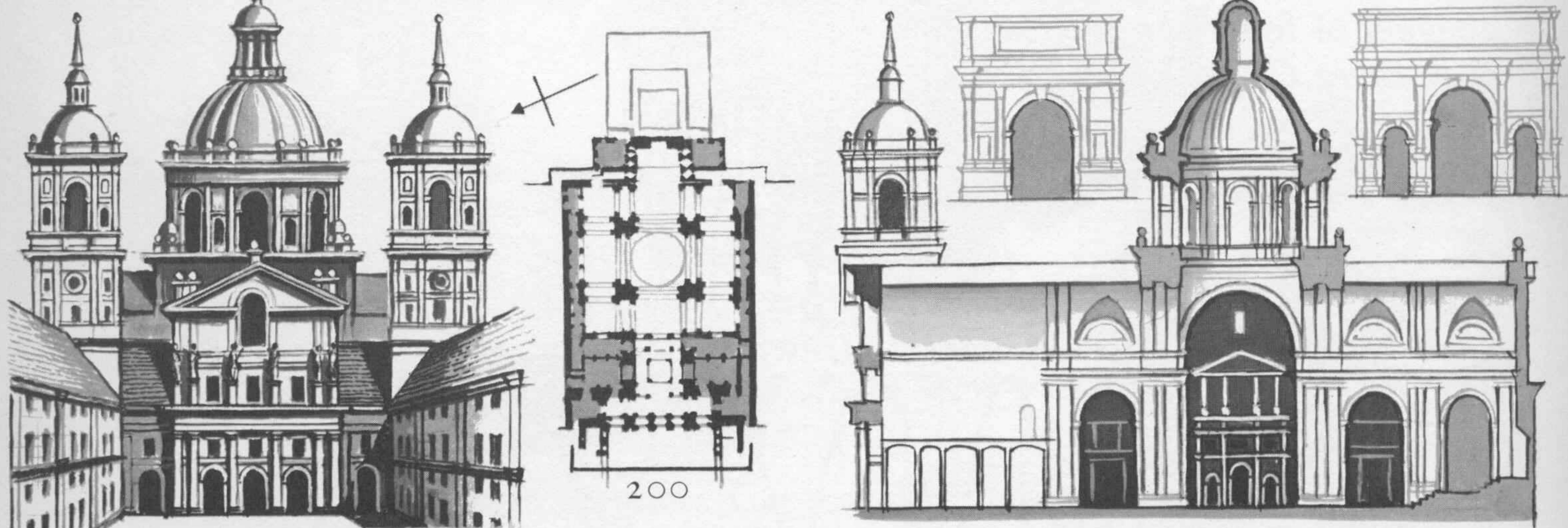
I 'Plateresque' (*platero* = silversmith), from the use of extravagant decoration 1492-1556



Cathedral, Granada,  
 'designed in the Roman  
 to the conquest of the  
*Diego de Siloé*

Portal of Pardon,  
 1536 *Siloé*  
 begun 1528 and  
 manner' as a memorial  
 Spanish Moors in 1492  
 (c.1495-1563)

II Herreran style or '*Estilo desornamentado*' (plain style), 1556-1650: design of the Italian High Renaissance by *Juan de Herrera* (c.1530-97)



The Escorial 1574-82 (p.115), Doric Church, first designed by Juan Bautista de Toledo (d.1567), philosopher and mathematician, who worked under Michelangelo; redesigned by *Juan de Herrera* (c.1530-97) built in yellow-grey granite, in 2:3 ratios

## III 'Churrigueresque', named after *José de Churriguera* (1665-1723)

Cathedral,  
Santiago  
de Compostella:

west façade,  
known as  
'El Obradoiro',  
c.1738  
*Fernando  
de Casas y Novoa*  
(fl. 1711-94)



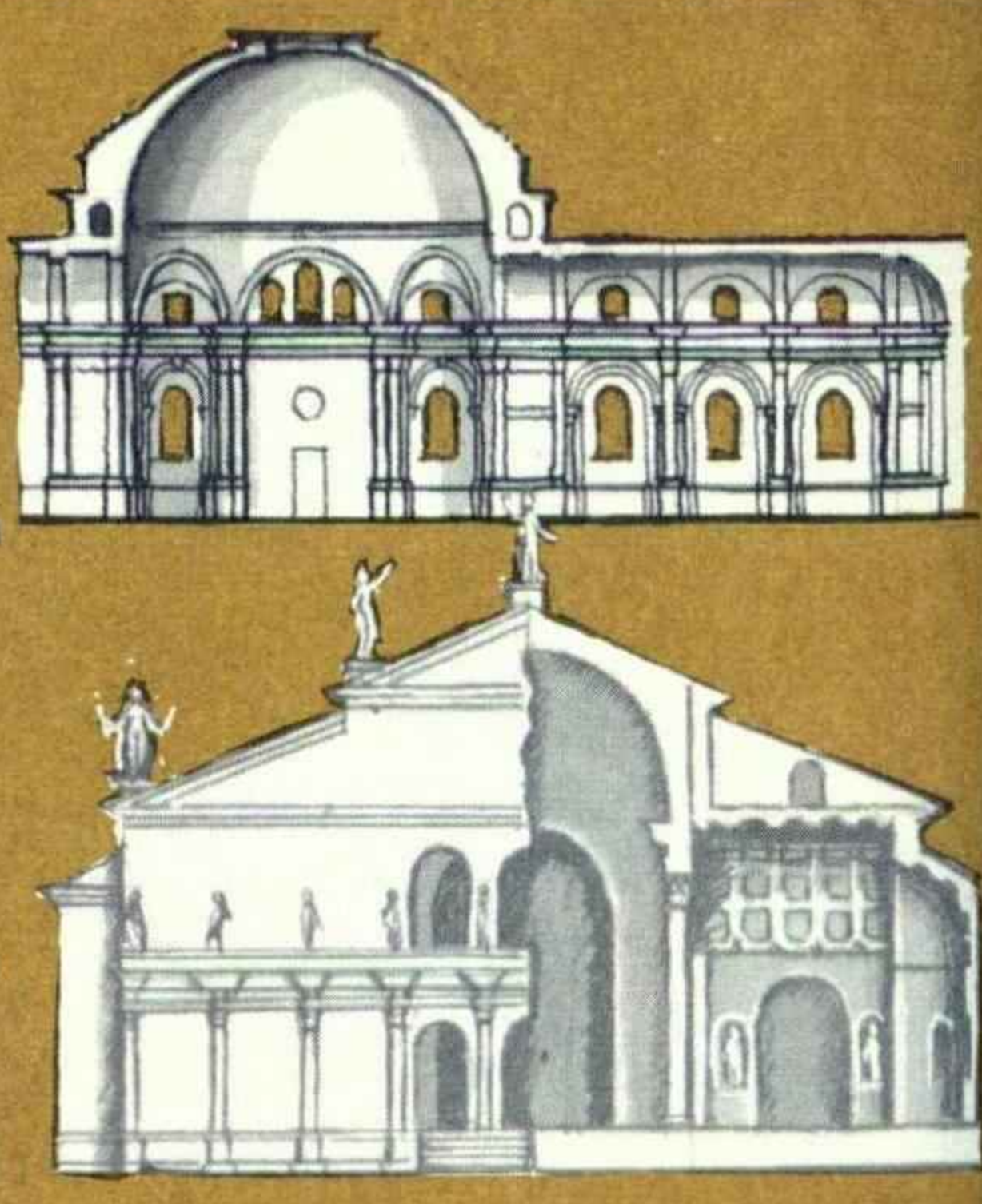
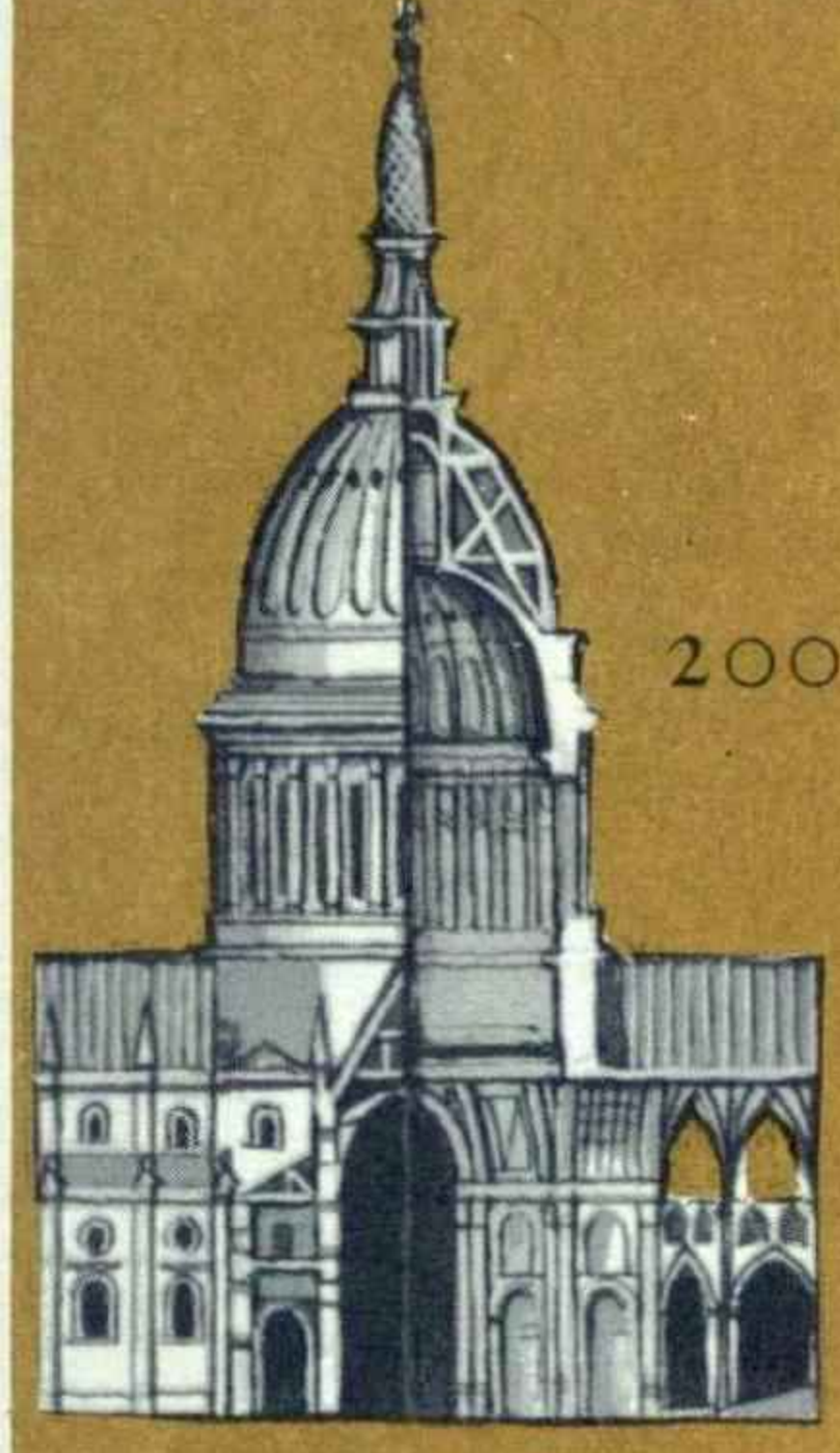
Charterhouse sacristy, Granada, 1713-47.

Designed by *Francisco Hurtado* (1669-1725), begun 1730  
by *Luis de Arévalo* (1727-64), stonemason; plasterwork by *Luis Cabello*

The Alhambra, Granada, 1309-54: Moorish stalactite capitals in plasterwork



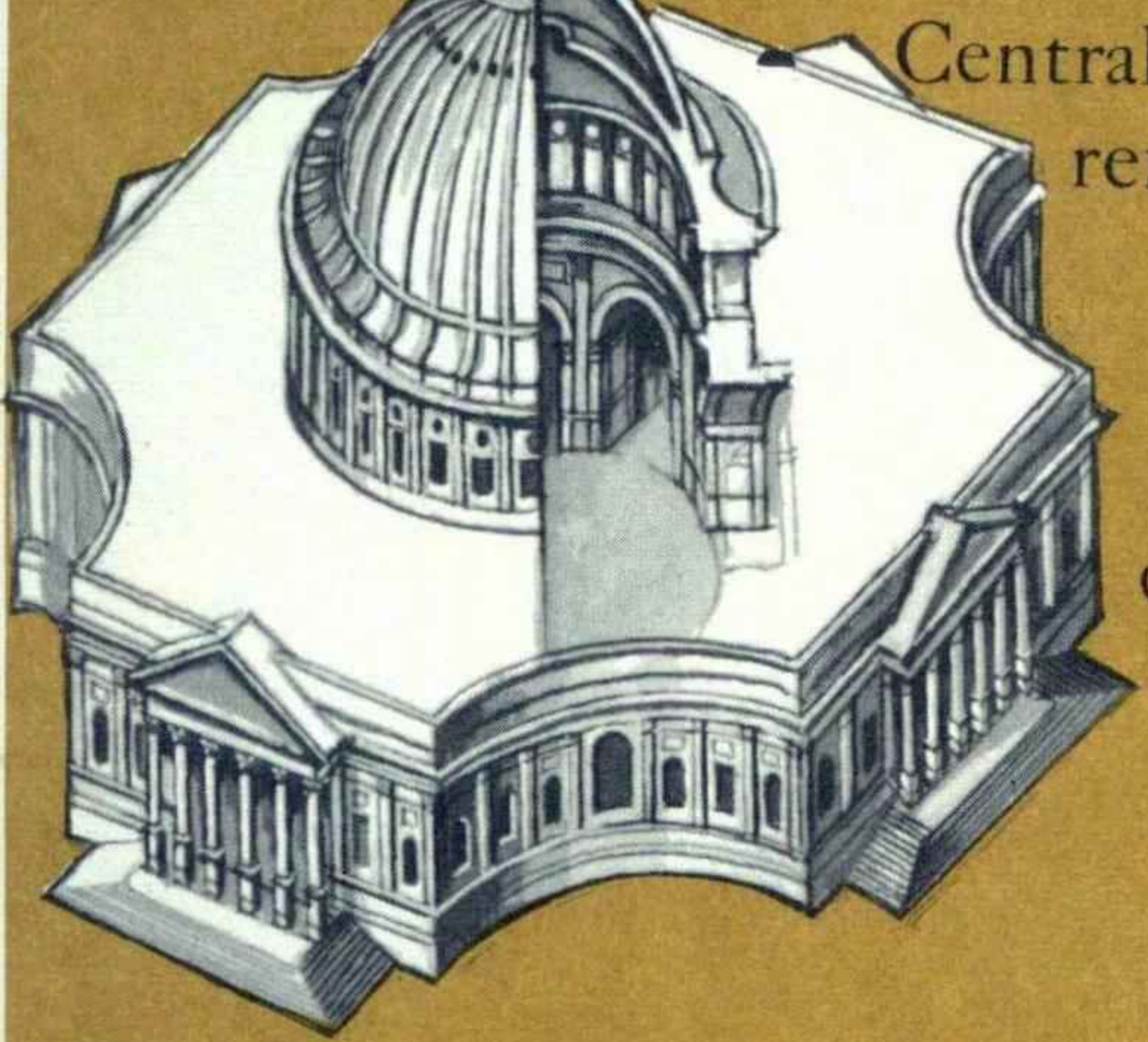
# RENAISSANCE - BAROQUE



Pre-Fire Design for a domed crossing, 'in a Latine style' 1666

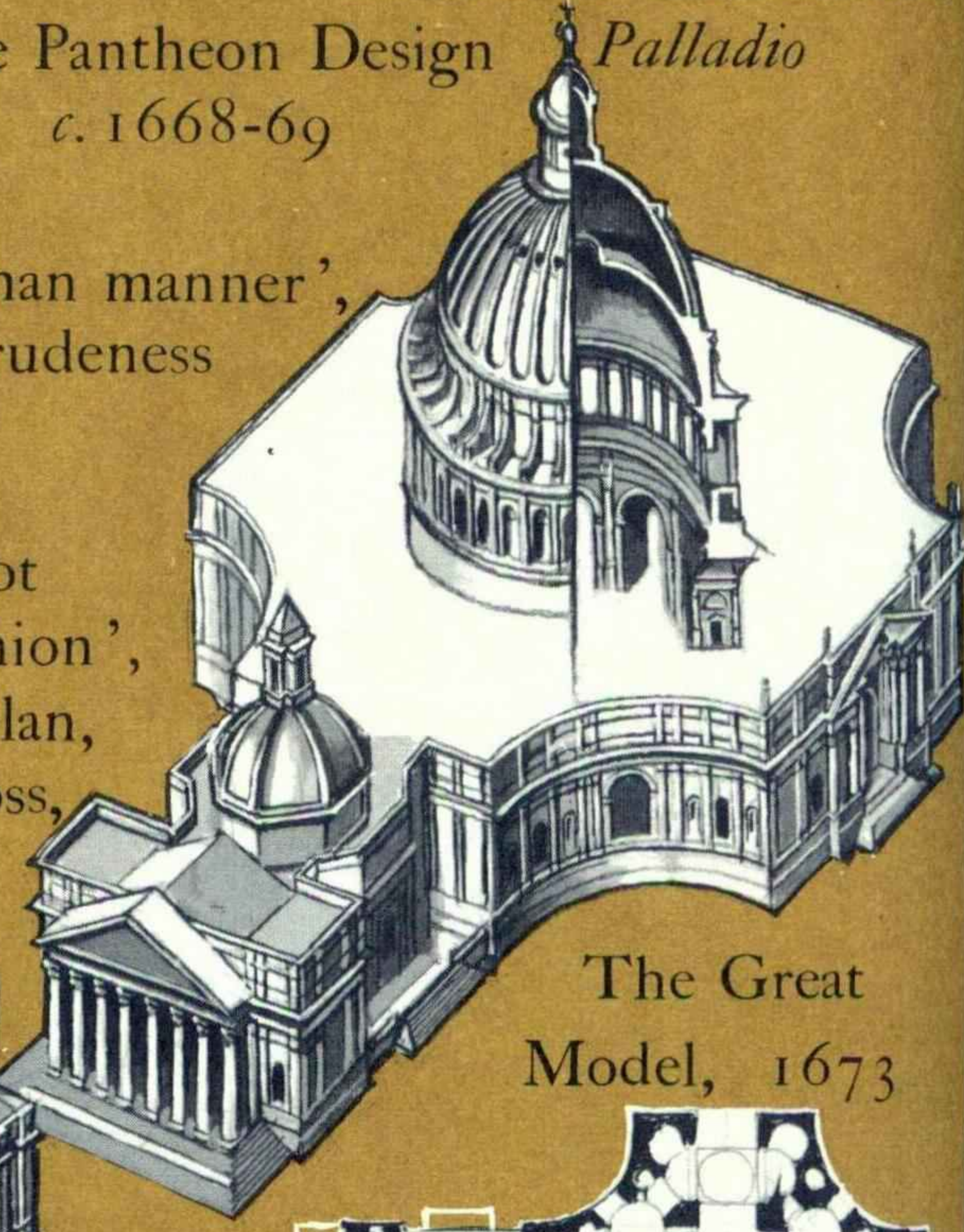
Old St Paul's, destroyed in the Great Fire, 1666

The Pantheon Design c. 1668-69  
Basilica of Constantine *Palladio*



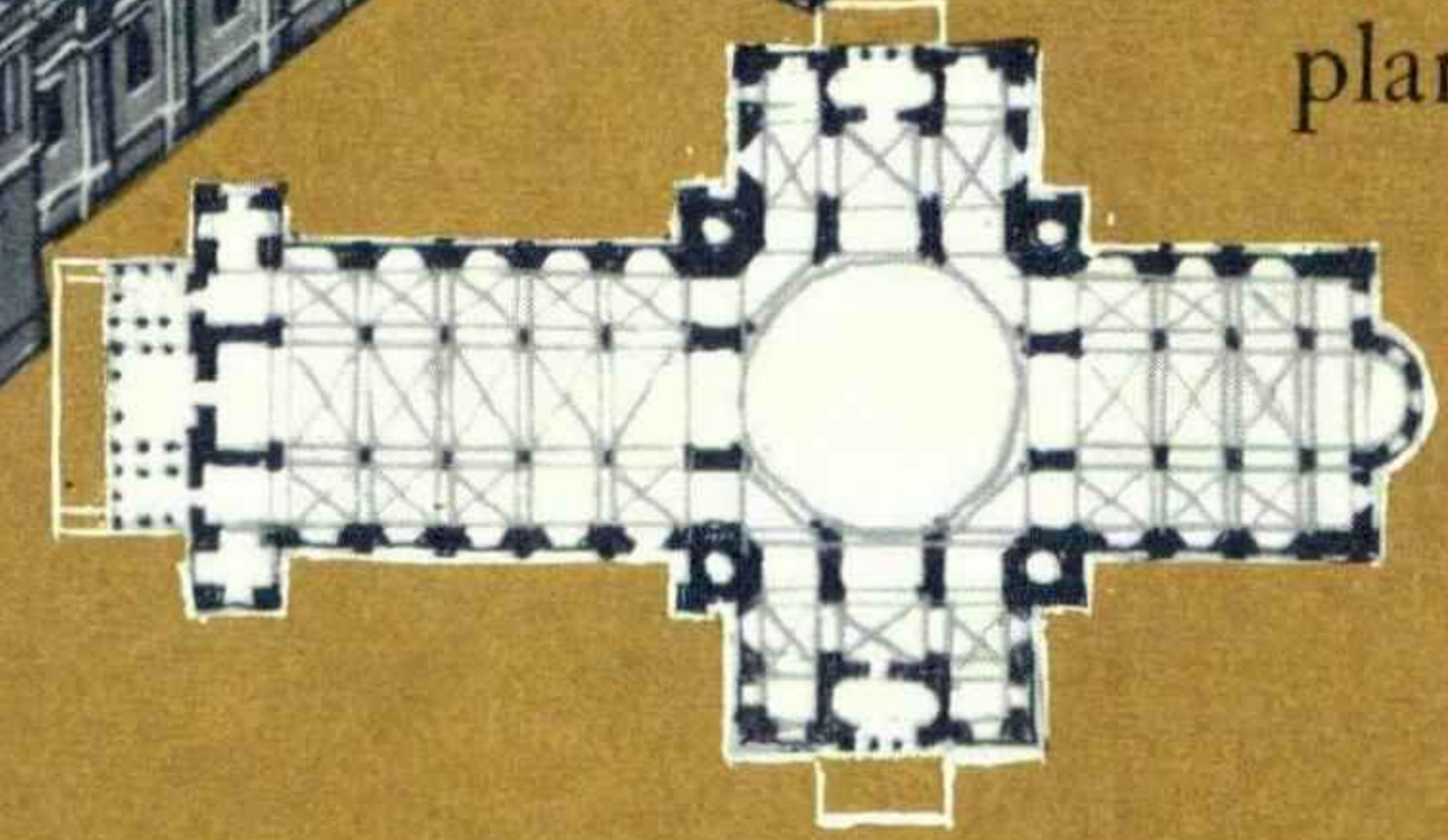
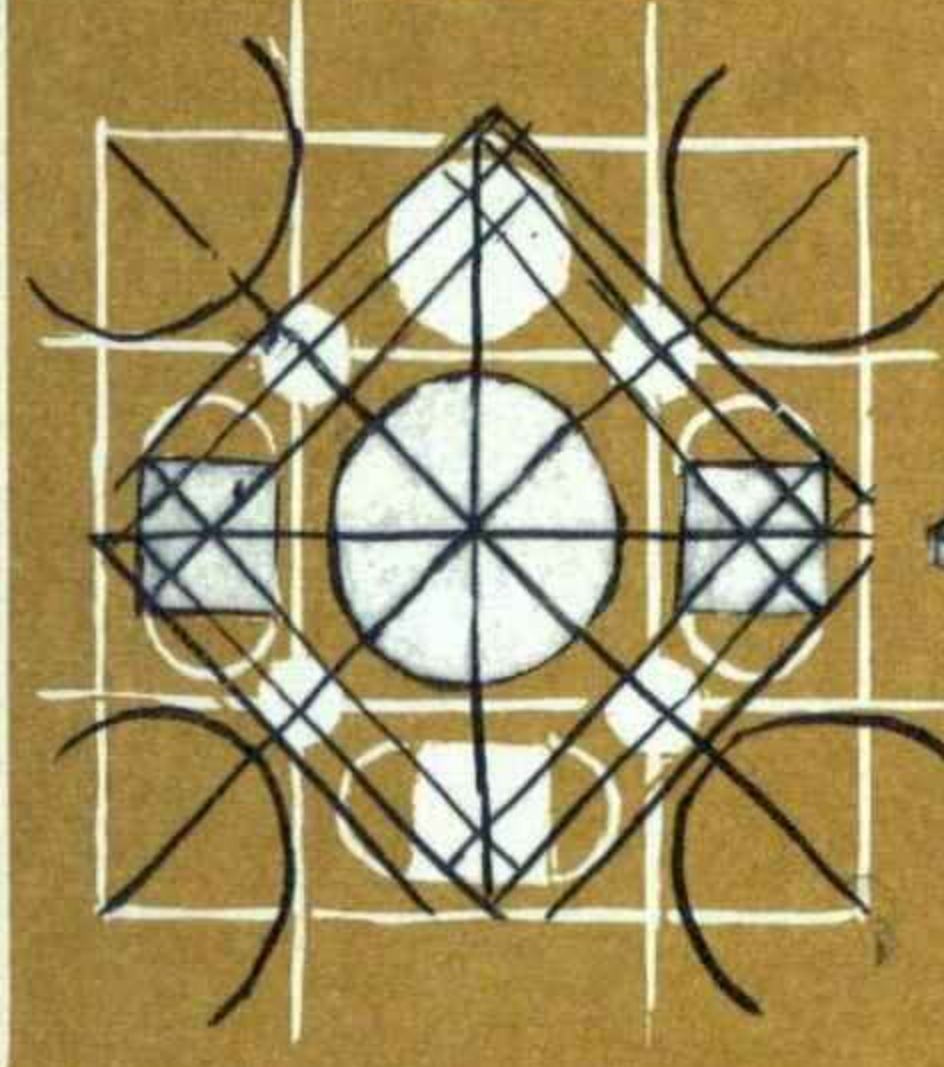
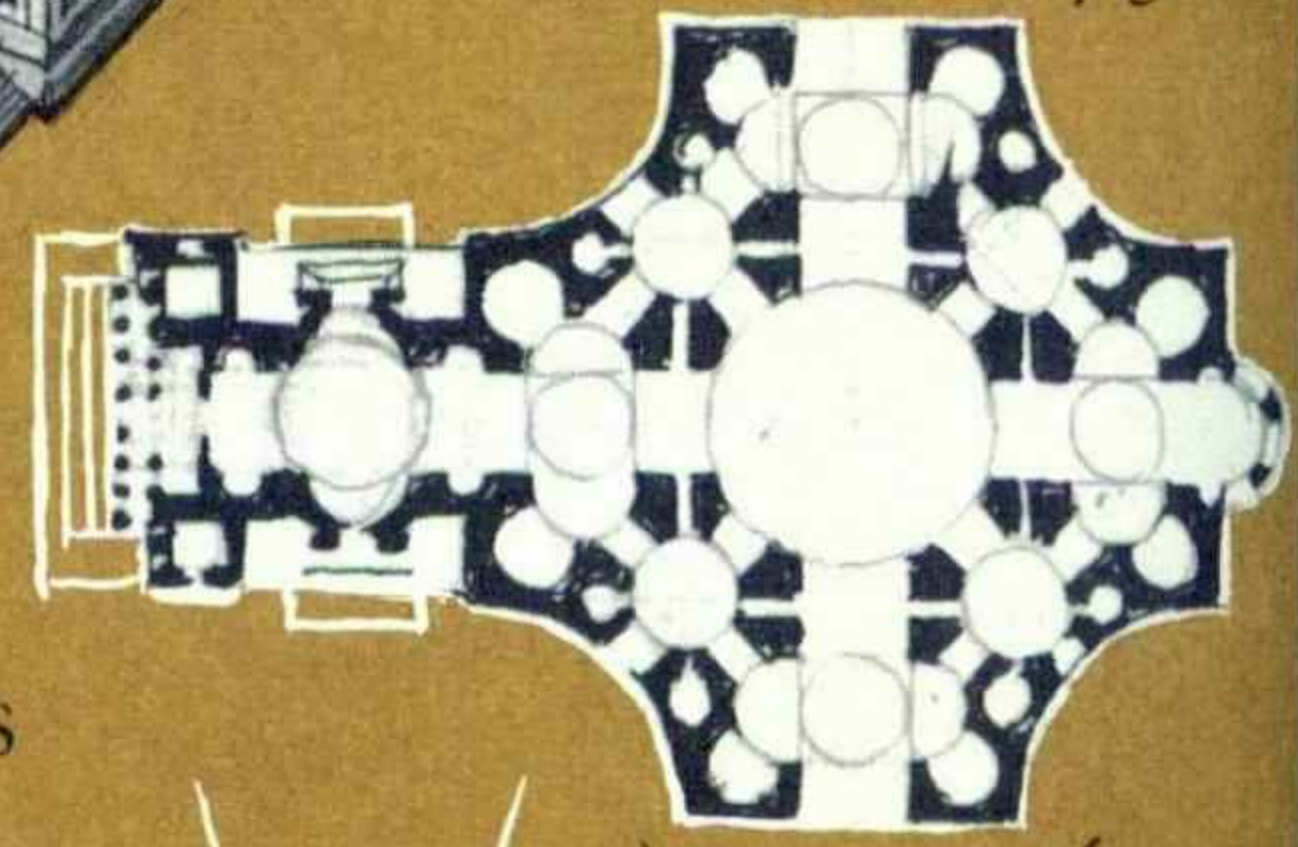
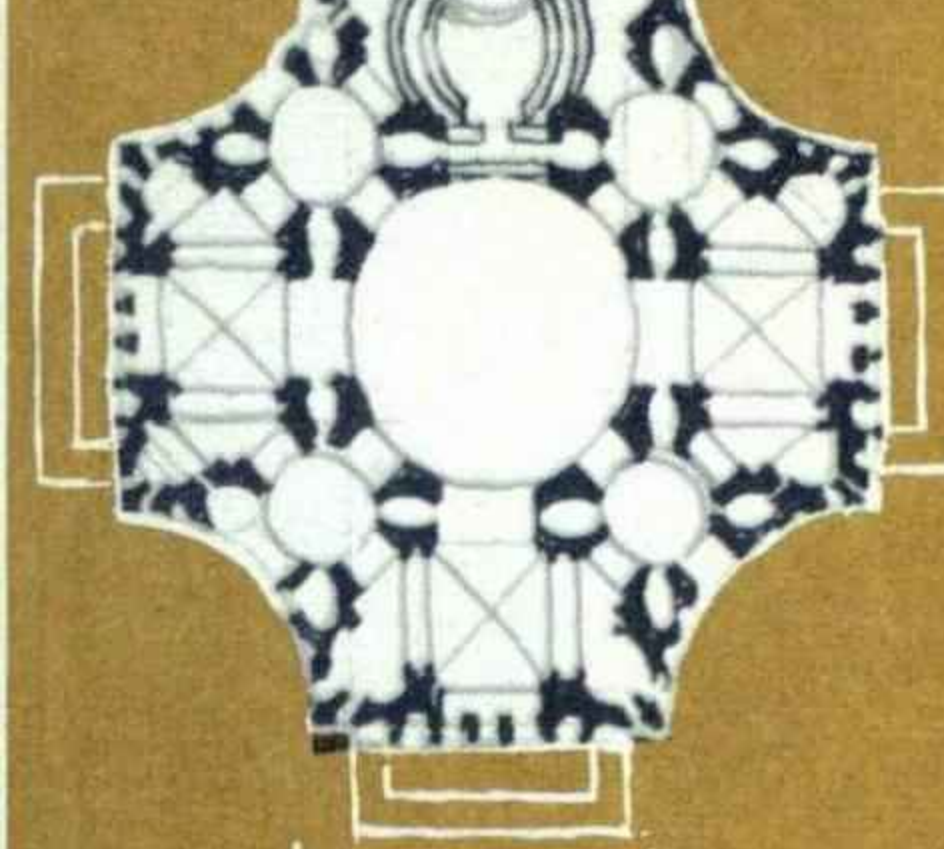
Centralized designs 'after a Roman manner', remote from 'the Gothick rudeness of ye old Design'.

The chapter 'thought the model not enough of a cathedral fashion', and a longitudinal plan, based on the Latin Cross, was adopted.



