9. THE ARCH

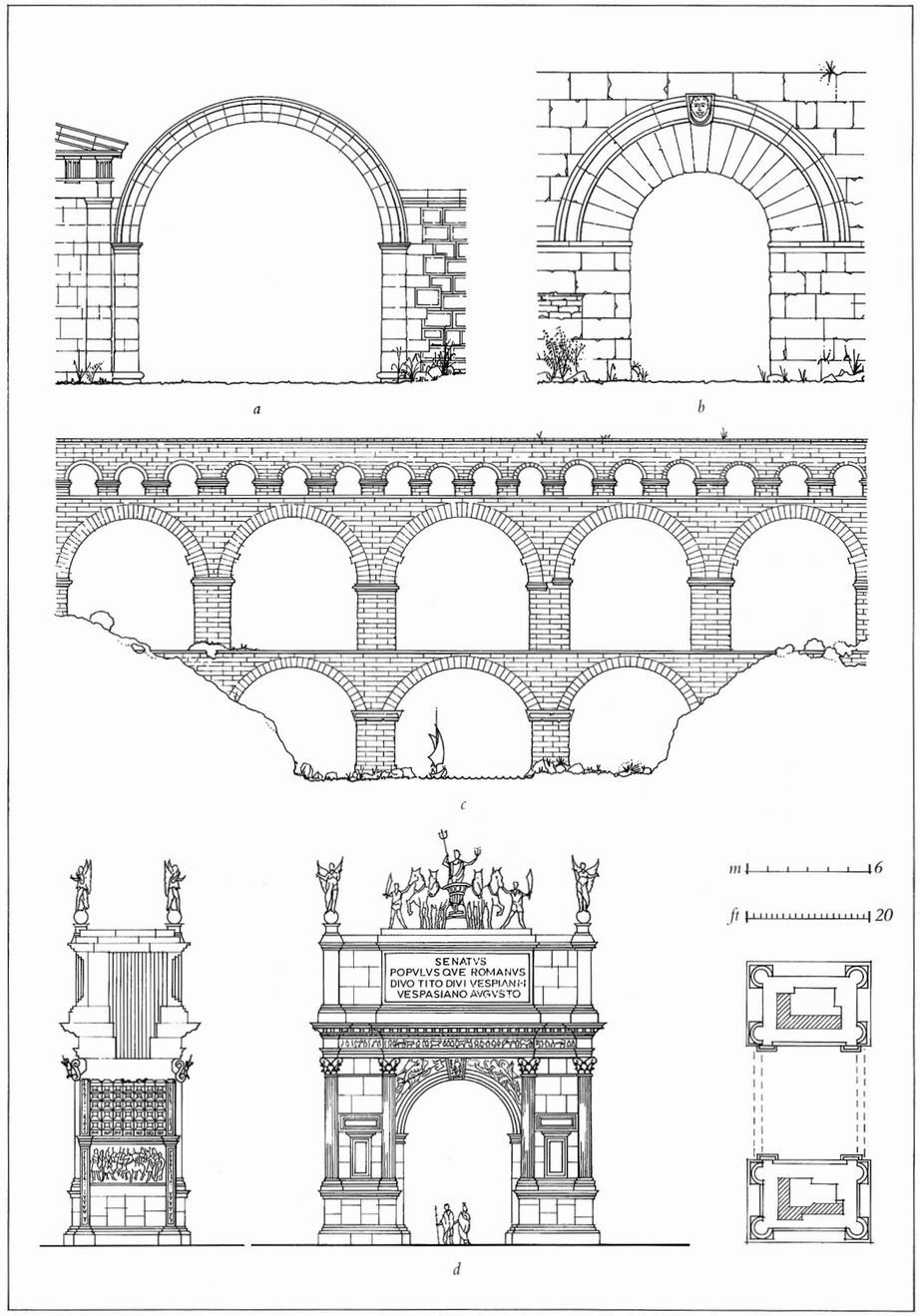
THE ARCH IN ANTIQUITY

The invention of the arch was an important technical innovation. By wedging a series of tapering stones together around a semicircle it is possible to span much greater distances using stone or other dense building materials than is possible with flat beams in the same materials. This was known by the Egyptians, who were using full structural arches as early as 1400 BC. The Greeks also used arches, but principally for utilitarian structures. The earliest known decorative example is a market-place gate in the city of Priene in modern Turkey (a) from 156 BC. Neither the Egyptians nor the Greeks used arches for parts of buildings that had any prestige, evidently being averse to the form for stylistic reasons.

It was the Etruscans who first began to develop the arch in European architecture. Like the Romans after them, the Etruscans built permanent roads between cities and brought their water supplies from remote sources. Arched bridging structures were often used for these civil engineering schemes and arches were also used for important visual features such as city gates. A gate in the Roman colony of Falleri in central Italy (b) from the third century BC has all the essential elements of arch design that became an integral part of the classical vocabulary some four centuries later.

The Romans continued to develop the use of the arch, erecting viaducts and aqueducts throughout their growing empire for the movement of people and goods, the supply of water and the levelling and terracing of steep hills. The most impressive survival of these unprecedented feats of engineering skill and daring is the Pont du Gard in southern France (c) from the late first century BC, which not only carried water in an aqueduct 49 metres above the River Gardon to the city of Nîmes, but also a road bridge at a lower level.

The Roman development of the arch as an architectural element is of major significance. One of the principal factors in this evolution was the Roman triumphal arch. These large commemorative structures were built to record a triumph, the coveted public celebration of a victory awarded to a returning general. The form may have originated in temporary wooden gates erected specially for the procession, and structures such as the Arch of Titus (d) of about AD 82 became important symbols of the glory of the Roman state.



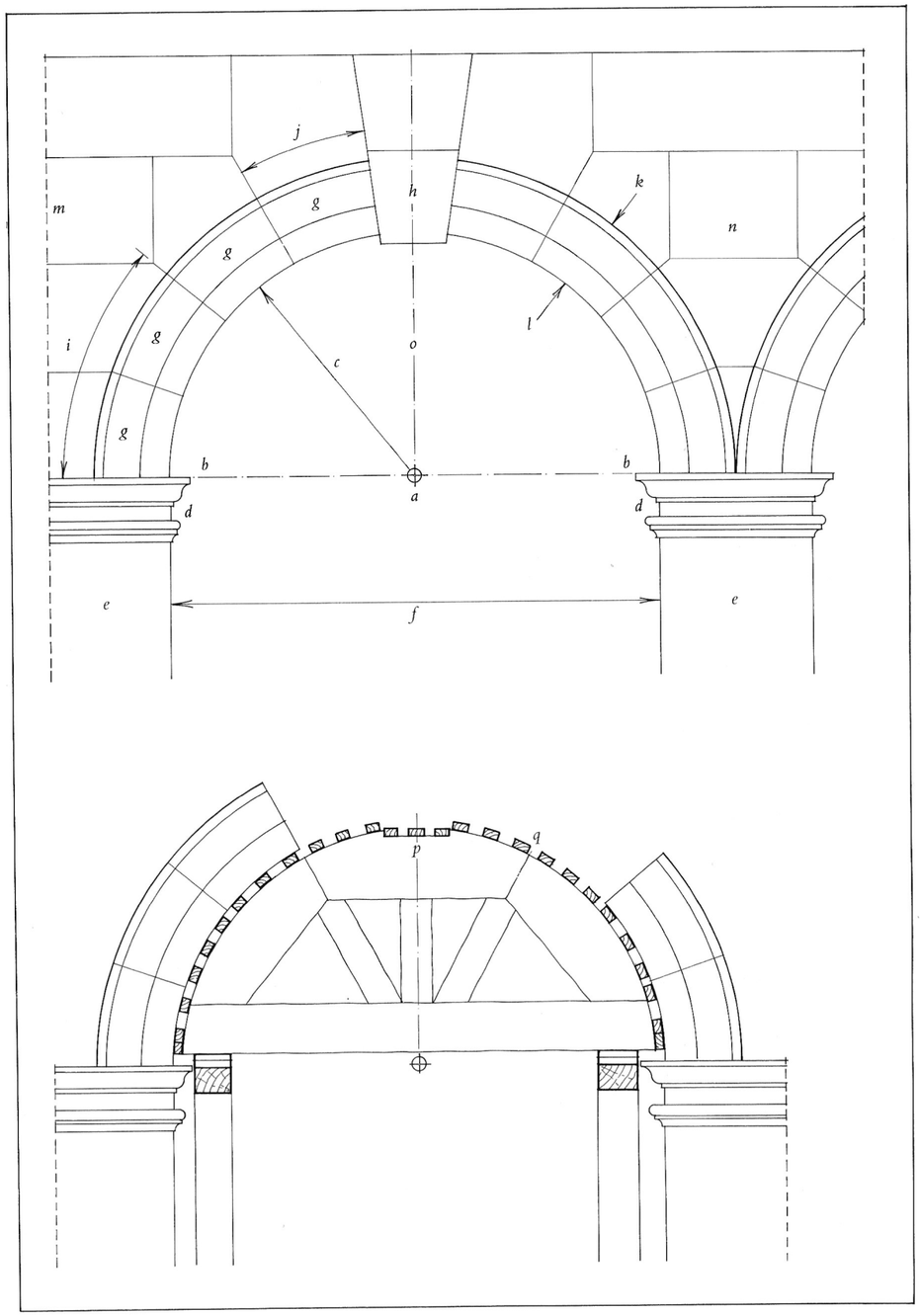
The Construction Of Arches

The Greeks used flat stone beams to span openings in buildings, in imitation of earlier wooden structures. Stone is, however, an unsuitable material for beams as it is brittle and breaks under the stress of downward pressure when unsupported. Hard stone will, on the other hand, offer considerable resistance to being crushed and broken while supported on the opposite side. To make an arch, wedge-shaped pieces of stone or brick are set together over an opening in a radiating pattern so that the weight above each of the pieces pushes them against one another. The resistance of the stone to being crushed prevents the collapse of the arch. The same principle applies to the construction of flat and shallow arches. Round arches are the common classical type, while pointed, Gothic, arches are the most efficient.

A round arch has a single centre (a) which sits on a line (b) from which the arch rises, or springs. From the centre, a constant radius (c) describes the line of the arch from the line of springing upwards. The arch springs off two blocks, or imposts (d), which often project and can be carved with mouldings. The diameter of the arch, the distance between the columns, or piers (e), is the span (f). The arch is made up of a series of tapering blocks, or voussoirs (g), which can be many or few according to the size of stone or span of the arch. The central voussoir, which binds the whole arch together, is called the keystone (h); it is often emphasized through projection and/or decoration. The lower part of the arch is the haunch (i) while the upper part is the crown (j). The entire outer surface or edge of the arch is known as the extrados (k) and the inner surface below the arch as the soffit or intrados (l). The stonework to one side of an arch is the abutment (m) and the area between two adjacent arches is the spandrel (n). The space inside the arch is the tympanum (o).

Arches cannot support themselves until they are complete. They must be constructed on a temporary support known as centering (p). This is usually made of timber and is supported from below. It seems likely that imposts originated as supports for centering. The shape of the arch is formed in the centering and a series of small timber battens (q) is fixed in place in sufficient number to support each voussoir. The voussoirs are laid progressively up from the imposts on each side until they meet and the arch is completed by the keystone. The keystone, therefore, 'locks' the design into place. Large early Roman stone arches were sometimes laid by two gangs, one on each side, and this must have given the keystone particular significance.

The purpose of any structure that spans an opening is to transfer the weight above to the walls on either side and thence down vertically to the ground. The round arch is not the perfect shape for this, the weight tending to push the side of the arch outwards. For this reason arches or rows of arches usually have a substantial section of wall at each end.



