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Organ, §IV: The classical and medieval organ

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IV. The classical and medieval organ

Since the 3rd century BCE it has been possible to regard the organ as an instrument composed of four elements: (i) a wind-raising device operated by lever, pulley or other mechanism, directing air under pressure to (ii) a 'chest' in which the wind is stored until admitted by (iii) a mechanism operated by some kind of keyboard to (iv) one or more rows of pipes (see [RANK](#)). The absence of any one of these elements prevents an instrument from being properly considered an organ. But other instruments could well have presented models or given ideas to early organ makers, particularly those in east Mediterranean countries. It is unlikely that at any single period the hydraulic organ was so firmly established that builders were indifferent to the influence of such wind instruments as the [SYRINX](#), the [MAGREPHA](#) or the [BAGPIPE](#).

The most comprehensive recent surveys of archaeological and documentary evidence relating to classical and medieval organs are the studies by Jean Perrot (D(i)1965), K.-J. Sachs (C1970–80) and Peter Williams (D(i)1993).

1. Greek and Roman antiquity.

No evidence, literary, iconographical, archaeological or even mythological, suggests that the pipe organ existed before the Hellenistic period or originated in any other than the Hellenistic sphere of influence. Later texts such as Athenaeus's *The Sophists at Dinner* (c200 CE) and Vitruvius's *De a architectura* (1st century CE) accredit the invention of the [HYDRAULIS](#) to one man, Ctesibius, an Alexandrian engineer and practical theoretician of the 3rd century BCE. Curt Sachs's assessment (*SachsH*) of Ctesibius's achievement as uniting a mechanically raised and constant wind supply to a set of panpipes is not a totally unreasonable conjecture; but the surviving accounts of his work (written after his time) make it clear that he had also incorporated a wind-chest and even some kind of keyboard. Thus the hydraulis has the essential features of an organ. That Ctesibius was also said by Vitruvius to have invented a water clock offers an interesting parallel to the makers of organs and clocks in the medieval cathedrals of western Europe: such makers were, in effect, specialists in complex machinery. (See also [WATER ORGAN](#).)

The principle of the water-pump is shown in [HYDRAULIS, fig](#). But forge bellows were known much earlier, and their power potential had already been described in the *Iliad*. Bellows could have provided wind either directly to a regulator-chest under a row of pipes, or indirectly via the cistern of a water organ. But there is no evidence that either of these was done before the 2nd century CE, and it is possible that the organ was indeed born as a kind of engineering model, demonstrating the efficiency of Ctesibius's wind-raising and wind-stabilizing equipment. Hero of Alexandria's account (in *On Pneumatics*) gives no details of the pipes (whether flue or reed, open or stopped) or what the material, size, compass, tuning, pitch or voicing were.

Vitruvius's musical interests are more obvious than Hero's. The ranks of his organ were made to play separately by means of a specially constructed chest in which a channel ran lengthways under each row of pipes, wind being admitted to the channel through a valve operated by an iron

handle. The keys are returned to position by an iron spring. As the key was set immediately under its pipes, either the close-set pipes or (more likely) the keys may have been unequally spaced.

The oldest reference to organ playing is a century and a half after Ctesibius: the 'Delphic inscription' (90 BCE), full of implication about the organ's fame. Cicero, Lucretius, Petronius and other authors also wrote of its powers. By the 2nd century CE the Roman organ was heard in some of the more important theatres, games, amphitheatres, circuses, banquets and perhaps processions; a 3rd-century Greek inscription at Rhodes even suggests that it was played in Dionysian festivals. But the cylinder-pump water organ had so many disadvantages – requiring precision engineering and good metal, yet difficult to maintain, move and keep from corrosion – that it is easy to imagine bellows being applied over the years. Eventually, they replaced both pump and cistern, but it is not known when, where and how. Even in the later Roman Empire, however, organs were to be heard, and such poets as Claudian (c400) show organ playing to have accompanied celebrations attending accessions to a consulate, weddings and banquets during a period when 'the singer has thrust out the philosopher' (Ammianus Marcellinus, c350). Inscriptions found in several provinces far from Rome (Arles, Colchester, Budapest, Asia Minor) make it clear that organ playing was heard in gladiator contests.