Greek Cross Design, c. 1672

The Great Model, 1673

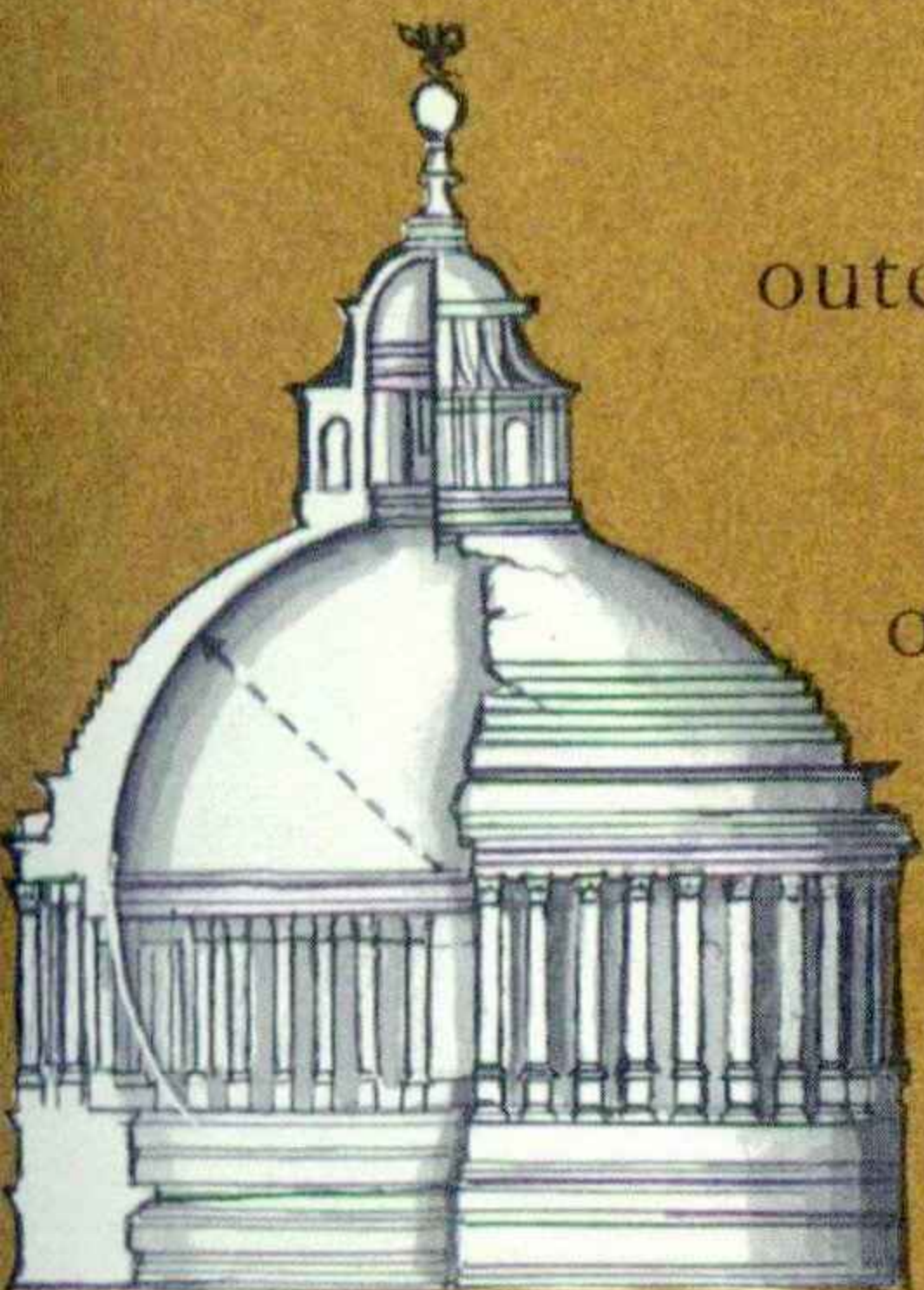


elevations  
plans

100

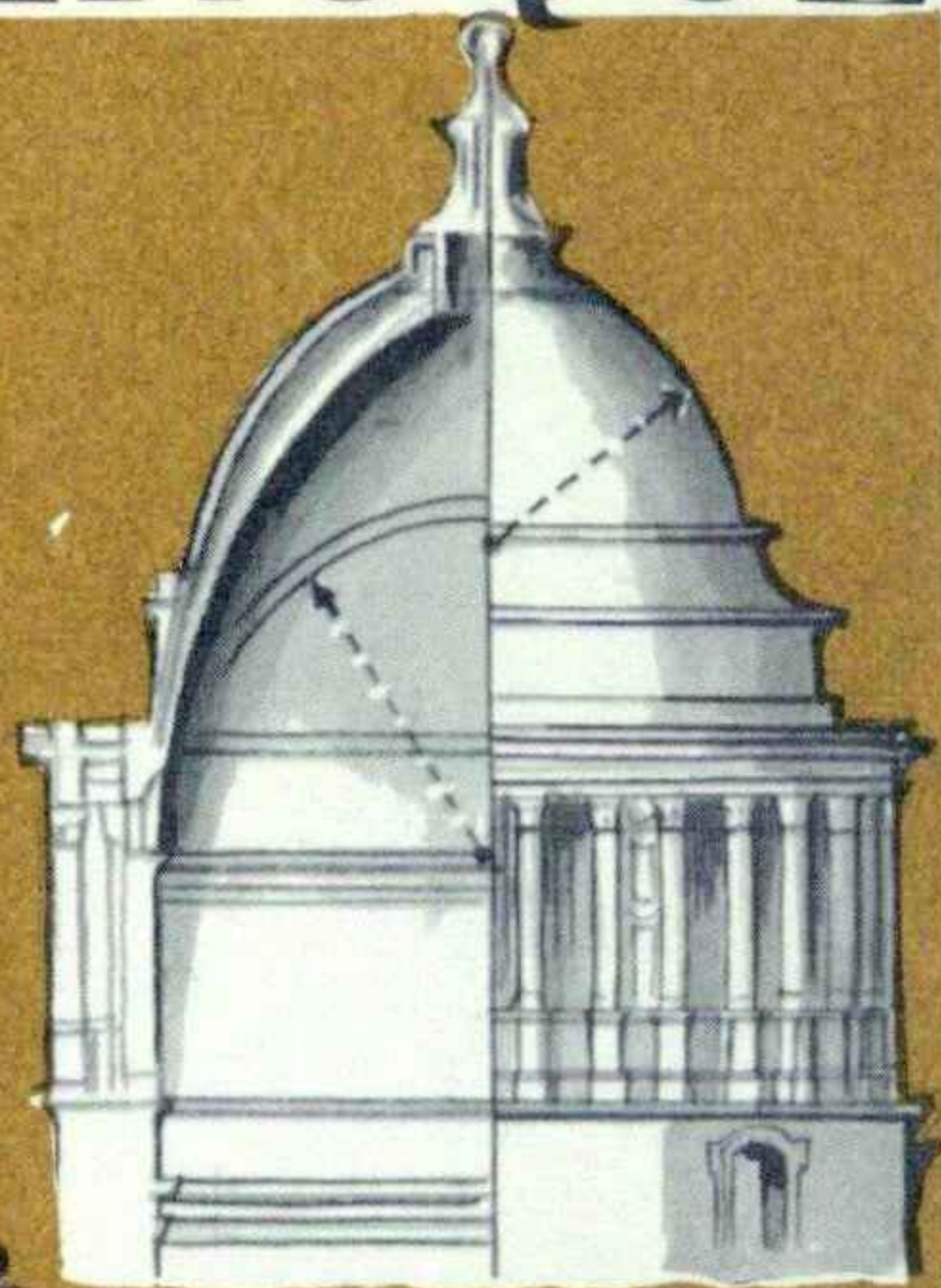
The Warrant Design, before 1675

# ENGLAND, WREN & THE BAROQUE



outer dome of timber covered with sheet lead, on a brick cone 18" thick, also with an inner brick dome 18" thick

Study for dome

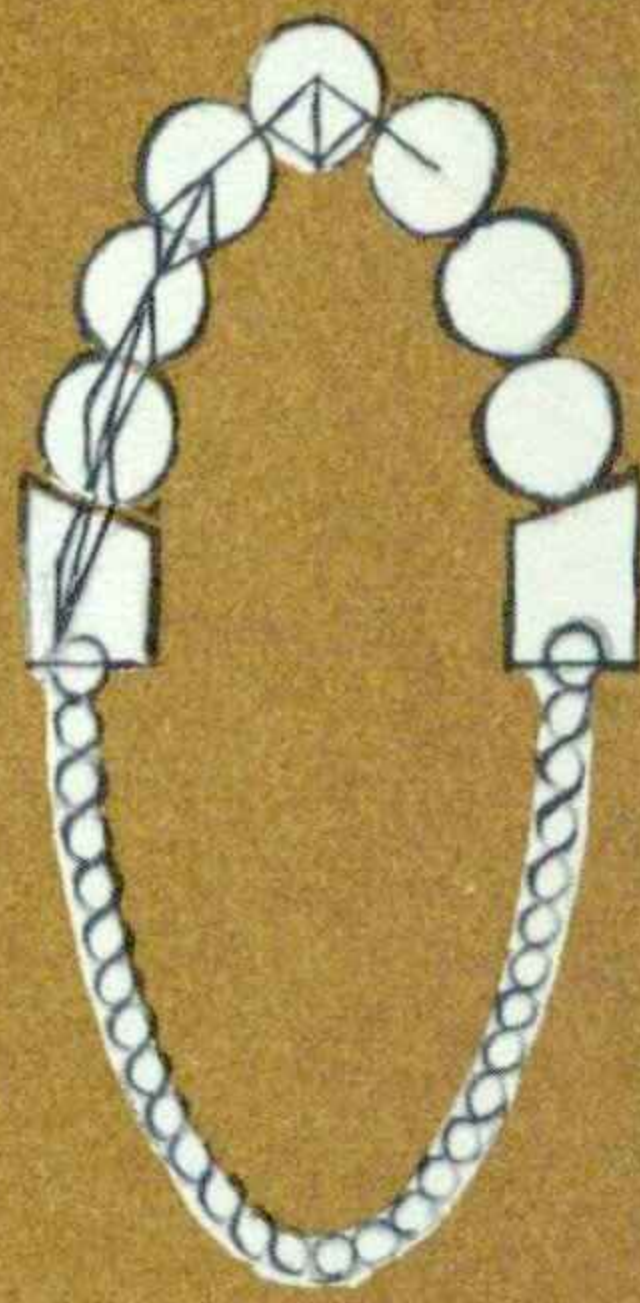


C chains

St Peter's, Rome: dome *Bramante* (1444-1514) (from Serlio)



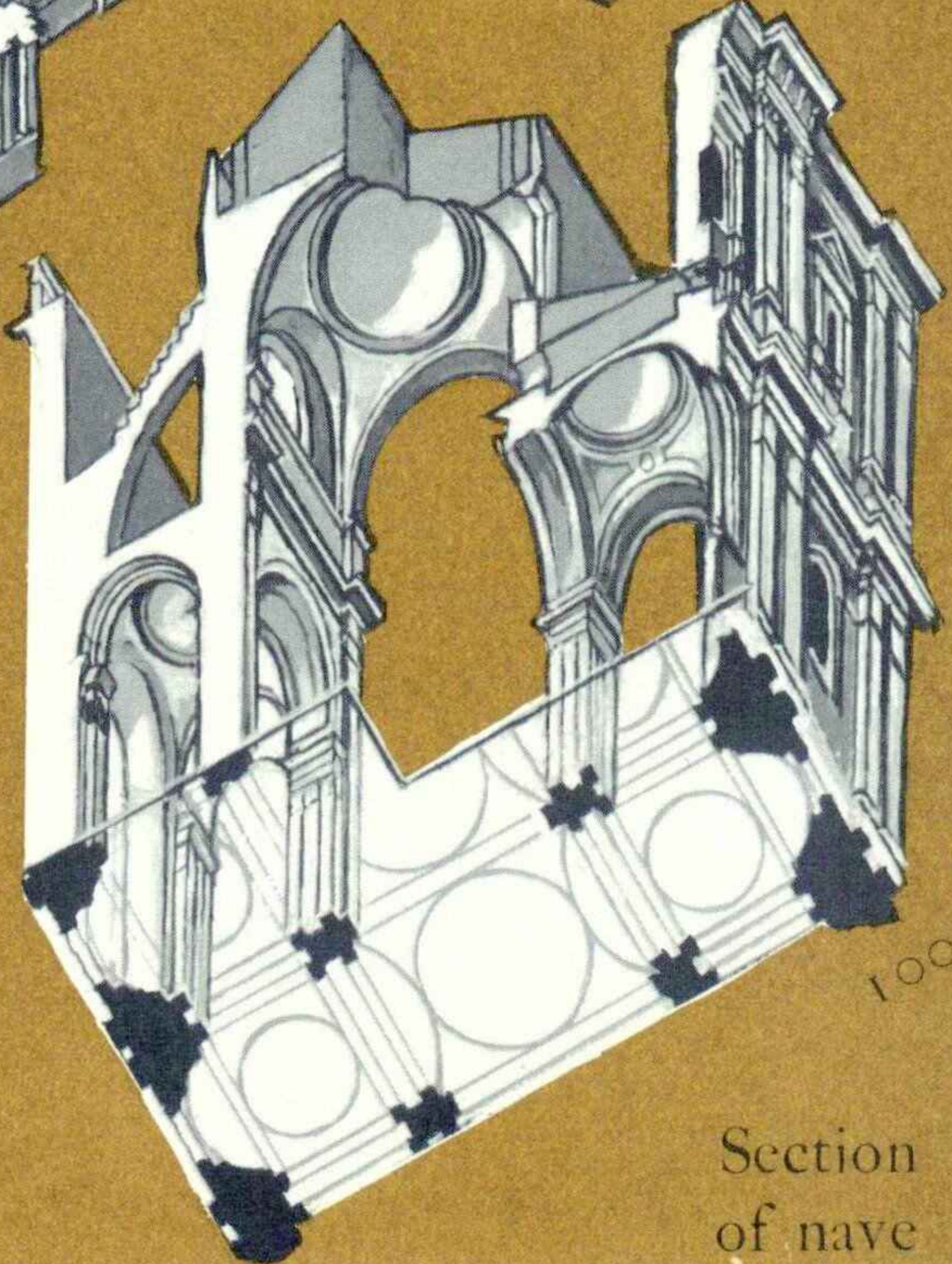
355' 6"



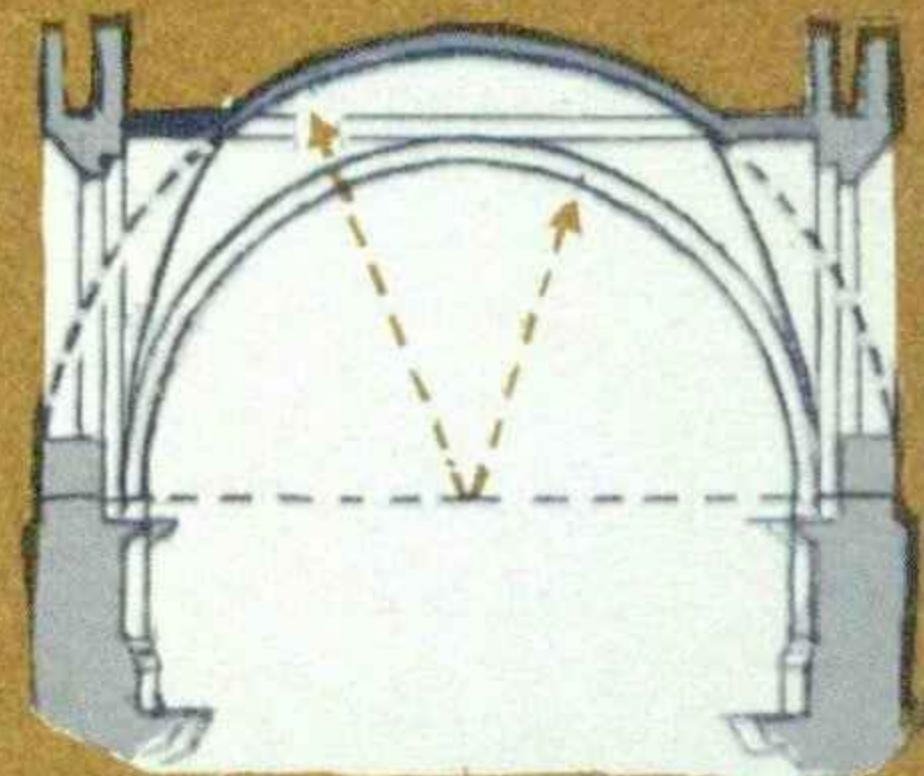
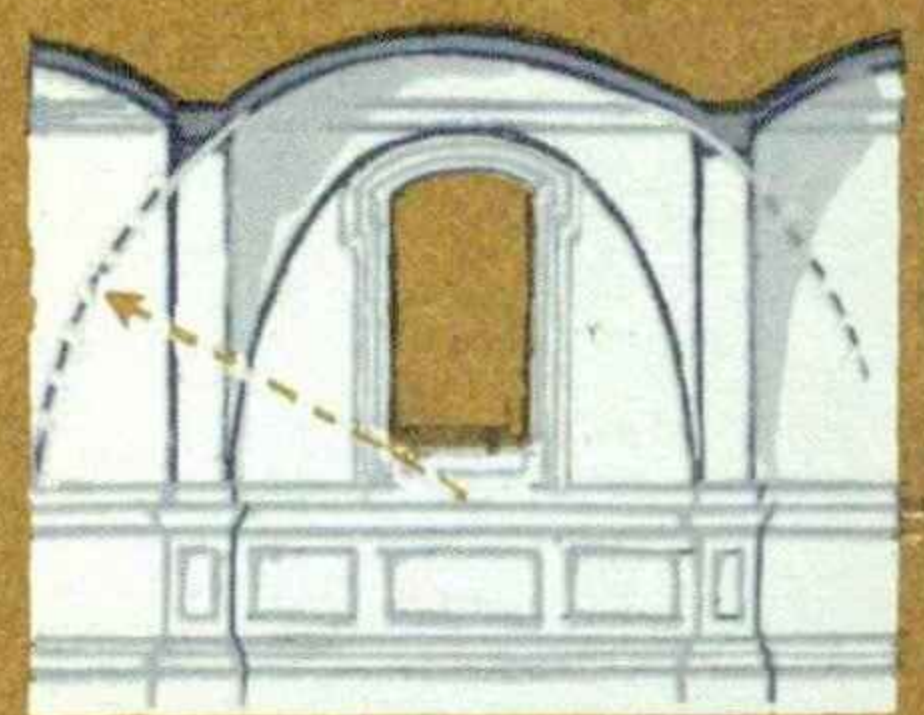
The mathematician Robert Hooke wrote that Wren used the 'catenary line'

St Paul's Cathedral, London, c. 1675-1711 *Sir Christopher Wren* (1631-1723)

Vaulting of brick, walls of ashlar stone with rubble filling, façades of Portland stone



Section of nave



# RENAISSANCE - BAROQUE

226' 11"

*Sir Christopher Wren (1632-1723).*

Early scientific pursuits: optics, hyperbolic lenses & a treatise on cycloids.

Newton in the *Principia* described Wren as 'one of the greatest geometers of our times'.

Professor of Astronomy, London 1657 and Oxford 1661.

First architectural works 1662. Studied buildings in and around Paris 1665; met F. Mansart, Le Vau, Bernini and probably Guarini.

215' 1"



St Bride, Fleet Street, 1670-84; spire, 1701-3

St Mary-le-Bow, Cheapside, 1670-83

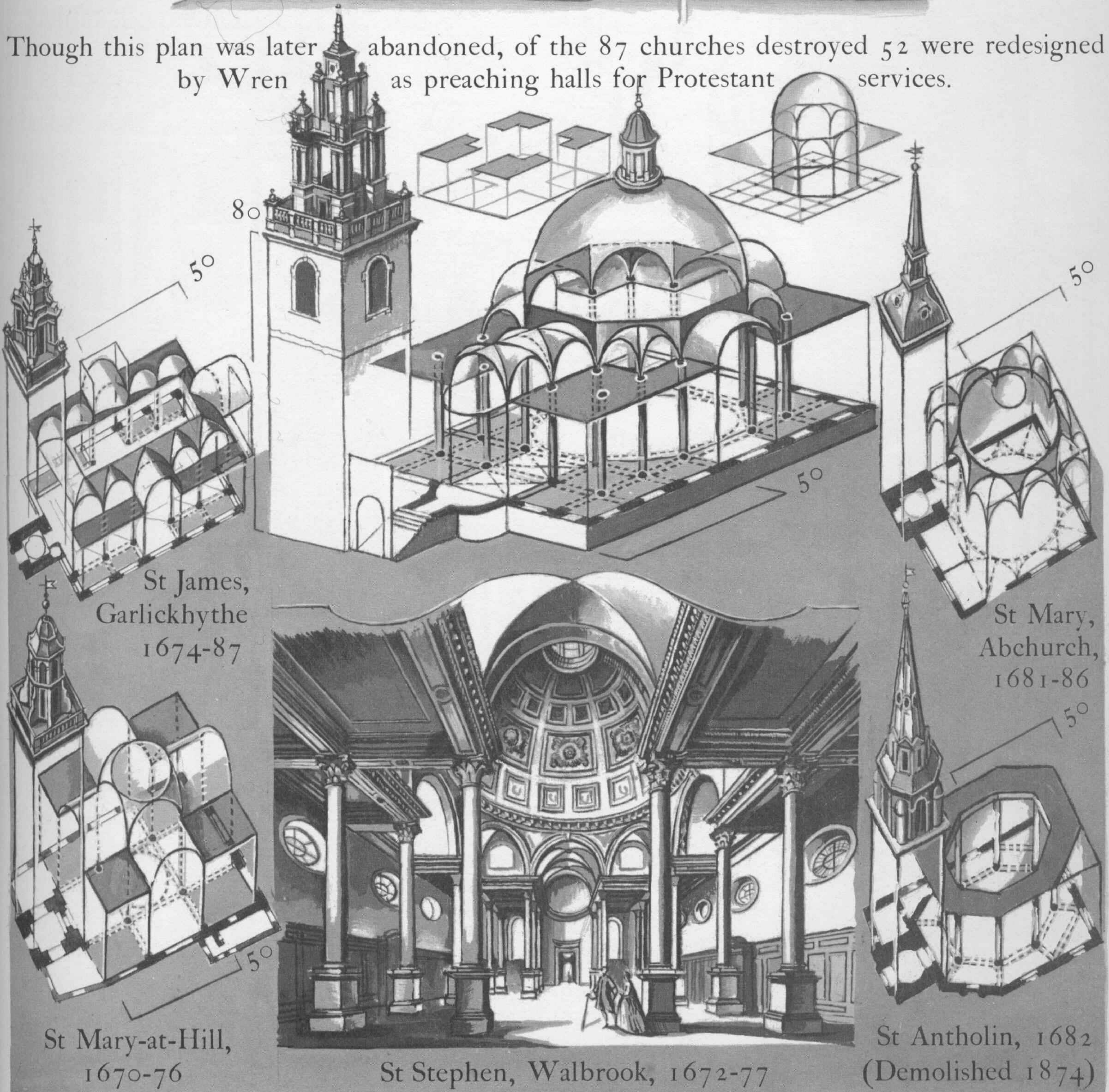
# ENGLAND, WREN'S CITY CHURCHES



The fire of London lasted from 2-5 September 1666. On 11 September

Wren submitted a plan for rebuilding the City of London.

Though this plan was later abandoned, of the 87 churches destroyed 52 were redesigned by Wren as preaching halls for Protestant services.



80

50

50

50

50

50

St James,  
Garlickhythe  
1674-87

St Mary,  
Abchurch,  
1681-86

St Mary-at-Hill,  
1670-76

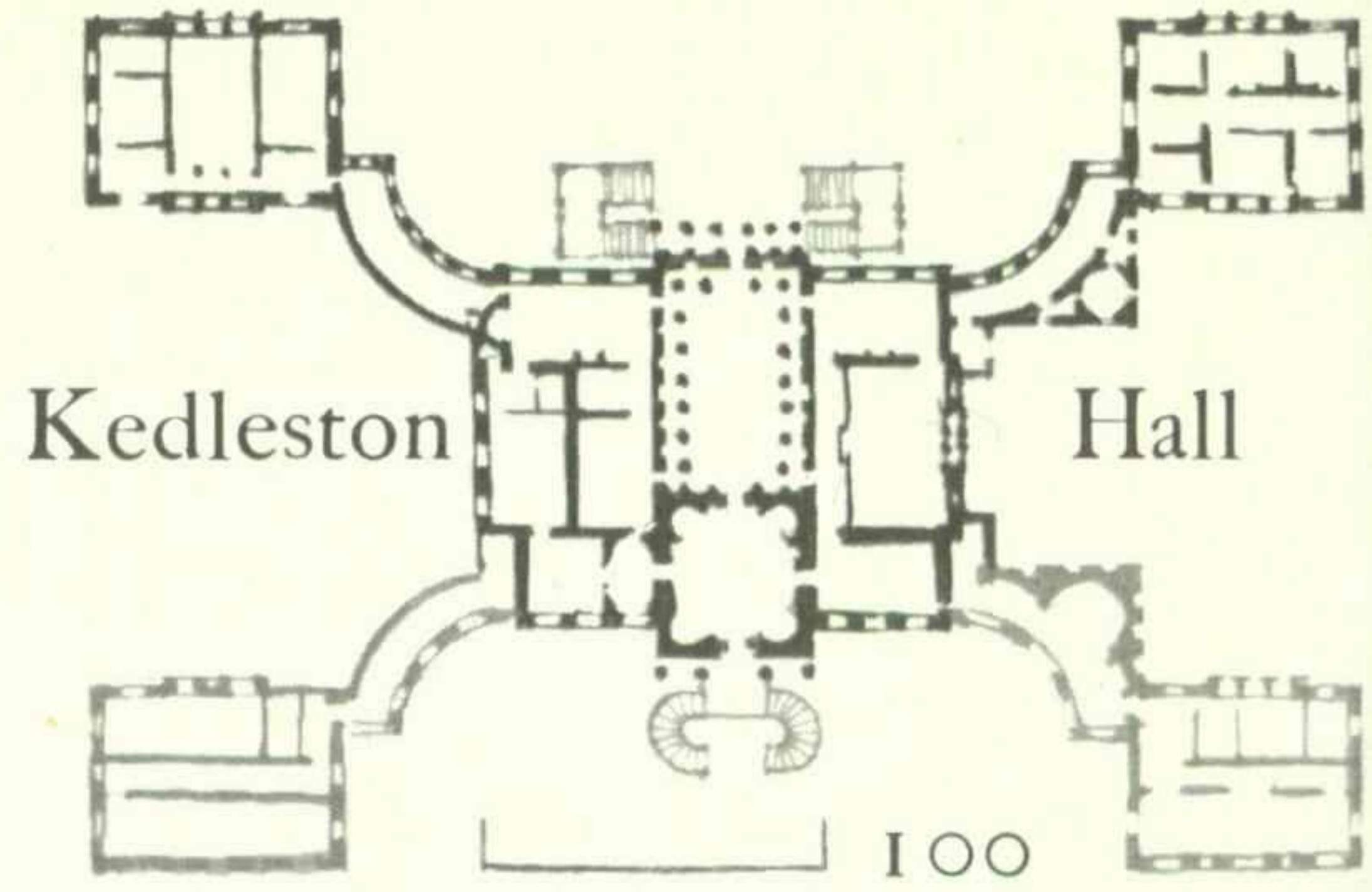
St Stephen, Walbrook, 1672-77

St Antholin, 1682  
(Demolished 1874)

# RENAISSANCE - BAROQUE

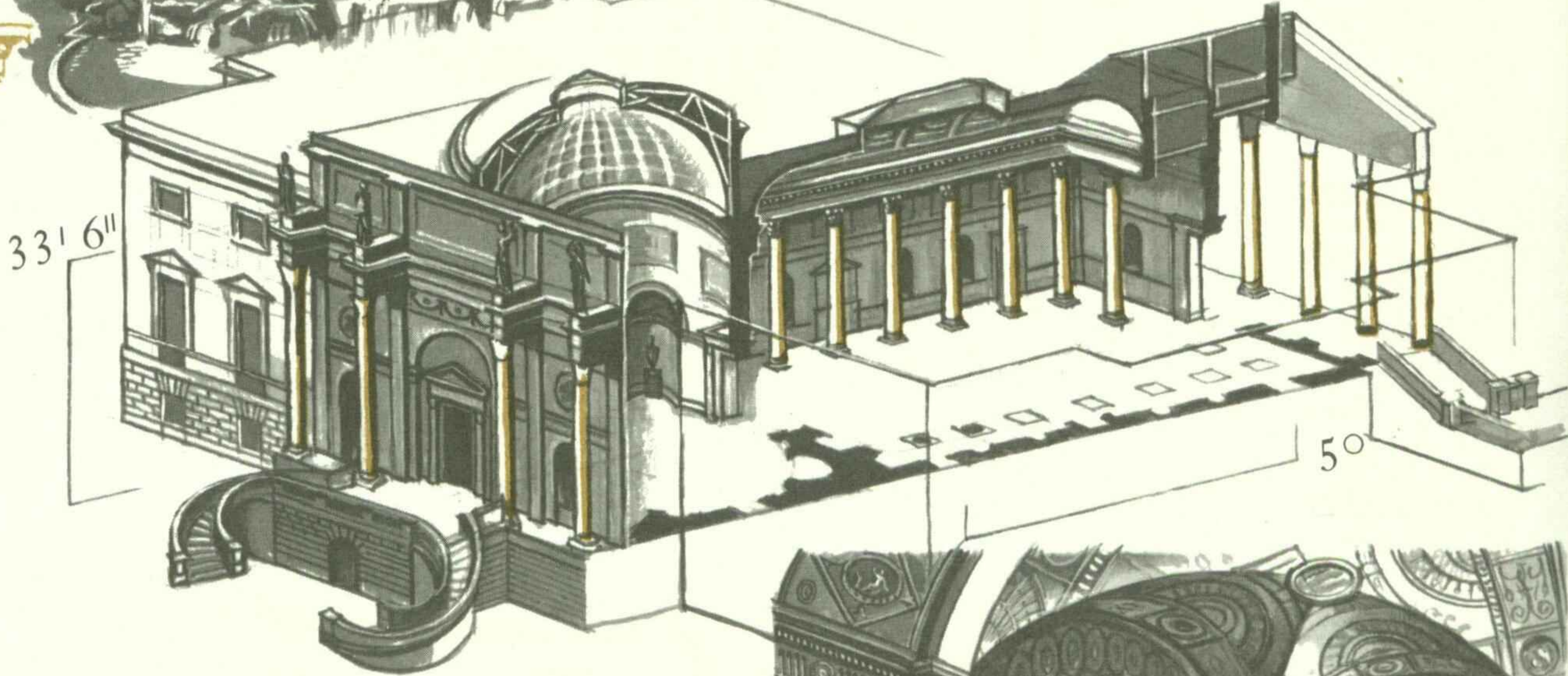


Fontana  
Trevi,  
Rome,  
1732-1762  
*Salvi*



Kedleston Hall

100



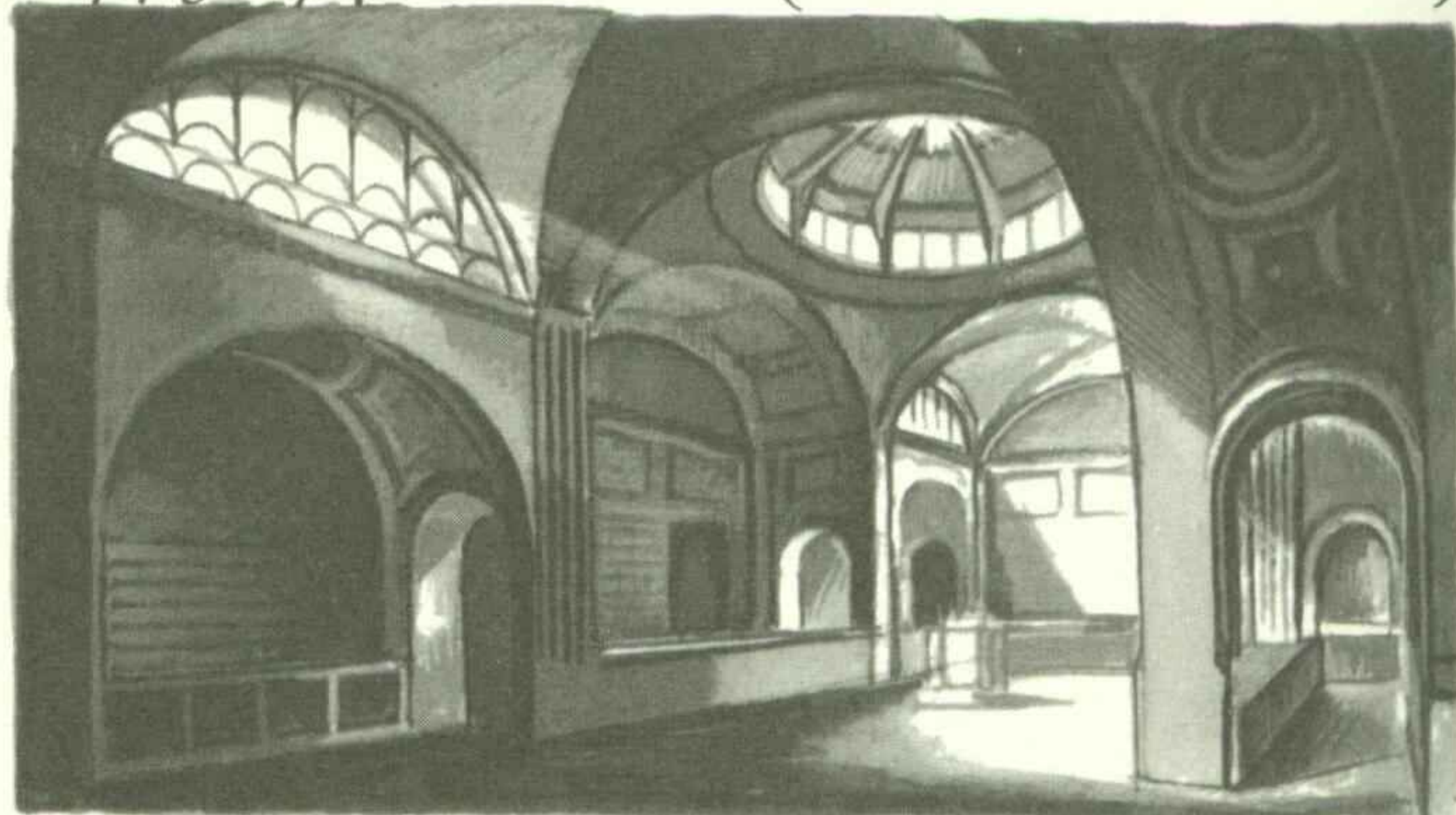
Kedleston Hall, Derbyshire, 1756-70  
designed by *James Paine* (1725-89);  
south front & interior by  
*Robert Adam* (1728-92).  
Studied in Italy 1754-58



26, Grosvenor Square, London,  
1773-74 *Adam* (demolished 1862)



Pitzhanger Place, Middlesex,  
1800-1803



Bank Stock Office, Bank of England,  
1792-93 (demolished 1927)

*Sir John Soane* (1753-1837) Visited Italy 1778-1780

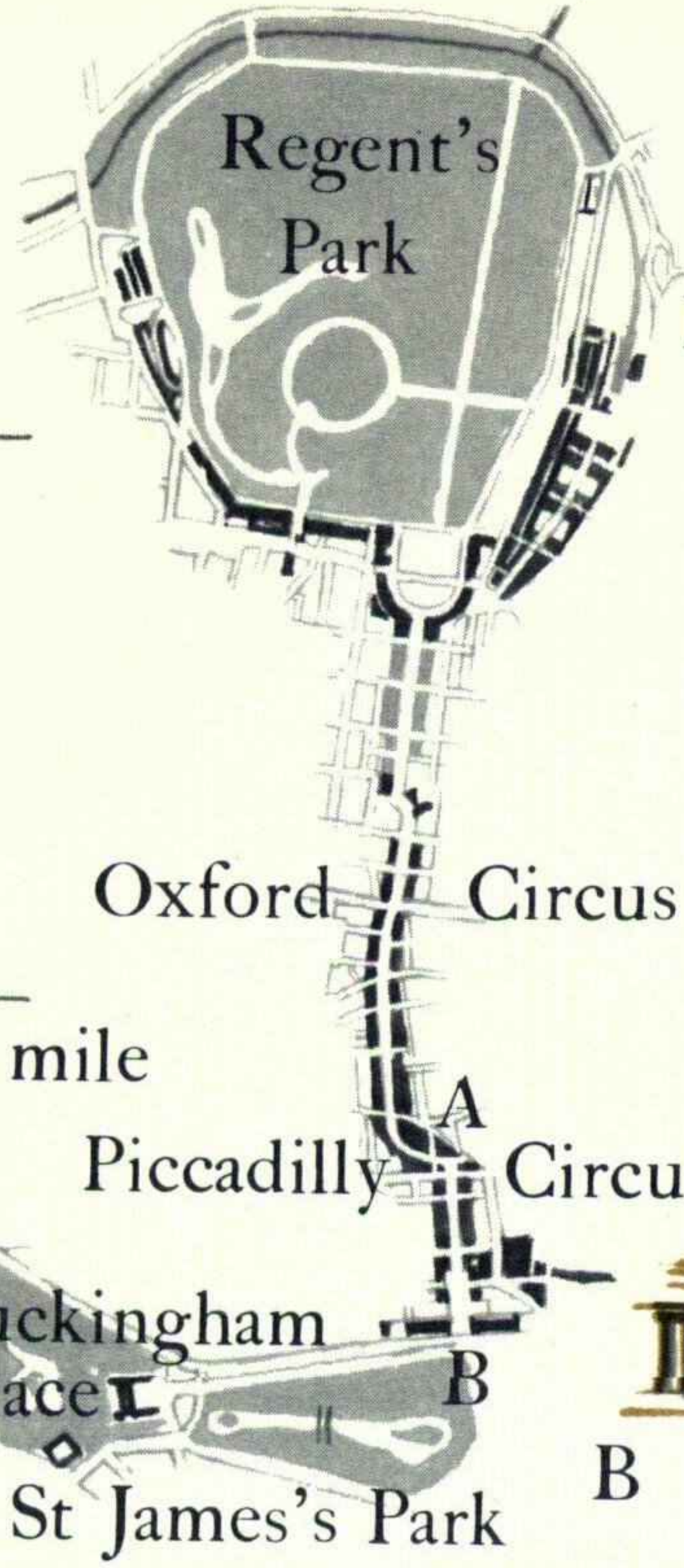
Gate column: Syon House, Middlesex,  
1762-63 *Robert Adam*





# ENGLAND, STONE, BRICK & IRON

section of cast-iron column Watt & Boulton  
Mill, 1801



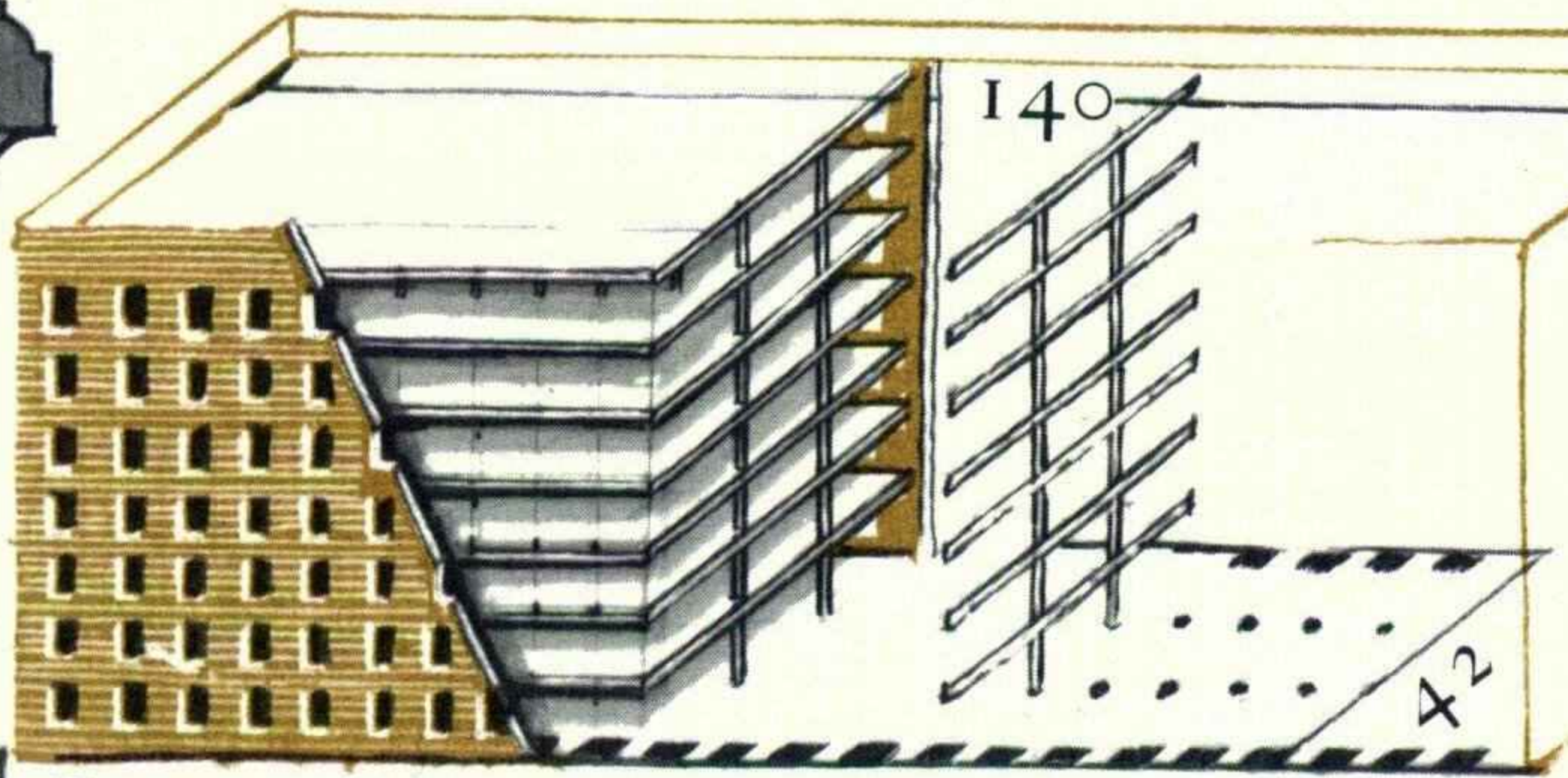
London's 'Metropolitan Improvements' 1812-1835  
*John Nash* (1752-1835)