Arches And The Orders

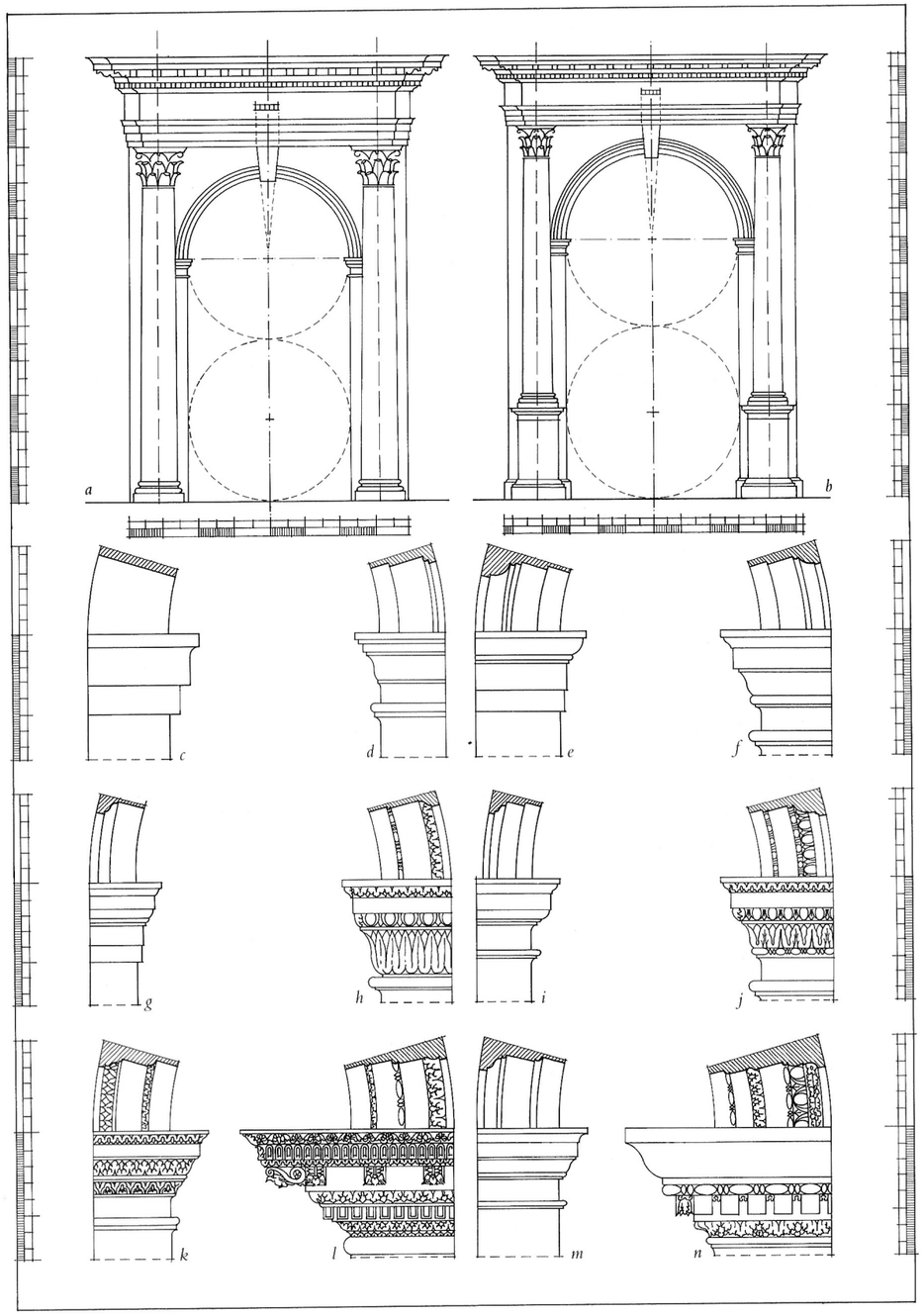
The combination of the arch and the classical orders led to the introduction of new features that could be associated individually with each order. These are the impost and the archivolt. The impost is the detail just below the point where the arch springs. It resembles either a column capital or a piece of cornice. The archivolt is the profile that follows the line of the arch and is a curved architrave.

As the arch is combined with the orders by sitting between two columns, the proportions of the arch will determine the spacing of the columns. One of the most commonly used proportions has an arch with a height twice its width, (a) and (b). If the columns are to be placed as close to the arch as possible and there is no pedestal, then the column base and the archivolt will establish the width of the arch and this will be about 5 diameters (a). If there is a pedestal, the piers must increase in width to allow for the projection of the cornice of the pedestal, but as the columns will become smaller, the spacing will increase to about 7 diameters (b). If a space of 0.5 diameters is left between the top of the archivolt and the bottom of the architrave, the proportions of the combined arch and order will be fixed.

The relatively late introduction of combined arches and orders by the Romans did not give rise to a clearly established series of conventional forms for imposts and archivolts. In order to maintain the progression of the orders, Renaissance authors keep their Tuscan arch details simple. Examples (c) by Vignola and (d) by Scamozzi are both from the sixteenth century. The Doric is also simple and both Vignola (e) and Palladio (f) show imposts that are versions of Doric capitals.

When the capital for the order becomes more complex it cannot be so readily adapted as an impost. Vignola (g) and Palladio (h) when illustrating Ionic arches continue to use modified Doric capitals, but Palladio adds further decoration to reflect the more decorative character of the order.

The Corinthian order was the most popular in ancient Rome and, perhaps as a consequence, has the most varied arch details. Vignola (i) contrasts the arch with the order by using a Doric capital and archivolt, while Palladio (j) makes the archivolt by adding an egg and dart moulding to a Corinthian architrave and the impost by adding further decoration to a Doric capital. Scamozzi (k) is more conventional, using a late Roman capital and two-part Corinthian architrave with no modifications. The Arch of Constantine (l) offers a complete contrast. Here, the impost is a whole section of cornice above a plain astragal moulding. Similar contrasts are to be found in Composite arches. Vignola (m) only varies his details slightly from his Corinthian arches, while on the Arch of Septimus Severus (n) of AD 203 the impost resembles a section of cornice modified to make an ornate capital and the archivolt is a Composite architrave enriched with an egg and dart moulding.



Arches And The Orders: Variations

Although an internal arch width of half the internal height (a ratio of 1:2) is a useful rule of thumb, it is not always possible or desirable to use this precise proportion. The relationship between the piers and the columns, the crown of the arch and the architrave and keystone can also vary.

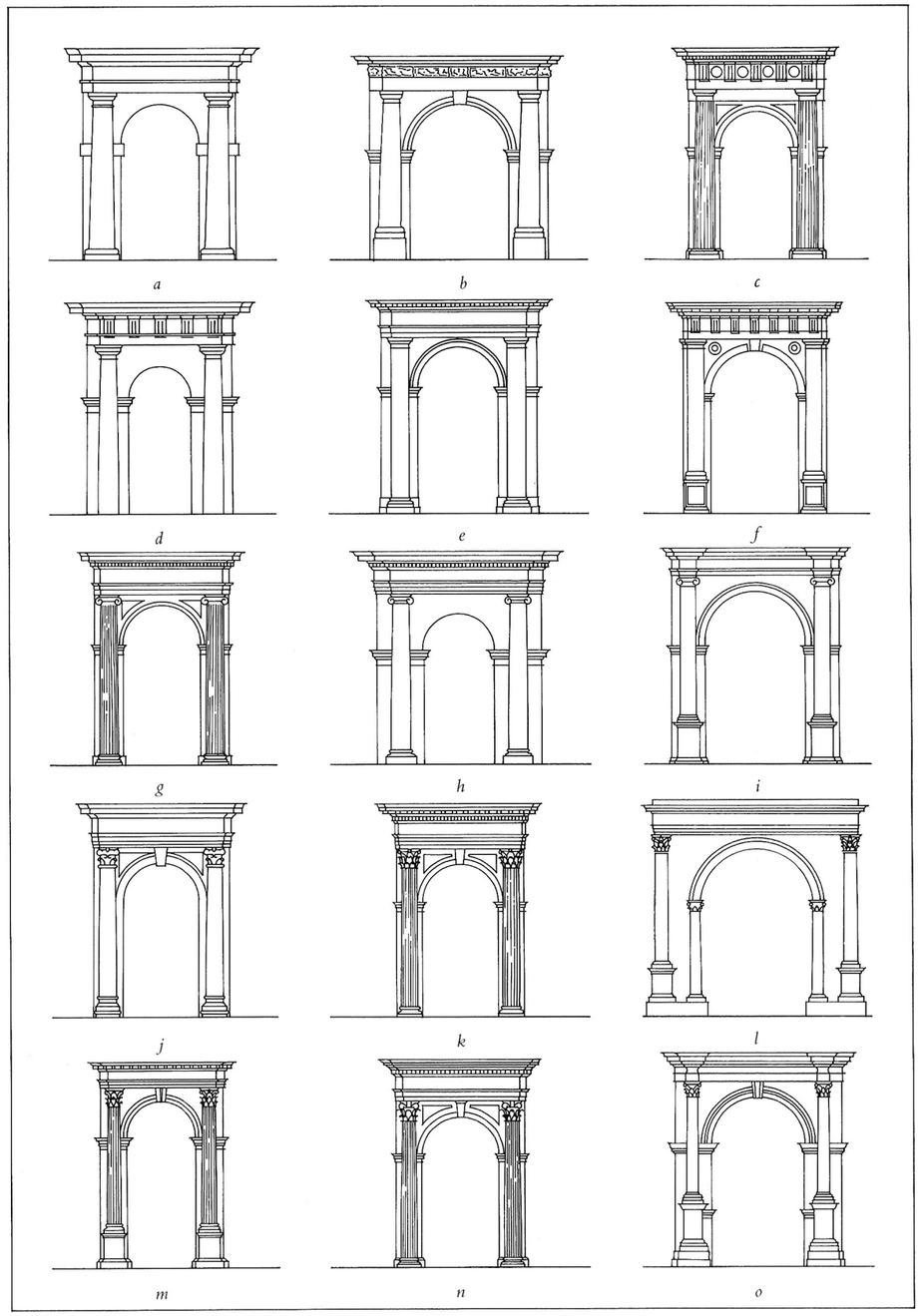
Guides for the proportions of the Tuscan order are based solely on theory, due to the lack of evidence from antiquity. Vignola in 1562 shows a ratio of 1:2, with no keystone and no form of archivolt when the columns have no pedestal (a). Palladio, on the other hand, writing in 1570, has a ratio of 1:1.65, an archivolt and a keystone (b).

Vignola's Doric arch (c) is also 1:2. It has an archivolt, but again lacks a keystone. The pier has its own base and, only when there is no pedestal, he introduces a moulding on the line of the bottom of the capital to lengthen the columns. This is to be contrasted with one of the earliest examples from antiquity, from the Theatre of Marcellus in Rome (d) of 13 BC, where the ratio is 1:2.4, there is no architrave or projecting keystone and the arch sits well within the frame of the order. Two further Renaissance Doric arches, (e) and (f), have ratios very close to 1:2, but other details vary. The order is much simplified in (e) with the archivolt touching the architrave, while (f) has a keystone and narrow piers.

Vignola's Ionic arch (g) again has a ratio of 1:2 and, although his arch with an order on a pedestal does have a keystone, no keystone is shown for a simple base. The upper storey of the Theatre of Marcellus (h) has a very similar arch proportion, but the lack of an archivolt and the width of the piers create a very different impression. An Ionic arch with a pedestal from the Villa Giulia in Rome (i) of 1550 has the more usual Renaissance configuration, but the arch is lower with a ratio of 1:1.7.

An unusual Renaissance arch (j) sits within an order that combines Tuscan and Corinthian details; the arch is notable for the archivolt unbroken by an impost. The more conventional Corinthian arch from Vignola (k) shares the ratio of 1:2 with his other orders and now has a keystone. This ratio is repeated in Palladio's Corinthian arch with a pedestal (m). The Arch of Augustus in the north Italian town of Susa (l) of 9 BC, in common with many examples from antiquity, is much more individual. The ratio is 1:1.5 and the arch sits so far within the principal order that it has its own small pilasters supporting the archivolt.

Vignola's Composite arch (n) is similar to his Corinthian arch and again has a ratio of 1:2. The Composite Arch of Septimus Severus in Rome (o) of AD 203 is of approximately the same ratio at 1:1.8, but the columns of the order sit on very high pedestals, changing the relationship between the order and the arch.