The few 5th- and 6th-century references include one or two by early Church Fathers, particularly those on the south and east coasts of the Mediterranean. But whether it was from personal experience that such writers as Boethius wrote of hydraulic organs, or Cassiodorus of a bellows-organ with wooden keys, is not certain; nor has 20th-century research shown what music the organ played, much less whether it played polyphony. Much can be tentatively conjectured from the iconographical evidence (see [HYDRAULIS, §§2 AND 3](#)).

Parts of two Roman organs are said still to exist: fragments from Pompeii (now in the Museo Nazionale, Naples) and major remnants of a small organ found in Aquincum, Hungary (now in the Aquincum Museum, Budapest). But the Pompeii fragments, which seem to belong to two different instruments, may not be parts of an organ, although their pipes are of cast metal, like those of an organ. The Aquincum organ has a plaque dated 228 CE; its 'reconstruction' in 1959 somewhat hampers more recent study of its parts. It has four rows of 13 cast bronze pipes, one open and three stopped, and a wooden wind-chest, lined inside and out with bronze. Wooden keys operate perforated sliders rather than pallets. E.L. Szonntag's analysis (D(xvi)1981) appears to confirm that, although the wind-raising mechanism is missing, the Aquincum organ was a hydraulis, rather than a bellows-blown organ. Each set of pipes can be played separately from the others, and Walcker-Mayer (D(i)1970) theorizes that the four ranks of pipes were tuned according to four separate modes. Further research on this theory is necessary, but if the four registers of the Aquincum organ did in fact produce modal scales based on different pitches, the knowledge will have significant impact upon the understanding of the later development of modes, scales and keyboards.

Reconstructions of the hydraulis suggest that it might have had a wind pressure anywhere between 7.5 cm and 30 cm; also unknown is whether the pipework was always flue and, if so, whether the diameters were constant. While written sources give no firm evidence, iconography seems to suggest that: the pipes were usually flue; their diameter was constant; the tuning (in the more complete examples) was probably multiple, providing a choice of modes for rather less than an octave; and multi-rank chests may have provided different timbres with or without octave and 5th-sounding ranks. But none of these conclusions is reliable. The Aquincum organ supports the case for flue pipes, contradicts the suggestion that the diameter was constant, and leaves the tuning and timbre uncertain.

2. The Byzantine organ.

By the end of the 5th century the new Roman Empire of the east, with its base at Constantinople, had achieved a character of its own, intellectually conservative and favouring a world of abstract thought far removed from the practical technology of ancient Alexandria and Rome. Although the old Greek treatises were preserved in Byzantine copies and hence known to the Arabs, engineering projects like organ making remained undeveloped for a millennium. But by the 8th century western Europe itself no longer knew such masterpieces of Roman engineering as the Vitruvian hydraulis. All the sources suggest that the European 9th- and 10th-century 'organ revival'

came about because the instrument was reintroduced from Byzantium.

Despite some hints in the sources, the organ was certainly not used in the Byzantine Church itself (and indeed is still not except occasionally in churches in the USA). But at least two facts seem to be clear: that most references relate to bellows-organs, and that the instrument continued to be part of the secular, courtly pomp in the capital city. In the first connection, a 10th-century Arabic source suggests that three (or two) bellows fed air into a large reservoir below the pipe-chest; in the second, it was no doubt because of their use at banquets, chariot races, weddings, processions and the like that organs were decked out in gold and costly decoration. Both the 'blue' and 'green' factions at court had an organ, but the instrument otherwise remained a rarity. At his palace the emperor had both automata (the famous 'golden tree' with moving, whistling birds activated by bellows) and true organs in which at least one emperor (Theophilus, 9th century) took an interest. Nothing is known of the pipework, sound, compass, precise function or repertory of the organ in the Great Reception Room, or indeed anywhere else, though one 9th-century source does refer to '60 copper pipes' in what appears to have been a large table-organ.