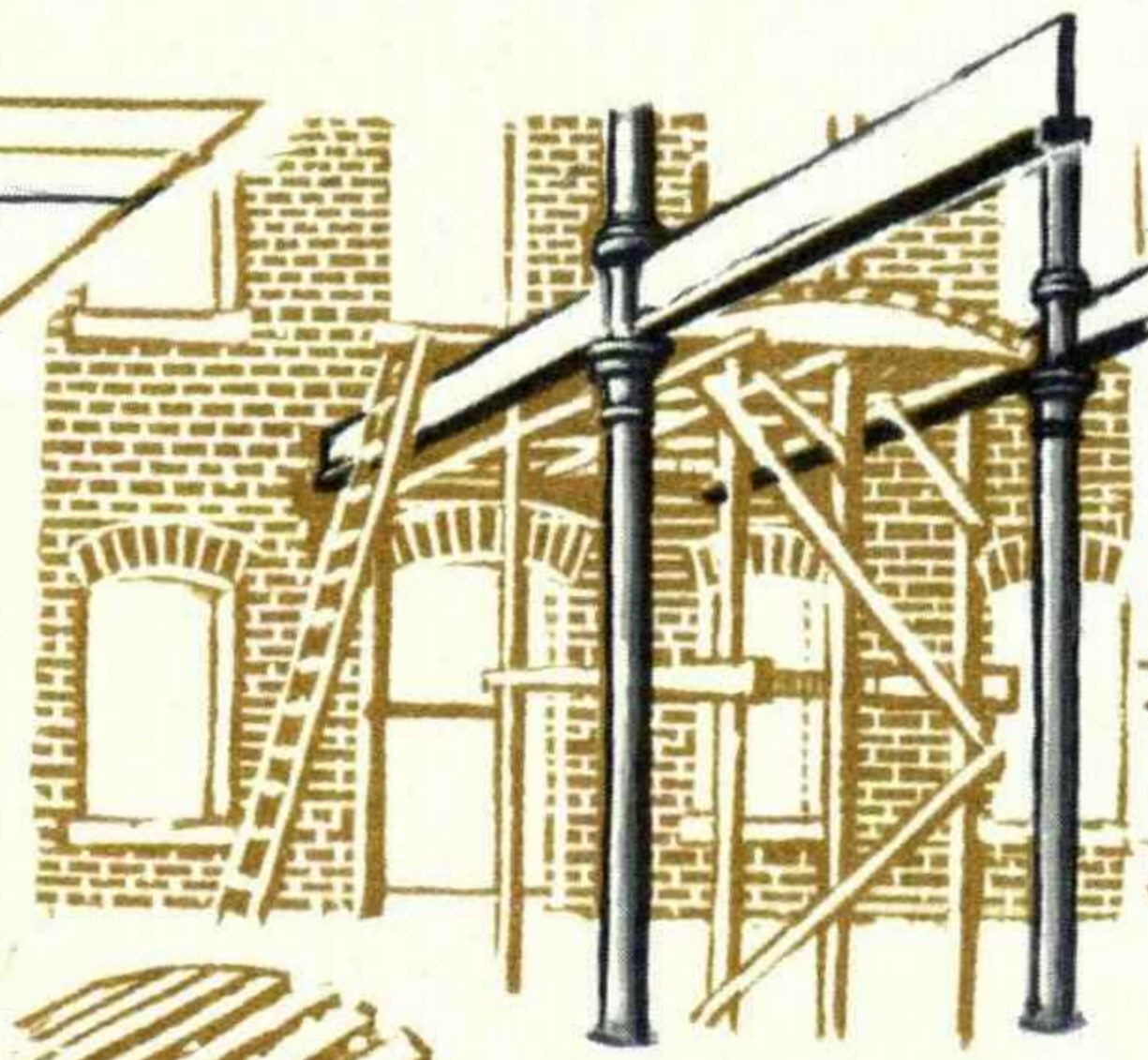
A The Quadrant, Regent Street 1818  
Cast-iron columns



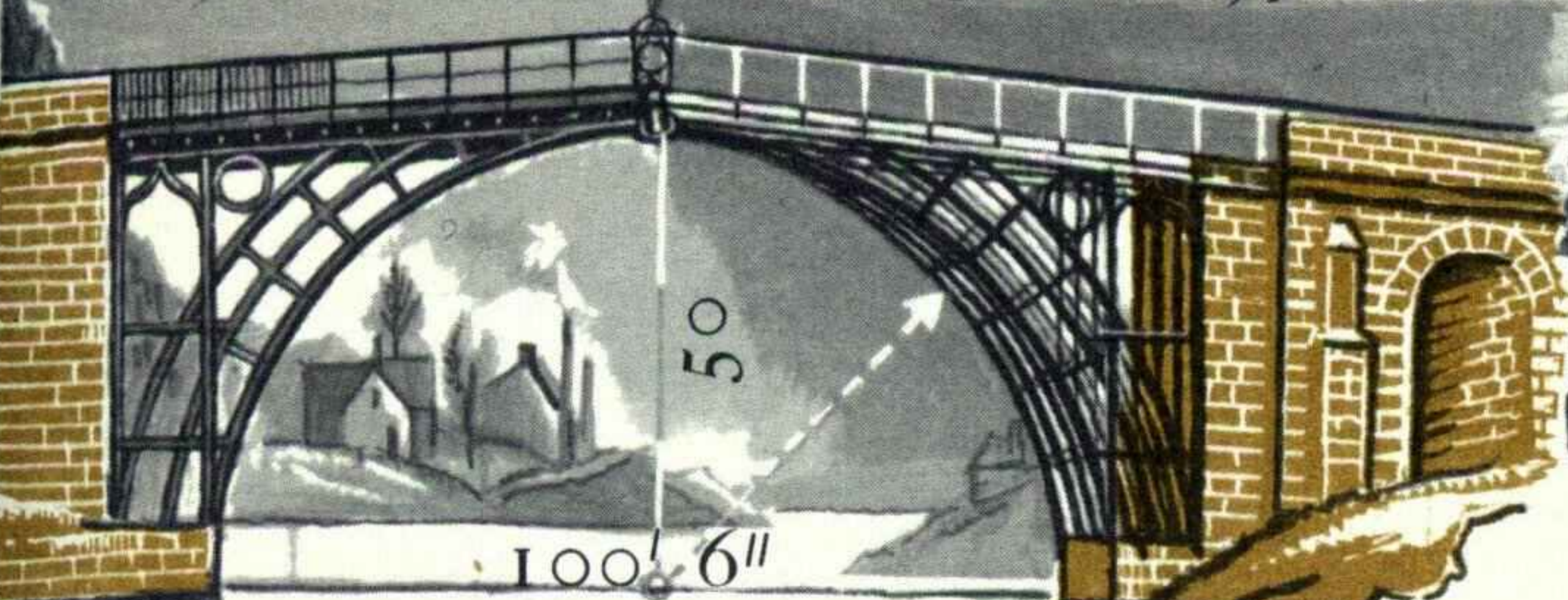
B Carlton House Terrace, 1827 Cast-iron Doric columns



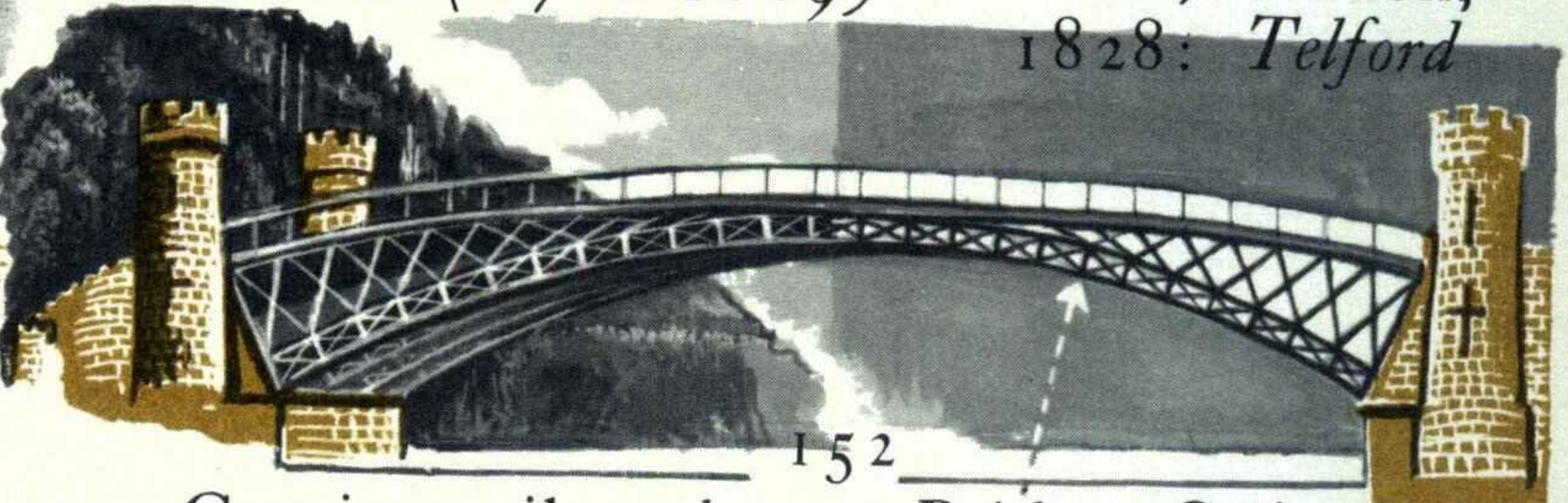
Cotton mill, Manchester, 1801. Cast-iron columns & beams  
*James Watt* (1736-1819) & *Matthew Boulton* (1728-1809)



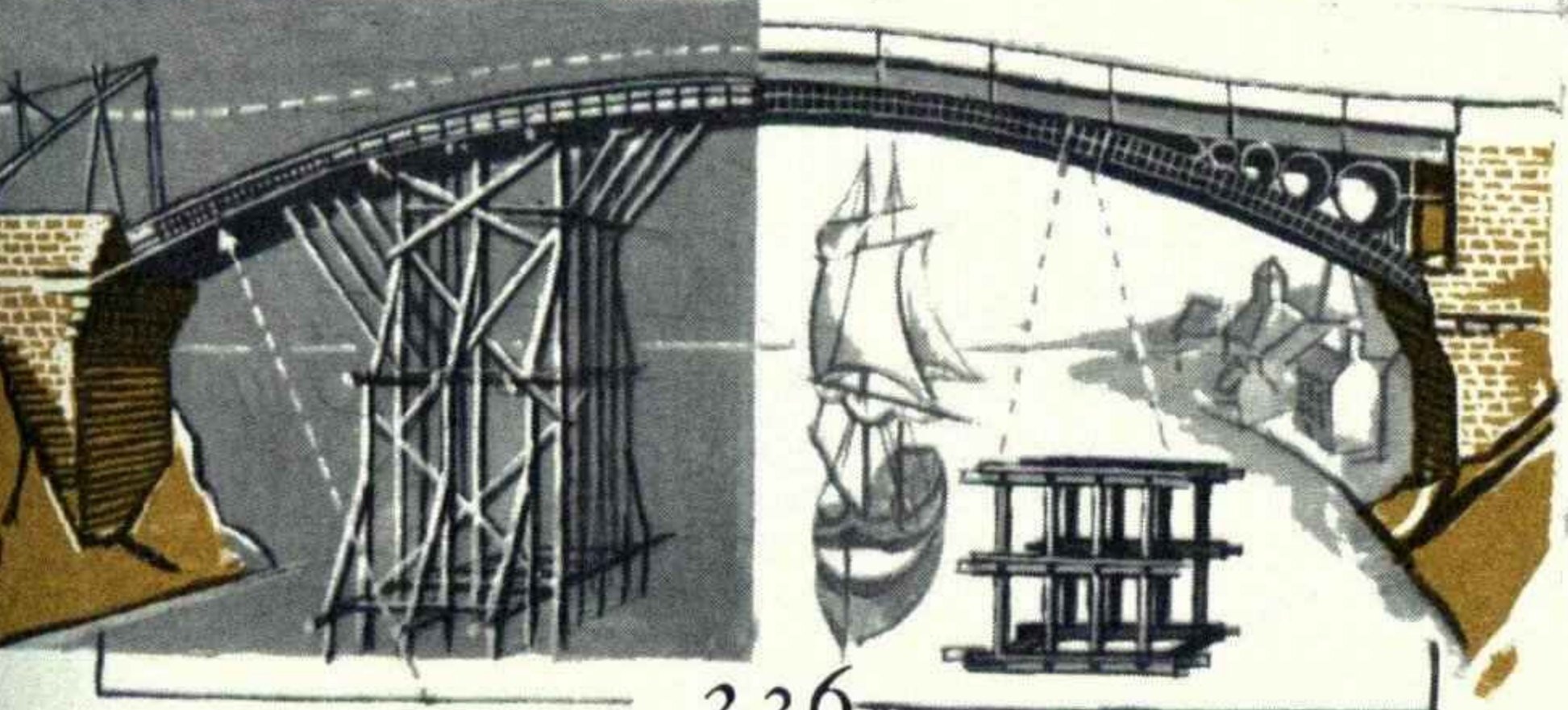
St Katherine's Dock, London, 1828: *Telford*



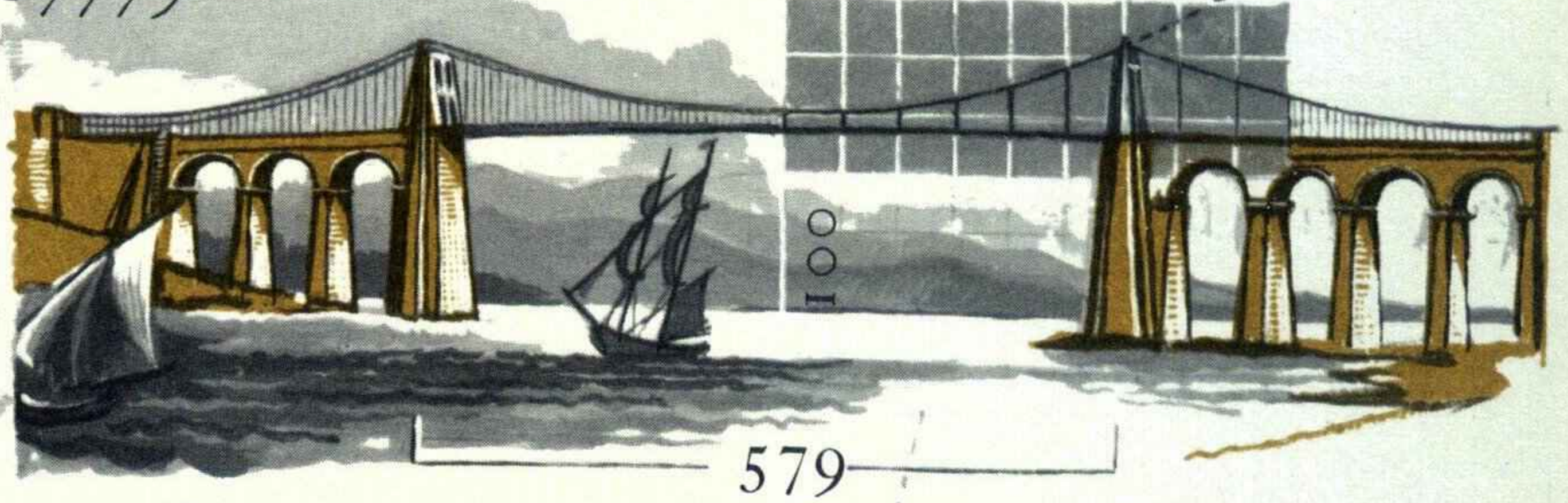
First iron bridge: Coalbrookdale, Shropshire, 1775-79 *Thomas Farnoth Pritchard* (d.1777)



Cast-iron rib-and-truss Bridge, Craigellachie, 1815 *Telford*

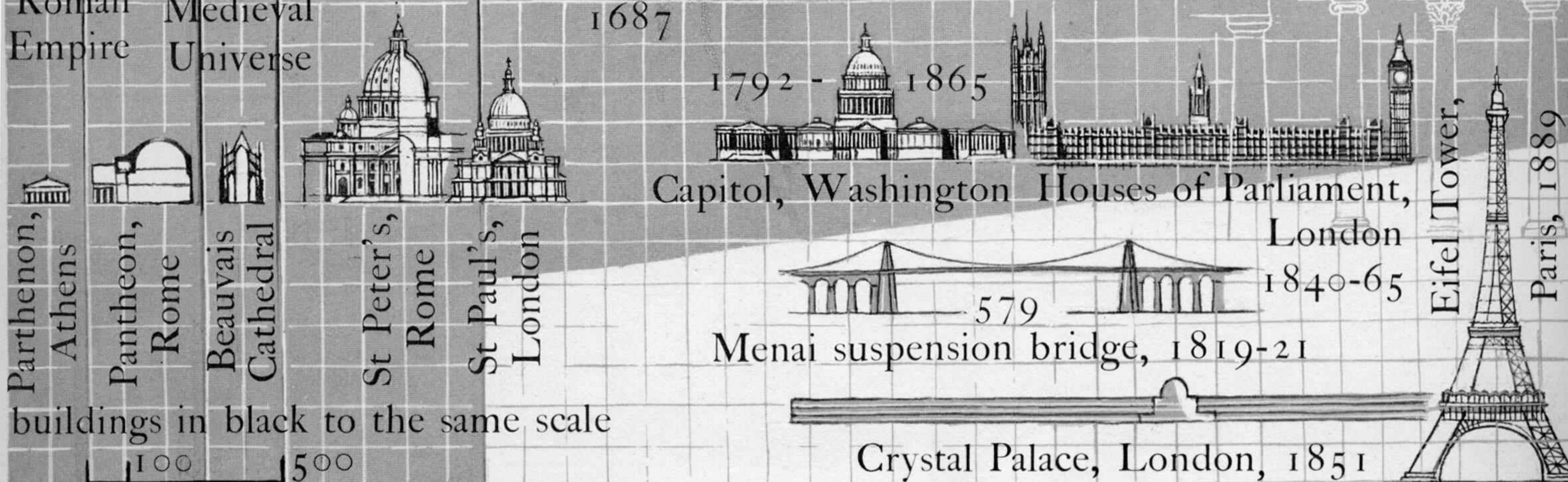
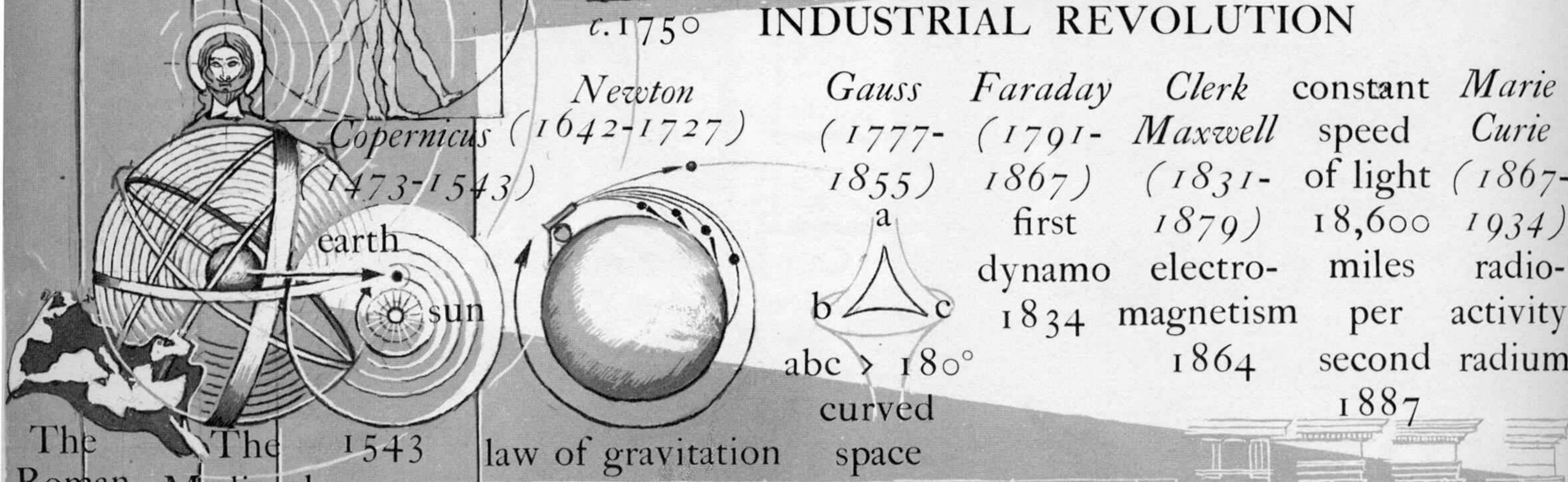
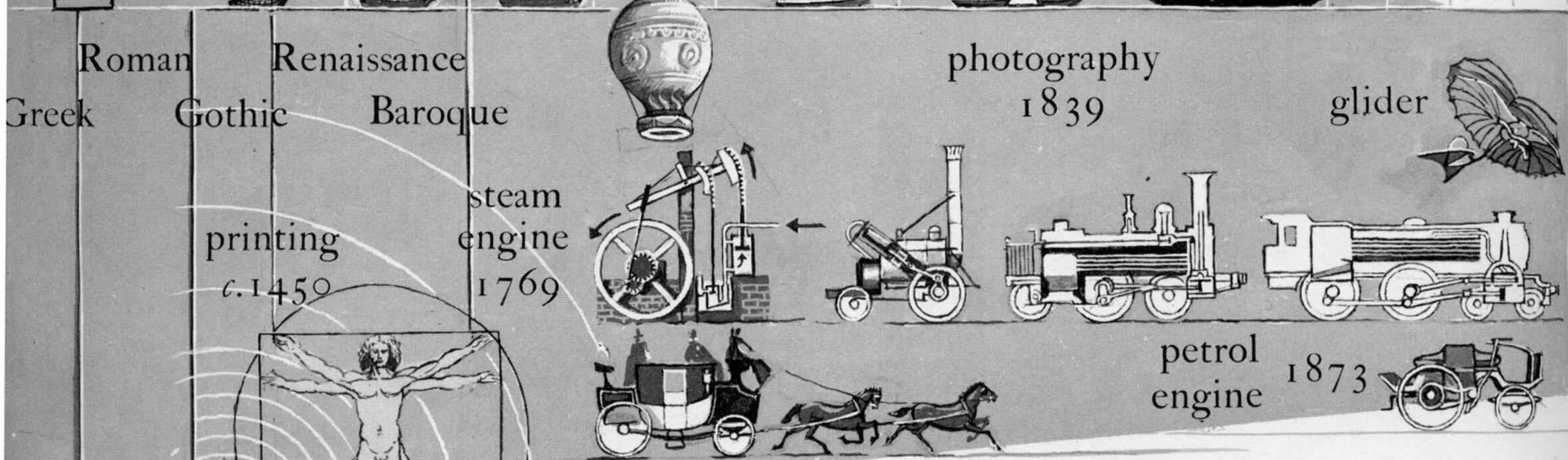
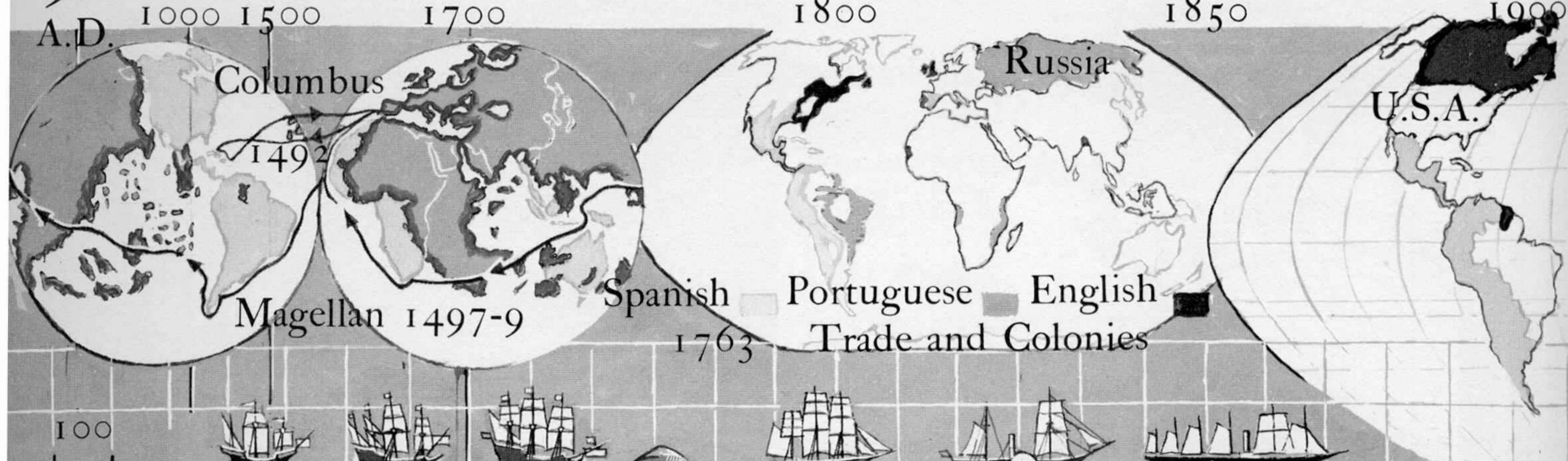


Cast-iron Bridge, Sunderland, 1793-96



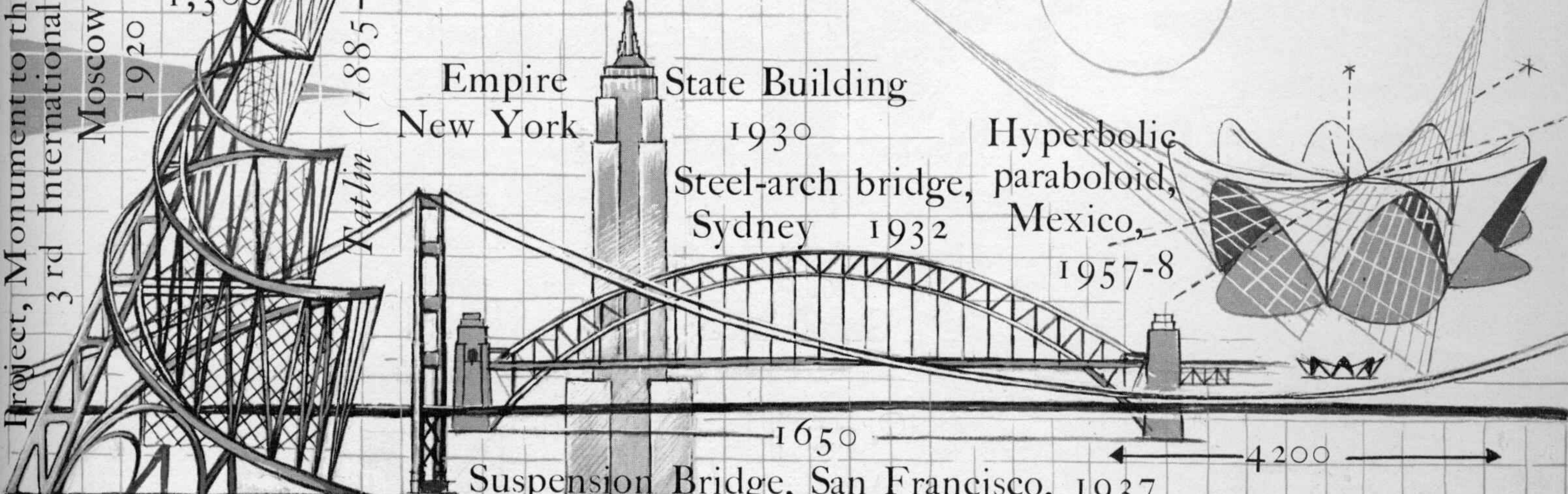
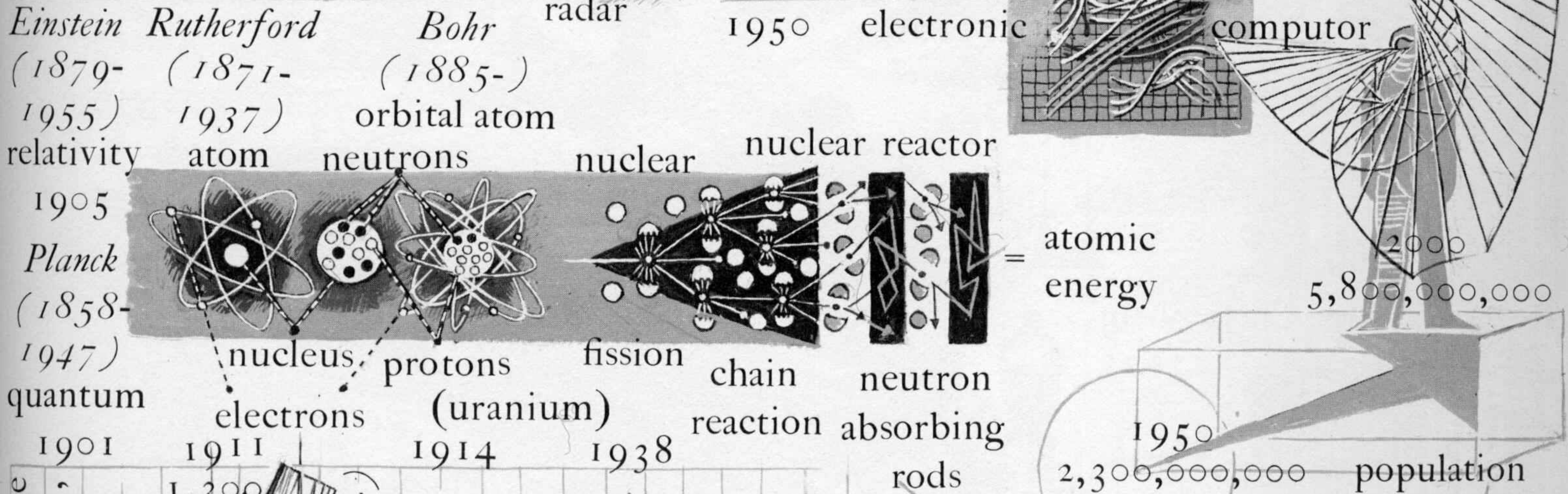
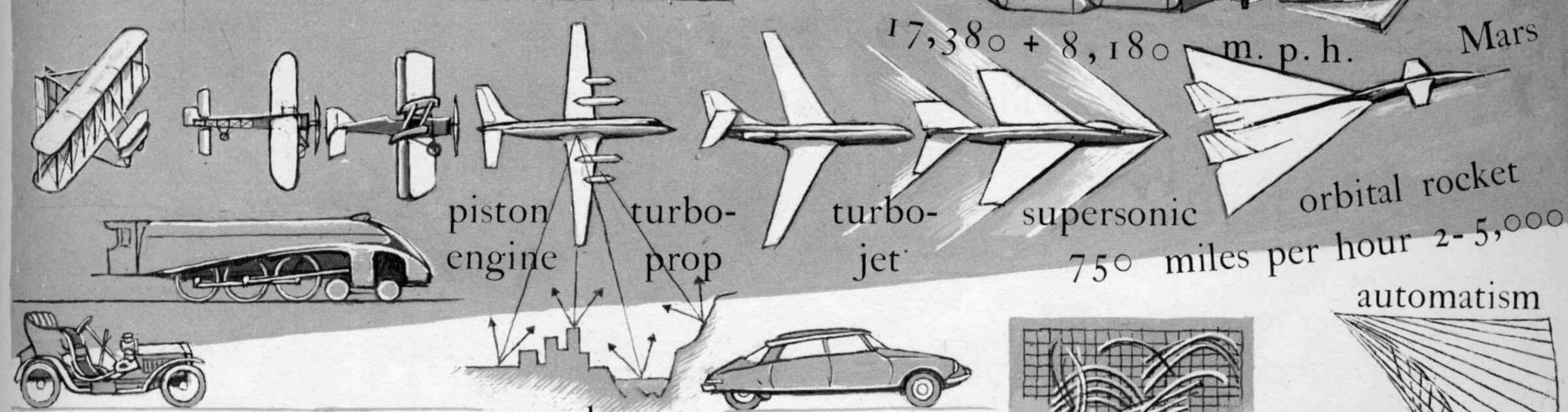
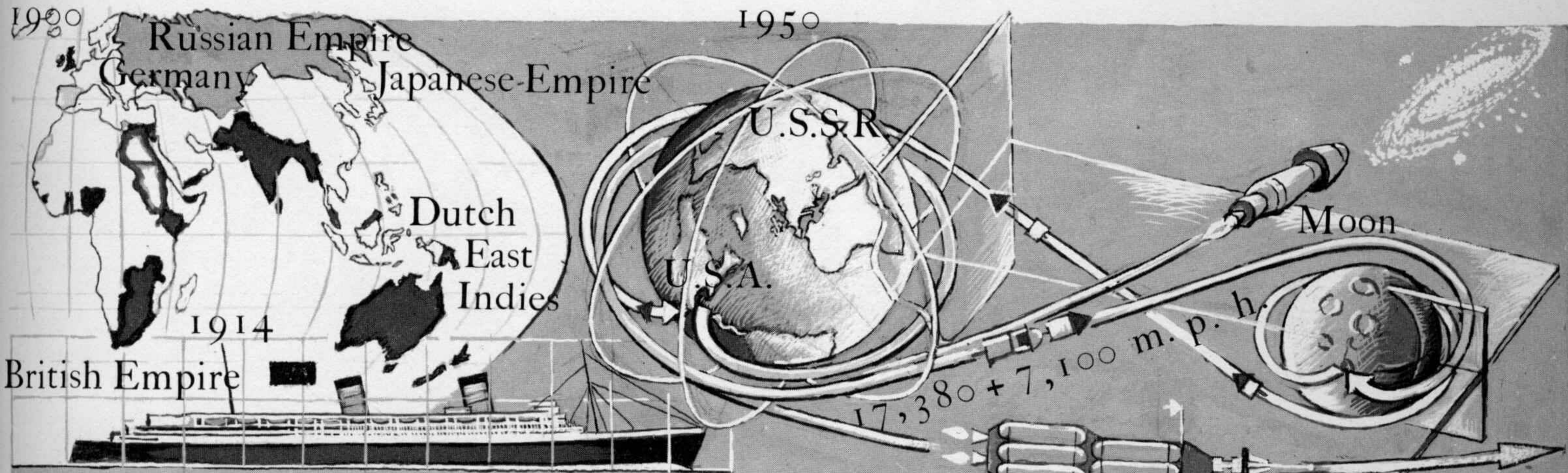
Suspension Bridge, Menai Straits, 1819-26  
*William Telford* (1751-1834)

# 19 TH & 20 TH CENTURIES



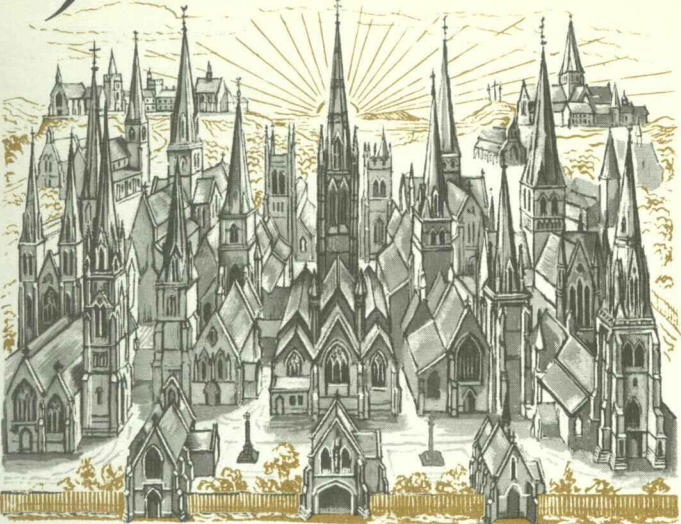
buildings in black to the same scale  
100 500  
timber stone brick cast iron wrought iron steel (mass-produced) Portland cement reinforced concrete

# INTRODUCTION



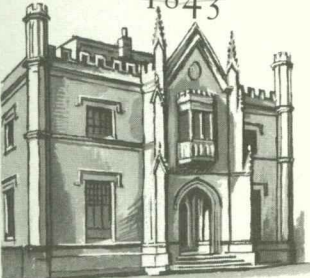
aluminium magnesium prestressed concrete shell concrete nickel titanium tungsten selenium germanium

# 19 TH & 20 TH CENTURIES



22 churches and chapels built by Augustus Welby Northmore Pugin (1812-52)

from frontispiece to *An Apology for the Revival of Christian Architecture*, 1843