Arches And The Orders: Further Variations

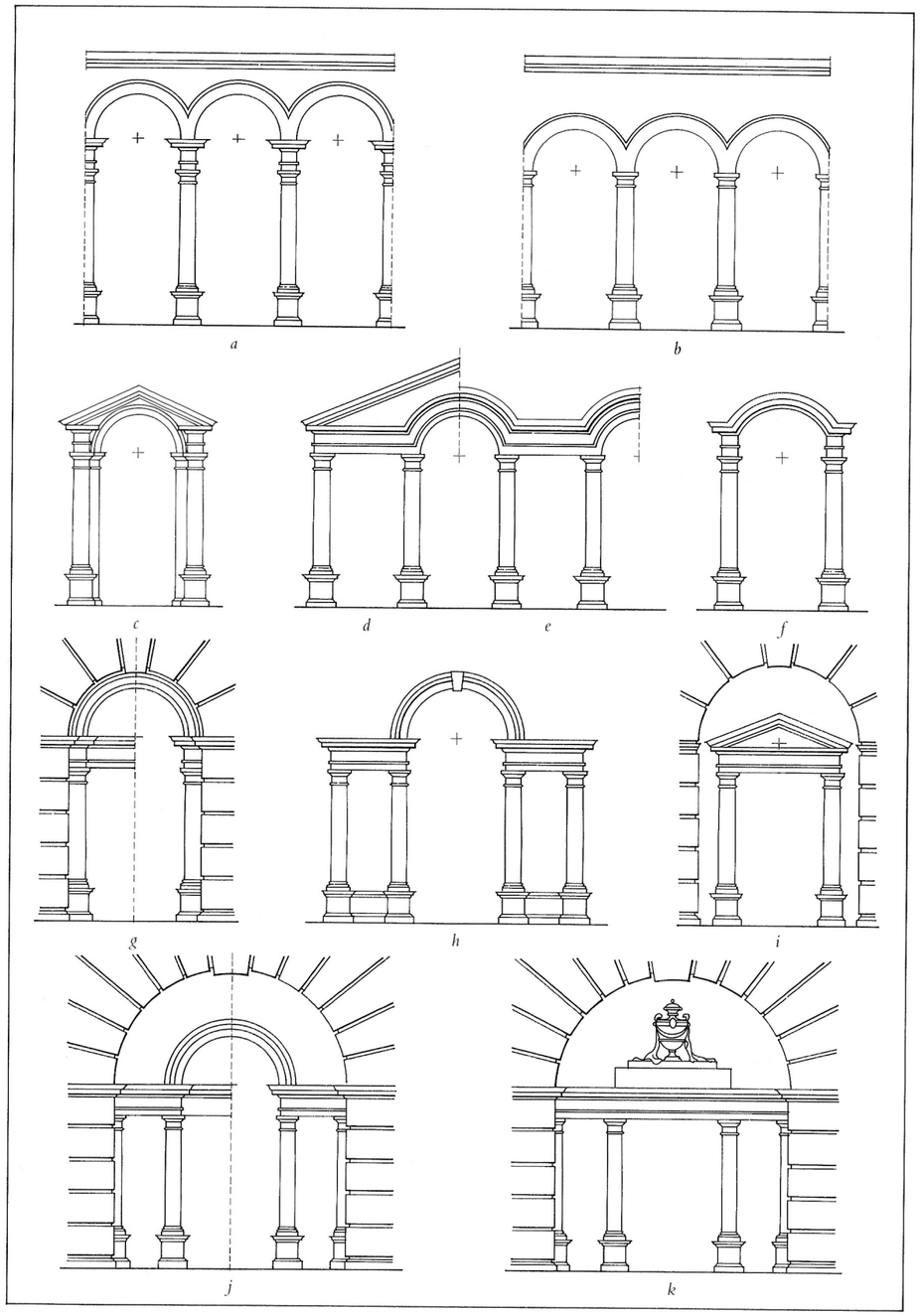
Classical arches do not always sit within a frame created by the columns and entablature of an order. Although this is how they first became assimilated into the classical vocabulary, the widespread use of the arch in Roman architecture led to an increase in the number of ways of combining the orders with the arch.

Arches were placed above entablatures in the first century AD and the entablature was interrupted to form a high opening. In later years the same principle was applied to continuous rows of arches, or arcades. The arches then sat on isolated vertical pieces of entablature called dosserets, which gave the order the appearance of greater height (a). In the eastern provinces of the Roman Empire another variant form (b) evolved for continuous rows of columns supporting arches. Here, the arch and its archivolt sprang directly from the column capital and the entablature was omitted altogether. This type of arcade spread to all parts of the later Roman Empire and was to influence the development of Romanesque architecture. Both these forms of arch were also popular in the early Renaissance.

In the later Renaissance, arches springing directly from columns were combined very successfully with pediments that had the central part of the entablature left open (c) making the column capital or impost of the arch level with the column capital of the order. This achieved a similar effect to another late Roman detail (d) in which the whole entablature arched over the column. Known as an arcuated lintel, this innovation also reached the late Roman Empire from its eastern provinces. It can be seen either as a central feature in a pediment or alternating with horizontal sections of entablature in an arcade (e). A less pronounced but contemporary treatment (f) involved arching the cornice only from a centre point level with the column capitals.

In the Renaissance a particular kind of arched opening (h) was developed which combined the horizontal entablature and arch. It was invented by Bramante, but both Serlio and Palladio used it frequently to great effect and it has become known as a Venetian, Serlian or Palladian window. It became very popular in the eighteenth-century Palladian revival.

The orders can also be contained within arches. The order can sit independently inside the arch (i) or can line the inner face of the arch, with or without a horizontal entablature, giving added intricacy to the edge of the opening (g). On a larger scale there are many ways of placing the orders inside arches of various sizes. It is, for example, possible to use the orders as a screen across an arched opening. Robert Adam used a simple row of columns supporting a vase to act as the entrance to Balbardie House in Bathgate, Scotland (k) in 1792 and a Palladian window inside a larger arch (j) gives a reduced window size and a crescent of plain wall which can receive a decorative pattern.



Tympanum And Spandrel

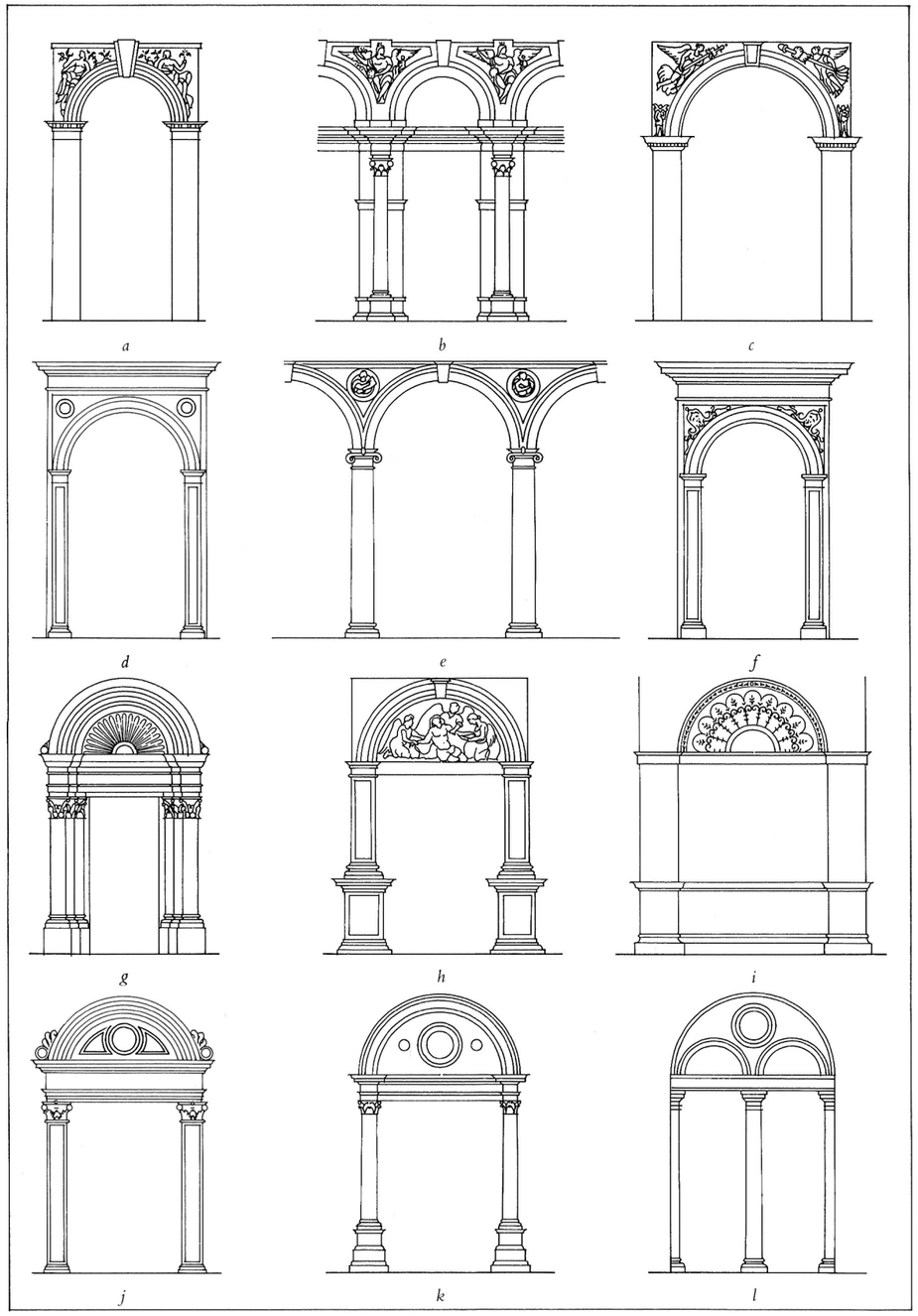
The combination of the semicircular shape of the arch and the rectangular shape of the orders created two intervening surfaces that have developed their own decorative vocabulary. The area inside the arch from the line of its springing to its keystone is called the tympanum. When an arch is created over a rectangular opening and the opening does not rise into the arch, the tympanum thereby created can be decorated or filled with a decorative pattern of openings. The two virtually triangular areas created on either side of an arch inside a rectangular opening are called spandrels, and these are also frequently decorated.

Roman triumphal arches were heavily decorated with statues and inscriptions and sculpture filled the spandrel panels. The central opening of the Arch of Septimus Severus (c) of AD 203, in common with other triumphal arches, had two figures of winged Victory flying with trophies of captured arms and armour towards the keystone. On the same arch there are also side-arches (a) with spandrels containing reclining river gods. This type of spandrel decoration has been repeated many times due to the importance of these monuments in antiquity and their survival virtually intact to the present day. In St George's Hall in Liverpool, England (b), by H. L. Elmes and C. R. Cockerell in 1839, this sculptural theme was modified to suit arches springing above the orders. Allegorical figures fill the T-shape spandrels, their wings spreading towards the keystones.

A simple spandrel decoration (d) has circular details centred on the widest point. These can be decorated or filled with smaller sculptures and can also be placed in the larger spandrels of arcades (e) centred on the column below. More capricious sculptural themes, such as acanthus leaf or other naturalistic designs (f), are frequently used for spandrels, often centred on a dominant geometric form at the widest point.

The decoration of the tympanum can be more varied, due to the broader and less restricted shape of the panel. The semicircular form immediately suggests radiating designs and one of the most common themes is a pattern of radiant fluting which can be abstract (g) or take the form of a shell. Other geometric or natural patterns (i) are often added and are only restricted by convention or the imagination of the designer. Panels of sculpture are frequently placed in arches over entrances or other important positions. The development of tympanum sculptural groups for theological subjects (h) became a particular feature of Romanesque architecture and remained popular for churches in the Renaissance.

Simple circular details are as appropriate to the tympanum as to the spandrel. Circular panels centred on the arch can form a framework for decorative changes of colour, texture or material, or can divide the space for smaller sculptural groups (j). The circles are themselves often windows grouped into simple geometric patterns, (k) and (l), based on their relationship with the semicircle of the arch.