Organs became objects of visual and aural show, eliciting wonder and respect as diplomatic gifts or signs of royal power. In 757 a famous diplomatic instrument was sent to Pepin, King of the Franks, at Compiègne. A monk of St Gallen (possibly Notker Balbulus) reported that the 'King of Constantinople' also sent an organ to Charlemagne in 812, with bronze pipes, 'bellows of bull leather' and three sound effects (rumbling thunder, trembling lyre, tinkling *cymbali*) possibly suggesting *pleno*, flutes and little bells; but the source is doubtful, the language being somewhat hyperbolic (or possibly psalmodic). In any case such instruments were not church organs but extravagant gifts, like the 13th-century organ of 90 pipes sent from one Arab court to the Emperor of China.



Hydraulis (centre) with horns, cymbals, lyres, a psalter and lute:...

An event of evident importance in the 9th-century chronicles was the arrival at Aachen in 826 of Georgius, a Venetian priest who undertook to construct a hydraulis. According to a poem glorifying Charlemagne's son Louis, Georgius's organ was a kind of royal or national symbol of power: 'The organ, not seen in France before, a subject of pride for the Greeks, the only reason the people of Constantinople felt themselves your master: even the organ is now represented in Aachen'. Its intricate technology must have been the justification for such respect. The Aachen organ was used for occasions of pomp, not for chapel services; the Utrecht Psalter (compiled in France, perhaps near Reims) depicts, with little understanding, a hydraulis taking part in an ensemble illustrating Psalm cxlix (fig.22); this too has little to do with church services, being merely symbolic, or perhaps depicting some sort of 'signalling' organ.

3. The organ of the Arabs.

The high level of Arabic and Islamic culture from the 8th century to the 10th gave theorists and craftsmen the opportunity to work on bellows-organs; theorists in particular knew of such 'instruments' but seem rarely, if ever, to have seen one. A famous source, the Epistle to (or from) Muristus, describes two organs, one of which is a kind of siren or signal-organ; the sources containing Muristus's writings are also interesting in that two of them (in Beirut and in the British Library) show how a diagrammatic plan can become, under the scribe's hand, an unintelligible pattern of abstract design.

Nothing is known of Muristus, and the graphic similarity of his name in Arabic to Qatasibiyus (Ctesibius) was pointed out by Farmer (D(i)1931); Muristus appears to have been a Greek (or Byzantine), and in any case derived his descriptions of instruments directly from Ctesibius's *Commentaries*. But neither of them is a true organ. The first contains a chest of 12 pipes fed with wind from the lungs of four men blowing through tubes into a regulator; the weight of the pipes compresses the wind; the pipes themselves appear to be reeds, all of the same length but of varying diameter and requiring different volumes of wind; the wind is admitted to each pipe through a valve, presumably one worked by some kind of key. This seems to be the instrument of 'formidable power' referred to in the 'Letter to Dardanus' once attributed to St Jerome. The second or 'Great' organ is a signal-organ perhaps not unlike the (smaller) *magrepha* and containing a siren pipe or pipes blown at great pressure, used in battle by the Greeks, according to Muristus,

or for similar purposes by other Middle Eastern peoples. The siren worked on the same principle as the hydraulis, four pumps or cylindrical bellows providing wind pressurized by water in a cistern.

There is no evidence that the organ became known again in western Europe through the cultural activities of the Arab caliphate of Córdoba in Spain. But the possibility that this might have been the case adds further importance to any work undertaken on this period in Iberian musical history, for links may perhaps be discovered between Spanish–Arab instrument making and 9th-century Benedictine musical life. In the eastern caliphates organs seem to have developed into mere ingenious automata; but even in that state the Eastern organ seems not to have survived the fall of Constantinople in 1453.

4. Early church organs.



Hydraulis (centre) with horns, cymbals, lyres, a psaltery and lute:...