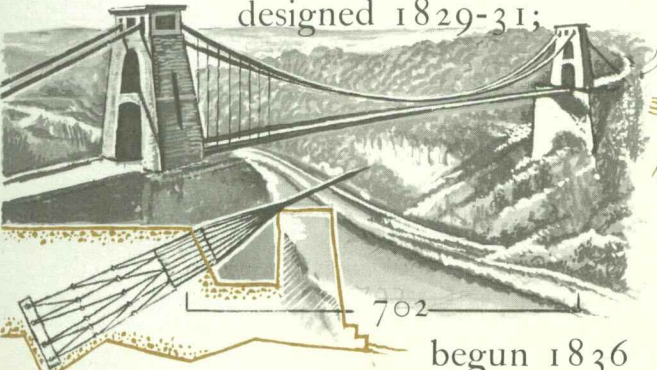


Regency Villas, Cheltenham, c.1825



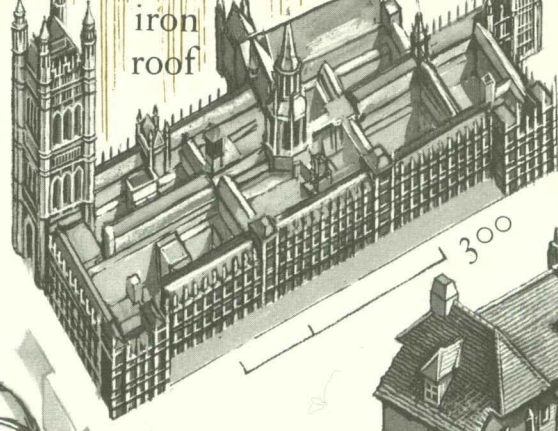
Classic

Clifton Suspension Bridge, Bristol, designed 1829-31;



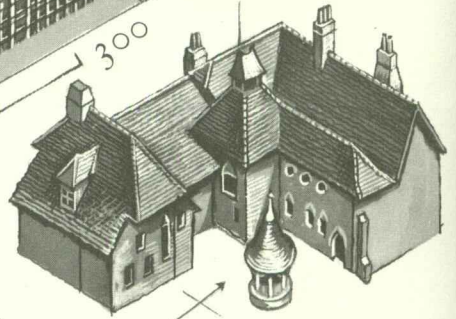
begun 1836  
Isambard Kingdom Brunel (1806-59)

The Houses of Parliament, London, 1840-65 Sir Charles Barry (1795-1860), assisted by Pugin



iron roof

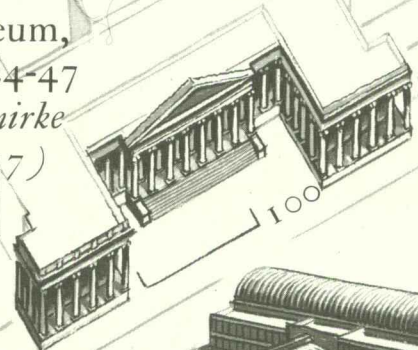
John Ruskin (1819-1900), *The Seven Lamps of Architecture*, 1849  
*The Stones of Venice*, 1851



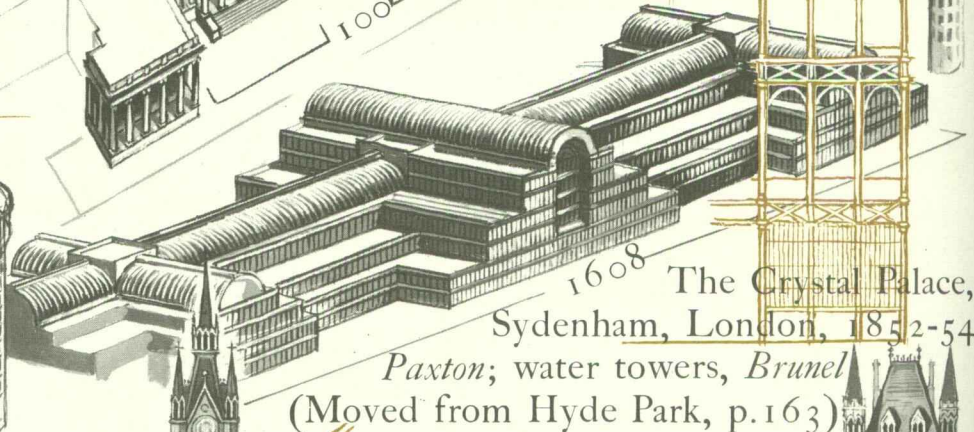
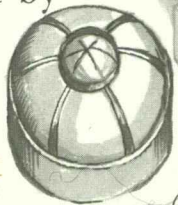
The Red House, Kent, 1859 Philip Webb (1831-1915) for William Morris (1834-96)

British Museum, London, 1824-47 Sir Robert Smirke (1780-1817)

Gothic

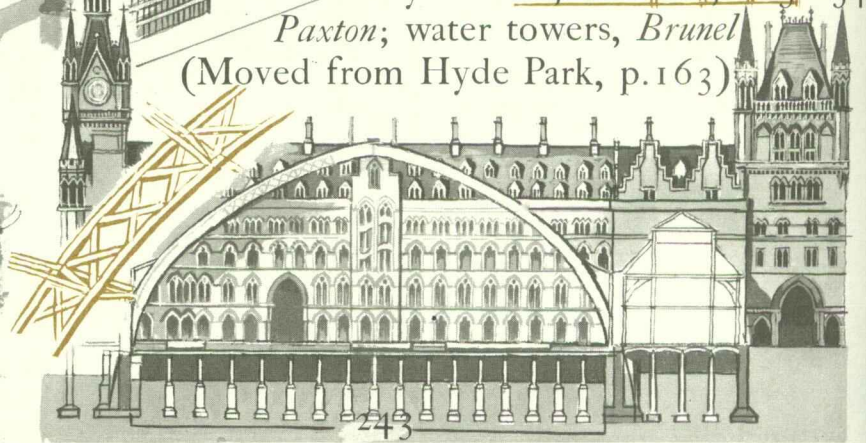


cast-iron dome Sidney Smirke (1799-1877)

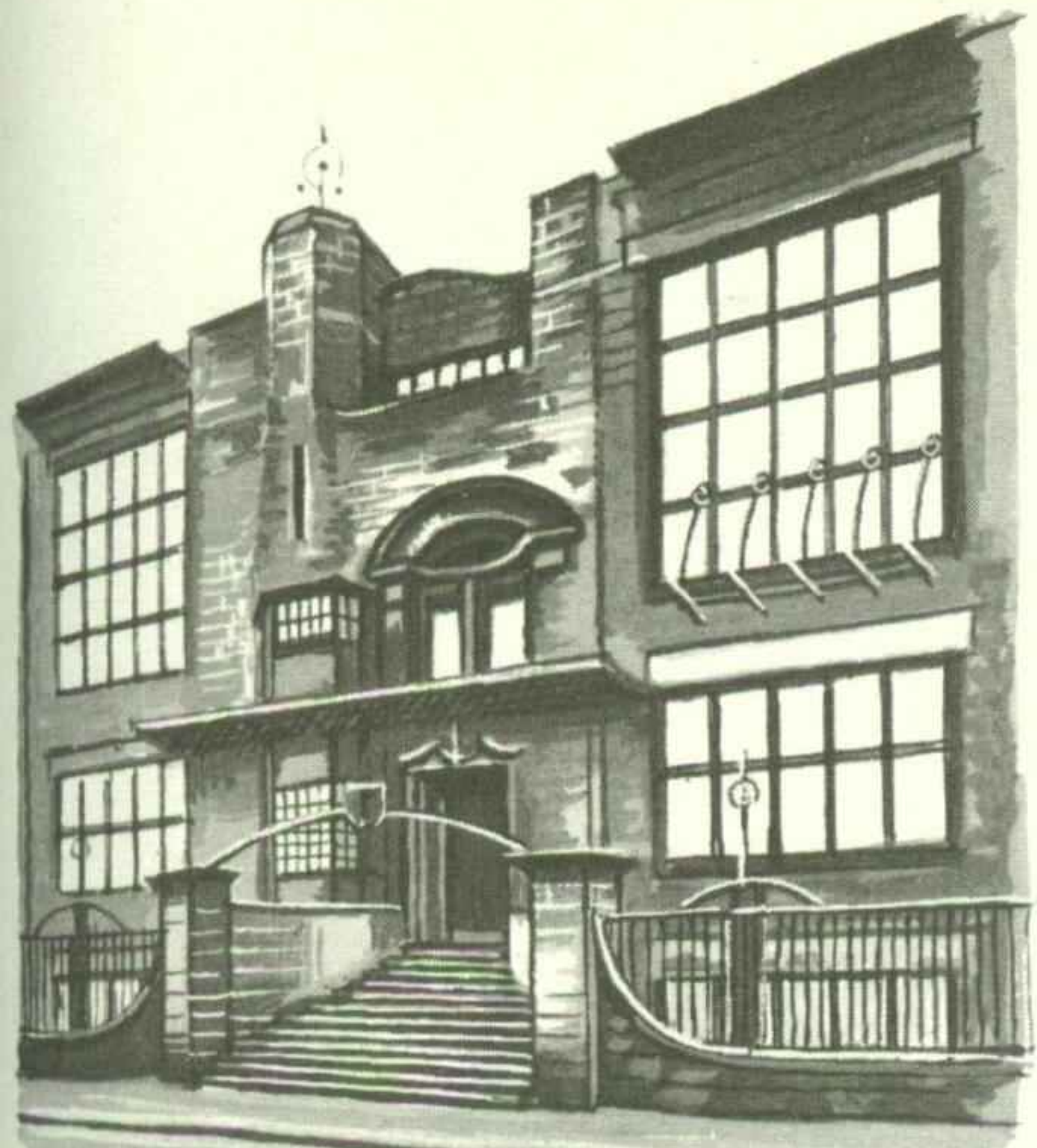


The Crystal Palace, Sydenham, London, 1852-54 Paxton; water towers, Brunel (Moved from Hyde Park, p.163)

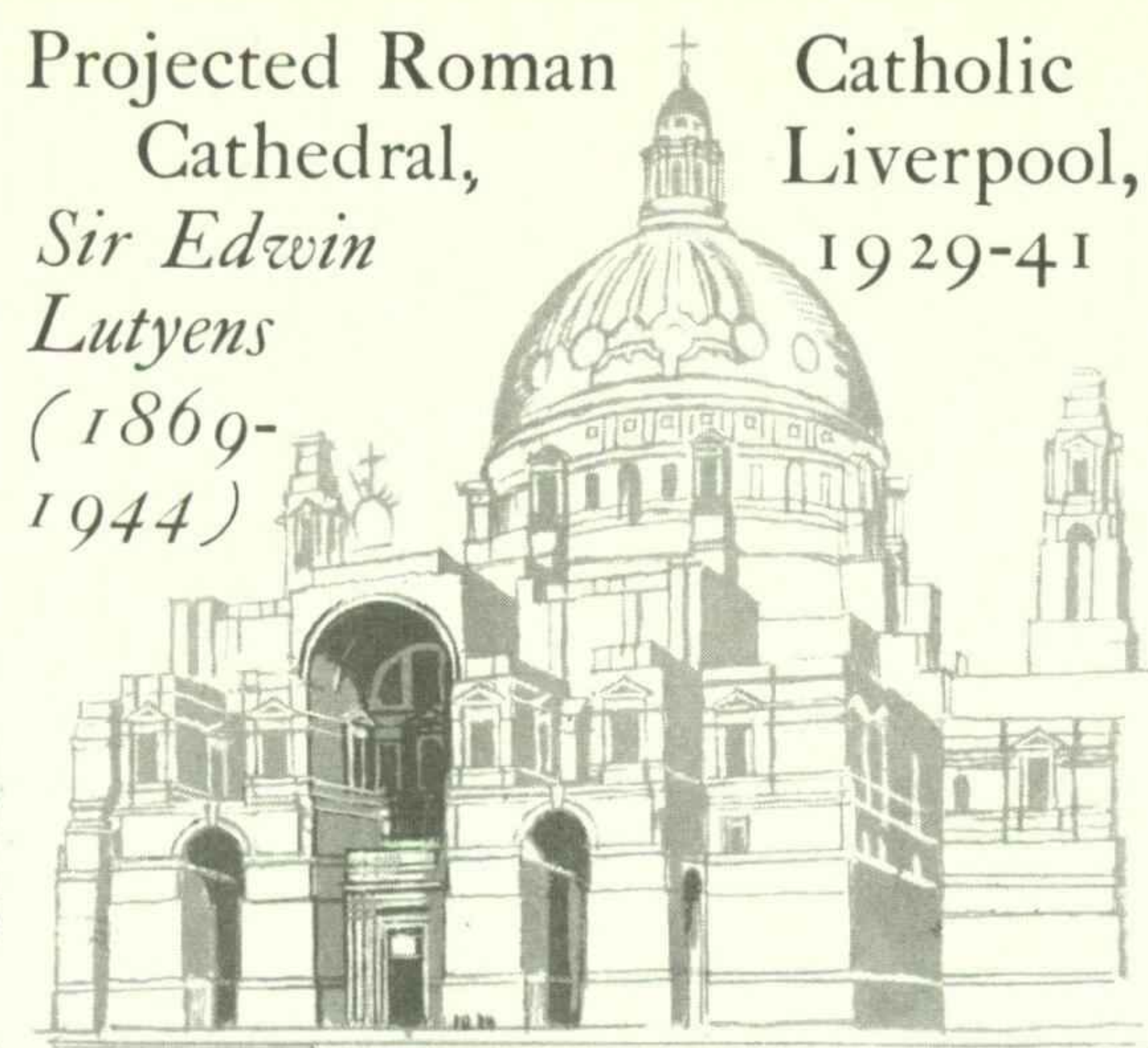
St Pancras Station, London, 1865-73. Engineers, W.H.Barlow (1812-1902) & M.Ordish (1824-88)  
Hotel, 1865-75 Sir George Gilbert Scott (1810-77)



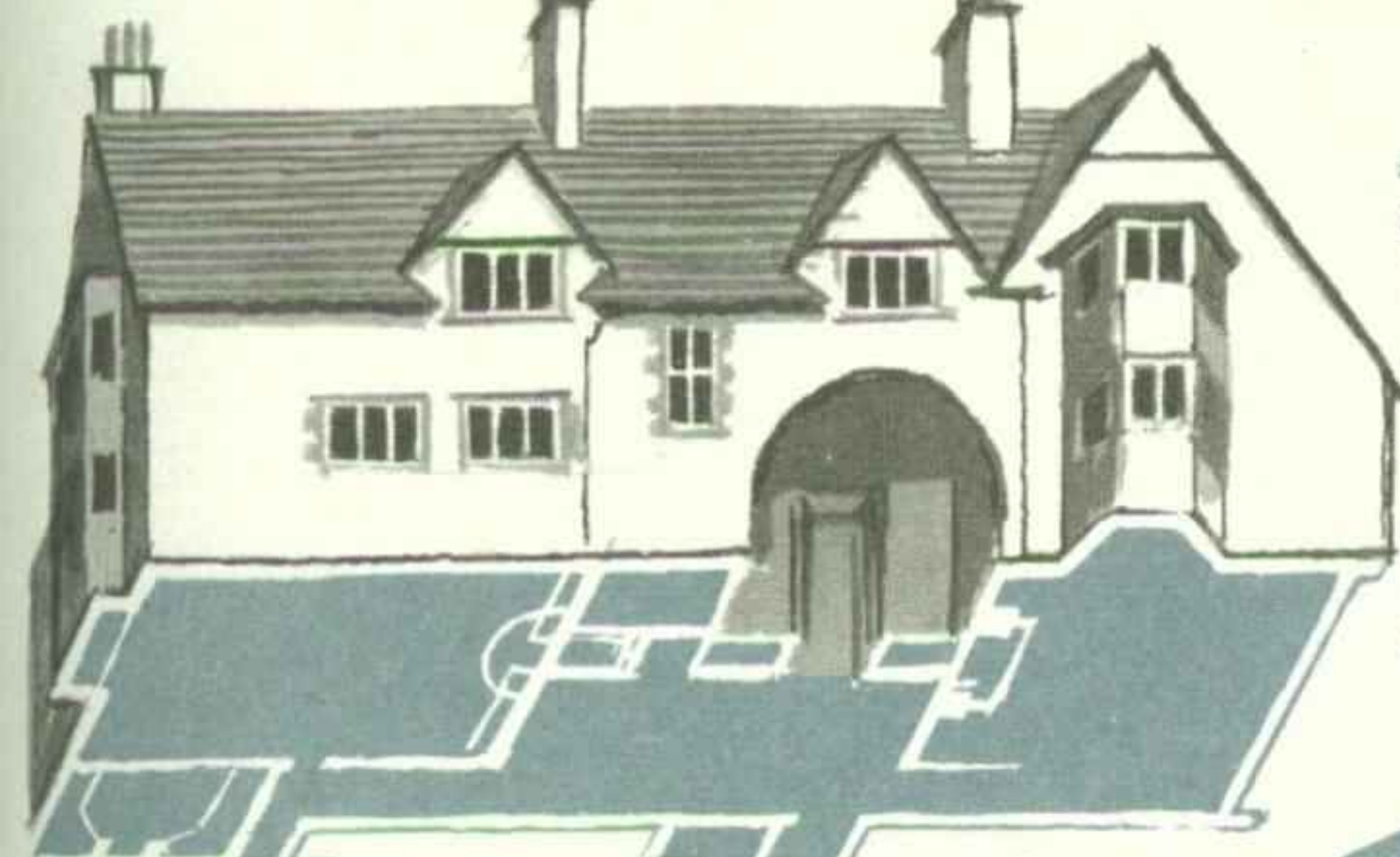
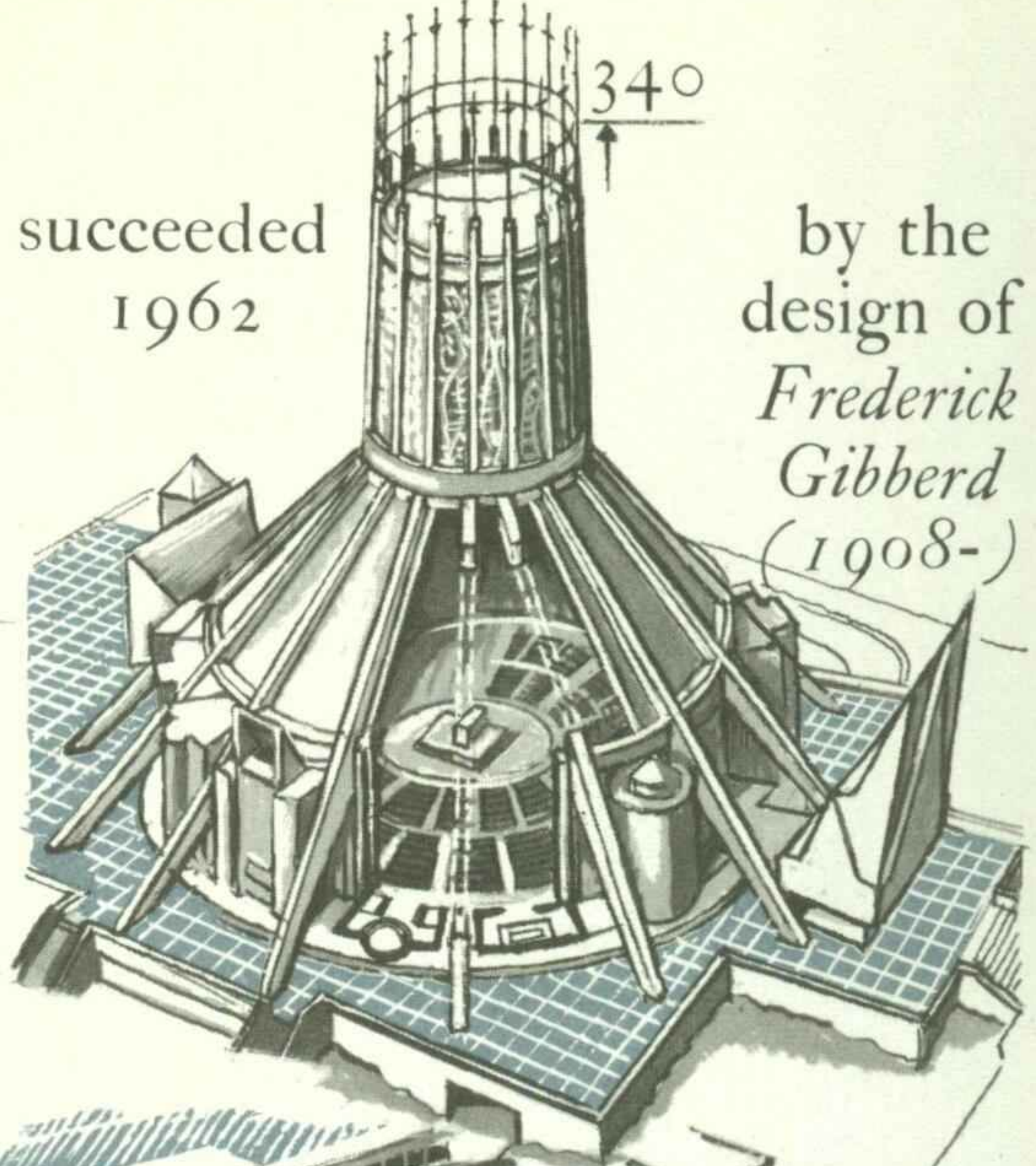
# ENGLAND



School of Art, Glasgow, 1896 Art Nouveau  
Charles Rennie Mackintosh (1868-1928)



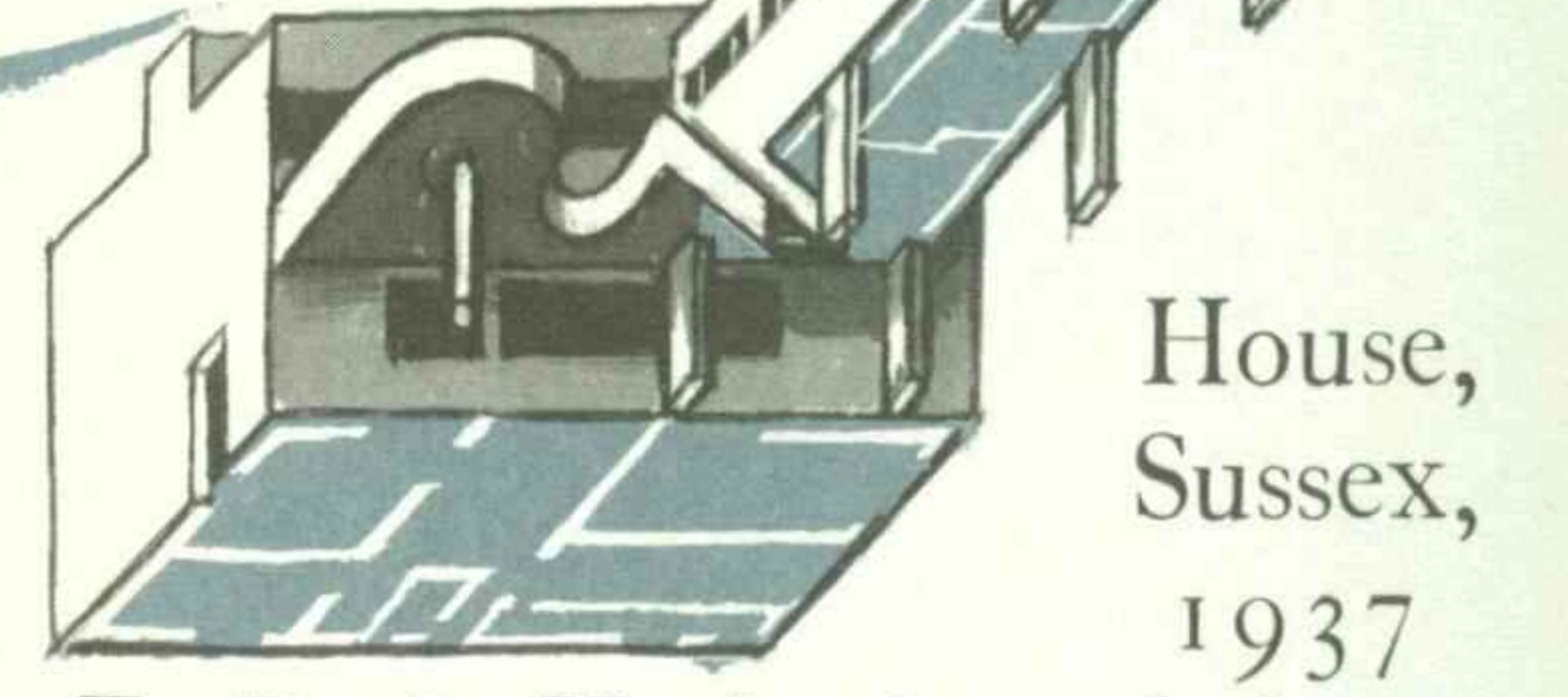
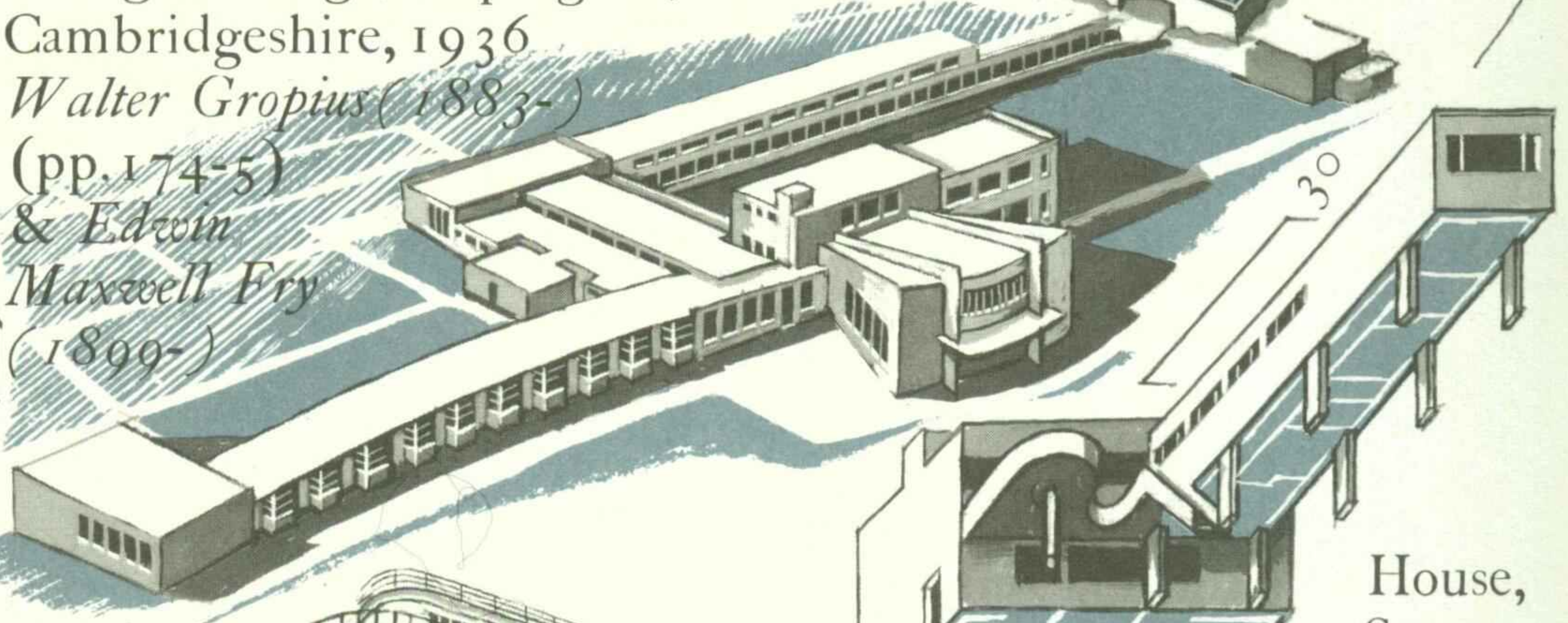
Projected Roman Catholic Cathedral, Liverpool, 1929-41 succeeded 1962 by the design of Frederick Gibberd (1908-)



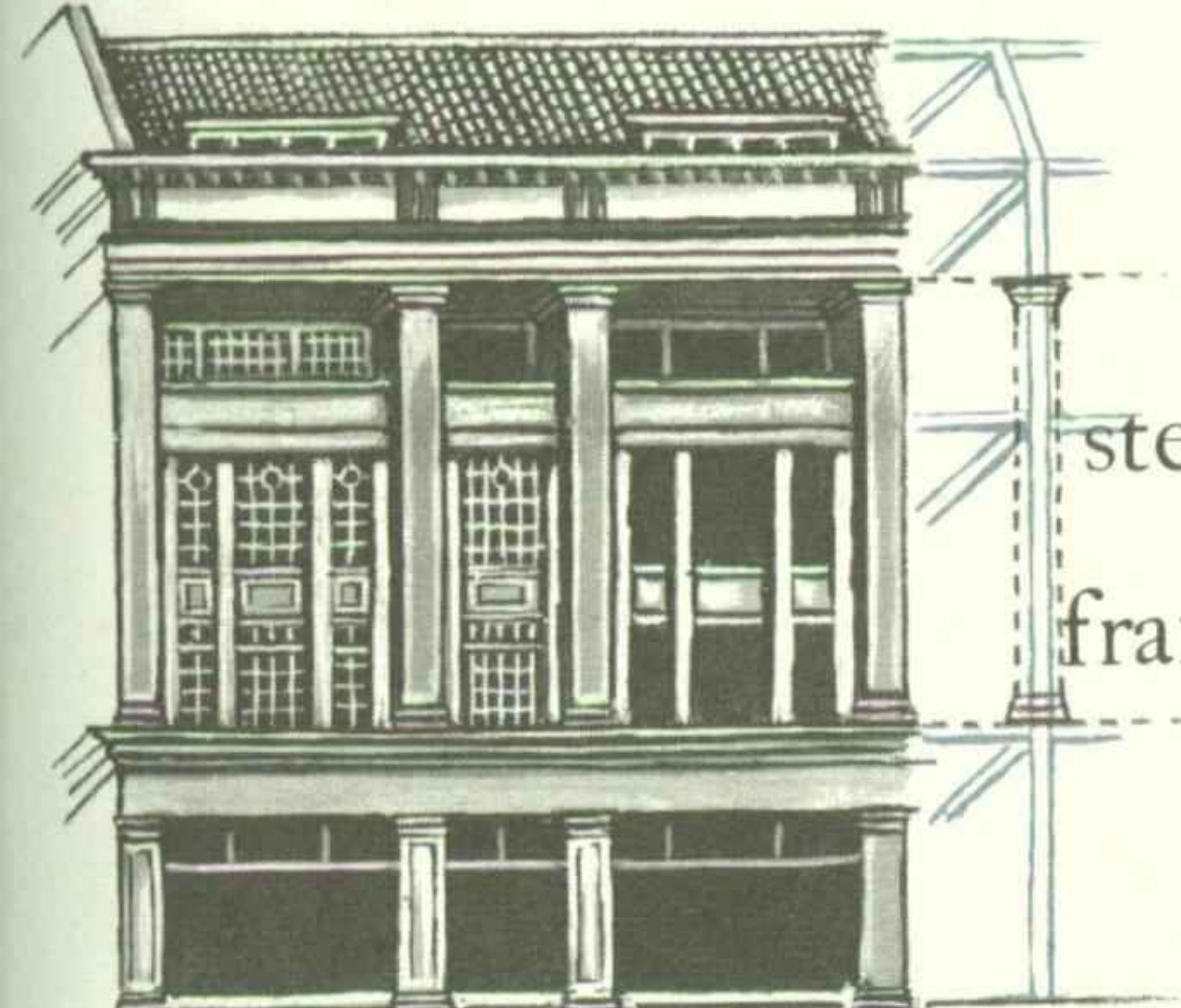
House, Rutland, 1901 Charles Annesley Voysey (1857-1941)

Village College, Impington, Cambridgeshire, 1936

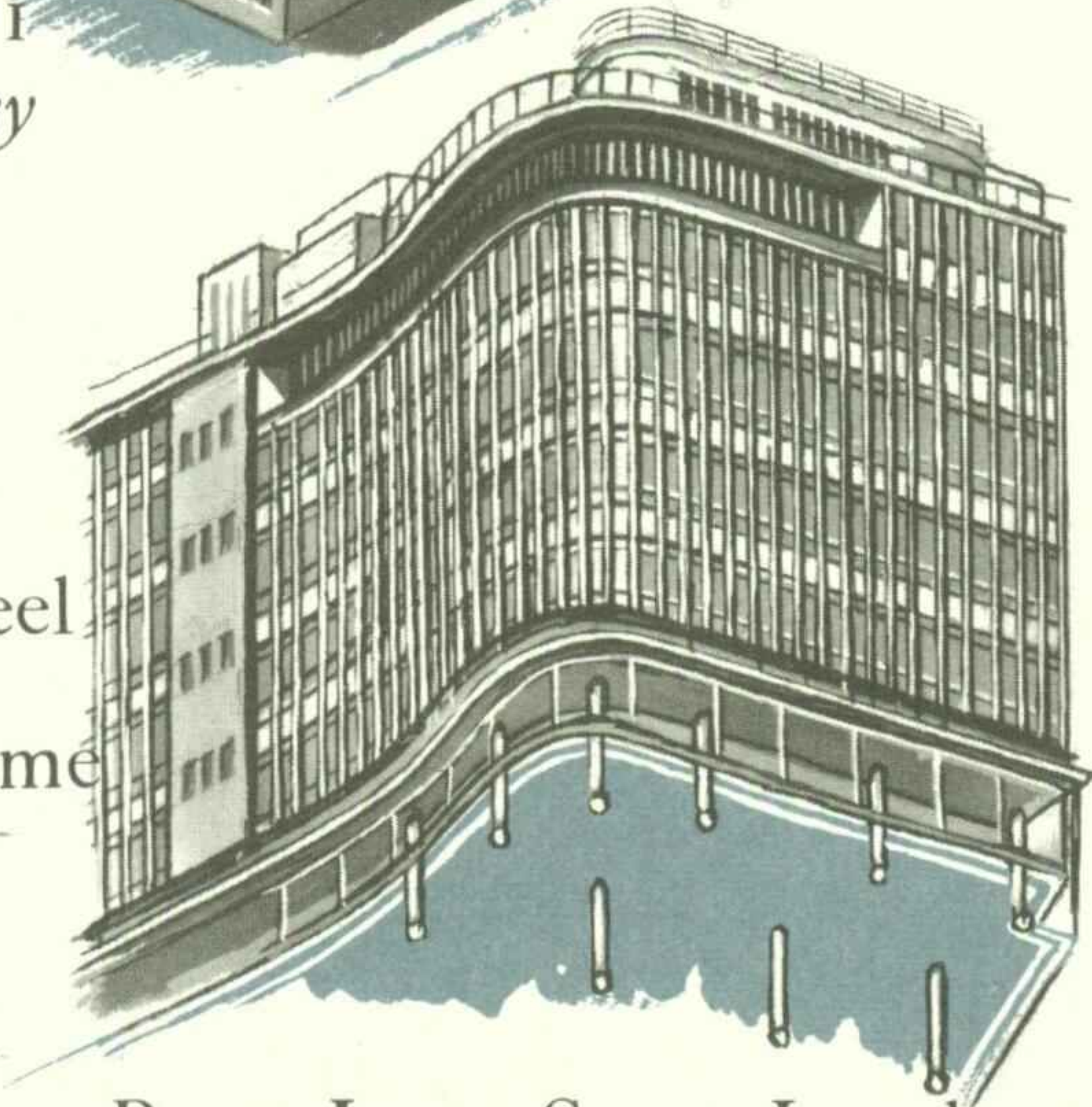
Walter Gropius (1883- (pp.174-5) & Edwin Maxwell Fry (1899-)