Arches And Vaults

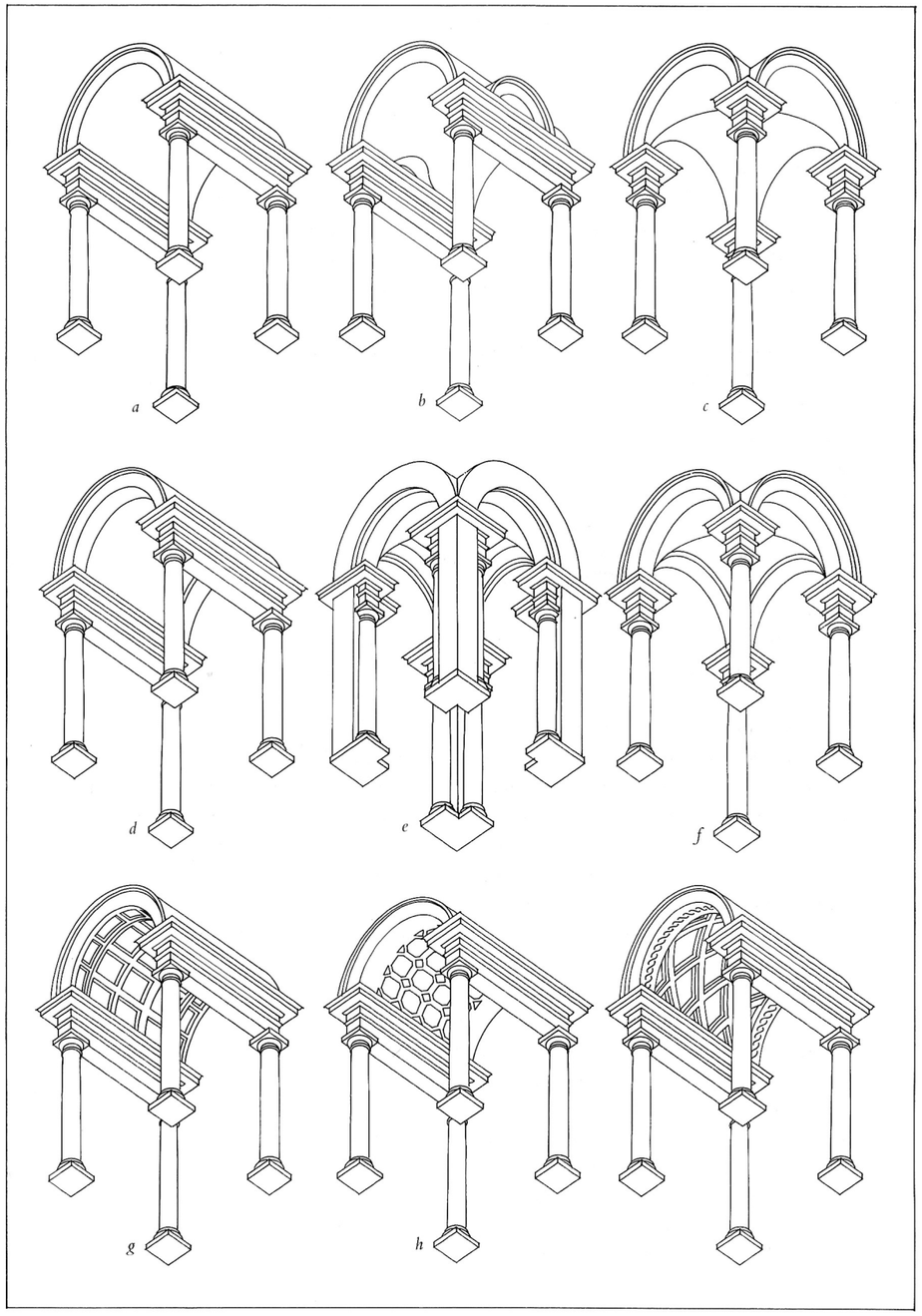
When the underside, or soffit, of an arch is lengthened it will cover a space rather than form an opening. This lengthened arch becomes a vault and if it has an unbroken semicircular soffit it will be a barrel vault (a). The barrel vault, or continuous arch, is as old as the arch itself and probably had no separate identity. The Roman invention of concrete, however, resulted in the extension of the old stone arch in three dimensions to create a complete structure which set hard to form one solid mass. This enabled Roman architects to create vast, vaulted structures with relative ease and encouraged the development of the design of vaults. The fluid nature of the wet cement permitted great freedom in the geometry of these structures and the use of permanent thin brick structures to contain the wet material while it hardened did little to limit this freedom. Stone was often added later as a thin decorative surface and, with the temporary structural requirements of the brick skin, an appearance of independent arched structures was maintained.

The barrel vault can have small windows added in its length. If these are also arched (b) a complex, curved shape is created in the vault. If two equal barrel vaults intersect (c), four curved lines will mark their point of intersection, crossing the square space diagonally. These lines are groins, and this type of vault is a groin vault. Concrete groin vaults spanning up to 25 metres were constructed for Roman baths and basilicas.

In the interests of construction, strength or solely for aesthetic purposes, the arches over the points of support in vaults are sometimes expressed by dropping the soffit. This can break up the line of a barrel vault (d) or define the plan of a groin vault (f). The effect of separating the vault structure from real or apparent supporting arches can be taken further and clusters of columns or a mixture of columns and piers (e) provide visually independent supports for each element. This late Roman design was widely adopted in the Middle Ages.

The decoration of the soffit of vaults can also differentiate arched elements in the structure. Simple square recesses, or coffers, in the vault (g) can be continued as rectangles on the arch. A different design, such as guilloche (i), on the arch will give added contrast to the vault, shown here with diamond coffering. On an uninterrupted vault surface, just the omission of part of the design can suggest an arch in the vault (h) which is shown here as less than a full semicircle.

Roman concrete construction ended with the Western Empire. Byzantine architects used great skill in translating the concrete vault and dome structures into brick and stone. In the west, Romanesque and then Gothic architects, aided by the fashion for pointed arches, simplified the stone construction of groin vaults with diagonal arches, or ribs, to create structures of an unprecedented slenderness. The barrel vault and its derivatives were revived in the Renaissance.



Types Of Dome

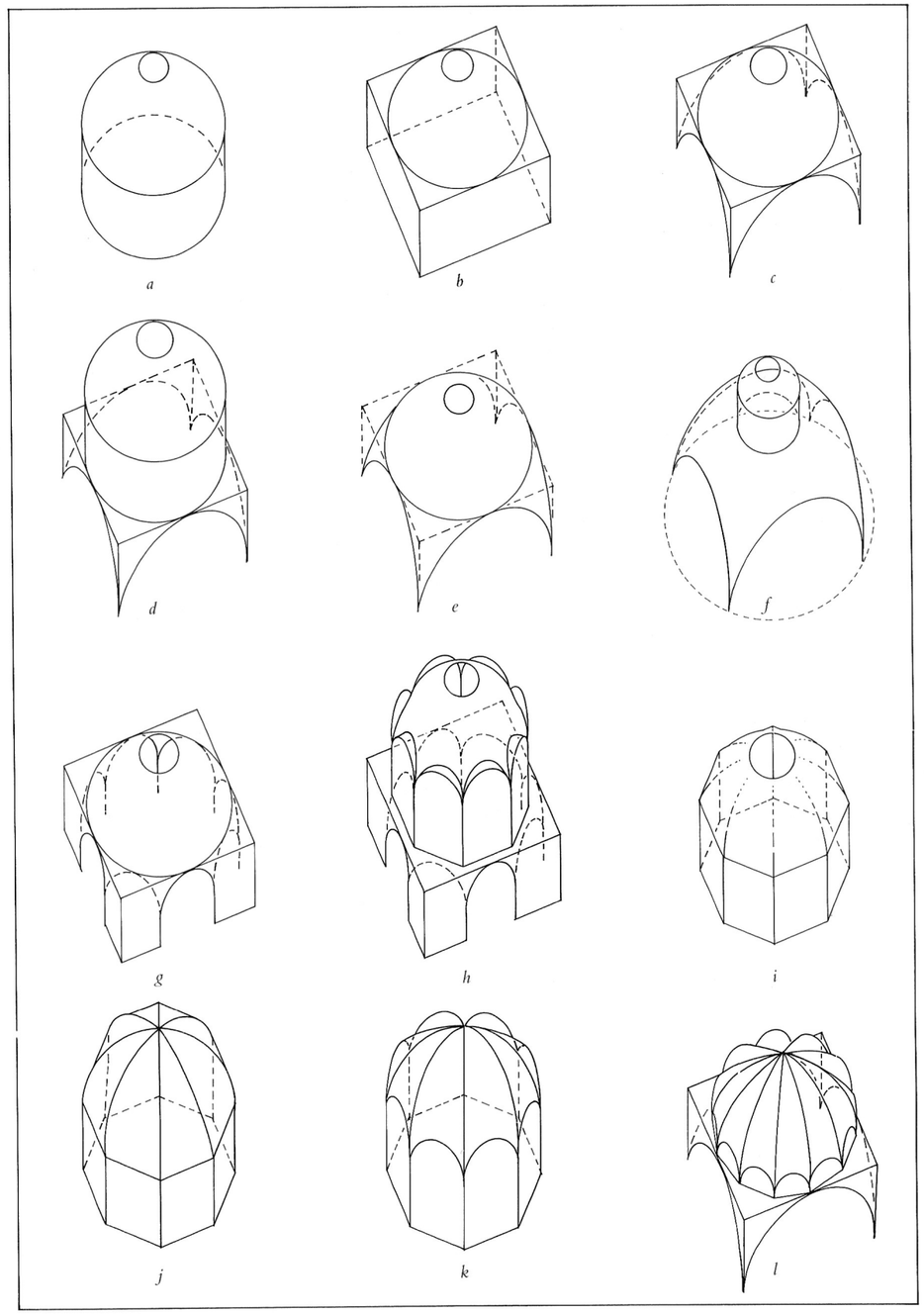
In the history of classical architecture, domed structures have taken many different forms influenced by the shape of the supporting structure, the means of admitting light, the method of construction and the desire for visual effect.

The circular plan of the dome sits comfortably on a circular supporting structure called a drum (a). This arrangement has been used frequently since antiquity. When the shape of the underlying walls is square, however, the relationship between the square and circular plans becomes a significant feature of the design.

The dome can just be placed on the square structure and the geometric difference clearly expressed (b), but this arrangement is not often used as the weight of the dome is only supported by the walls at four points. To overcome this problem the dome can gradually merge into the square. This type of construction is generally associated with arches in each side of a square (c). The triangular space at each corner, between the curves of the arches and the edge of the dome, can be curved down to the springing of the arch and is known as a pendentive. Pendentives were particularly favoured by Byzantine architects. A pendentive structure does not have to merge directly into the circumference of the dome but can support an intermediate drum (d). If the dome is less than a full hemisphere it will eventually merge so completely with the pendentives that the two forms become a single dome, made square by removing four segments from the circular plan of the dome, (e) and (f). In example (f) the distinction between the shallow dome and the pendentives has completely disappeared.

A substitute for pendentives is an arch across the corner of a square. This is known as a squinch (g). It can be a single arch or a series of arches diminishing downwards towards the corner, following the line of a pendentive. In their simplest form, squinch arches form an octagon with the four arches on the sides of the square. This in turn can support an octagonal drum (h) – in this example with arched windows rising into the dome. Squinch arches were another Byzantine device, but domes on octagonal drums are also to be found on early Roman domed structures. The eight sides of the octagon can quite effortlessly merge into a circular dome (i) or extend to the central point of the dome as flat leaves (j). If eight arched openings are placed to rise into the dome (k) the arched forms can be gradually diminished in each segment until they meet in the centre. This distinctive shape gives the name umbrella dome.

These shapes and others have been used in the design of simple domes. There are many varieties and combinations. An umbrella dome can, for example, have twelve sides each with an arched window rising into the dome and (viewed from the inside) concave segments. This can sit on a circular opening in a square, arched structure with pendentives (l).



8. THE PEDIMENT

The Temple Roof

A pediment is the gable-end of the roof of a Greek temple (a). Greek temples were entered by their gable-end, making the pediment an important architectural feature.

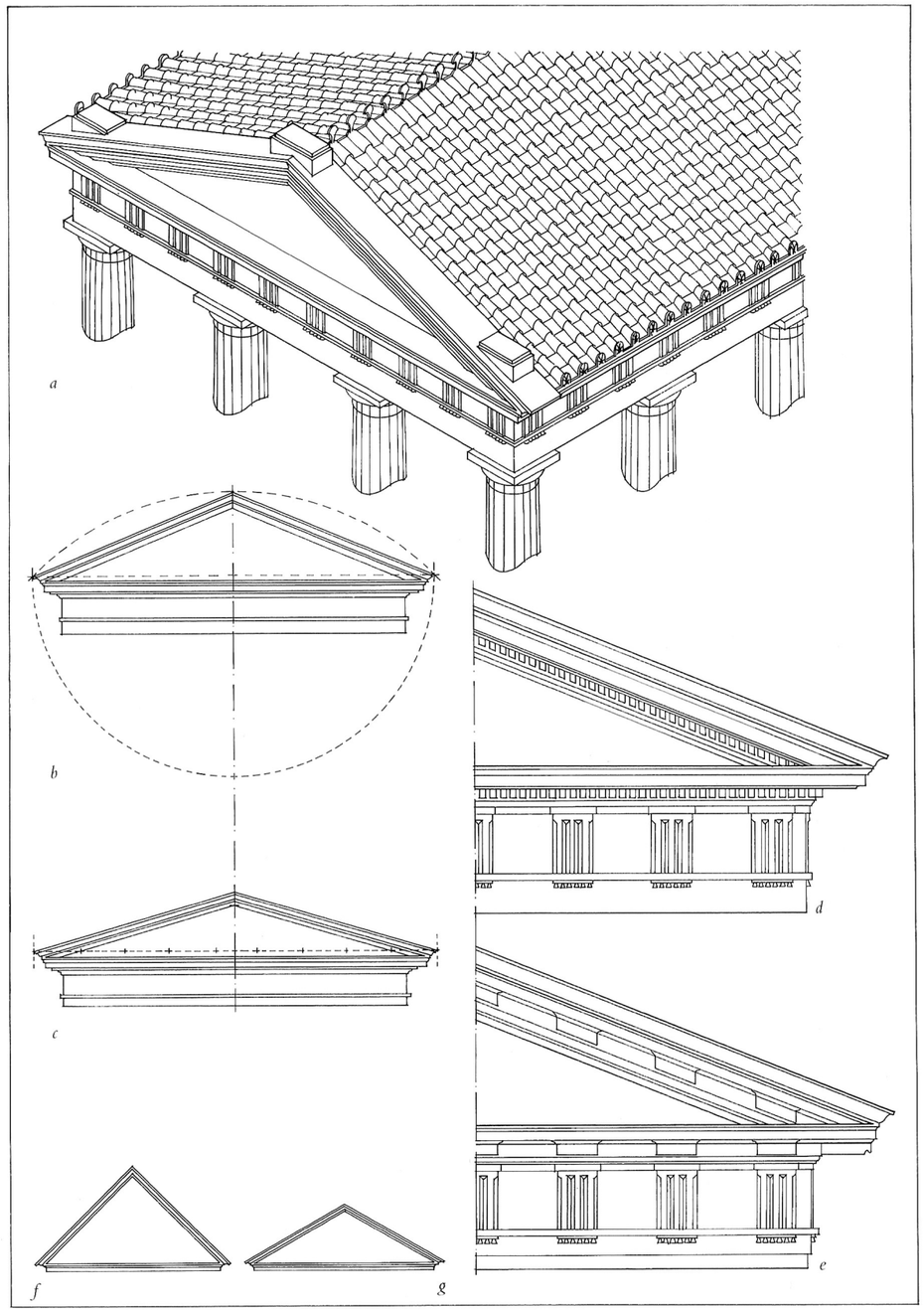
Classical pediments usually have a shallow pitch. The Greek invention of a special type of clay roof-tile in about 700 BC established the pitch of temple roofs. This roof-tile, still in use today, was large, flat and turned up at the sides. The joints between the tiles were covered by smaller half-round tiles. The new roofing system was very efficient and replaced earlier flat mud roofs and steep thatched roofs. The tiles were laid loose and, to stop the outermost tiles falling off, special decorated clay brackets, or antefixa, were secured to the roof beams and hooked up over the end of each row of half-round tiles.