The gift organs of the 8th and 9th centuries were Byzantine organs, called 'organum' in the chronicles and still perhaps regarded as an 'engineering contrivance' rather than musical instruments. The fanciful clock given to Charlemagne in 807 by an envoy of the Persian king was Arabic; the Venetian priest Georgius, sent to Aachen in 826, was possibly trained in Byzantium. Several Western writers from the 8th century to the 13th knew of the Greco-Roman

organ but in most cases from vague written sources from which even the more astute authors got the impression that the pipes were made to sound by water rather than by air – an idea sustained by the Jesuit amateur physicists of a later century. The well-known picture in the Utrecht Psalter (fig.22) of a hydraulic organ with two players and four alternating pump blowers is also based on a misunderstanding of the Mediterranean hydraulis. Many of the early church writers refer to organs in such hyperbolic or apparently unreal terms that their sources of 'information' must have been in most cases literary. It is even possible that such references to organs with 100 pipes, like that of St Aldhelm, were mistaken allusions to *hydra*, the 100-headed monster whose name is the same as a documented abbreviation for the hydraulis. All ecclesiastical references to organs before the 10th century are to be treated with caution, and even scepticism.

All these organs were secular. One of the great unsolved puzzles of music history is how and why the organ came to be almost exclusively a church instrument in western Europe from about 900 to about 1200. The early church was subject to two particular influences against any instrument in church, and especially in the liturgy: the liturgy's origins in the Jewish synagogue, and Patristic resistance to anything of profane or luxurious association. By the 9th century, however, the intellectual and liturgical style of the church had changed. Like sung organum, the instrument owed a great deal to Benedictine cultural centres, not only in their literacy and scholarship but also in the opportunities which their large churches gave to the advancement of music. The monastic revival in the late 10th century must itself have been a factor in the appearance of organs, which had become ingenious objects for the use of the clergy, not the people. The organ was never officially approved or even acknowledged in any known papal or pontifical document despite the traditional legend that Pope Vitalian (657–72) introduced it. Nor, for one reason or another, are any of the references to organs placed or used in church before the 9th century at all reliable.

Organs, like tower bells later, were one of the irrelevances complained of by the new reformed order of the Cistercians, judging by remarks made by St Aelred, abbot of Rievaulx in 1166; his reference to the sound of the bellows, the tinkling of bells and the harmony of organ pipes is highly reminiscent of older reports. St Aelred also referred to the crowd of people watching this display as if in a theatre, 'not a place of worship', which suggests that organs were placed inside buildings, perhaps for example a large Benedictine church. But all this does not necessarily indicate that an organ was used during the service, nor even before or after the service. Perhaps it was rather an object of curiosity, like a cathedral almanac clock. Other 12th-century sources imply more clearly that an organ was used in some way during the services, perhaps for signalling purposes, like bells at the Elevation.

Whether organs were used liturgically is not clear from the many 9th- and 10th-century references to them. The notice describing the consecration in 972 of the Benedictine abbey of Bages, Spain,

for example, makes it clear that an organ played near the entrance, 'praising and blessing the Lord'; but to surmise more is conjecture. Much the same could be said for the archiepiscopal coronation at Cologne Cathedral in 950. Pope John VIII (872–82) wrote of an organ required 'for the purpose of teaching the science of music', for which it remained useful to scribes writing about and teaching musical proportions, for example at Benedictine centres such as Fleury and St Gallen. The practical function of organs set up by, or in memory of, great abbots or landowners is unknown; reference to organs used on feast days (e.g. in the Life of St Oswald, 925–92) suggests if anything that they were extra-liturgical, a kind of church carnival object. The Benedictine abbot Gerbert (Archbishop of Reims, 991–5) was said by William of Malmesbury to have had a hydraulic organ put into the cathedral: an object of mechanical ingenuity, once again coupled with a clock in the written account. Gerbert may have learnt the principles of the hydraulic organ from the Arabs in Córdoba, where he lived for a time, since Benedictine manuscripts of the period do not suggest any practical familiarity with the writings of Hero or Vitruvius. Nothing is known of other 10th-century organs, such as that set up in Halberstadt Cathedral under its Benedictine bishop Hildeward; nor are contemporary references such as those of Notker Balbulus (*d.* 912) helpful towards an understanding of the nature and purpose of organs. So many of these writers were merely indulging in metaphor.