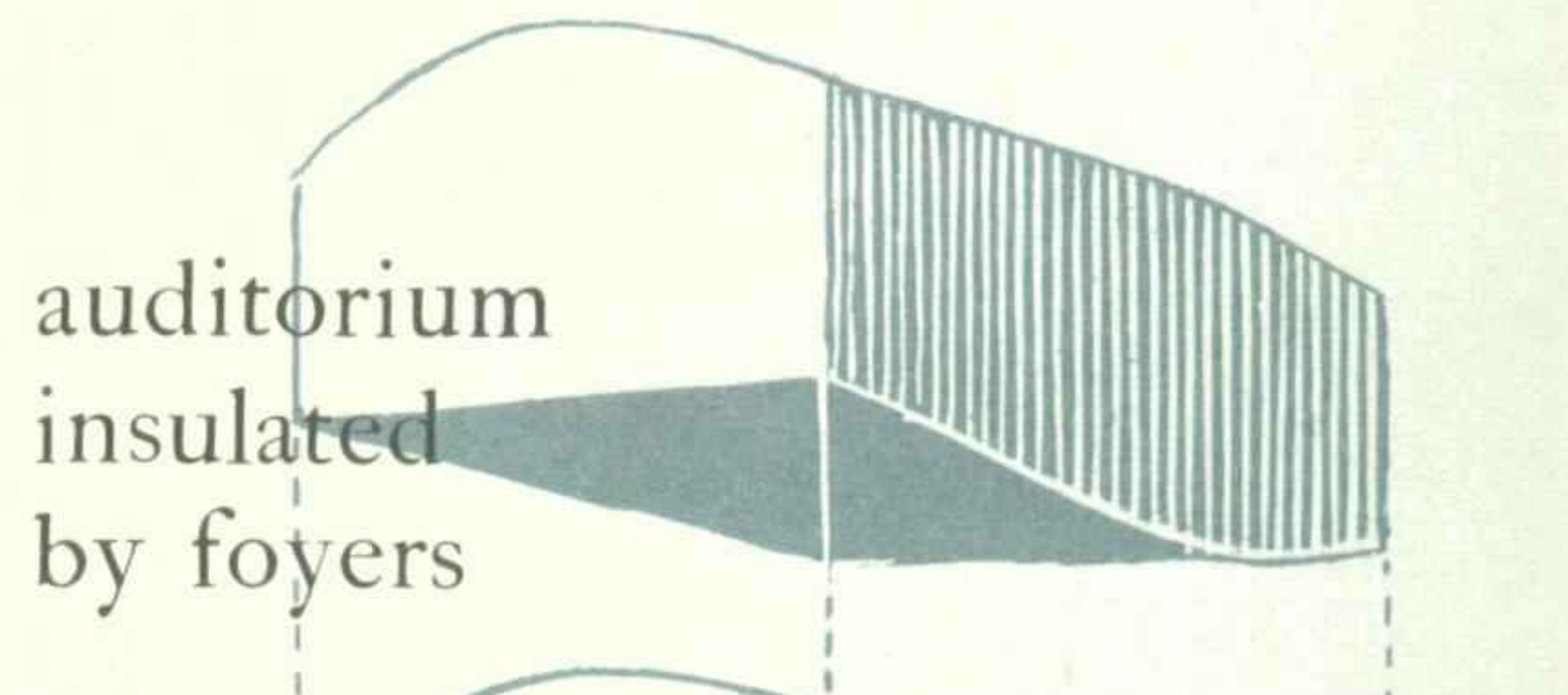
House, Sussex, 1937 F. R. S. Yorke (1906-62) & Marcel Breuer (1902-): born Hungary, U.S.A. 1937



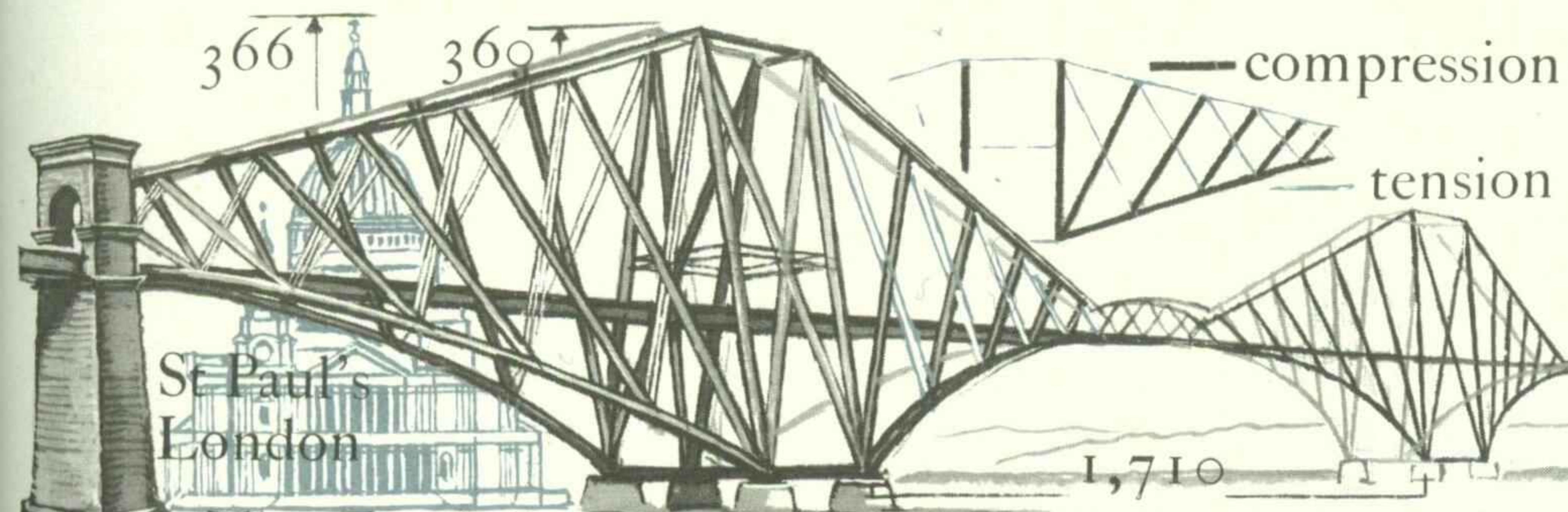
Heal & Son Store, London, 1910-14 Smith & Brewer



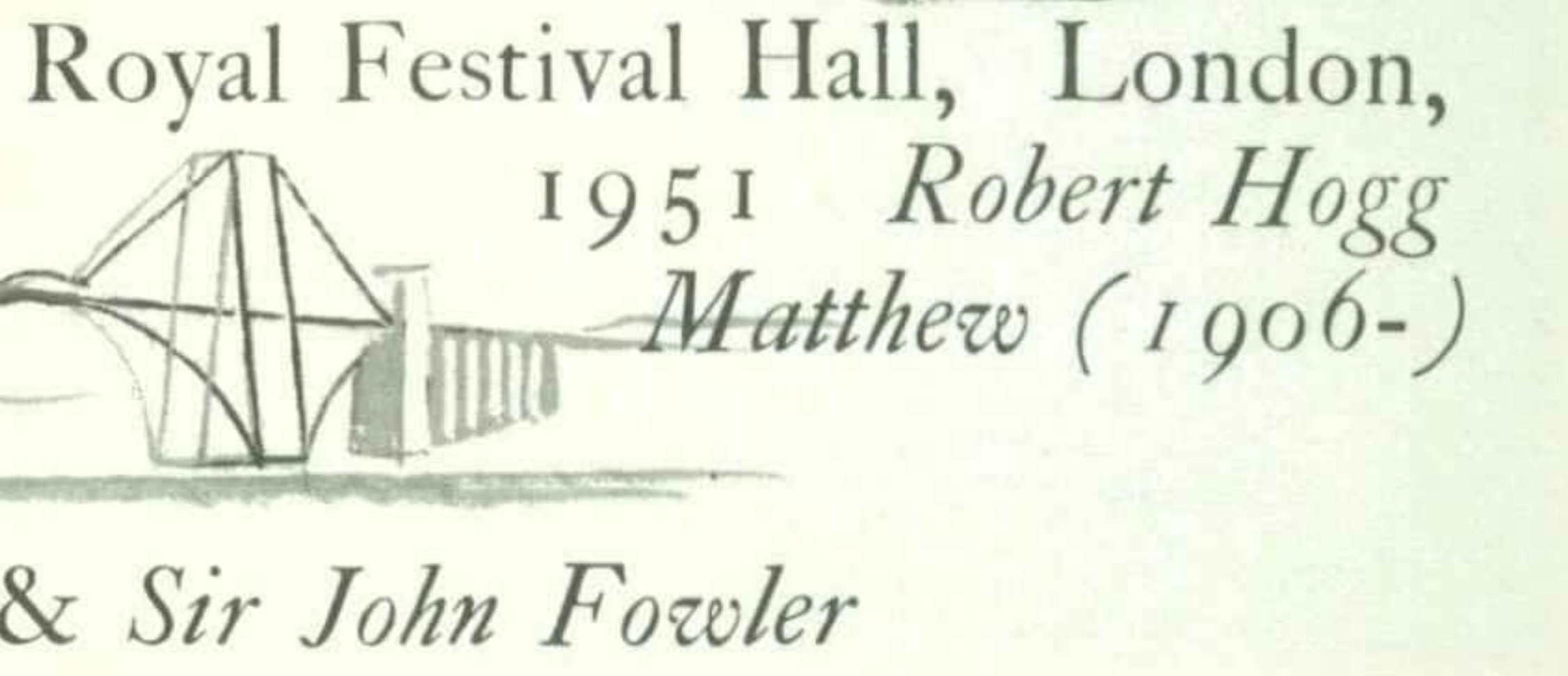
Peter Jones Store, London, 1936-39 William Crabtree



Royal Festival Hall, London, 1951 Robert Hogg Matthew (1906-)



The Forth Bridge, 1882-1890 Sir Benjamin Baker & Sir John Fowler

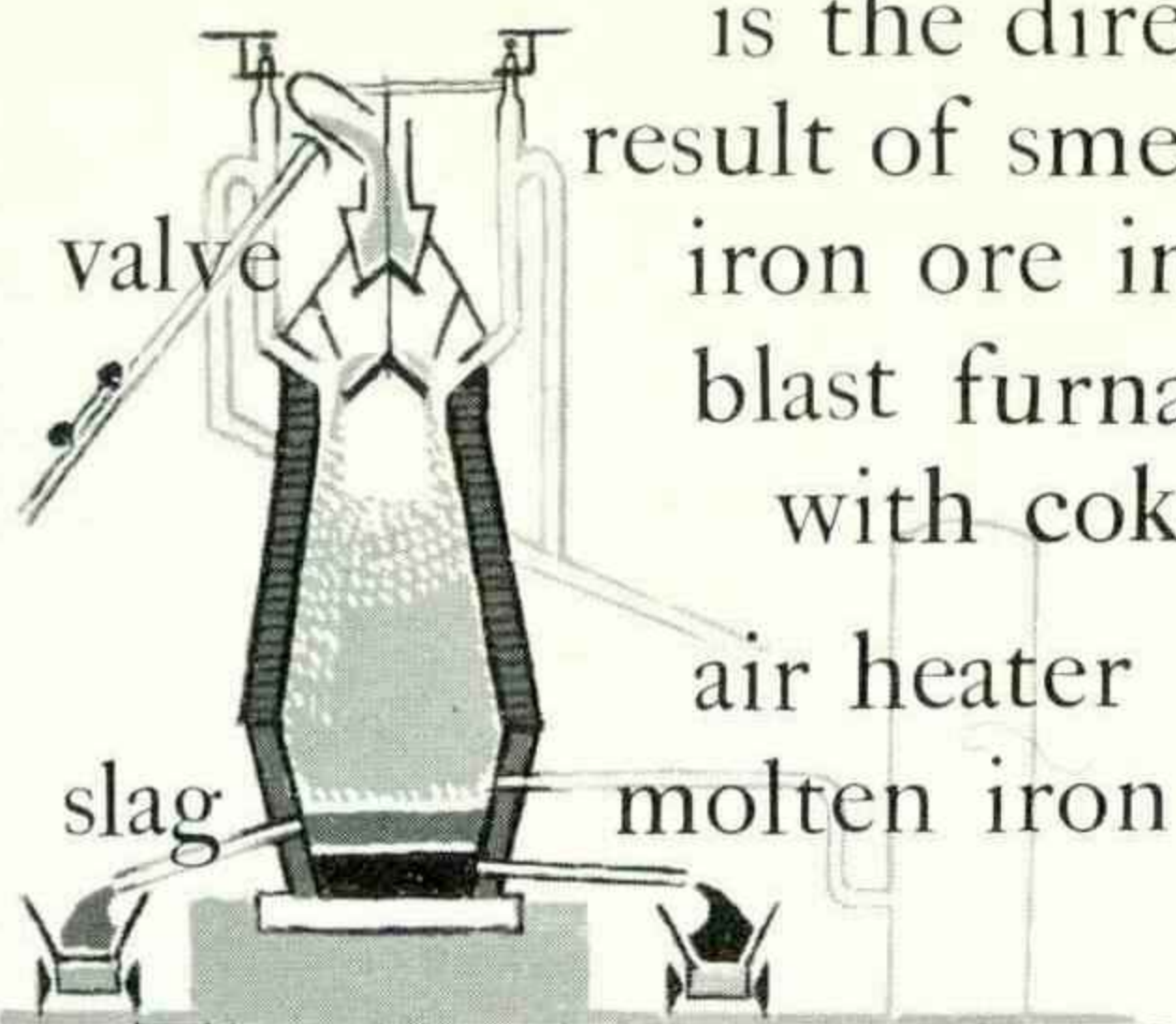


St. Paul's London

# 19 TH & 20 TH CENTURIES

## CAST IRON

is the direct result of smelting iron ore in a blast furnace with coke.



The liquid ore solidifies on cooling & can be given the desired shape by being poured into moulds. The process was first carried out c.1710 by Benjamin Darby (1677-1717). Cast iron is brittle & reacts to bending stress. Used primarily for vertical columns

## WROUGHT IRON

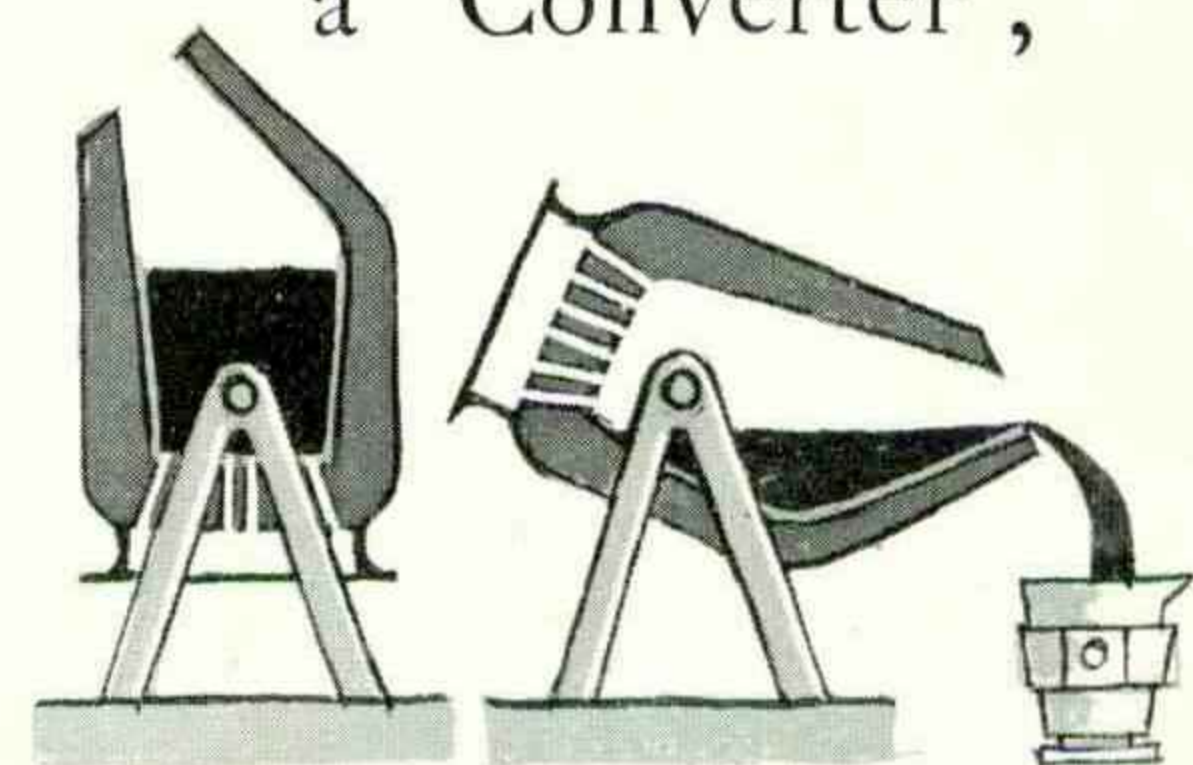
is obtained by oxidizing white-hot cast iron.

It is puddled (purified) from an excess of carbon & impurities in a 'reverberatory' furnace, introduced by Henry Cort c.1760s.

Ductile and malleable, wrought-iron can be pulled out into wire or rolled into beams

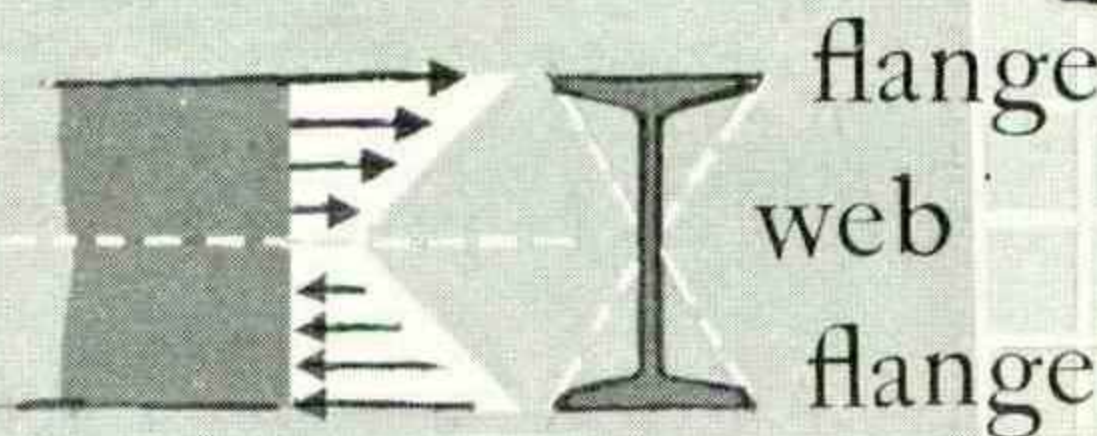
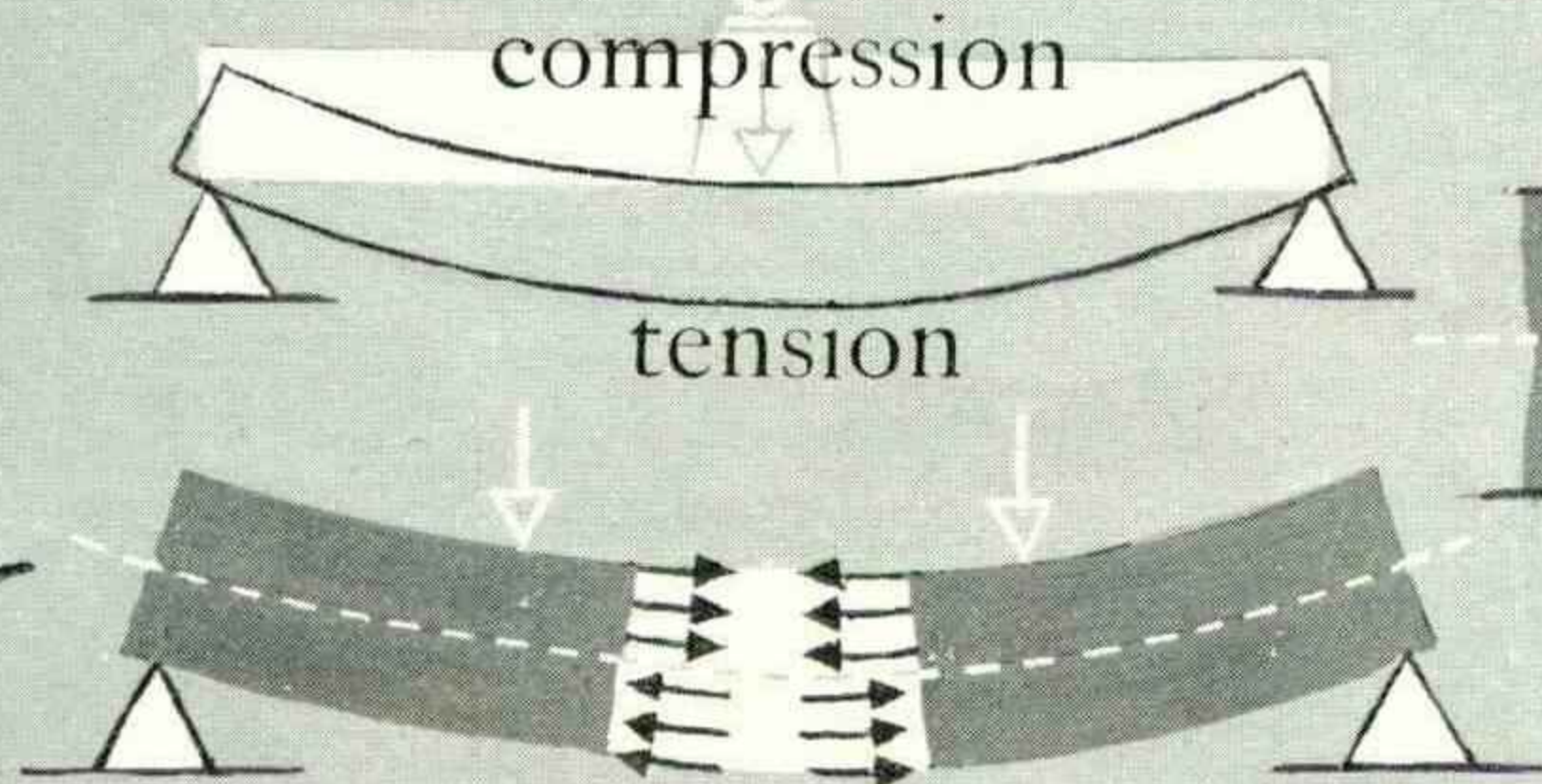
## STEEL

is made from cast-iron, the carbon being burnt out by a blast of air through the molten metal in a 'Converter',

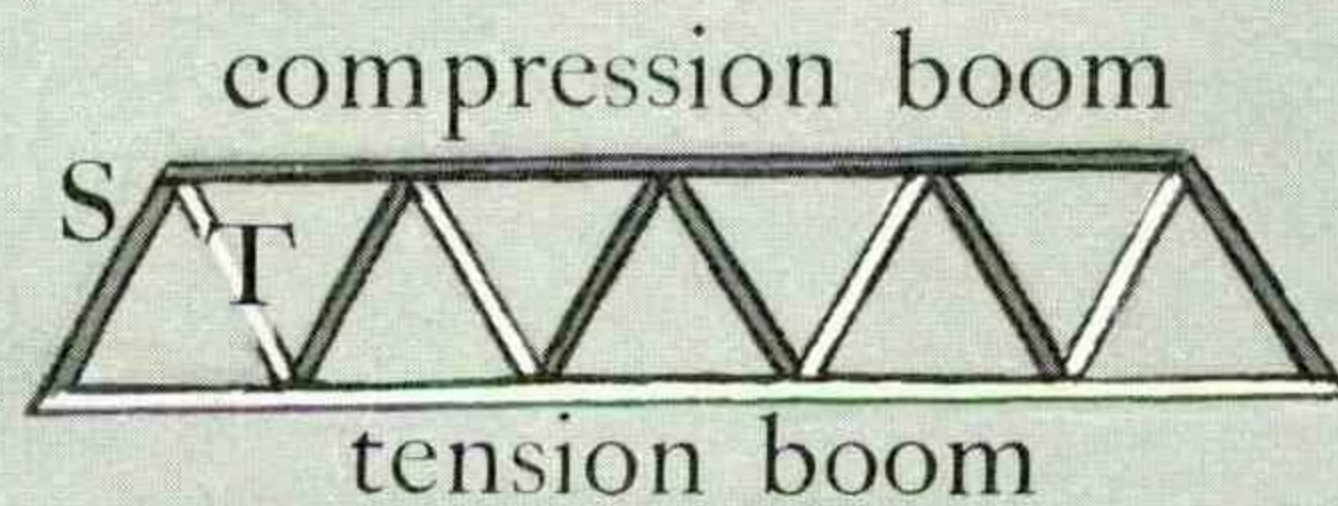


invented by Sir Henry Bessemer in 1856. Steel has equal strength in compression and tension

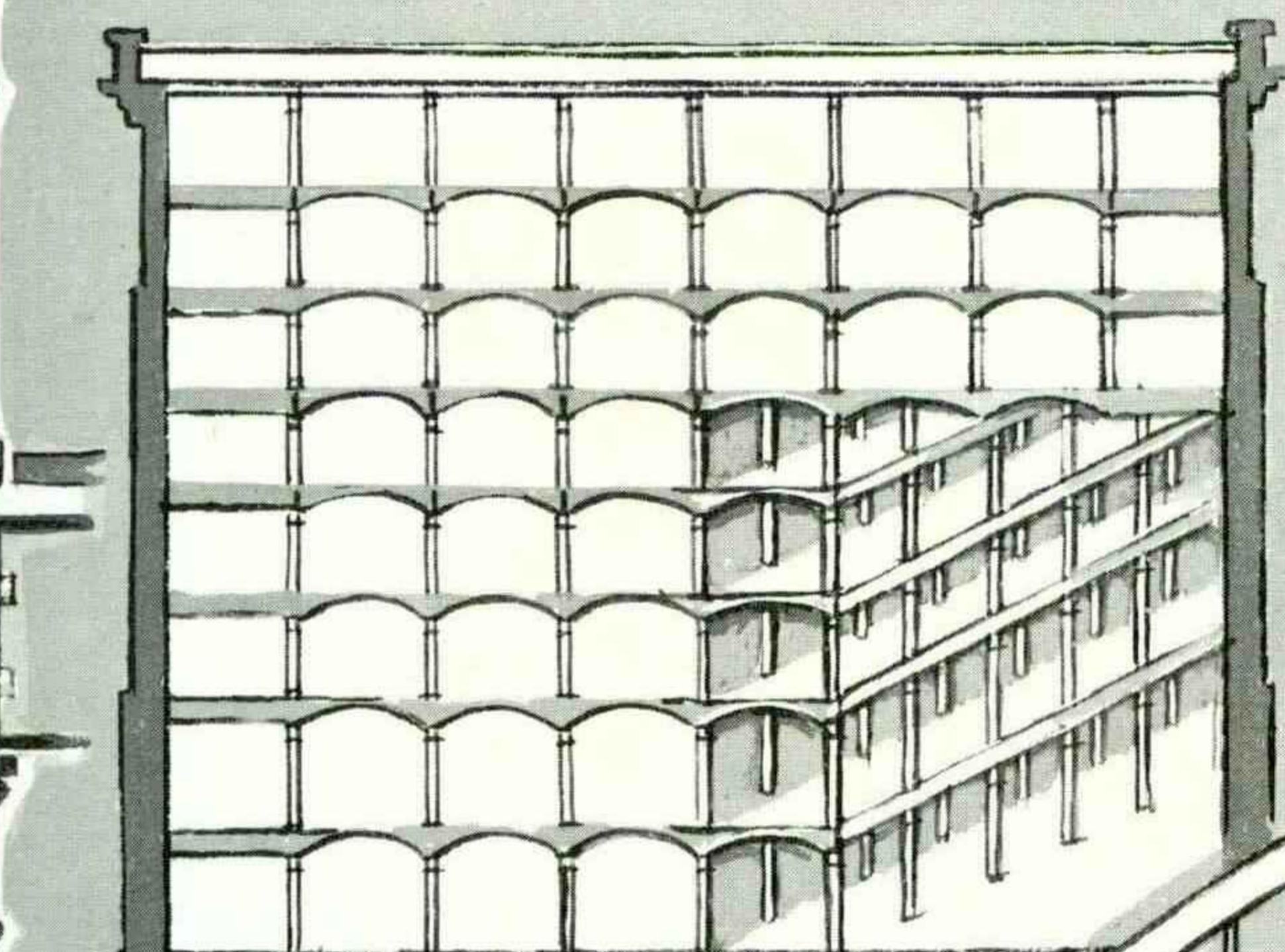
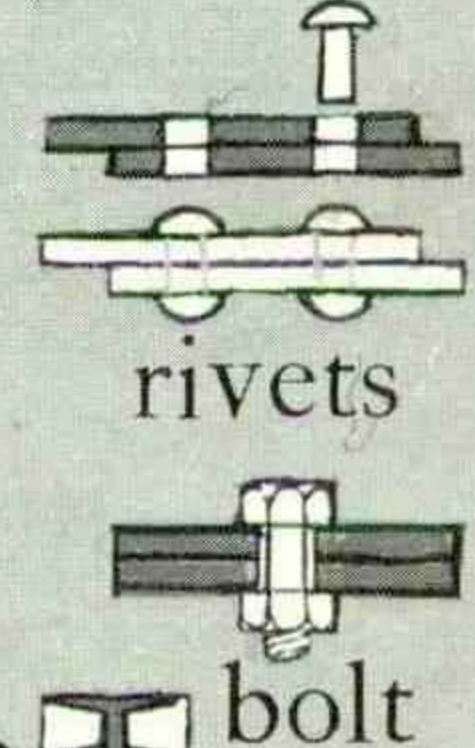
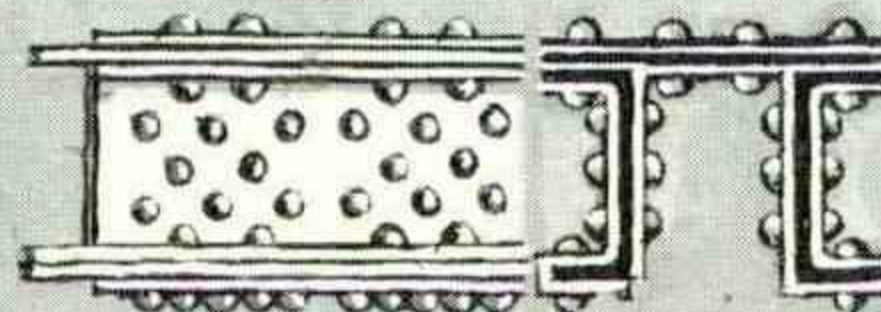
## THE BEAM



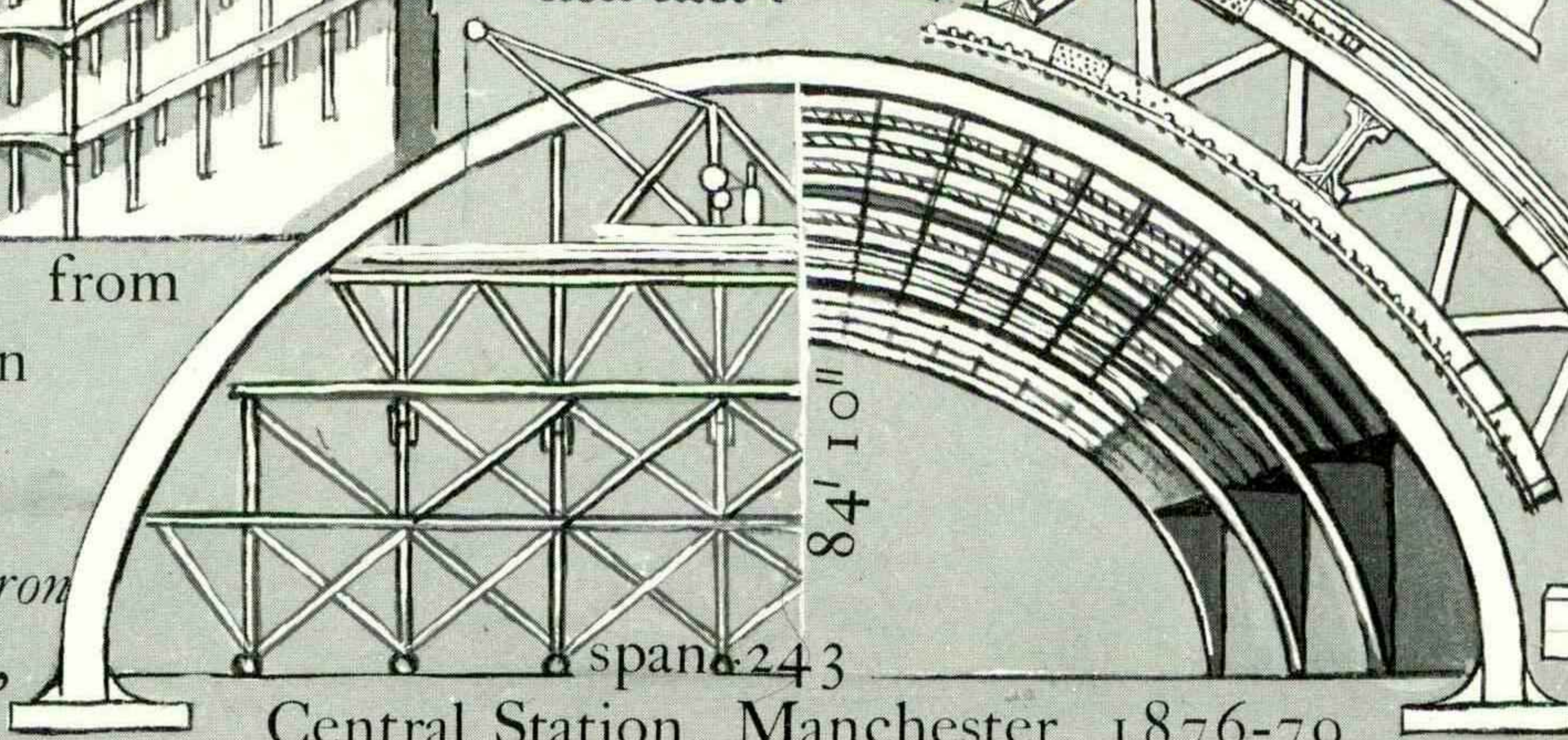
## & TRUSS



S. / compression or strut  
T. \ tension or tie



Sugar refinery, from Sir William Fairbairn (1789-1874), *The Application of Cast-iron & Wrought-iron to Building Purposes*, London, 1845



Central Station, Manchester, 1876-79

c.1845 Sir William Fairbairn

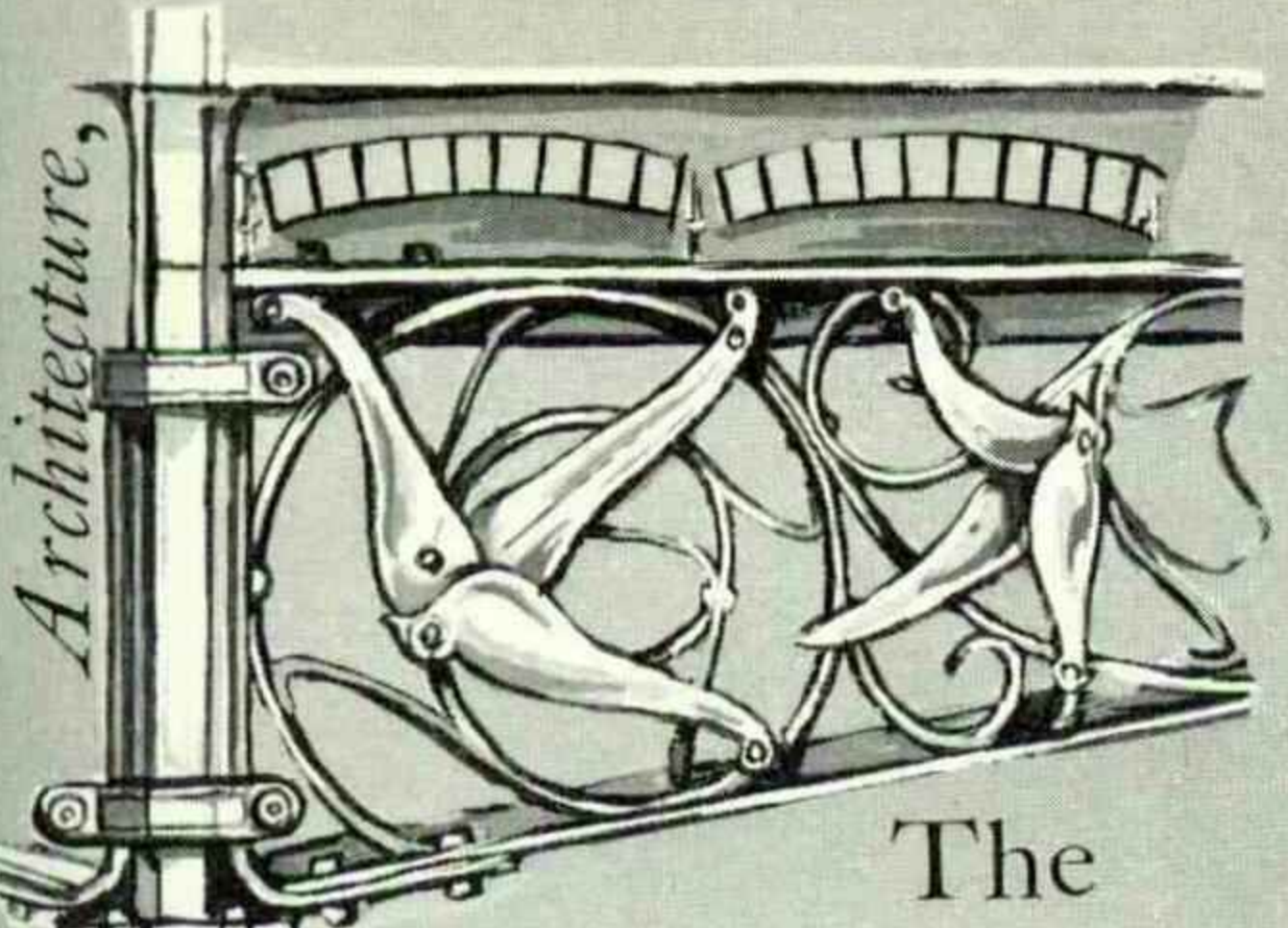
Cast-iron column and wrought-iron beams,