Pediments were often lavishly decorated. The triangular space inside, the tympanum, at times contained sculptural groups and the top of the pediment could have sculpture at the ends and centre called, with their supporting bases where appropriate, acroteria.

The Roman author Vitruvius set out pediments by dividing the maximum horizontal dimension into nine to find the height to the lowest moulding at the top of the pitch (c). In the sixteenth century, Serlio took a distance down from the centre equal to half the maximum horizontal dimension and made this the centre of an arc from the outside of the pediment to its uppermost point (b). These rules are, however, far from universal. Some Roman roofs had a thirty-degree pitch (g) and in buildings of the north European Renaissance, pitches of up to forty-five degrees (f) accommodated local forms of roof covering.

Some details of pediments obey strict rules. The top of the pediment is the same as the cornice of the horizontal entablature on which it rests, but on the entablature the cornice loses its top moulding, usually a cyma, as this was originally the gutter and would be redundant in this position. The corona, below, forms the junction between the pitch and the horizontal.

When the cornice contains projecting features, such as dentils (d), mutules (e) or scrolled brackets, these usually do not tilt over to follow the slope of the pediment but are distorted, so that the sides are vertical while the top and bottom of the features stay at the angle of the pediment. These features are spaced so that they are vertically in line with the equivalent detail below.



Types Of Pediment

The application of the pediment to parts of buildings which do not resemble the gable-end of a temple has, from the Roman period onwards, led to a number of modifications. The importance of the pediment is so well established that its identity survives even when reduced to little more than distorted remnants.

Many of the variations of the pediment involve the removal of different parts. The terminology for these modifications has become confusing. Pediments with part of the top omitted are sometimes called 'open' and sometimes 'broken'; for pediments with part of the bottom omitted, the terminology is similarly confused. There is no universally accepted system of terms.

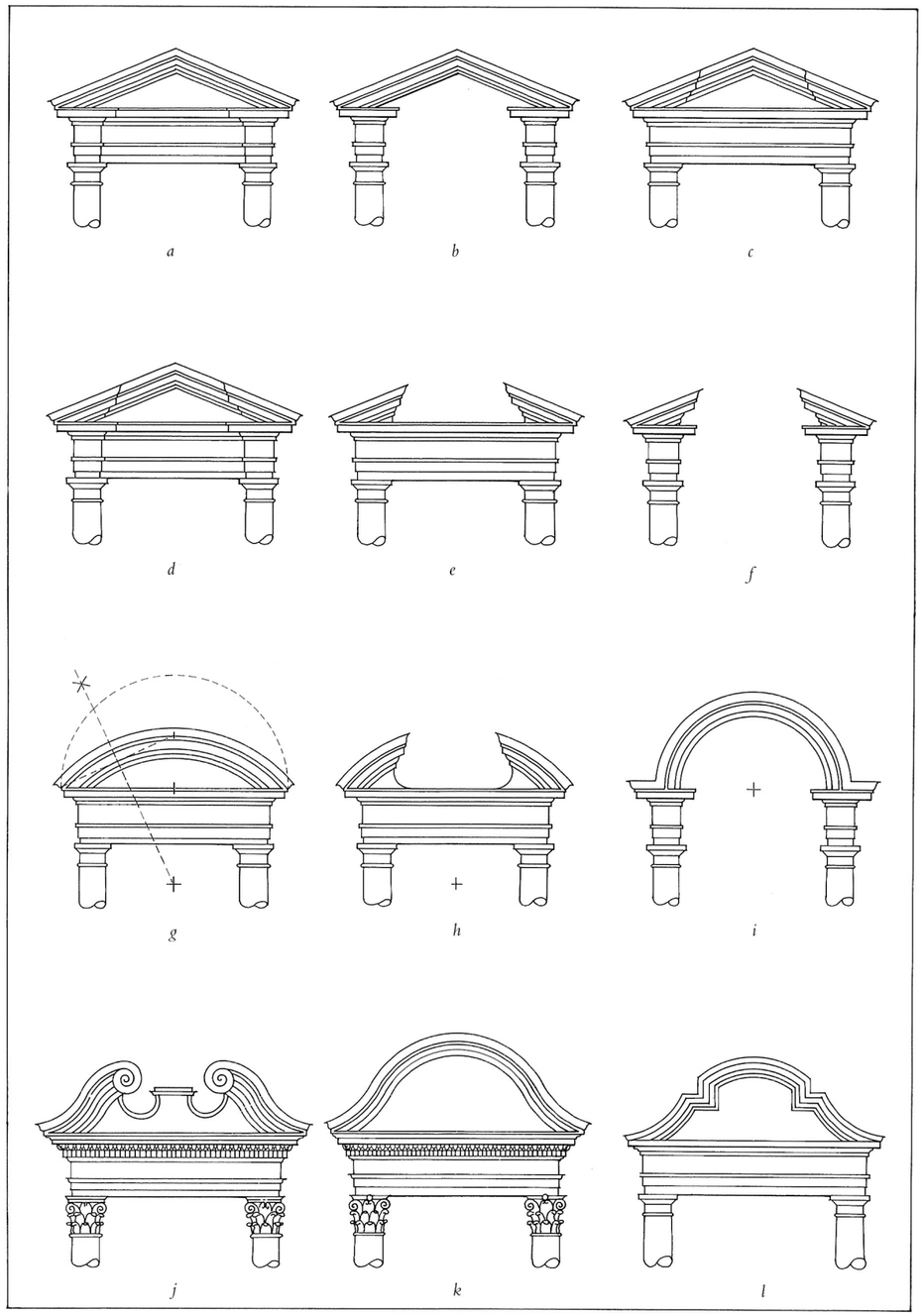
Part of a pediment can be brought forward on columns or brackets, leaving the central part of the horizonal entablature behind (a). The central portion of the entablature can be omitted altogether, creating an open space beneath the apex of the pediment (b). This arrangement allows an arch or some other vertical feature to rise unhindered past the column capitals.

The pitch of the pediment can be broken and brought forward. The broken entablature and pitch can be brought forward together (d) or the pitch alone can be broken (c). Again, the central portion of the pitch can be omitted, leaving the top of the pediment completely open (e). The gap created in (e) is set by the width of the vertical section of entablature above the column, or dosseret, but it can be reduced. It is also possible to omit both the recessed entablature and the recessed pitch leaving only two vertical remnants of pediment (f). This detail tends to be specifically associated with Mannerist, Baroque and Rococo architecture.

Pediments do not have to be triangular, they can have a curved top. These are generally low segmental curves (g) and of the same height as a triangular pediment. The centre of the arc of the pediment (g) is found by dividing a line from the outermost horizontal point to the equivalent point at the apex into two parts and projecting this centre point at right-angles to meet the centre line. Their equal height allows segmental and triangular pediments to be mixed in an alternating pattern or to give emphasis to one or more features by changing the type. Curved pediments can be varied in the same way as triangular pediments (h).

The pediment can also be a complete semicircle although the uppermost cyma moulding terminates facing downwards. This was sometimes avoided by bringing the bottom of the cyma moulding down in line with the centre of the column or bracket and turning it outward to terminate horizontally (i).

There are many further variations of curved pediments. The pitch can be turned into two scrolls which can meet at the centre or remain apart (j). The pitch can have a double curve (k) or be split into a series of curves, or curves and straight pitches (l). These variations are generally associated with Baroque and Rococo architecture.



11. RUSTICATION

Origins

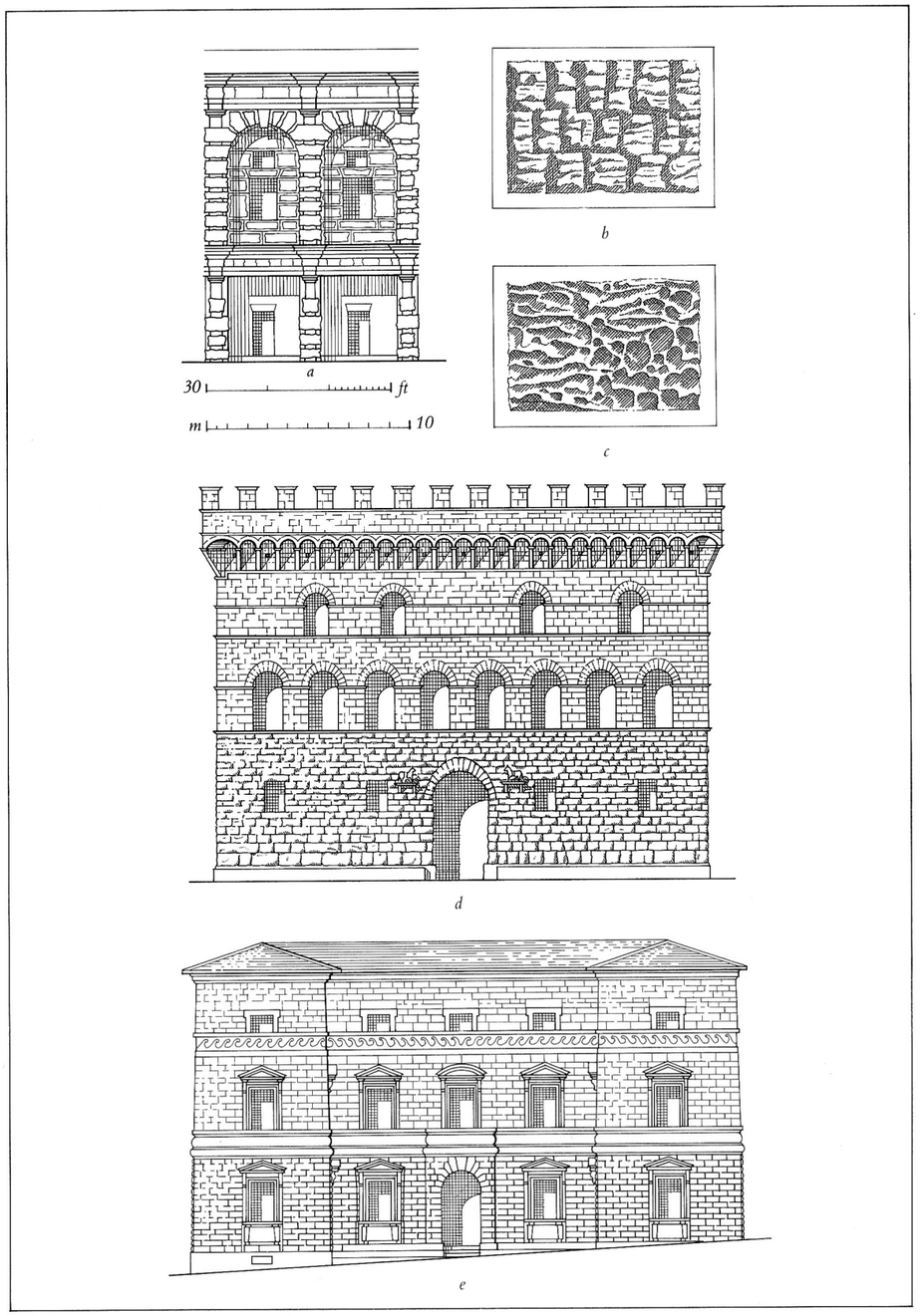
Rustication is stonework that is left rough and unfinished except where it fits together at the joints. The even joints form vertical and horizontal grooves in the uneven face of the stonework. A similar effect can be achieved with brick and stucco. The word implies construction that is crude and unsophisticated, but rustication has become one of the most widespread and subtle forms of decoration in classical architecture.