Cast-iron column, Victoria Station, London, 1861

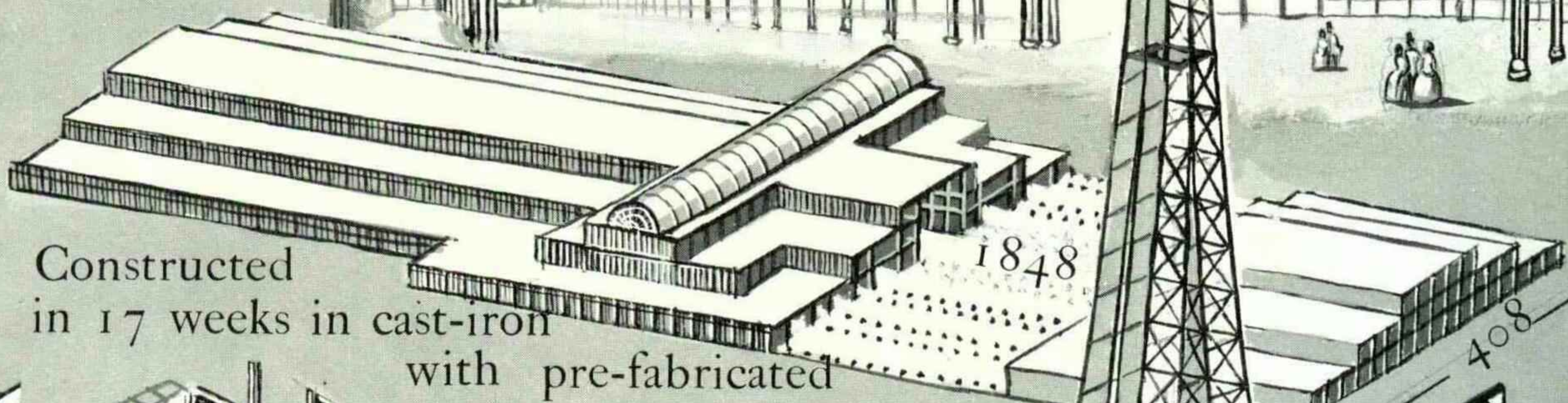
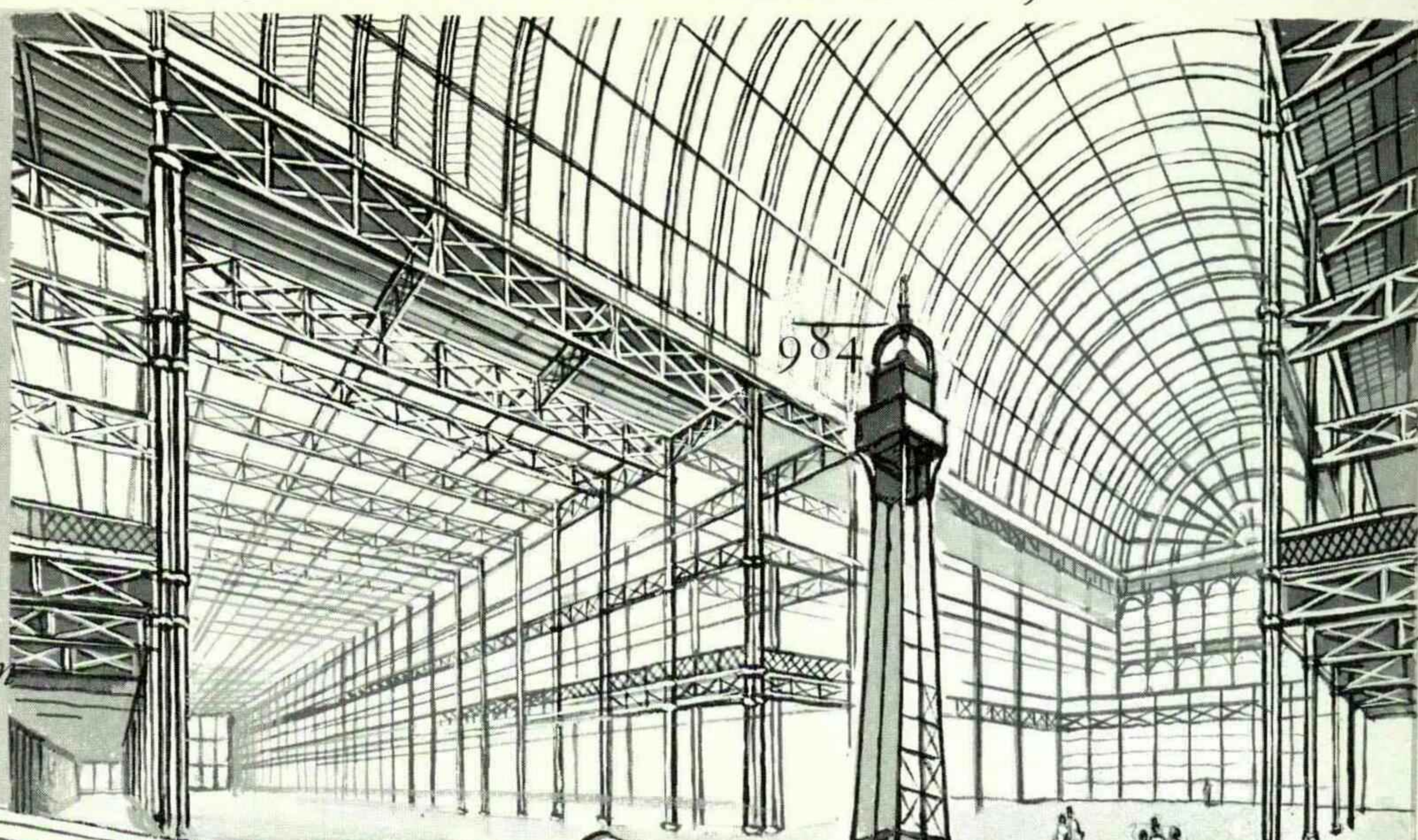
Cast-iron column, Woodside Station, Birkenhead, c.1876

# CAST IRON, WROUGHT IRON, STEEL

Design for wrought-iron column: *Viollet-le-Duc* (1814-79), from *Lectures on Architecture*, Paris, 1863-72



The Crystal Palace, Hyde Park, London, 1851  
*Sir Joseph Paxton* (1803-1865)

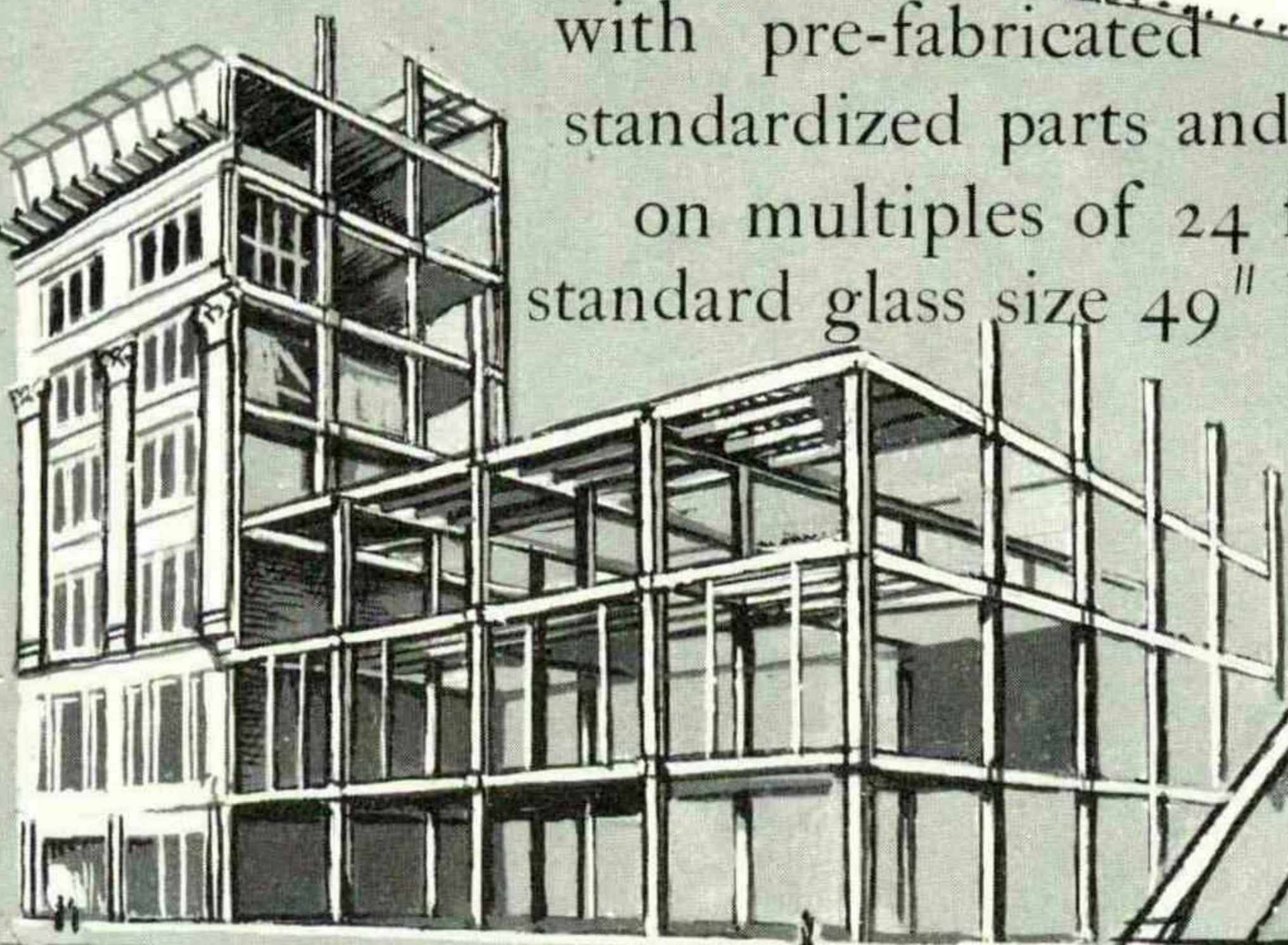


Constructed in 17 weeks in cast-iron with pre-fabricated standardized parts and based on multiples of 24 feet standard glass size 49" by 10"

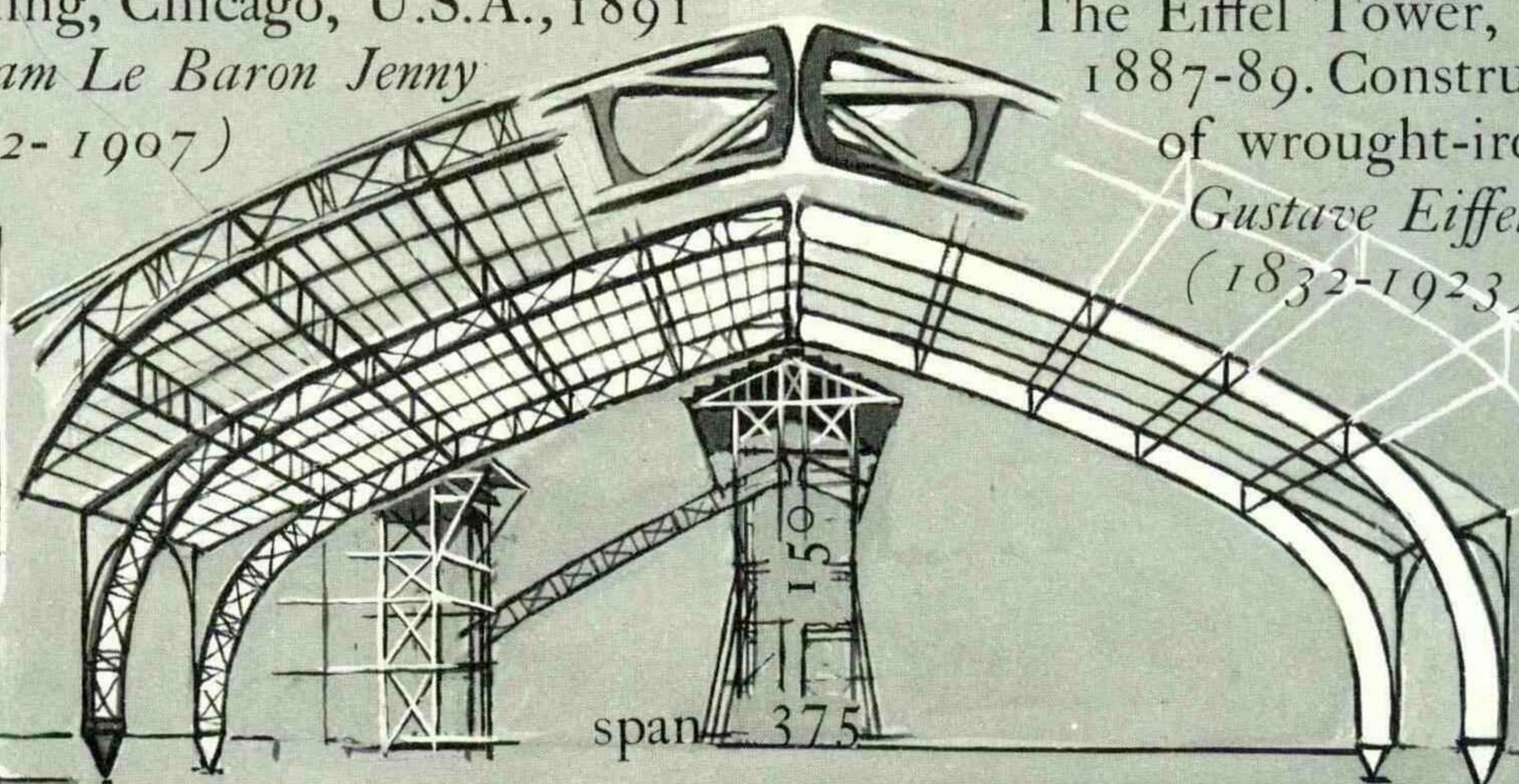
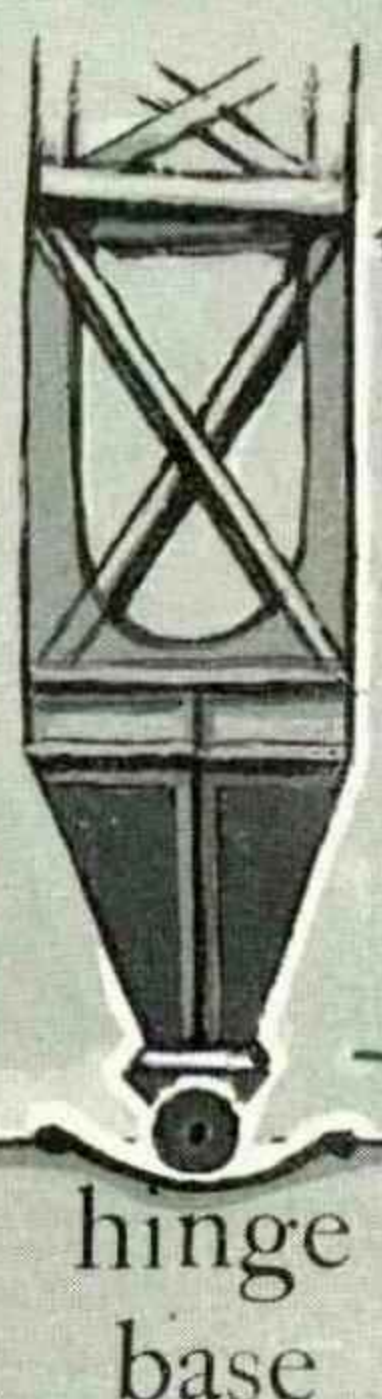
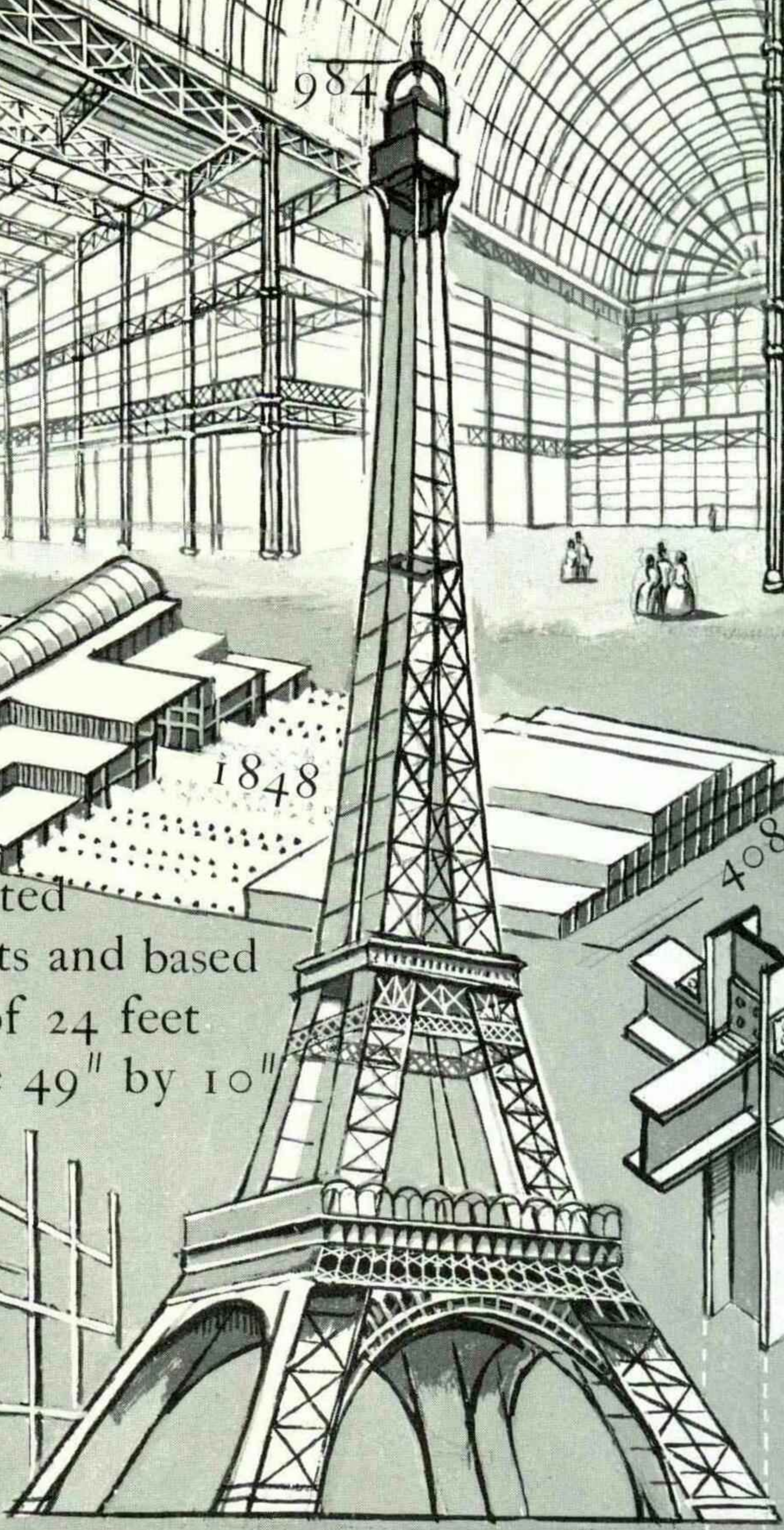
Art Nouveau: cast-iron structure, Brussels, 1893



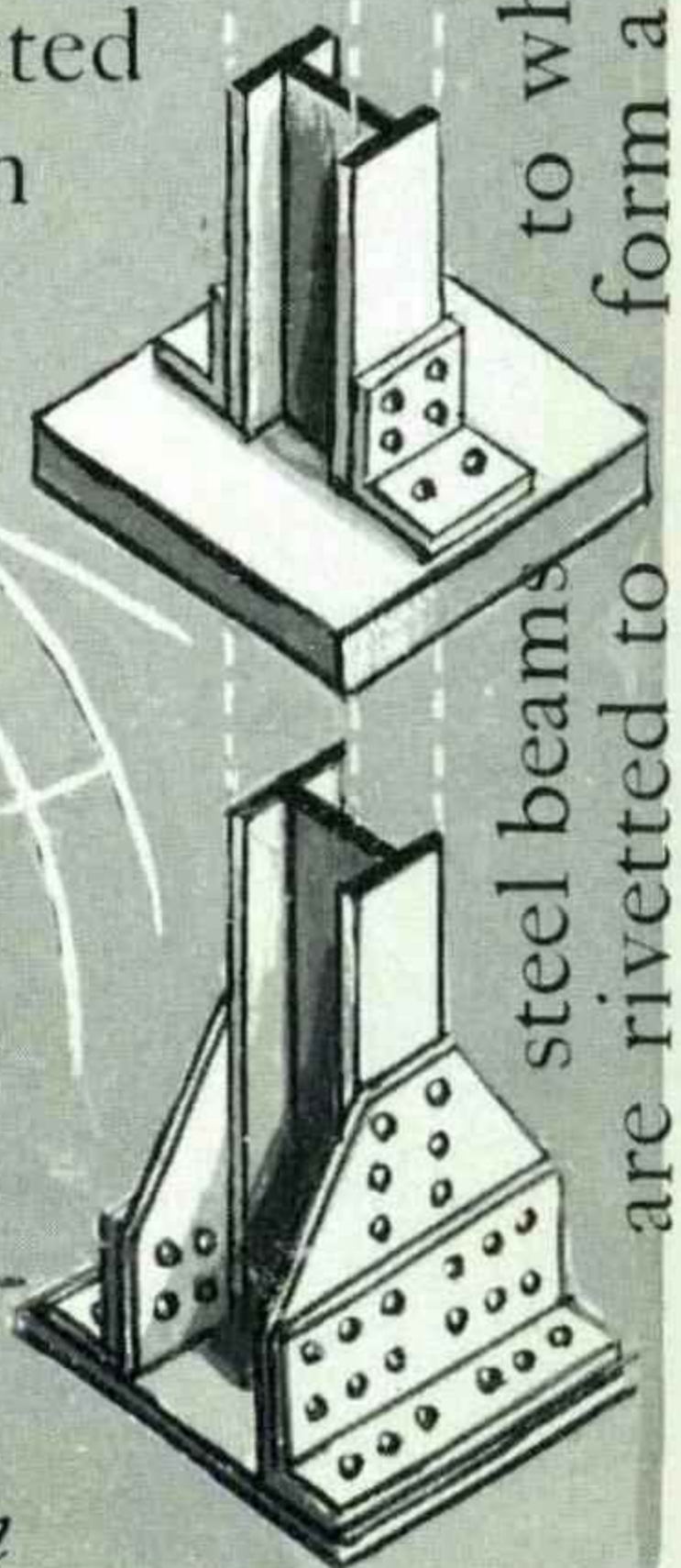
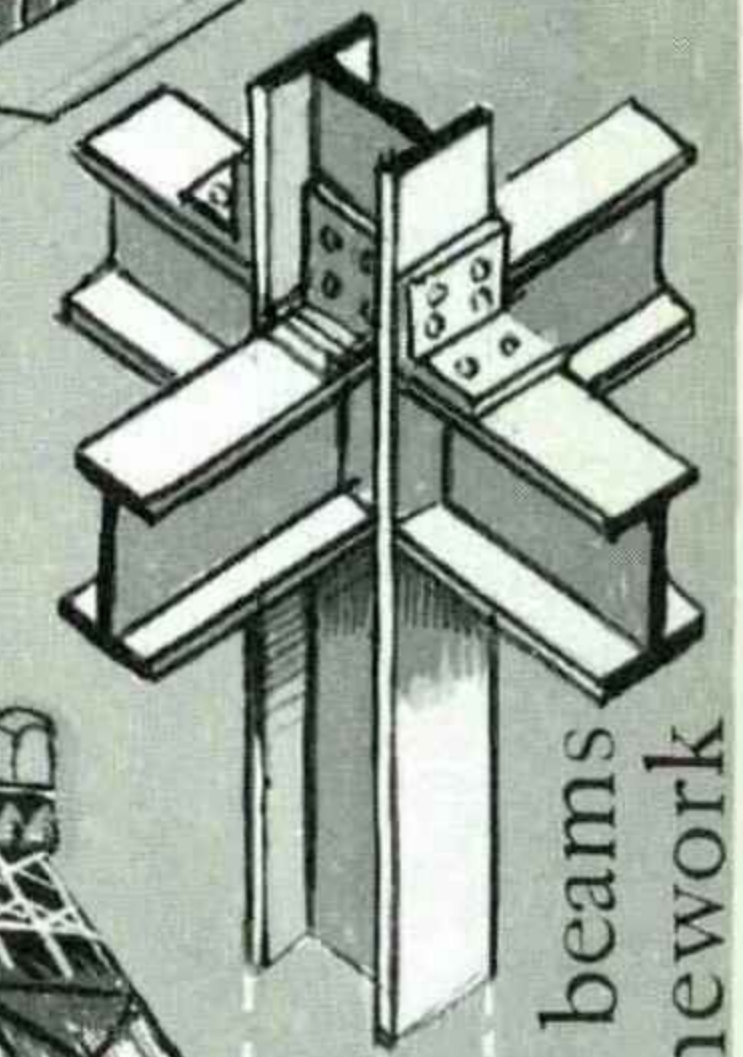
The Fair Building, Chicago, U.S.A., 1891  
*William Le Baron Jenney* (1832-1907)



The Eiffel Tower, Paris, 1887-89. Constructed of wrought-iron  
*Gustave Eiffel* (1832-1923)

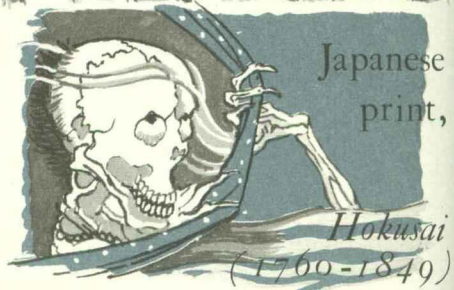
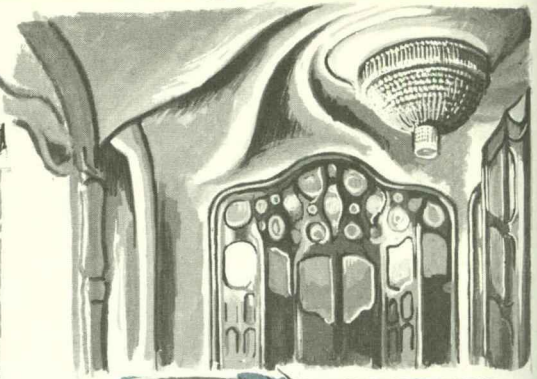
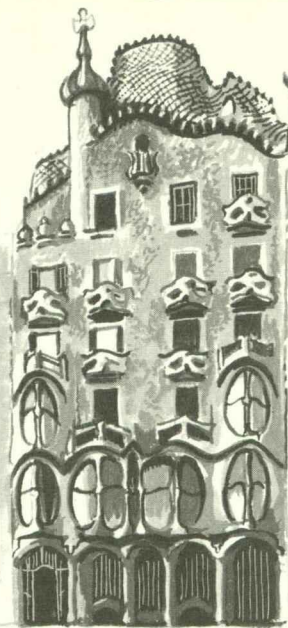
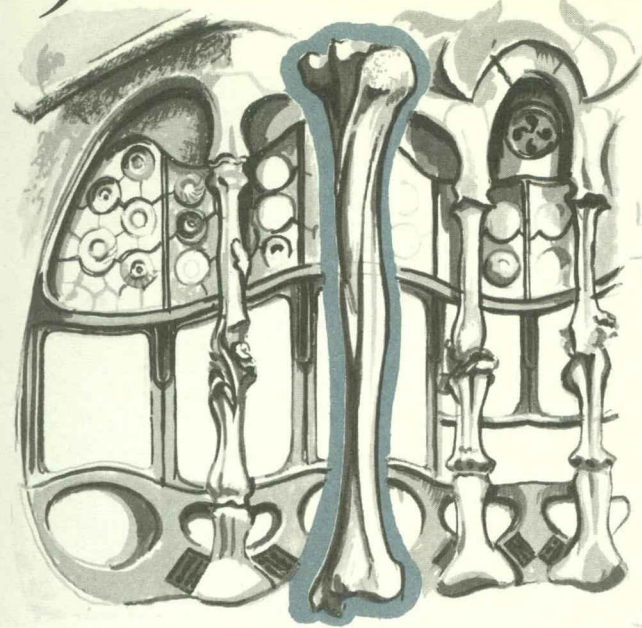


Galerie des Machines, International Exhibition, Paris, 1889: three-hinged steel arch  
*Dutert*, engineer *Cottamin*

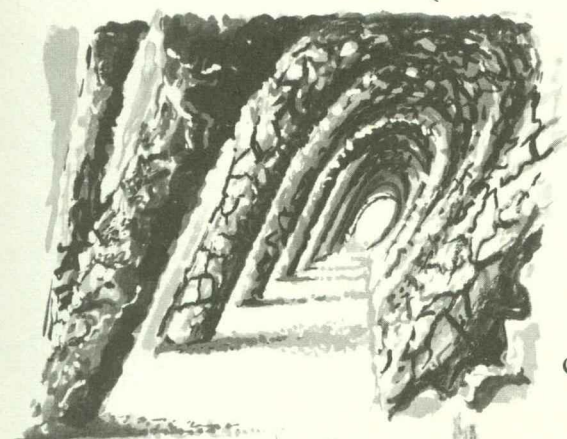


to which cross beams are rivetted to form a rigid framework

# 19TH & 20TH CENTURIES

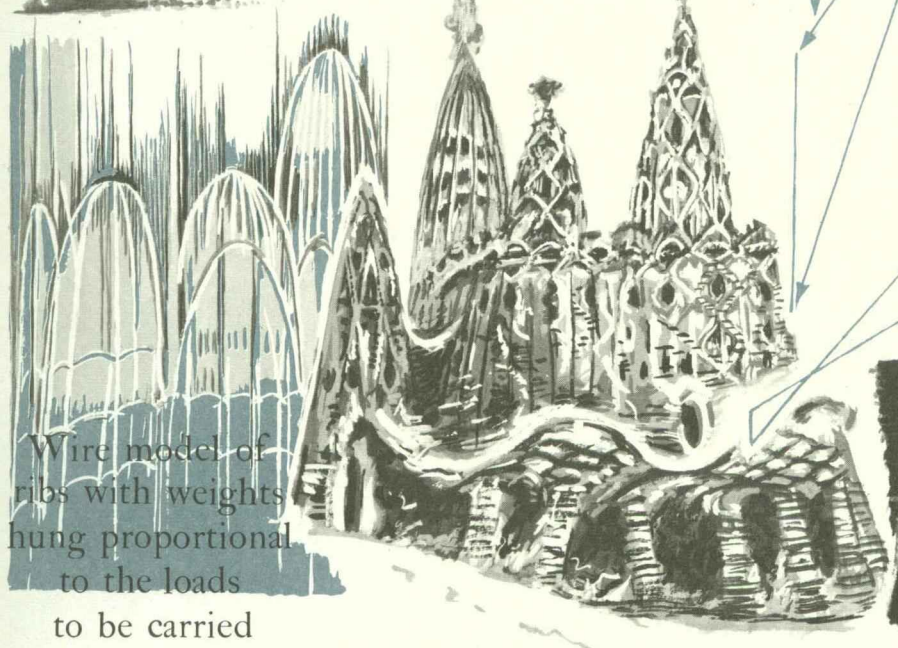
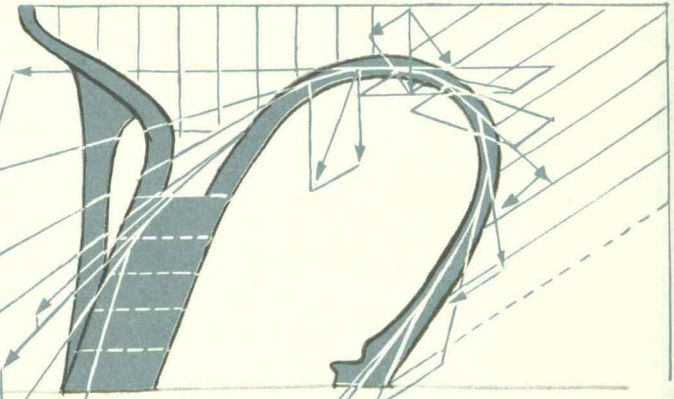


Casa Batlló ( 'House of the bones' ), Barcelona, 1903-07 Gaudí

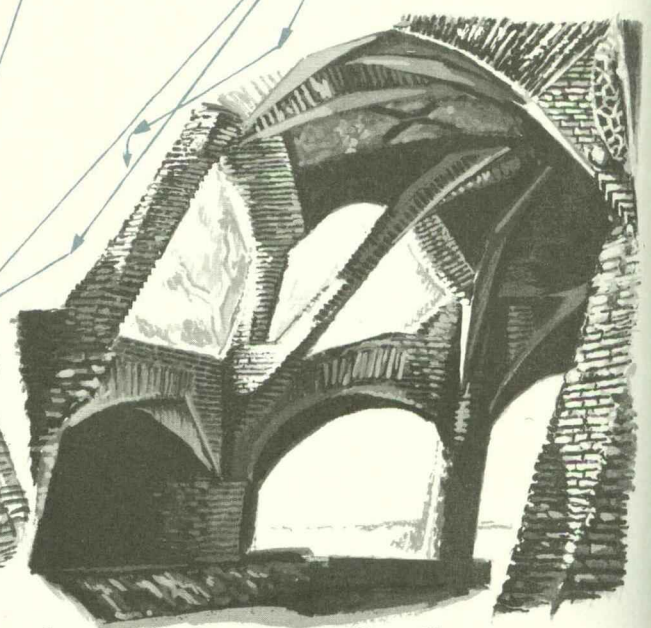


Parc Güell, Barcelona, 1900-14 Gaudí

tilted helicoid columns



Wire model of ribs with weights hung proportional to the loads to be carried



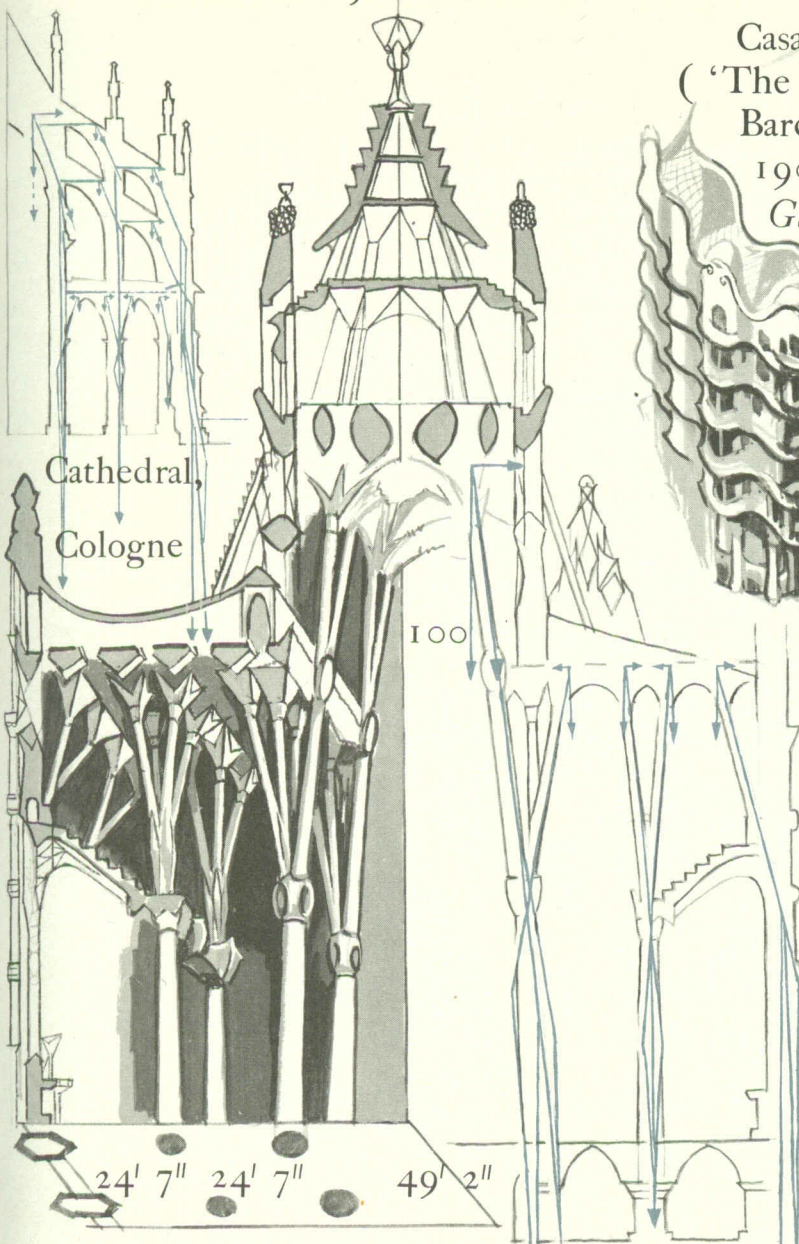
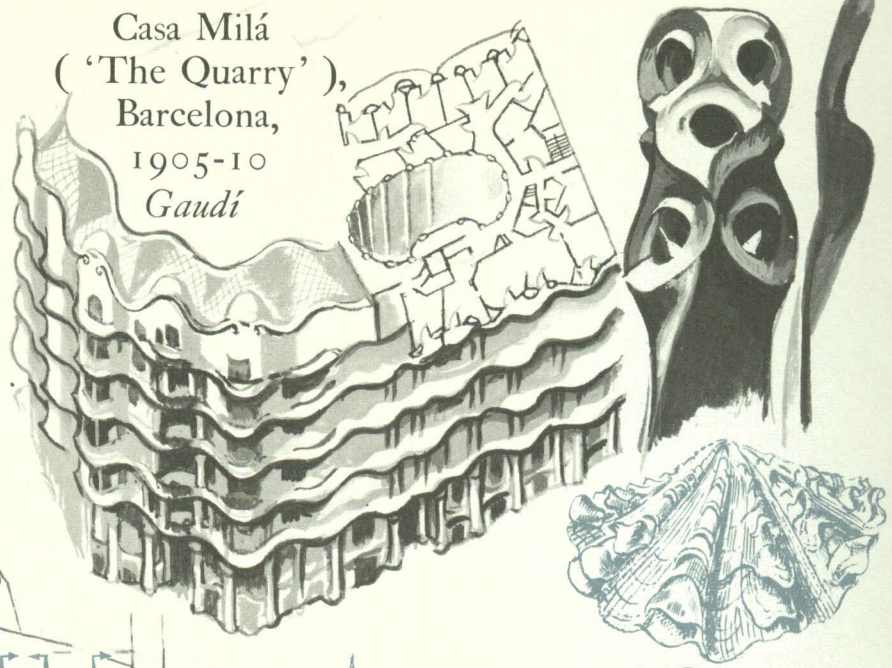
Project for Güell Colony chapel, nr Barcelona 1898-1914 Gaudí