Stone walls where the face of the blocks show the marks of coarse chisel work or bulge outwards between the joints are quite common in antiquity and can be found in utilitarian structures such as Greek city walls (b). There are also some Roman buildings where the joints in masonry are set in shallow channels for deliberate visual effect.

The first evidence of rough stone rustication being used extensively as an aesthetic device is on buildings constructed in the reign of the Emperor Claudius in the middle of the first century AD. A series of remarkable designs, such as the Temple of the Deified Claudius in Rome (a), date from this period and have the same exaggerated mixture of smooth finished and very rough unfinished stone. It is known that Claudius was a keen antiquarian and it is quite possible that this unprecedented architectural phenomenon arose out of a desire to evoke an imaginary antique primitiveness. Whatever the intention behind this work, it was not repeated in this form in antiquity.

In medieval Italian towns another unconnected tradition developed. Urban fortresses or palaces, such as the fourteenth-century Palazzo Comunale in the central Italian town of Montepulciano (d), were built of deliberately massive and rough blocks of stone to express their strength and impregnability, and consequently the nobility of the occupier. Renaissance architects, while striving to emulate antiquity, had to design for the same climate of urban violence and with the same traditional expressions of strength and status as their medieval precursors. Perhaps influenced by the remnants of Claudius' buildings, a more orderly system of rusticated decoration was created, distinct types became recognizable and the imitation of stone eroded by weather (c) became as pronounced as that of unfinished stone.

In spite of its brief flowering in antiquity, the systematic use of rustication is a Renaissance extension of a medieval tradition. Buildings such as the Palazzo Cervini, also in Montepulciano (e), designed by Antonio da Sangallo in 1520, add classical harmony to the established forms of their Gothic forebears.



Types Of Rustication

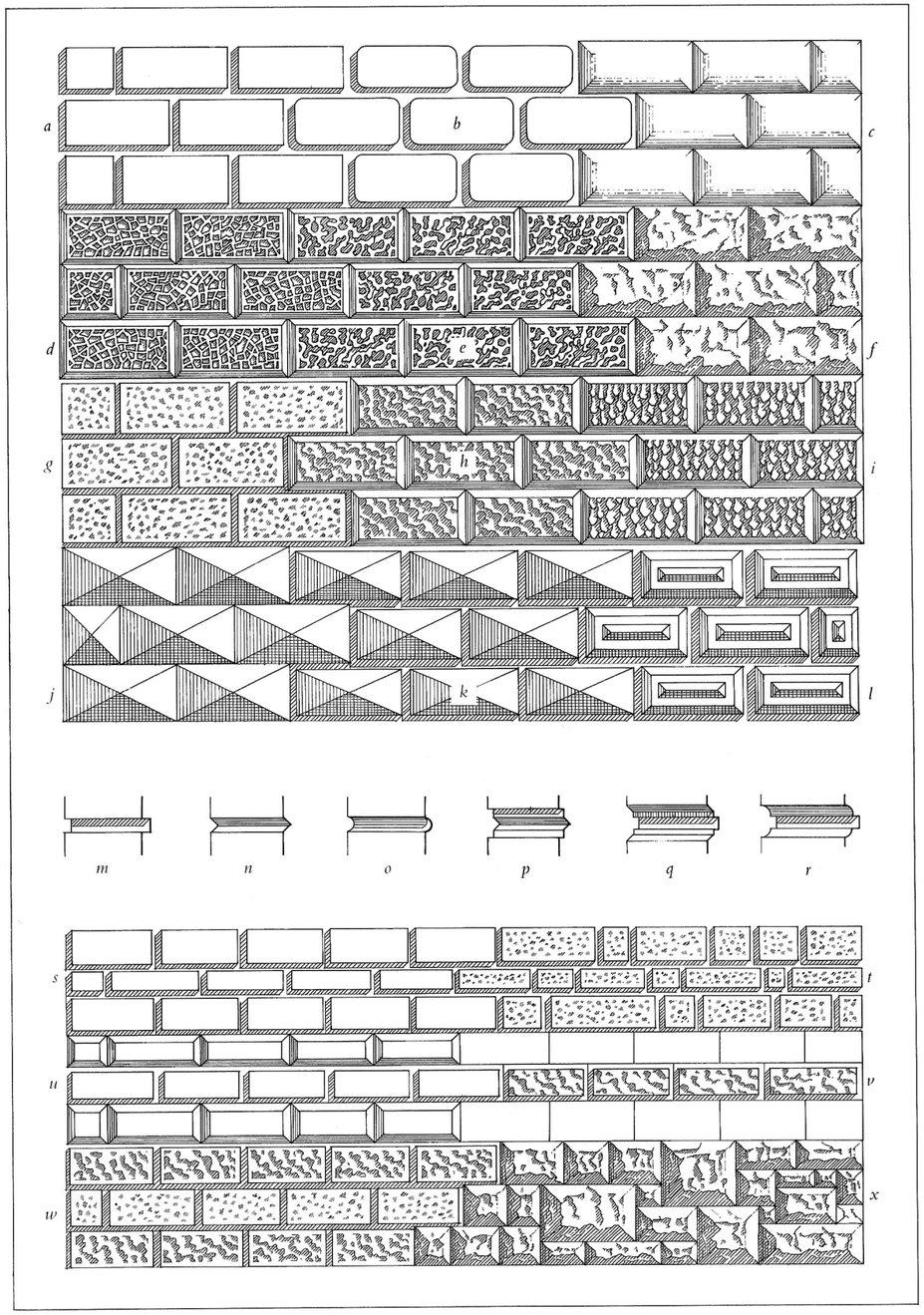
The word rustication has in the past been limited to rough stone blocks but has come to mean any form of stonework, brickwork or stucco where the joints are recessed or the face of each stone is separately expressed. Where only the horizontal joints of stonework are recessed, or occasional courses of bricks are set back, rustication is sometimes referred to as banding.

A large number of different types of rustication have evolved. It can be limited to recessing the joints between the stones (a). This smooth rustication is often reproduced in plaster or stucco, or even wood. Variations in the joints, (m) to (r), can significantly alter its appearance. The separation between the stones can be exaggerated by rounding the corners of the projecting faces (b), although this detail is unusual. Bulging, cushioned rustication (c) is much more common and frequently has even joints as illustrated. The face of the stonework can have many different types of finish. Reticulated rustication (d) is covered with a net-like pattern, while vermiculated stones (e) have a series of contorted forms which resemble worm-casts and can be cut to varying degrees of depth and complexity. These two types of rustication are often mistaken for each other. A rock-faced finish (f) has always been popular and is the most straightforward representation of uncut stone. The coarseness of rock-faced work can be diminished by chiselling to give a gentle, pecked finish (g) or a harsher, punched face (h). Most extraordinary of all is the frosted, or congelated, finish (i), used on Baroque buildings and cut to imitate the petrified drops of limestone found in caves. Mannerist architects developed a prismatic, or diamond-pointed, stone (j) which produces a very powerful pattern on a building. It can be emphasized by recessing the joints (k) or embellished by repeating the design (l).

Different types of recessed joint can be used. Simple straight (m) and chamfered (n) joints are found associated with all types of rustication while the half-round joint (o) is less common. Joints with two steps, (p) to (r), can strengthen the effect of smooth-faced rustication but are particularly useful for keeping the joints of rough-faced rustication distinct from the coarse surface.

Rustication is often mixed. Courses can be of different heights (s) and the sizes of the blocks can be varied to produce an irregular pattern (t). Joints can be varied, for example by alternating straight and chamfered joints (u). Rusticated blocks can be mixed with smooth, dressed stone to create textured bands, surrounds or edges (v) and different textures of rustication can be mixed (w). The horizontal courses of rustication are usually level, but a few buildings have random coursing (x).

The illustrated examples are by no means a comprehensive collection of types. There has been a great deal of individual interpretation of rustication, both by architects and stonemasons. Mixing types and details can produce many different textures and effects on the surfaces of walls.



Rusticated Walls And Openings

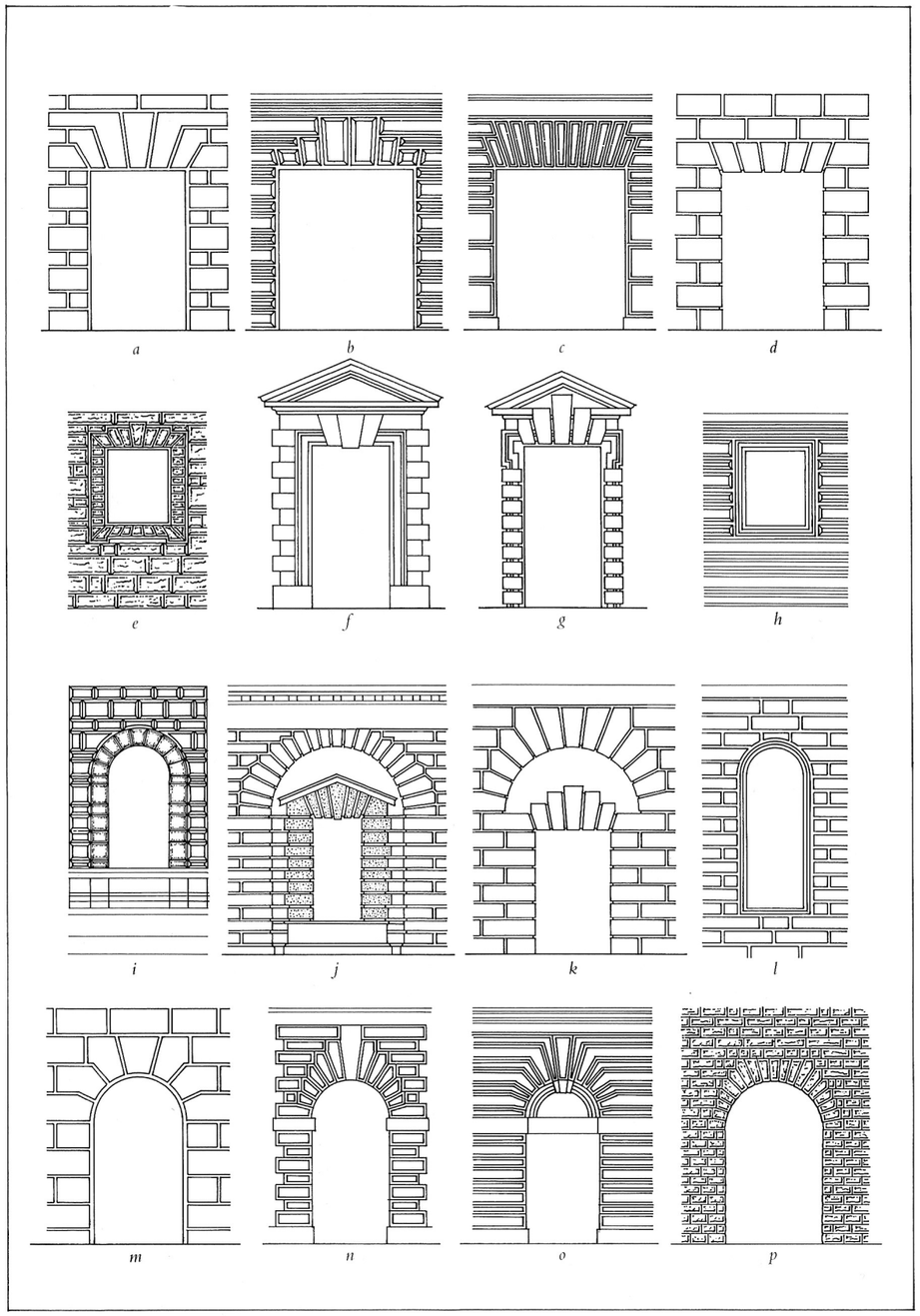
Before the creation of a series of rusticated orders in the sixteenth century, a number of methods of forming openings in rusticated walls had become established. As rustication is essentially an enhancement of the stone normally used for the construction of walls, the details of simple openings are an enhancement of the traditional method of constructing stonework.