Antoni Gaudí (1852-1926): born Reus, near Tarragona; worked & died in Barcelona. 'Gaudí'



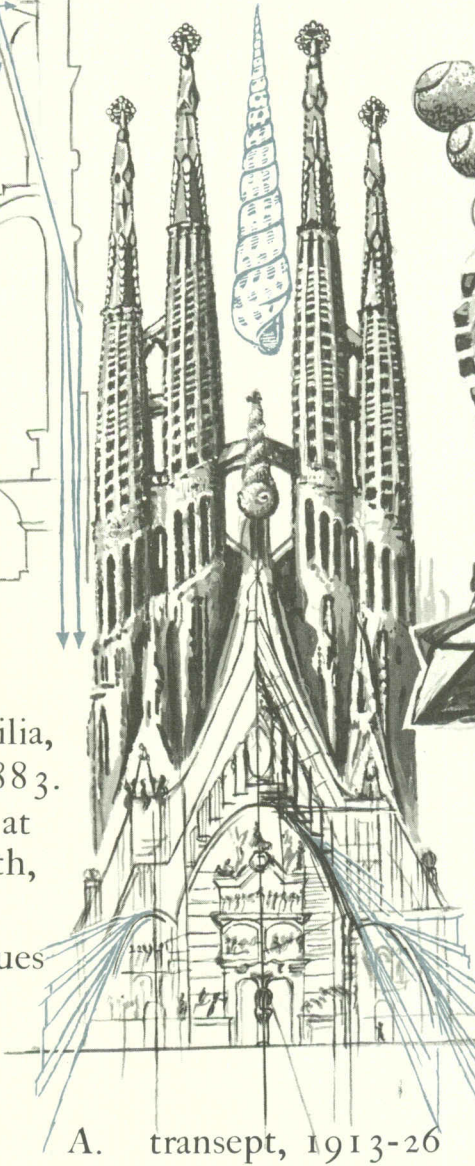
# SPAIN, MODERNISMO, GAUDÍ

Casa Milá  
( 'The Quarry' ),  
Barcelona,  
1905-10  
Gaudí

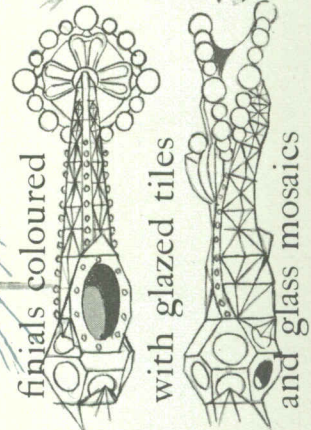
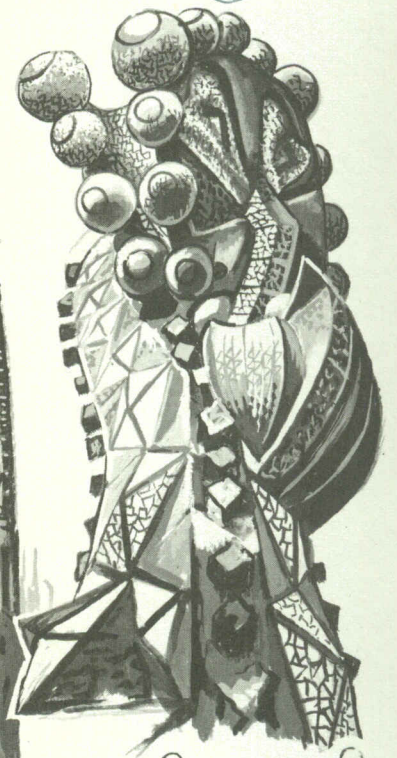


Cathedral,  
Cologne

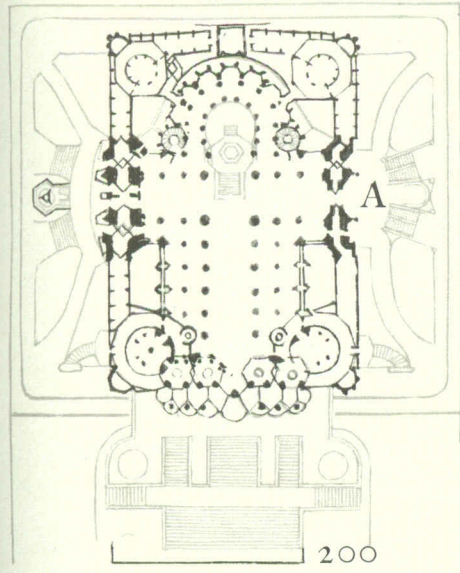
Sagrada Familia,  
Barcelona, 1883.  
Unfinished at  
Gaudí's death,  
1926;  
work continues



A. transept, 1913-26



finials coloured  
with glazed tiles  
and glass mosaics



200

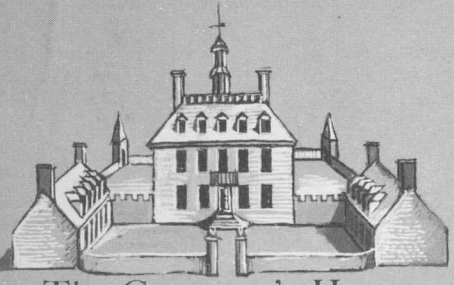
is the constructor of 1900, the professional builder in stone, iron and brick' *Le Corbusier*

# 19 TH & 20 TH CENTURIES

Colonial or Georgian period: The Revolution  
influence of *Wren, Gibbs, Chambers & the Palladians*  
1775-1783

Federal Period

Greek & Gothic



The Governor's House, Virginia, 1705 (rebuilt 1932)



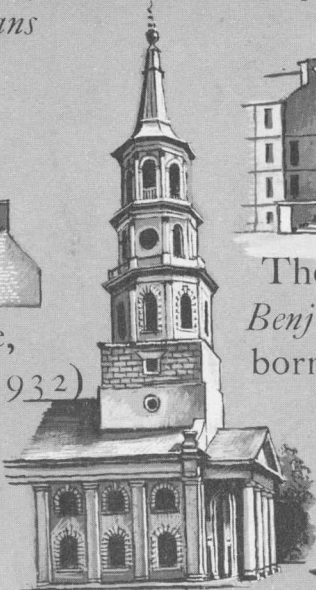
Westover, Virginia, c.1730 1761



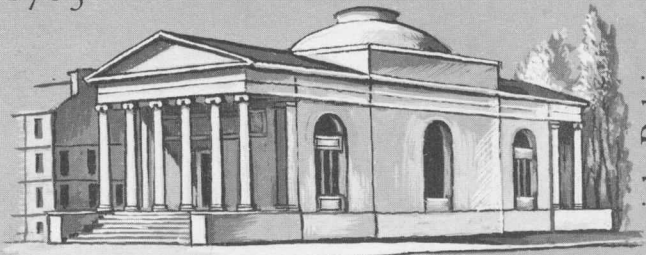
Redwood Library, Newport, Rhode Island, 1750 *Peter Harrison* (1716-75): born England; U.S.A. 1740



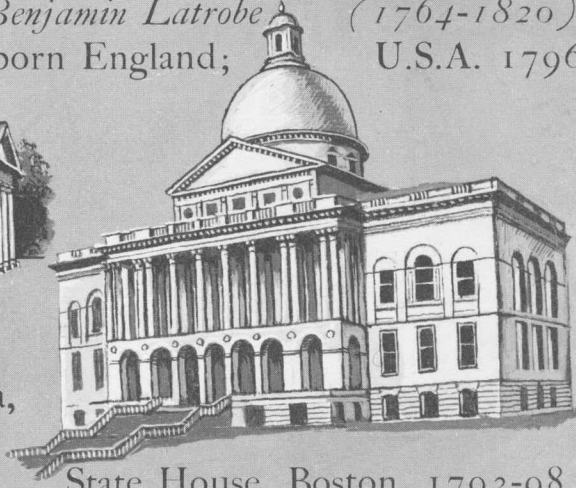
Monticello, Charlottesville 1770-1809



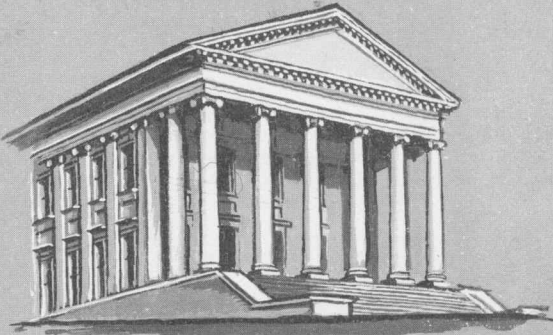
St Michael, Charleston, South Carolina,



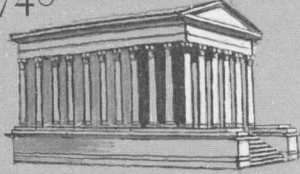
The Bank of Philadelphia, 1798-99 *Benjamin Latrobe* (1764-1820): born England; U.S.A. 1796



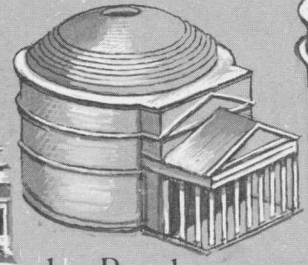
State House, Boston, 1793-98 *Charles Bulfinch* (1763-1844)



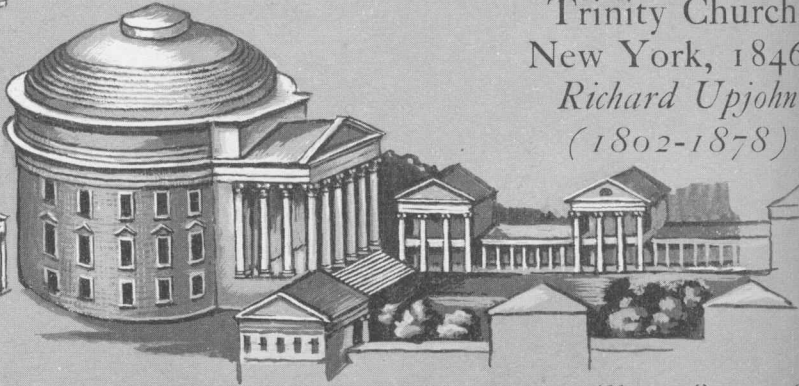
State House, Richmond, Virginia, 1785-96 *Jefferson*



Temple, Nîmes

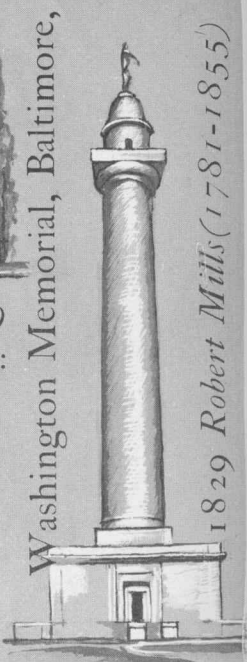


the Pantheon, Rome



University of Virginia, Charlottesville, 1822-26

*Thomas Jefferson* (1743-1820); studied Roman buildings in Europe 1784-89



Washington Memorial, Baltimore,

1829 *Robert Mills* (1781-1855)

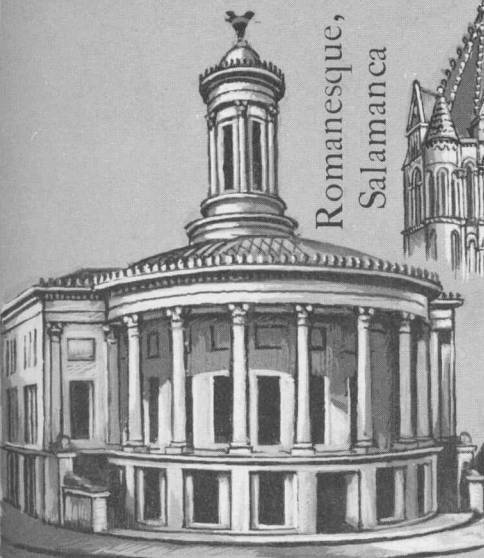


Trinity Church, New York, 1846 *Richard Upjohn* (1802-1878)

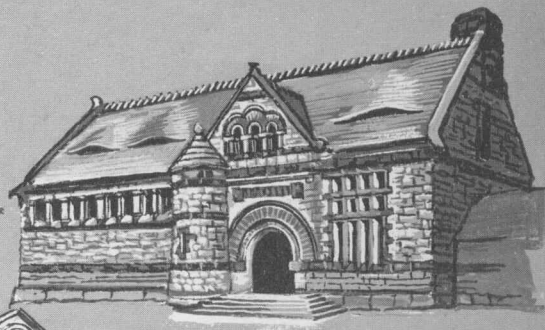
revivals

Civil War 1861-1865

The Chicago School 1883-(pp.168-9)



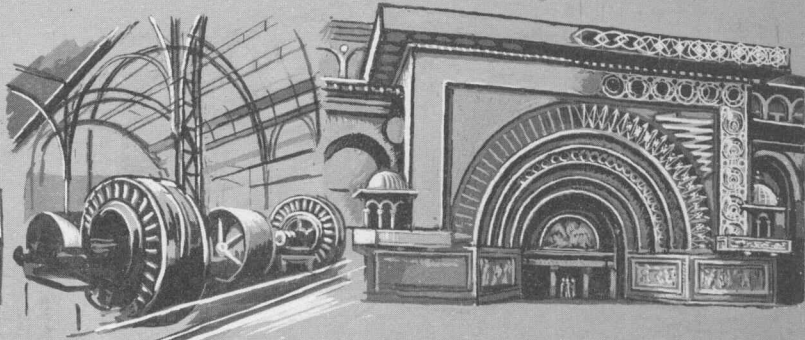
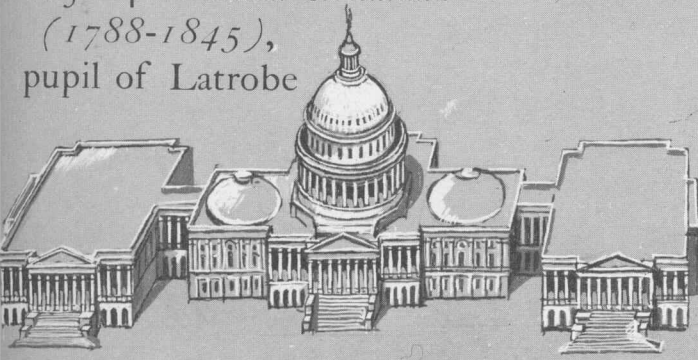
Romanesque,  
Salamanca



Crane Library, Quincy,  
Massachusetts, 1883

Exchange, Philadelphia  
1832-4 *William Strickland*  
(1788-1845),  
pupil of Latrobe

Trinity Church, Boston, 1872-77  
*Henry Hobson Richardson* (1838-1886) : studied in Paris



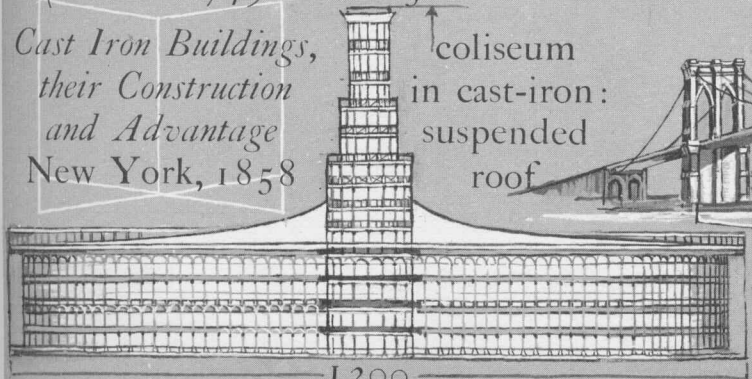
The Capitol, Washington:  
central block, 1792-1828,  
*William Thornton* (1759-1828) & others.  
Wings & dome (cast-iron), 1851-65  
*Thomas Ustick Walter* (1804-1887)

Transportation Building, Chicago Exposition,  
1893 *Louis H. Sullivan* (1856-1924):  
Paris 1874 *Frank Lloyd Wright* worked  
with Sullivan 1888-93

*James Bogardus*  
(1800-1874)

*Cast Iron Buildings,  
their Construction  
and Advantage*  
New York, 1858

300  
coliseum  
in cast-iron:  
suspended  
roof

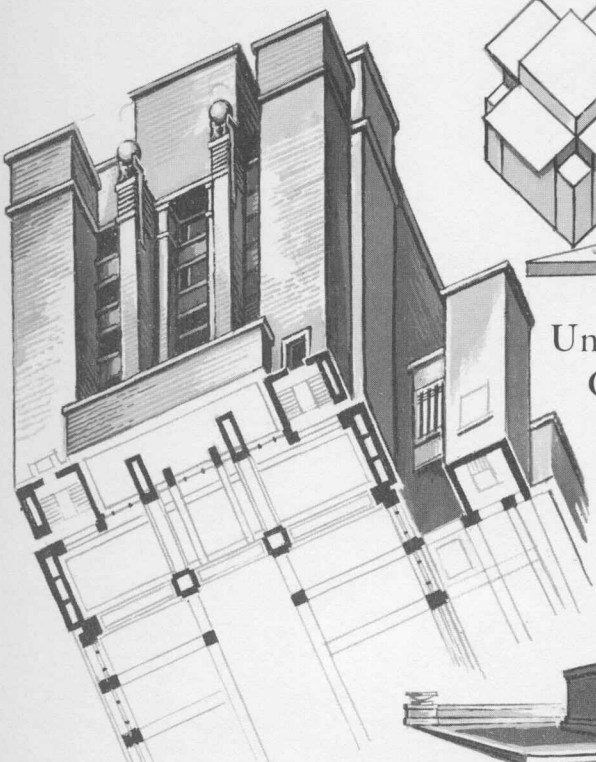


Project, New York World's Fair, 1853

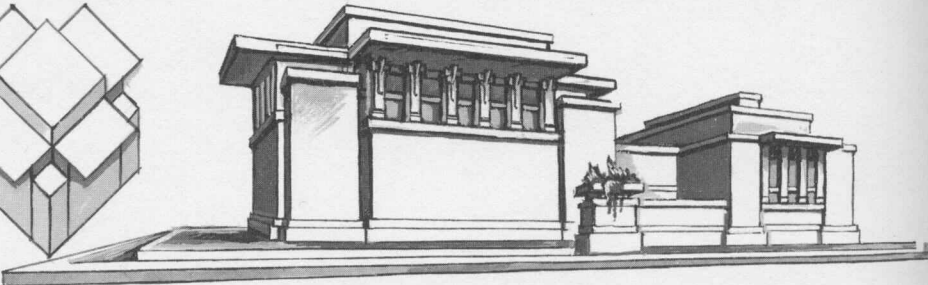
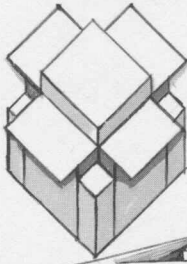


Brooklyn Bridge, 1869-1883 *John Roebling*  
(1806-69) & *W. A. Roebling* (1837-1926)

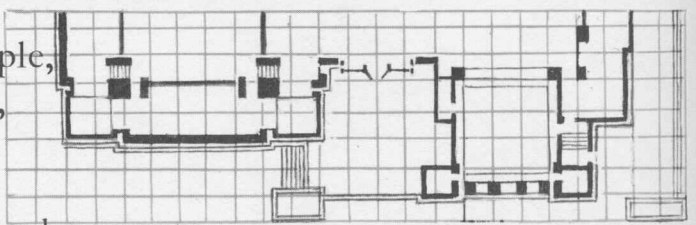
# 19TH & 20TH CENTURIES



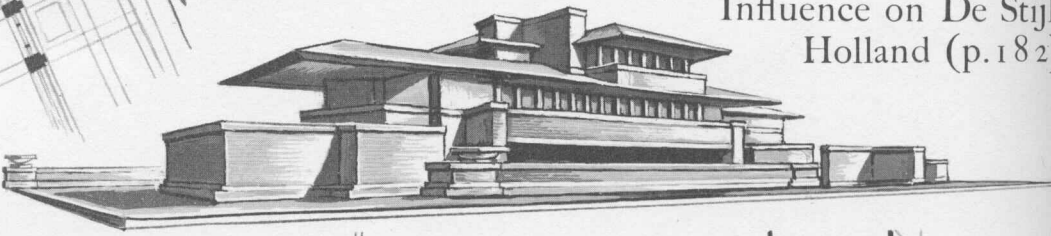
Larkin Administration Building,  
Buffalo, 1904. Brick



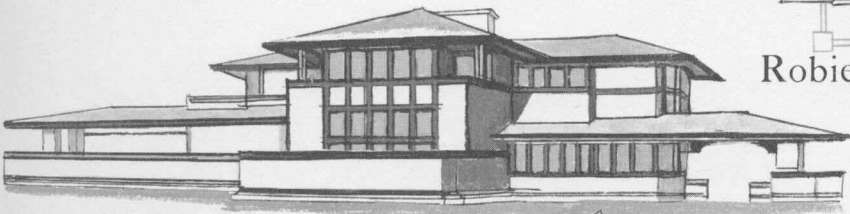
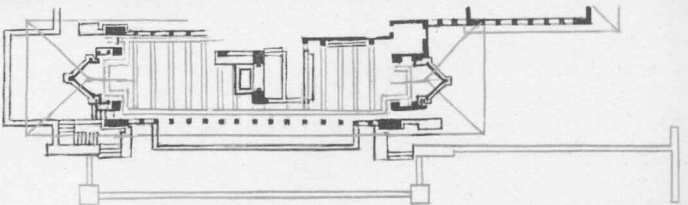
Unity Temple,  
Oak Park,  
Illinois,  
1906.  
Reinforced concrete



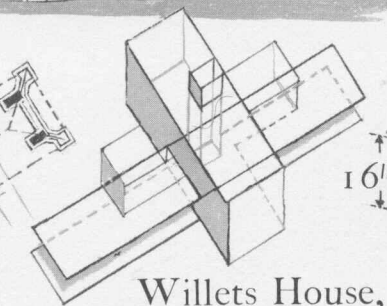
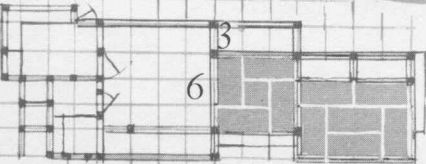
Influence on De Stijl,  
Holland (p.182)



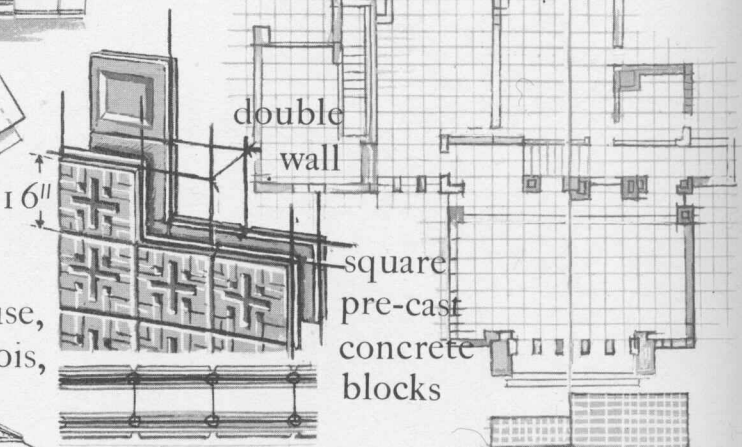
Robie House, Chicago, Illinois, 1909



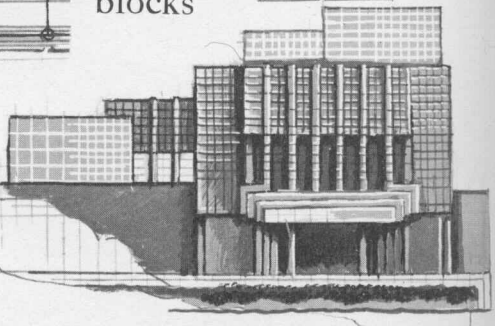
Japanese house  
based on the  
standardized shape  
of mats 6 by 3 feet



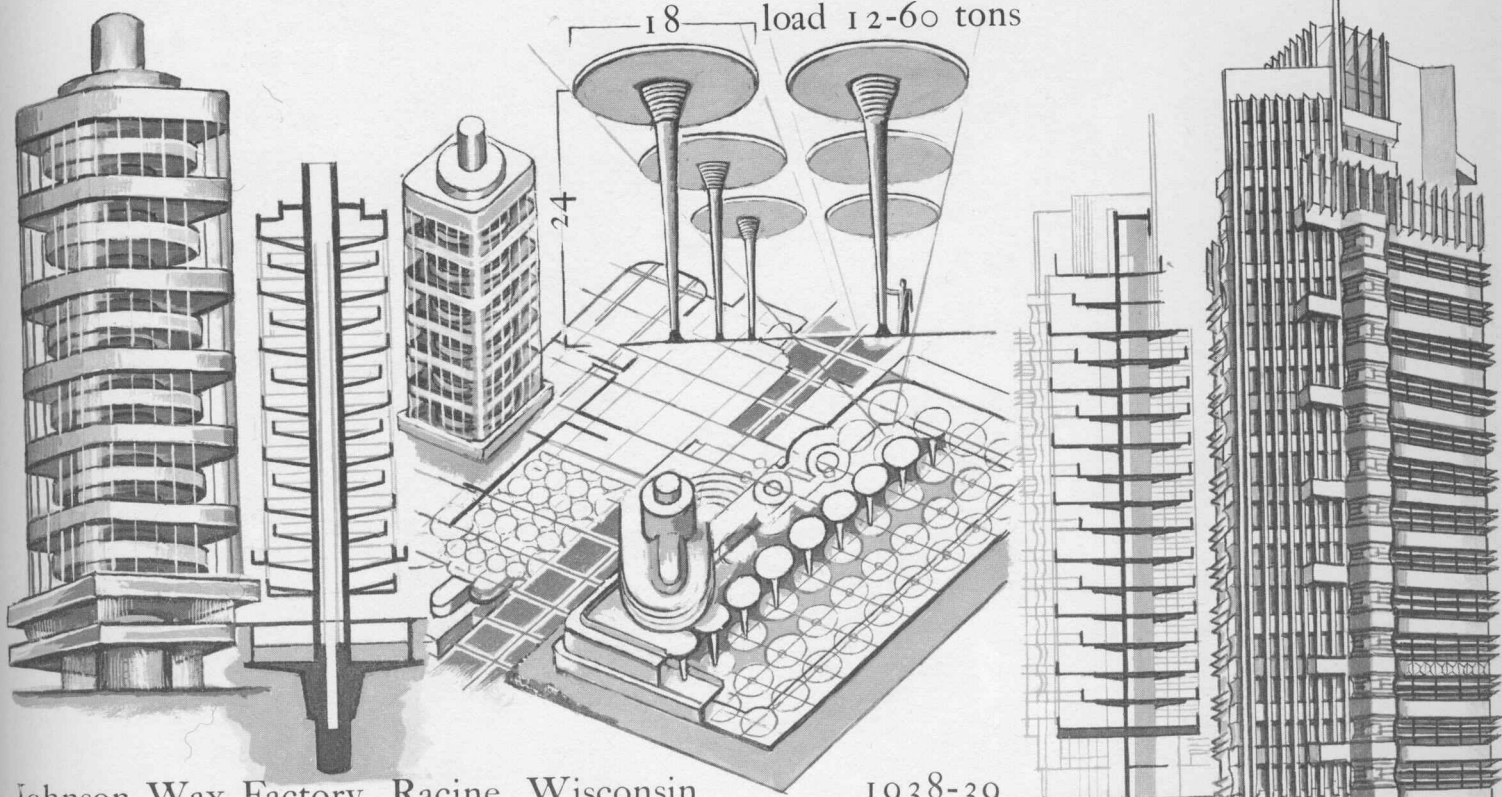
Willets House,  
Highland Park, Illinois,  
1902



Millard House,  
Pasadena,  
California,  
1923

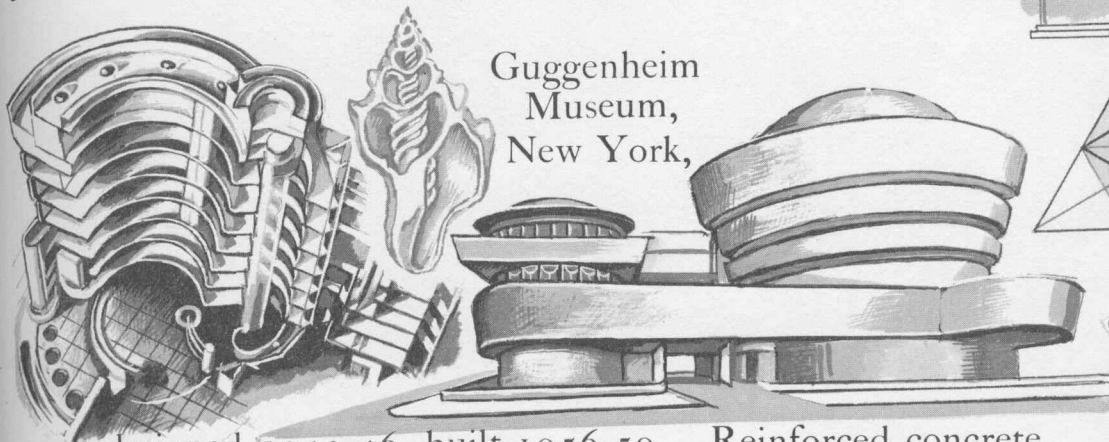


# U. S. A., FRANK LLOYD WRIGHT



Johnson Wax Factory, Racine, Wisconsin,

1938-39



Guggenheim  
Museum,  
New York,

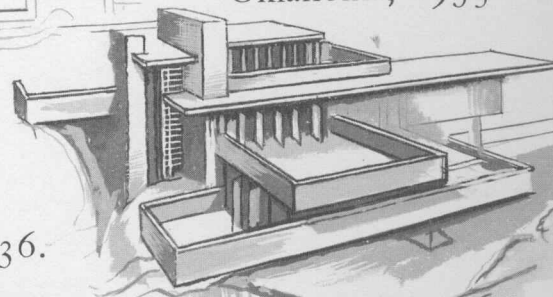
designed 1943-46, built 1956-59. Reinforced concrete



Falling Water,  
Bear Run,  
Pennsylvania, 1936.

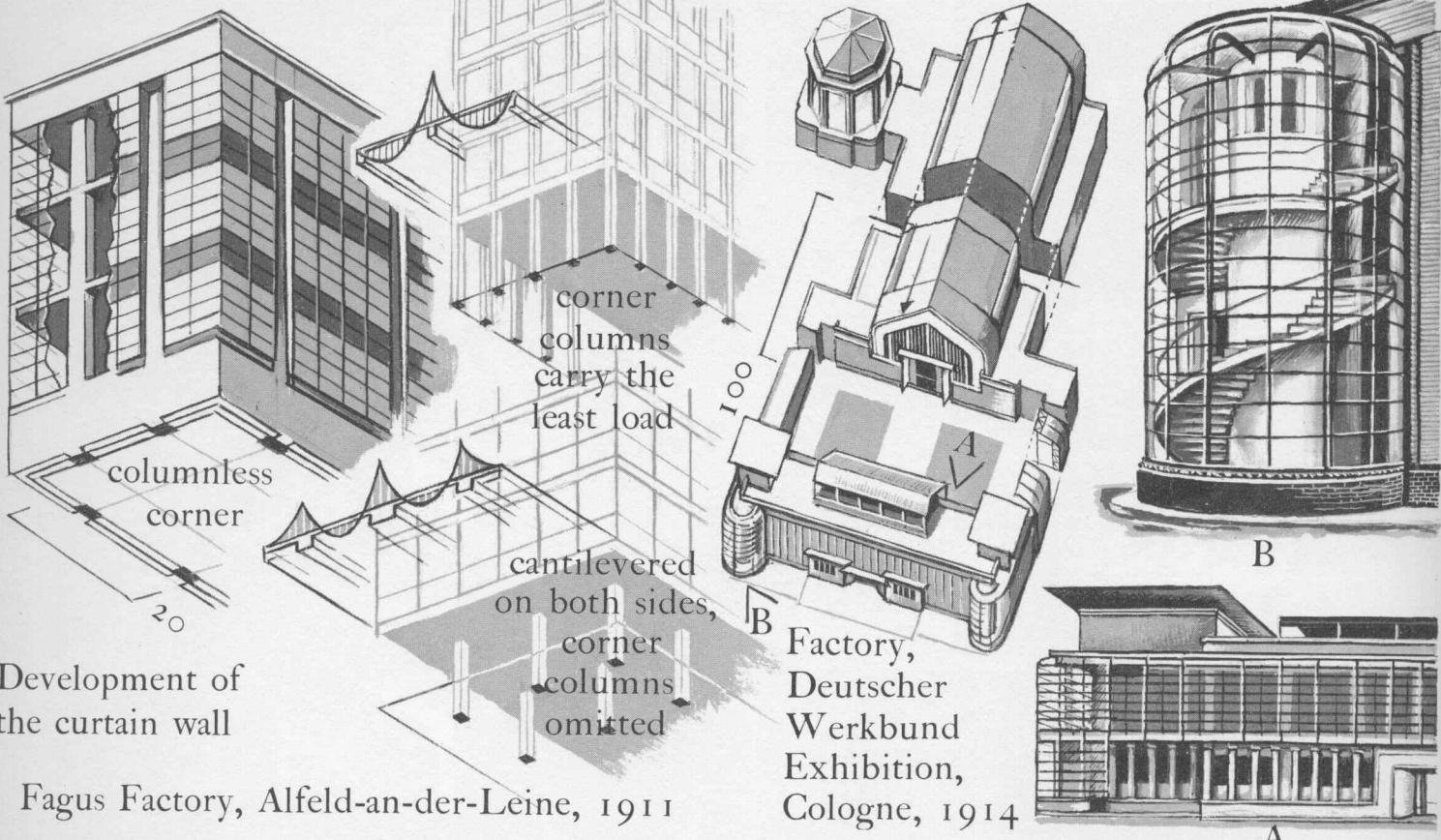
Reinforced concrete

Price Tower, Bartlesville,  
Oklahoma, 1953



He innovated designs for an 'organic' architecture, kaleidoscopic in its variety

# 19 TH & 20 TH CENTURIES

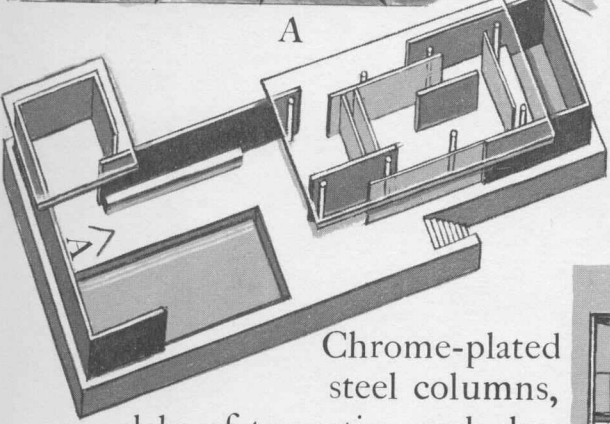
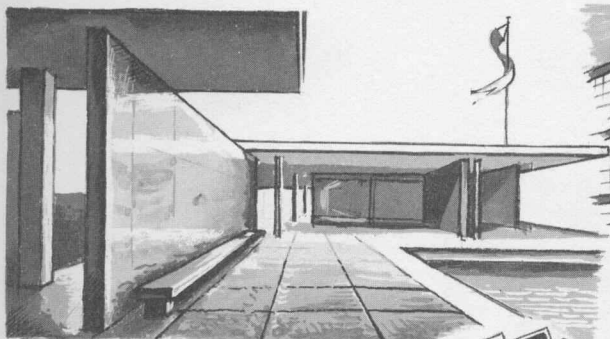


Development of the curtain wall

Fagus Factory, Alfeld-an-der-Leine, 1911

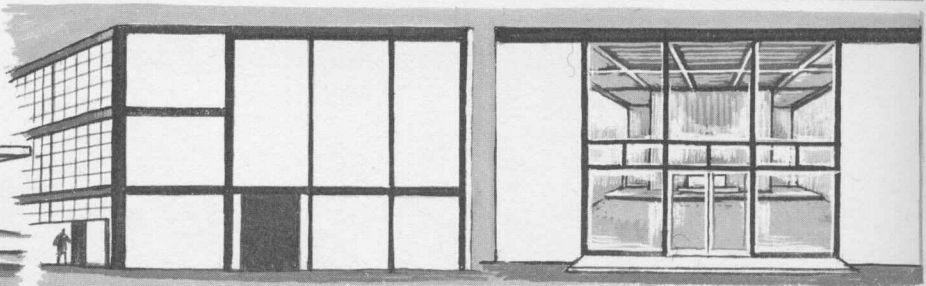
Factory, Deutscher Werkbund Exhibition, Cologne, 1914

*Walter Gropius (1883-):* assistant to Behrens, 1907-11 (p.173); director of the Bauhaus,



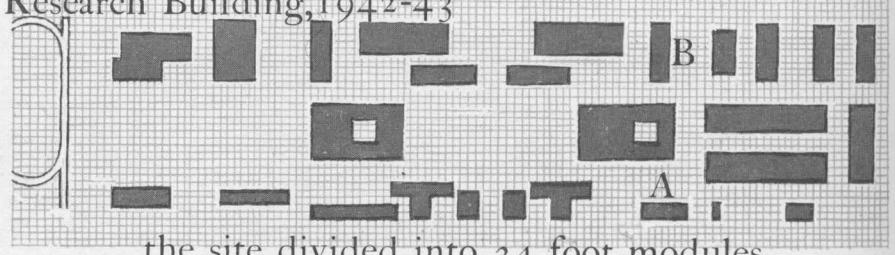
Chrome-plated steel columns, slabs of travertine and glass

German Pavilion, International Exhibition, Barcelona, 1929

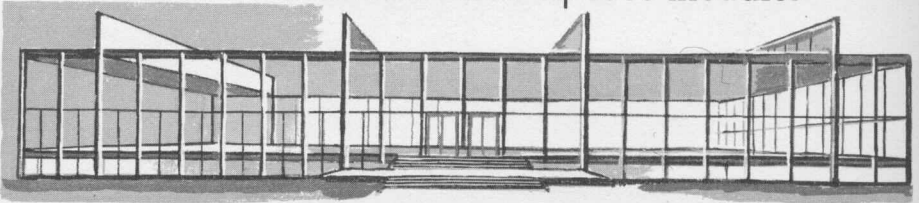


A. Minerals & Metals Research Building, 1942-43

Chapel, 1952



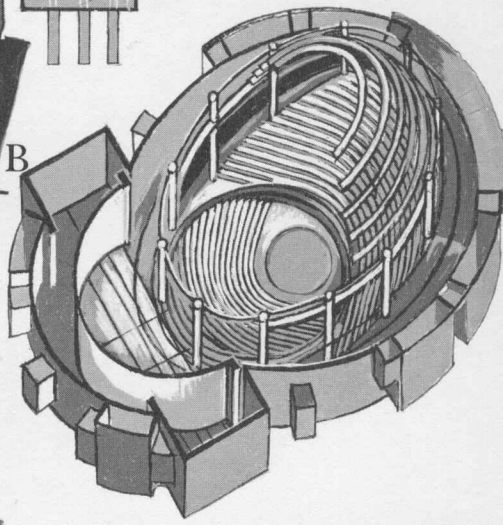
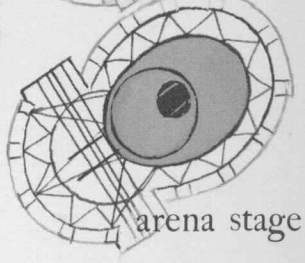
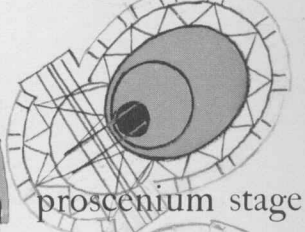
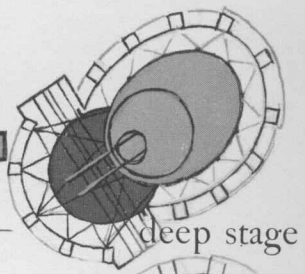
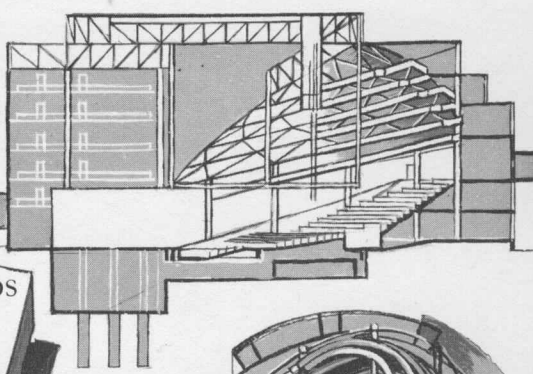
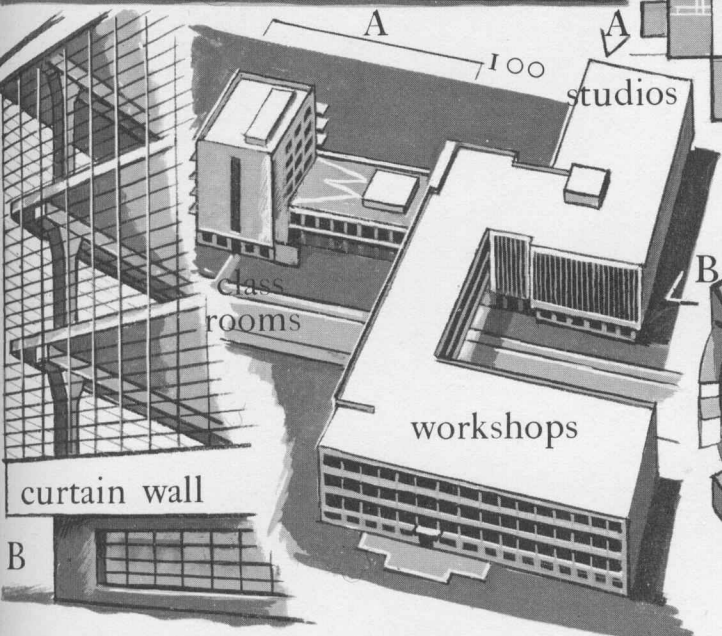
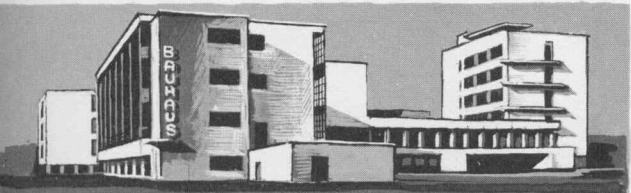
the site divided into 24 foot modules



B. School of Architecture and Design, 1952  
Illinois Institute of Technology, Chicago, 1940

*Ludwig Mies van der Rohe (1886-):* born Aachen, Germany; worked with Behrens 1908-11;

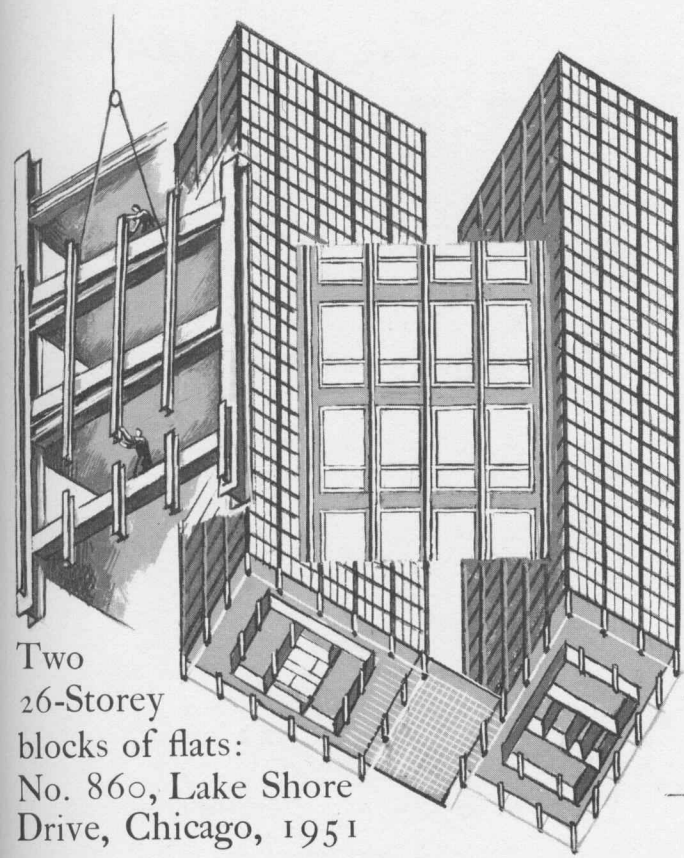
# GERMANY & U. S. A.



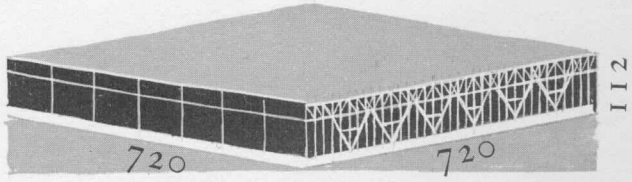
Bauhaus Buildings, Dessau, 1926.

Project: the 'Total Theatre', 1927

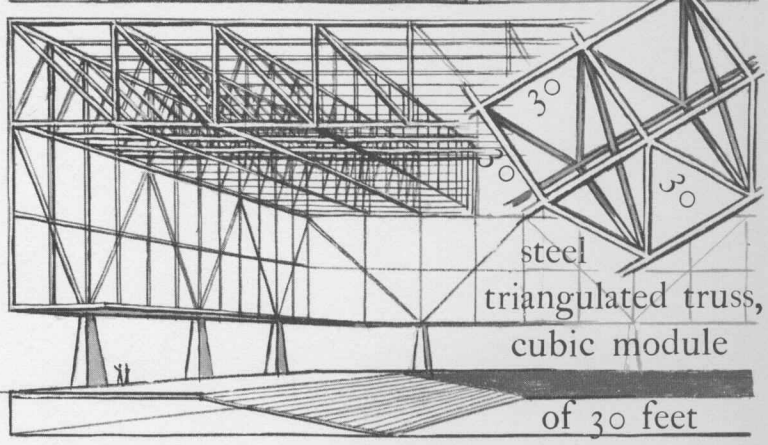
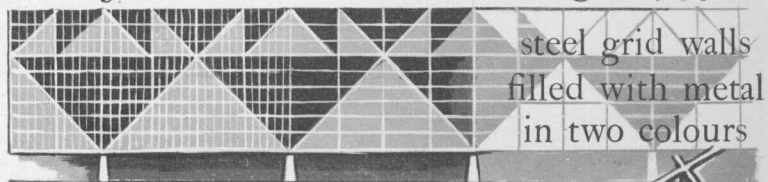
Weimar 1919-25, at Dessau 1925-8; worked in England 1934-37 (p.161), U.S.A. 1937



Two 26-Storey blocks of flats: No. 860, Lake Shore Drive, Chicago, 1951

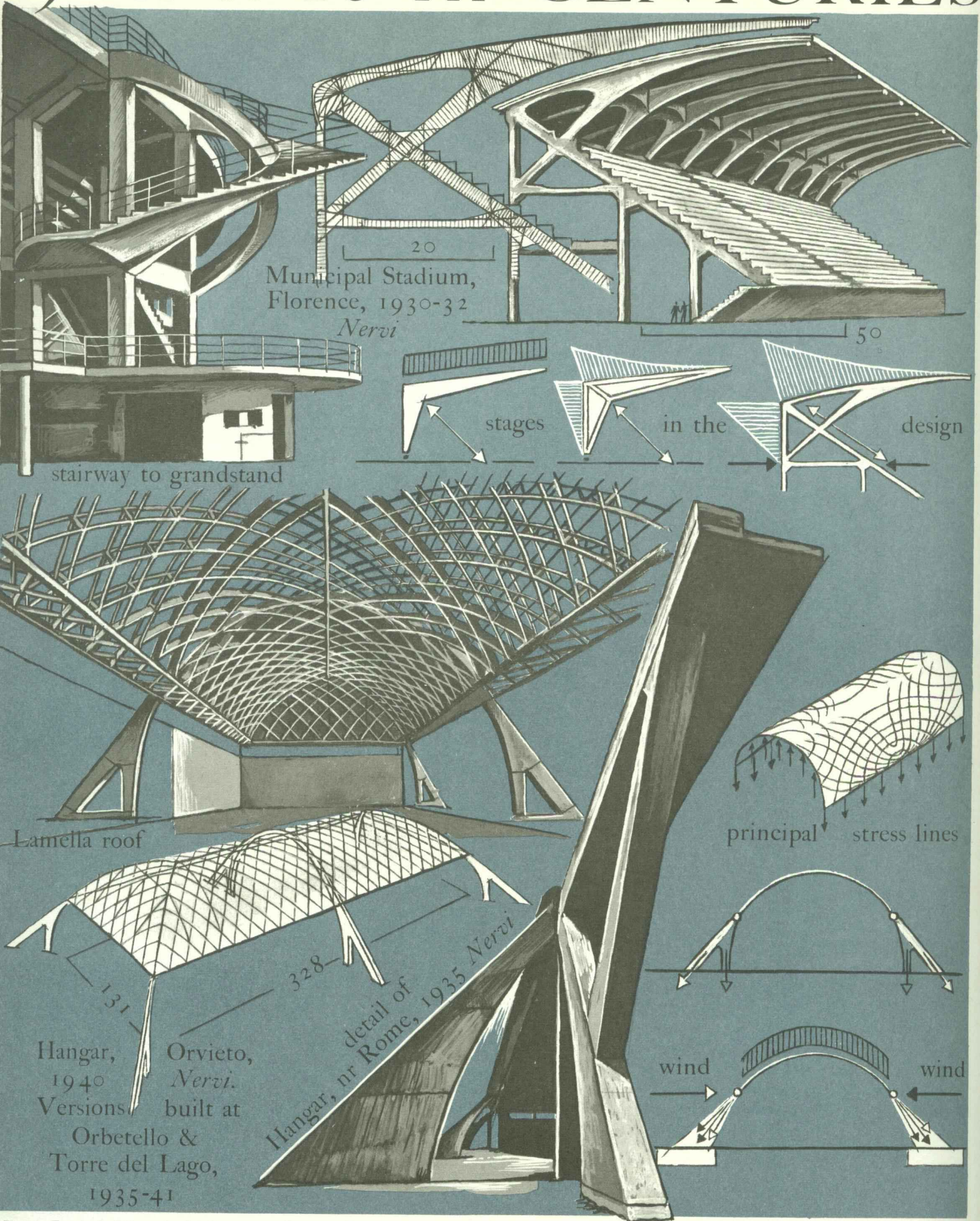


Project: Convention Hall, Chicago, 1953



director of the Bauhaus, Dessau, 1930-33; to U.S.A., 1937. His dictum: 'less is more'

# 19 TH & 20 TH CENTURIES



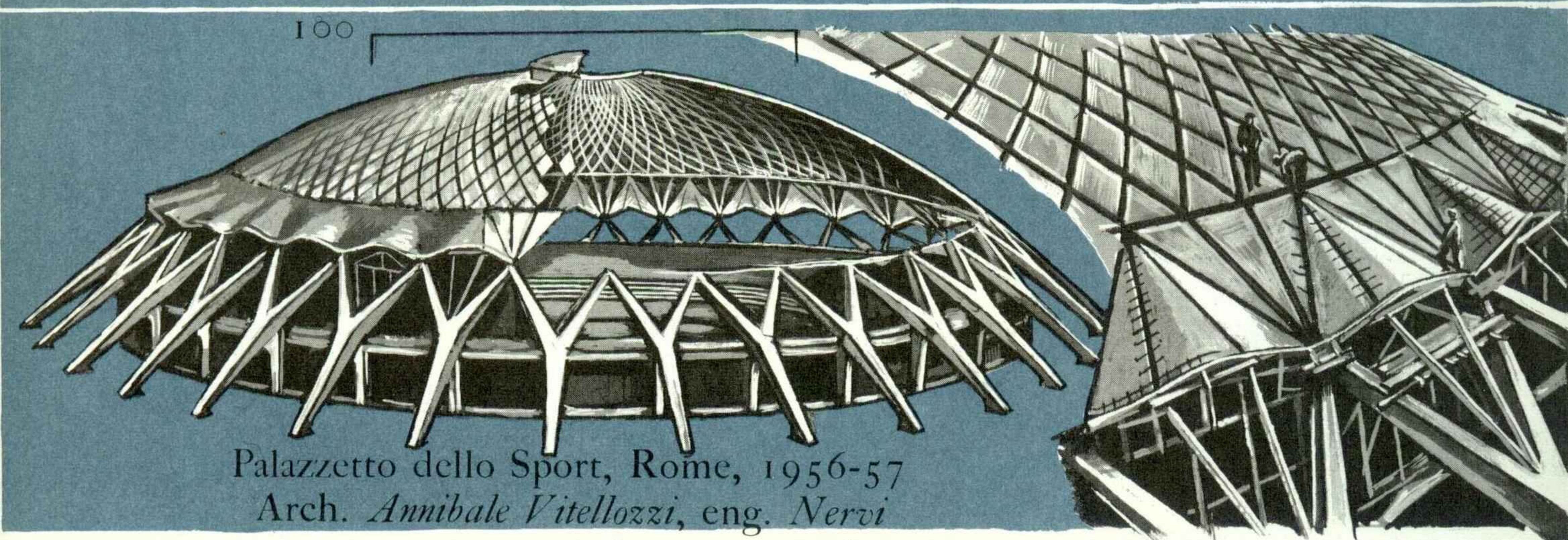
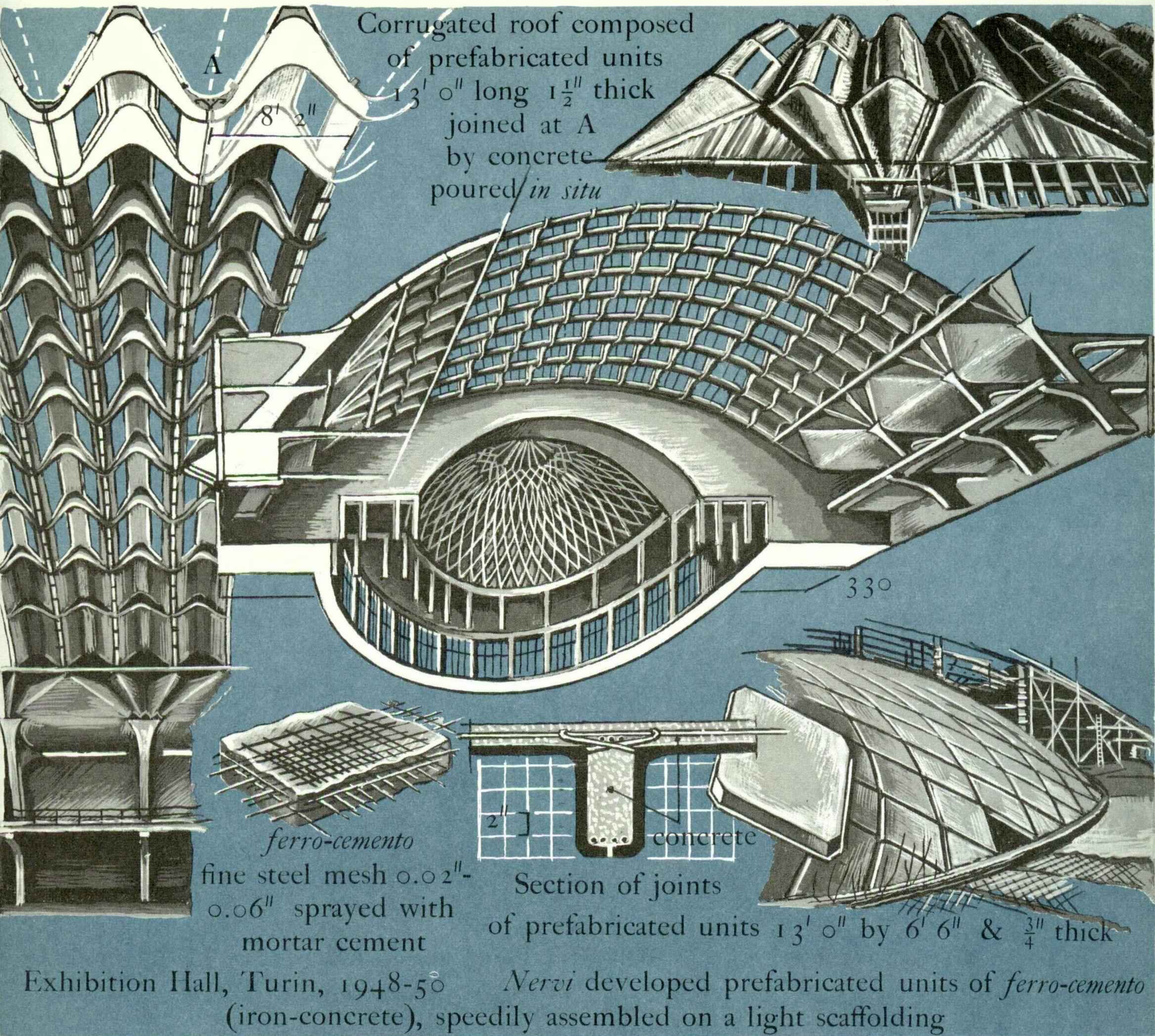
Hangar, Orvieto, Nervi, 1940  
 Versions built at Orbetello & Torre del Lago, 1935-41

Hangar, nr Rome, 1935, Nervi

Peri Luigi Nervi (1891-), born Lombardy, engineer in reinforced concrete, follows 'both

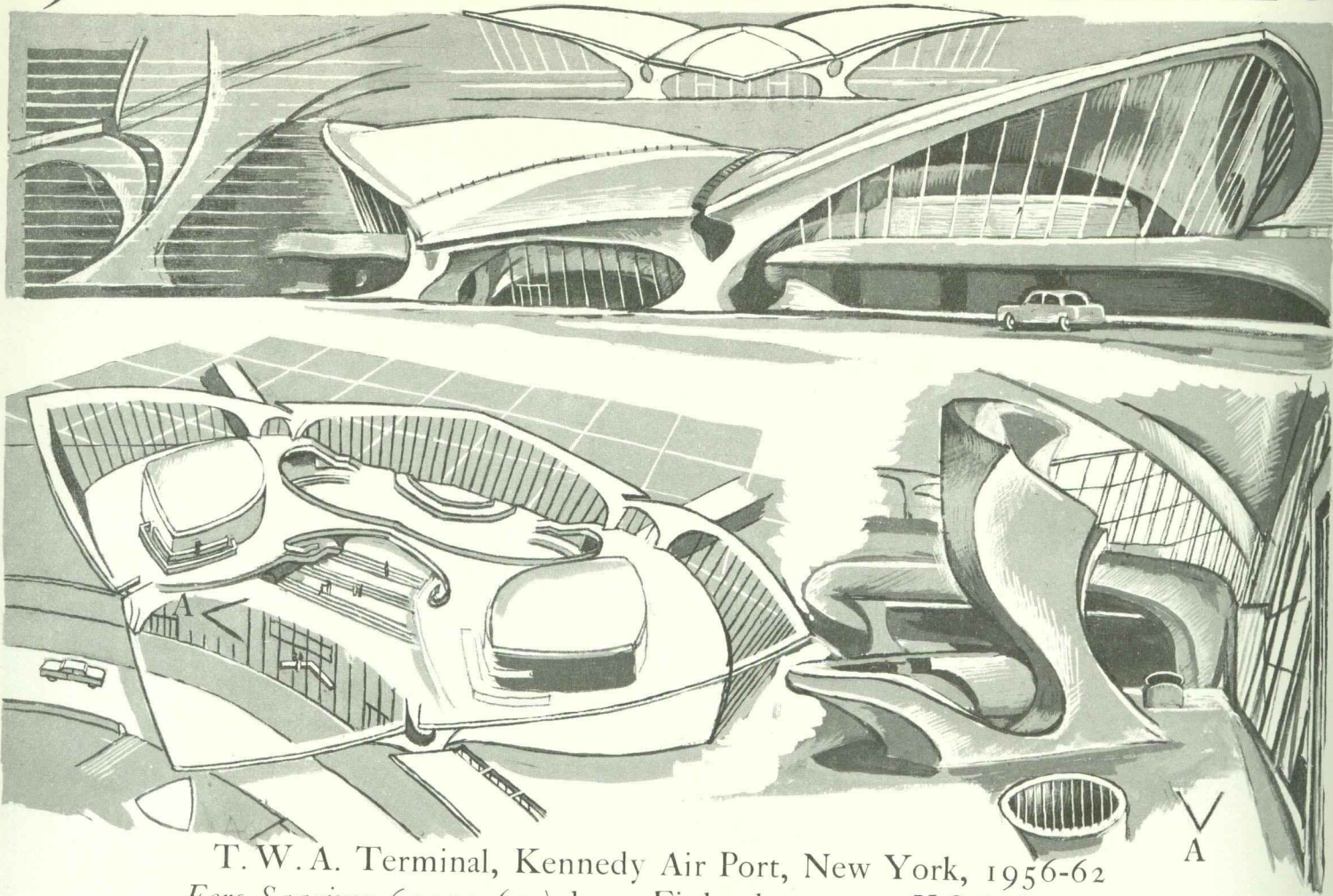


# ITALY, NERVI

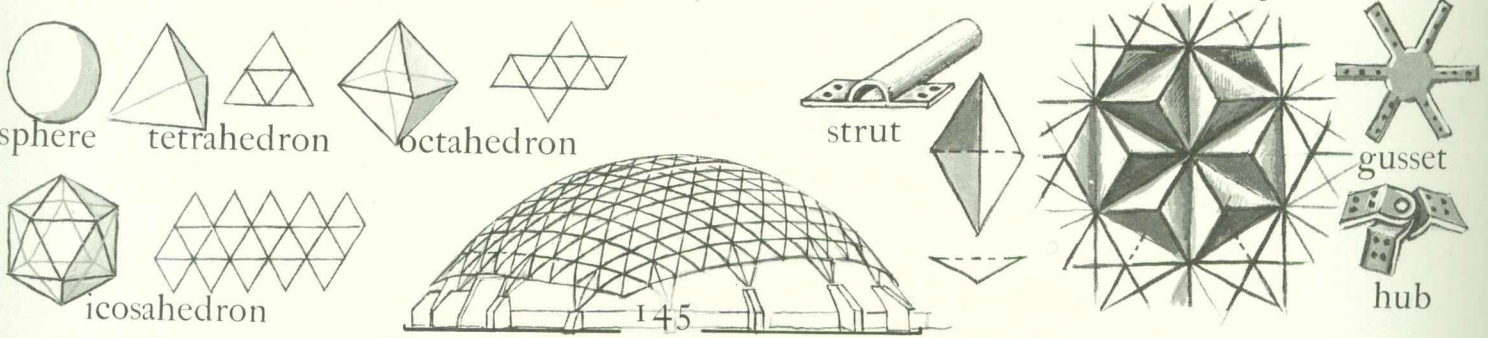


the intuitive & mathematical paths'. Author of *Construction, Science or Art?*, Rome, 1945

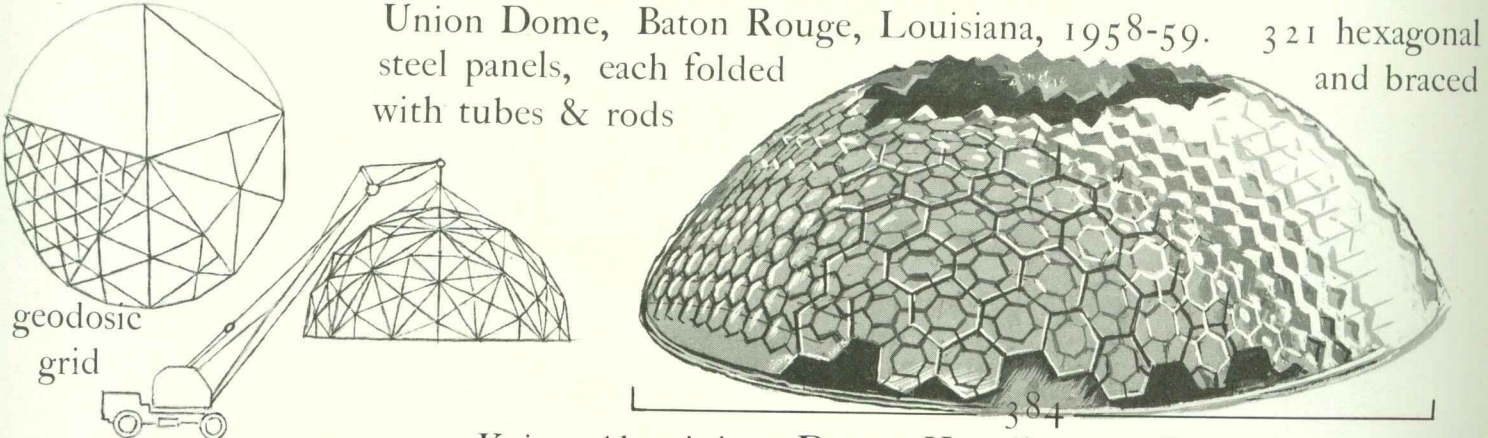
# 19 TH & 20 TH CENTURIES



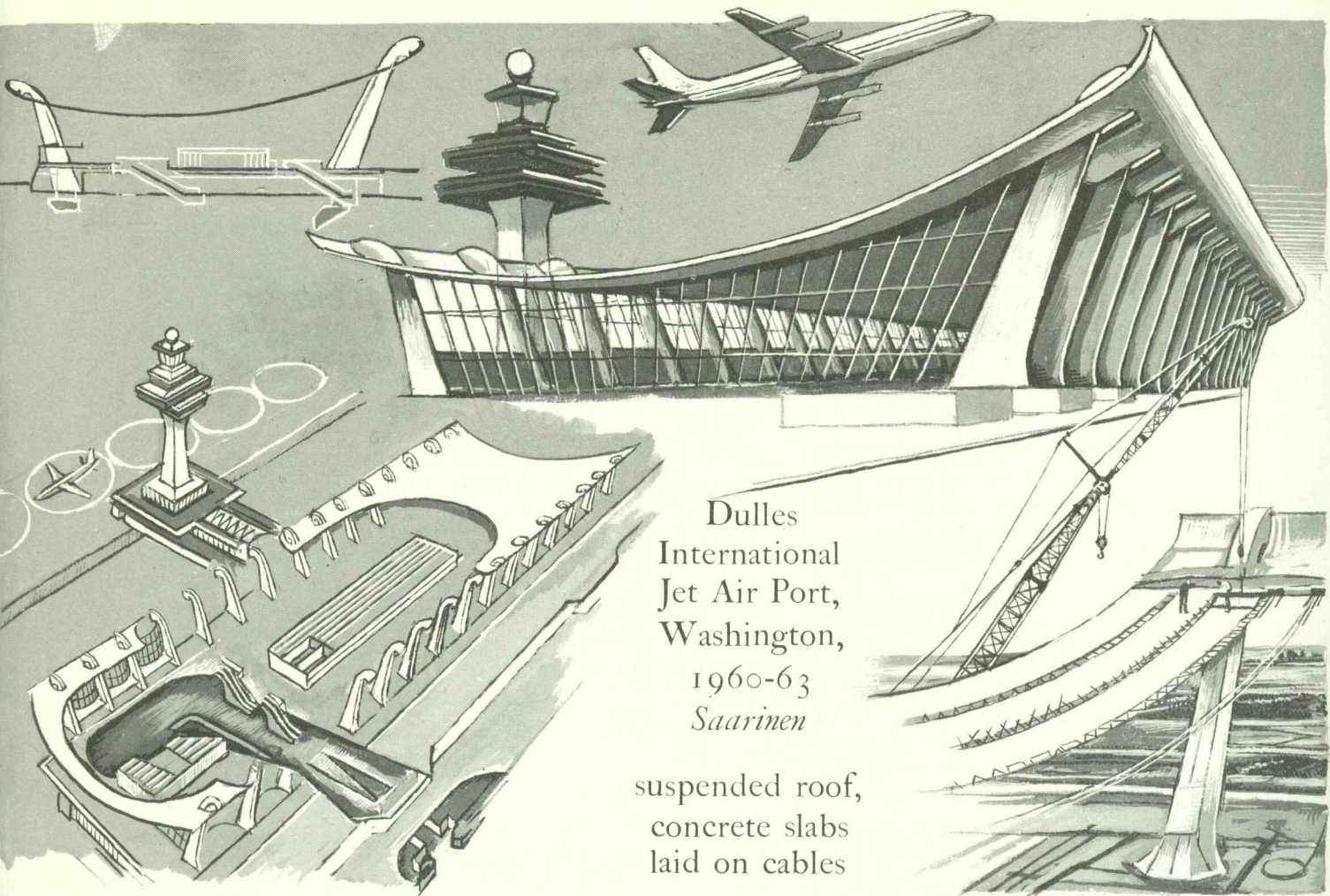
T. W. A. Terminal, Kennedy Air Port, New York, 1956-62  
 Eero Saarinen (1910-61), born Finland, went to U.S.A. in 1923



Union Dome, Baton Rouge, Louisiana, 1958-59. 321 hexagonal steel panels, each folded with tubes & rods

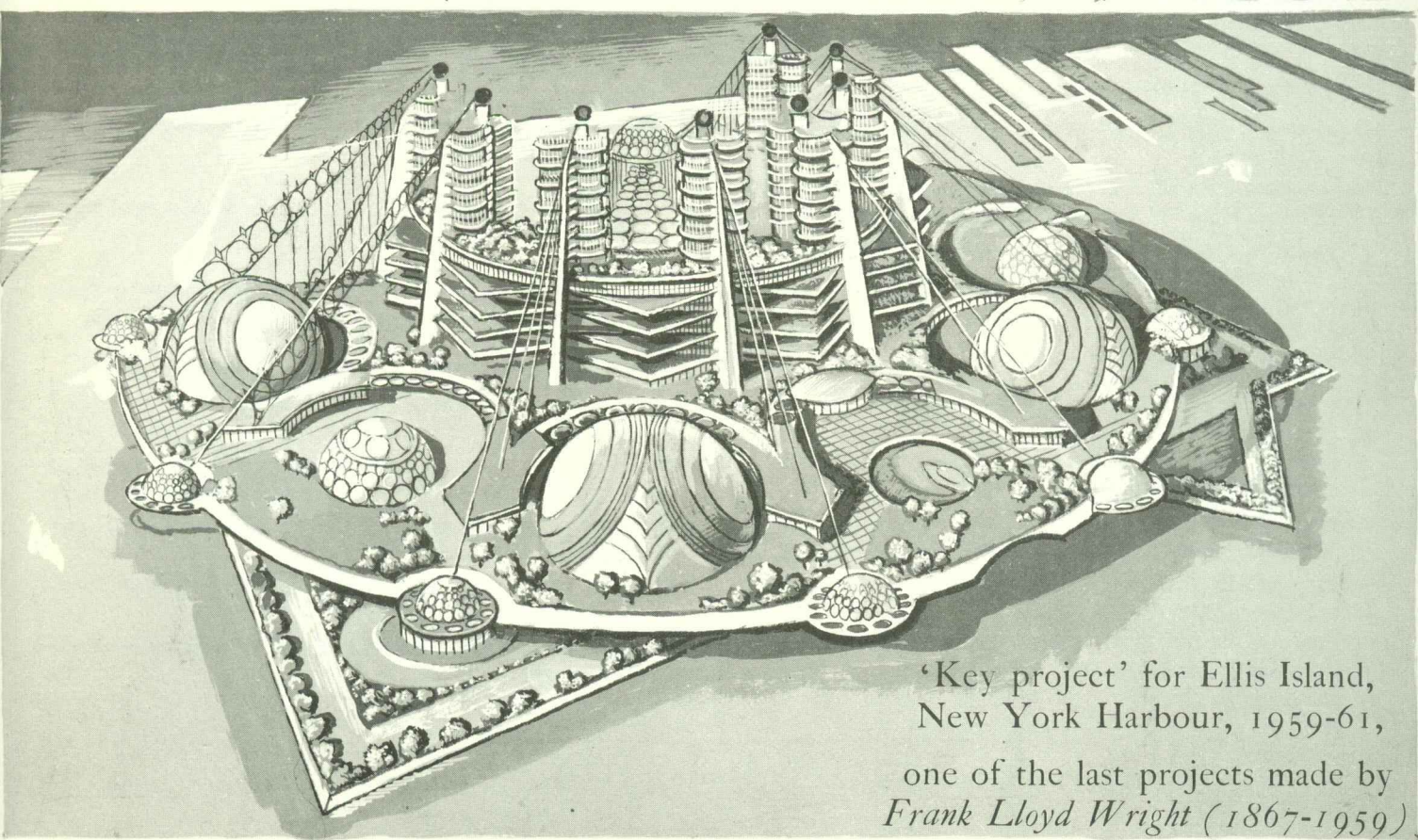


Kaiser Aluminium Dome, Hawaii, 1957. Erected in 22 hours  
 Geodesic Domes from 1948 Richard Buckminster Fuller (1895-), 'comprehensive designer'



Dulles  
International  
Jet Air Port,  
Washington,  
1960-63  
*Saarinen*

suspended roof,  
concrete slabs  
laid on cables



'Key project' for Ellis Island,  
New York Harbour, 1959-61,  
one of the last projects made by  
*Frank Lloyd Wright (1867-1959)*