A series of voussoirs forming a flat arch can be brought up to the level of an appropriate joint in a rusticated wall (d). A more interesting arrangement is the integration of the voussoirs with several courses of stone to form blocks that turn the voussoirs outwards into the wall (a). The pattern of the rustication on the wall can cut into the voussoirs of the flat arch progressively from the outside by lowering one (c) or more (b) of them to create a series of upward steps that resemble the arrangement of voussoirs for round arches. Example (b) from the Palazzo Costa in Rome is unusual as it has two keystones, instead of one.

Similar variations in round arches are dictated by the way the voussoirs meet the horizontal lines of the wall rustication. With more than three courses of rustication in the height of the arch the voussoirs will step progressively upwards as they meet each horizontal course to form the rough outline of a pointed arch in the stone, (n) and (o). This pattern can be marked with a joint at each intersection (n) or, particularly with banding, can run in unbroken lines into the horizontal courses (o). These two arrangements can be combined to form L-shaped stones (m). The height of the stepped, radiating voussoirs can be limited by stopping them in a horizontal line at a joint above the arch (p).

The rustication of both flat and round arches can be isolated from the wall by forming separate rusticated surrounds, (e) and (i). The surrounds can also be reduced to stone frames that contain no indication of the structural means of forming the opening, (h) and (l).

In the sixteenth century, designs for rectangular openings and surrounds derived from antiquity were rusticated. Blocks were placed around the architrave and penetrated part of the entablature as voussoirs (f) or, as on the window in Vignola's Villa Giulia in Rome (g) of 1550, a rusticated flat arch and classical surround were fused together. Different varieties of this union of rustication with classical detail have evolved and in George Dance's Newgate Prison in London (j) of 1770 the rustication has virtually consumed the surround, which is contained within an arch. This combination of rectangular and arched rusticated openings was established in Italian Renaissance palaces. Palladio's arch from the Palazzo Thiene in Vicenza in northern Italy (k) of about 1550 combines the two forms effortlessly within the pattern of the rustication, while Dance attempts to match the curve of the arch in the voussoirs and so gradually loses their relationship with the horizontal wall.



Rusticated Orders

Although some of the earliest rustication is Corinthian, when Renaissance theorists fixed the orders in a sequence, according to the slenderness of columns, they established Tuscan and Doric as the orders most often used for lower storeys of buildings. The same theorists enlarged upon the Roman author Vitruvius' mythological human characteristics for the orders, suggesting that robust details such as rustication would be most appropriate for the masculine orders, Tuscan and Doric. The Renaissance development of rustication was, consequently, contemporary with developments in the understanding of the orders that led both to the idea that Tuscan and Doric were most suitable for rustication and to the location of these orders in the often rusticated lower storeys of buildings. Tuscan and Doric rustication is, therefore, much more common than rustication in the other orders.

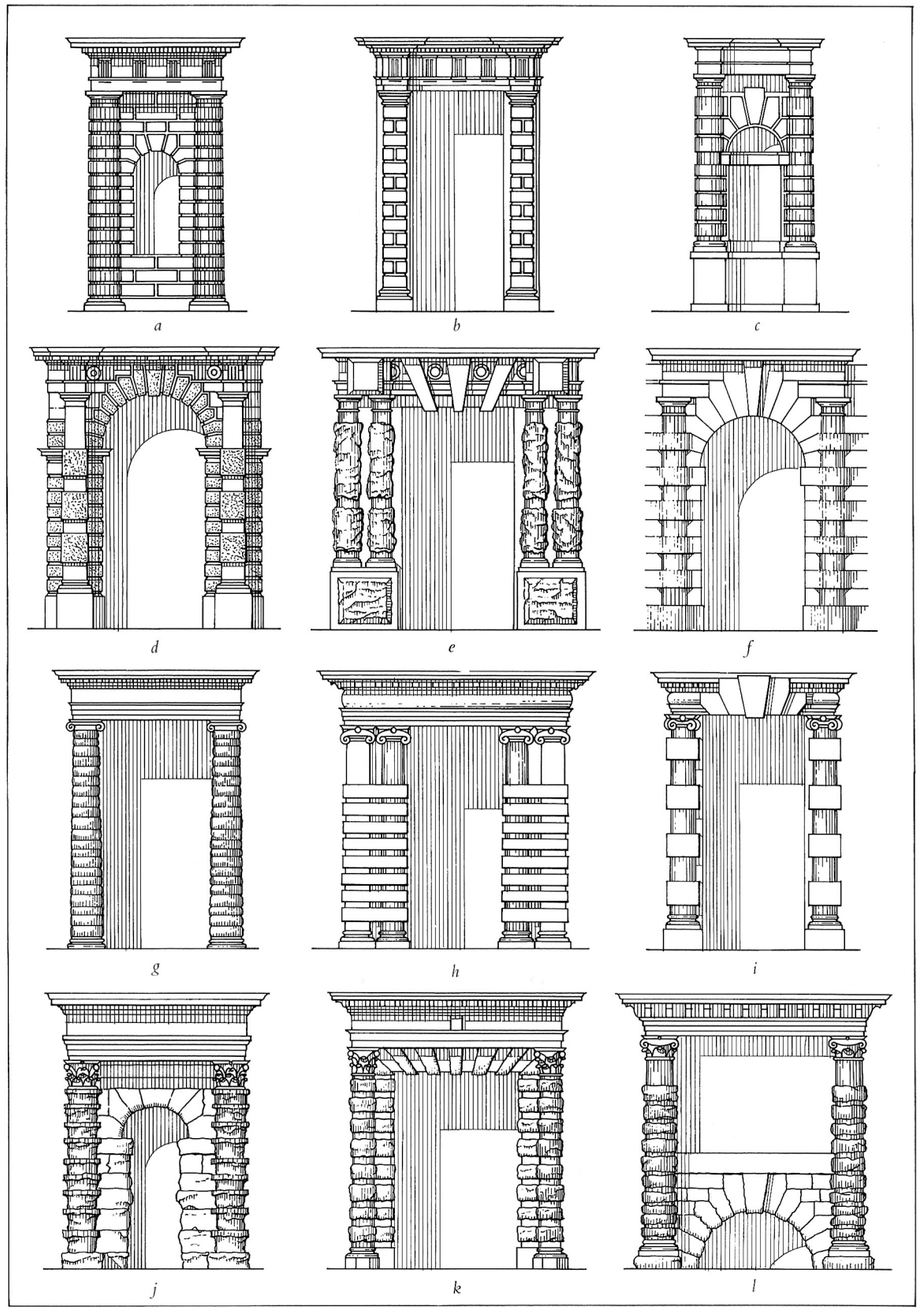
All the orders can, however, be rusticated, but there is no consistent difference in the details. Features seen on one order can be applied to another and these can take many different forms.

Regular circular blocks on the column shaft (a) give an orderly appearance and leave the finer details such as the capitals and entablature intact. These bands can be set out to reveal more of the true column shaft. Vignola's doorway on the Villa Giulia in Rome (c) of 1550 has the underlying column shaft exposed in line with the imposts of the inset rusticated arch. The spaces between the rusticated blocks can be increased progressively to expose more column, (k), (f), (d) and (i). An archway at Somerset House in London (d), designed by William Chambers in 1776, has no rustication on the columns above the impost of the arch.

Rusticated blocks can be regularly or unevenly spaced, (g) and (l), and can vary from the coarse stones of Serlio's extraordinary design (e) of 1551, to the late-eighteenth-century use of neat, square blocks with vertical joints (b). One of the first uses of heavy rustication, in the Corinthian Porta Maggiore (j) of the early first century AD, has stones like a series of uncut blocks for Corinthian capitals. In another detail by Serlio, the columns are strapped into the wall (f) as if captured by the stones, while illustration (h) shows how square blocks can bind two columns together.

Arches set into the order at times push through into the entablature. The upper voussoirs of the Doric arch at Somerset House (d) are very carefully coordinated with the triglyphs in the frieze, while Serlio avoids this by using simplified Doric details (f). Although the cornice often escapes the intrusion of rustication, at times it can occupy the whole entablature (i).

Rusticated voussoirs from flat arches can be contained within the horizontal zone of the column capital, as on the garden elevation of the Palazzo Pitti in Florence (k), by Bartolomeo Ammanati in 1560. They can also be cut into the entablature (e) or the entablature can, by the addition of voussoirs, become the flat arch itself.



The Pilaster

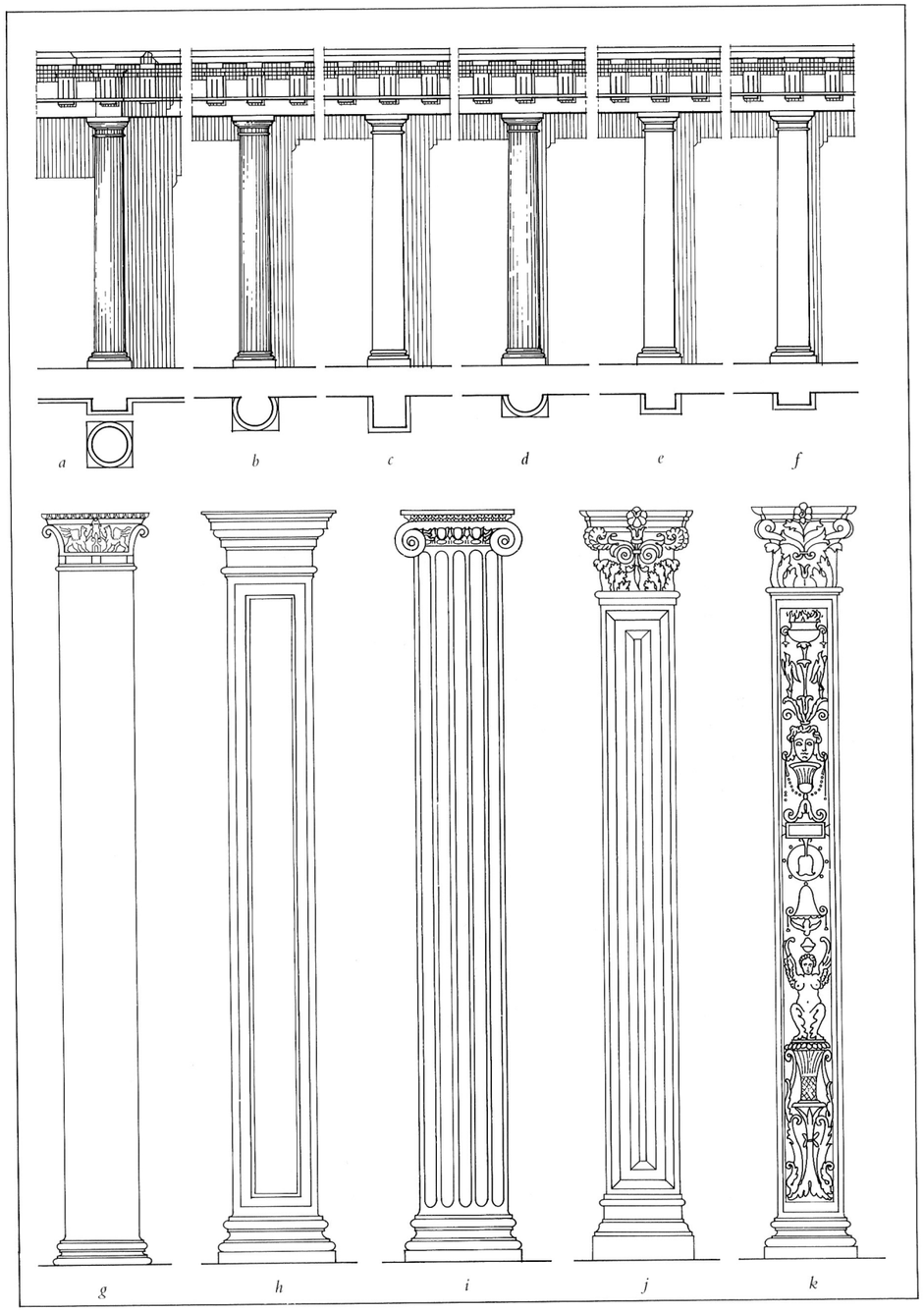
It is not always practical or desirable to use free-standing columns in a building. Although the orders originated with independent columns, it was not long before imitations of these colonnades were built by applying the same decorative system to projections in walls. These projections are called pilasters when they are shallow and engaged columns when they project more than half a column width.

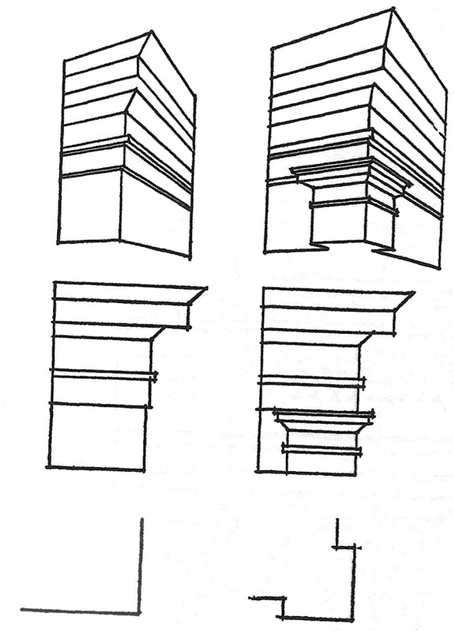
The early introduction of the pilaster allowed plain walls to be decorated in a way that related to free-standing columns on other parts of the building and gave the opportunity to apply the orders to any kind of structure.

The face of a pilaster can be set at different distances from the wall behind. Example (b) is an engaged column. The connection with the wall is concealed by the inward curve of the shaft, thereby giving the impression of a free-standing column. If this is changed to a square profile as in (c) the effect is lost and the rectangular section of the engaged column gives the impression of greater bulk. If a square engaged column is the full depth of the lower column width the apparent bulk is further increased, since the entasis of the column is lost as it connects to the wall behind. Example (d) is a pilaster half a column deep and is the minimum depth possible for a circular shaft. The curve of the pilaster diminishes the visual effect of the projection. The use of a rectangular form as in (e) can compensate for this. As the depth of the pilaster becomes shallower (f) a rectangular form has to be used. If there is to be any entasis this can be restricted to the two faces that return into the wall.

When a free-standing column sits adjacent to a wall, there is often a corresponding pilaster on the wall as in example (a). The Romans further developed the decorative effect of colonnades against plain walls by setting free-standing columns against the wall and bringing the entablature out in individual sections, called ressauts, over each column.

Pilasters are more often than not rectangular and this has resulted in a series of details specific to pilasters. None of the examples (g) to (k) has any entasis. Example (g) from the fourth-century-BC Temple of Apollo at Didyma is very much more slender than any contemporary free-standing columns and has a capital of a type that is only found on pilasters. The two pilasters (h) and (j) illustrate two versions of a panelled outer column face which can have inset marble or other decorative finishes. This is a popular variation and the panels can, as in example (k), be decorated with figures or other naturalistic or geometric decoration in relief. It is also possible to adapt fluting and capitals to the rectangular form. In the Baths of Diocletian (i) of AD 305 the flutes are reduced in number. Examples (j) and (k) show Renaissance capitals of a simplified Corinthian type modified to accommodate the square profile.





are coupled, it breaks back, so that the frieze and the lower band of the architrave are nearly in the plane of the wall below, there being only just enough projection to give a line of shadow, as shown at *G*.

When there is no pilaster, as in Fig. 63 *A*, the treatment of the cornice presents no difficulty. It returns around the corner just as if the corner were occupied by a column. When, also, as in Fig. 63 *B*, the pilaster comes exactly on the corner, forming a square pier, the entablature is treated just as when it rests upon a corner column, except that, since the pier has no diminution (the upper diameter being six-sixths of a diameter, instead of five-sixths), it projects beyond the face of the frieze by one-twelfth of a diameter, whenever the rest of the entablature rests upon columns. But this is undesirable, because the outline of a corner column, though it appears in line with the frieze when seen in elevation, always looks, when seen as usual in perspective, considerably behind it, and a pier projecting in front of it seems obtrusive. It is well, accordingly, to make such a corner pilaster smaller all the way up; viz., eleven-twelfths, or even five-sixths of a diameter. Since a square pier is likely to look too big even in comparison with the other pilasters, and very much larger than a round column, it will well bear this diminution.

The corner Doric pilaster comes under the first triglyph from the corner, and the Corinthian pilaster under the second modillion. The other pilasters are set under any other triglyphs or modillions that may be convenient. But when the pilasters are coupled, the spacing of the triglyphs and modillions over them must be slightly increased, as has just been explained.

Breaking the Tuscan entablature around double and triple corners is easily done, as in Fig. 63, and in the Ionic Order and in Vignola's Composite the dentils present no real difficulty. The Doric triglyphs and mutules and the Corinthian modillions are less easily managed. The arrangements shown in Figs. 64 and 65 offer a fairly satisfactory solution of the problem.

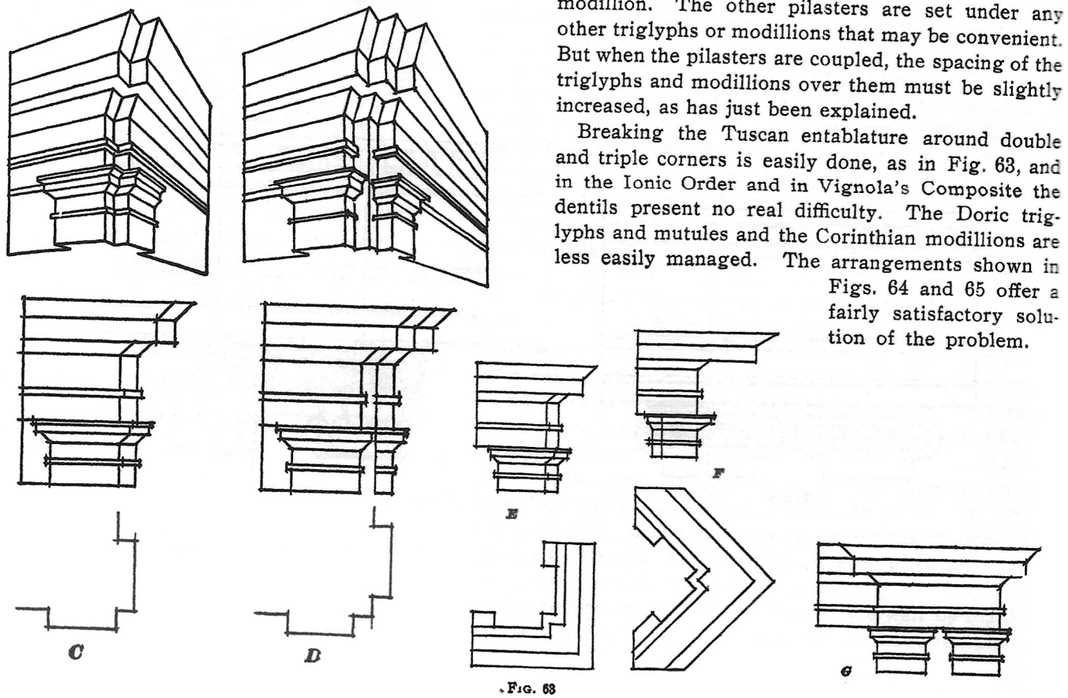
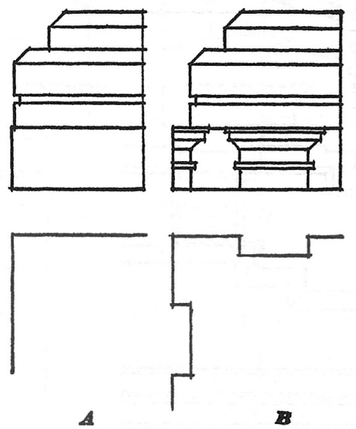


Fig. 63



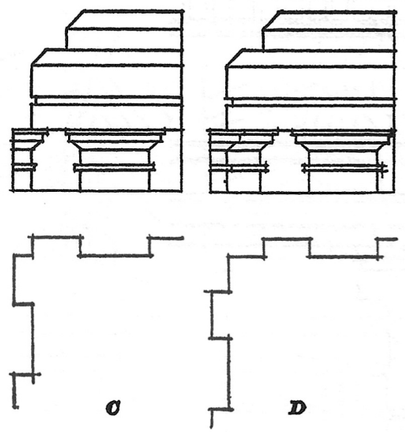


Fig. 66

When the entablature breaks back from the plane of the pilaster to the plane of the wall, the problem resembles that presented by external corners, and admits of analogous solutions.

Internal Corners or Reentering Angles.—Pilasters.—In an internal corner, as in an external one, there are several ways of arranging pilasters. In Fig. 66 *A*, the entablature simply crowns the wall without any other support. In this case, the frieze generally lies nearly in the plane of the wall below. At *B*, there is a single pilaster on each wall; at *C*, a quarter pilaster is added in the corner, giving a pilaster and a quarter pilaster on each wall, the depth of the pilaster being generally a quarter of its width; at *D*, the quarter pilaster is replaced by two half pilasters, giving a pilaster and a half on each wall, but here a larger or smaller fraction may be used. In both *C* and *D*, the whole pilaster is coupled with the fragment in the corner.

As in the case of external corners, the entablature does not generally break around the outer pilaster, and unless the pilaster is deeper than usual, the soffit overhangs so little that a sufficient support is afforded by the wall beneath.

In internal corners, as of a room or of a courtyard, care must be taken that the mutules, or modillions, of the two cornices that meet at the reentering angle do not crowd upon or interfere with each other.

The Tuscan Order having none of these details presents no difficulty. Dentils, where they occur (Fig. 67), sometimes have a square interdentil in the corner, flanked by a dentil on each wall, as at *A*, an arrangement that presents, in elevation, the aspect of a double dentil, such as regularly occurs on an external angle. Sometimes a square dentil occupies the corner, as at *B*, and sometimes it is convenient to employ an **L**-shaped dentil, as at *C*.

Double Corners.—The Mutulary Doric.—Fig. 68 *A* shows a wall surmounted by two entablatures of Vignola's Mutulary Doric Order, meeting on an external angle, and a third entablature forming an internal angle with one of them, so that the corners of the mutules just touch. Since the outer face of each mutule is three-fourths of a diameter distant from the wall behind it, the side of each must be just three-fourths of a diameter from the adjacent wall; and as the mutules are half a diameter wide, the axis of each mutule, and consequently the axis of the triglyph and pilaster beneath it, is just one diameter from the face of the adjacent wall. It follows that, in an internal angle, the edge of a pilaster must be set at least half a diameter from the face of the adjacent frieze, or else the mutules will interfere.

If the mutules are set so far from the adjacent walls that even the little cymatia that crown them do not intersect, then these three dimensions are increased by about one-eighth of a diameter, as in Fig. 68 *B*, and the axis of the pilaster is set about nine-eighths of a diameter from the

The Vocabulary Of The Window

Window types have developed parallel to the design of doors since antiquity. Examples (i) to (xiv) show many of the combinations of column, pediment, baluster, architrave and bracket that can be used with all rectangular and some round-headed windows. Most of these are also found on doors and are illustrated on other pages. The principal details exclusive to window-openings are the features that are added beneath to link them to the ground or to a lower horizontal band on a façade. Plain panels (vi) or small panels of balusters, (i) and (xiv), can give a base from which a window can rise. Brackets of various forms can also be placed below sills to support heavy decorative details. Full brackets, (ii) and (xiii), and small brackets, (iii) and (xii), will be appropriate to different sizes of window-surround. A Baroque and Mannerist detail (ix) flattens the bracket to a panel of projecting wall below the window, which can be decorated or left as a simple rectangle known as an apron.

The arrangement of glazing within the opening has taken numerous forms, constrained only by the limitations of glass manufacture restricting the size of pane available. Small panes of glass have been contained in grilles of various patterns in, or in imitation of, antiquity, (xv) and (xxix). Lead has frequently been used to bind together small pieces of glass in many different designs, (xx), (xxi), (xxiii), (xxiv), (xxxvi), (xl) and (xli). Stone (xxi) or timber (xx) bars, or mullions, often divided up large areas of leaded windows and, when glass came in larger sizes in the eighteenth century, wooden mullions or bars supported whole panes. Timber bars were originally broad (xix) but later became very narrow, and patterns changed to accommodate larger panes in the nineteenth century (xvii). The invention of plate glass in the nineteenth century made bars or mullions redundant, although the traditional use of small panes of glass continued as a choice not governed by necessity (xxxvi). Large sheets of glass were also used on buildings where bold designs did not need the delicate scale of small panes (xxxvii).

Circular or round-headed windows can be divided in a number of ways. The divisions can follow the line of the circle or ellipse, (xxii), (xxiii), (xxiv) and (xxviii), and can radiate out from the centre. Divisions can form rectangles independent of the circle, (xxxi) and (xxxiii). A particular form, more often used for large semicircular windows, is the Diocletian, or thermal, window, (xxix) and (xxx), divided vertically into three uneven parts. Small semicircular windows, or fanlights, placed over doors have been divided with a great variety of decorative designs, (xxv) to (xxvii).

Classical windows tend to be taller than their width. Width is usually achieved by placing two, or more often three, windows alongside one another. The Palladian window illustrated on page 161 has been very popular for this purpose. On other triple windows a larger centre opening is normal, (xxxvii), (xxxviii), (xxxix), while divisions of two and four, (xxxiv), (xxxv), (xxxvi), (xl), (xli), are equal.