One detail of the Bages consecration of 972 was that the organ music 'could be heard from afar', which may or may not imply that the organ was outside the church. But a large number of references, second-hand or glossed though many must be, suggest that the organ was a loud instrument by standards of the day. Is it possible to see the famous late 10th-century organ in Winchester Cathedral as a signal-organ, used on feast days to summon the congregation or overawe them (perhaps before or after services)? This does not preclude its having keys and some musical potential; 'signal-organ' simply describes its loud tone. If the Winchester organ was placed near the west or south door (stone screens were not known until the next century, and at Winchester only the nave may have been capacious enough) its use could hardly have been liturgical. Nor is it easy to see how an organ could have been liturgical in a much partitioned church of the type known to the later Cistercians.

The Winchester organ was built by about 990, some decades after the Benedictines were fully established there and later than modern commentators have said. Details of it appear in a fanciful verse letter written shortly afterwards by the monk Wulfstan. Much quoted, much translated and much misunderstood, the poem speaks of 26 bellows and 400 pipes in ten ranks, with the 40 notes arranged as two sets of 20 keys played by 'two brethren of concordant spirit' (see *BicknellH* for an up-to-date interpretation). Each key was a perforated slider pushed in and probably pulled out – hence the need for two or more players. Clearly some kind of organ did exist; but there are good reasons for distrusting Wulfstan's account: despite the fanciful references by St Aldhelm to what appear to be 100- and 1000-pipe organs, there are no other firm details extant of such large organs, at Winchester or anywhere else; the numbers given for bellows, blowers (70), pipes, ranks and keys are not plausible, whatever the diameter of the pipes and however the wind was raised (even the number of players smacks of literary tradition or at least of the poorly drawn hydraulis in the Utrecht Psalter); the general style and character of Wulfstan's poem are those of an impressionable layman not concerned with technical accuracy (for further details see McKinnon, D(xii)1974).

Three 11th-century sources are rather more practical than many later medieval manuscripts (see §5 below). *De diversis artibus*, a large encyclopedia written in the first half of the century by the German monk Theophilus, describes techniques used in making church objects – glass blowing, painting, gilding, metal forging, bell casting and organ making. The sources of his treatise leave its authenticity uncertain, the last part of it probably being a later compilation. A second 11th-century treatise is the anonymous Berne Codex, a manuscript possibly originating at the Benedictine abbey of Fleury; a third is a note by Aribo on pipe making.

Theophilus's organ (see fig. 1 [not available online]) could be mounted within a recess in an interior wall, presumably at gallery level, with only its chest and pipes visible from the church and these indeed covered by a cloth 'tent' when not in use. Later 13th-century screen organs would have been equally well placed, in some cases better placed, when they came to serve as *alternatim* instruments in the liturgy. Many details of Theophilus's organ are unclear, not least its function in the church. Theophilus first advised his reader to obtain a treatise on pipe measurement (*lectio mensurae*), which would presumably contain a table of concrete values or actual pipe-scales, rather than mere Pythagorean ratios. The copper for the pipes was first to be

beaten very thin, then shaped around a gently conical mandrel, which suggests that foot and resonator would be all of one piece, having the shape of a modern Trumpet resonator; pipes of this shape are in fact depicted in some iconographic sources (figs. 23 and 24 [not available online]). The Berne Codex seems to suggest a more familiar type of pipe-foot, and gives 'almost 4" as the longest pipe, but does not indicate the length of the foot unit. Theophilus's pipes are equal in diameter, which may not be unreasonable in an organ of less than two octaves. In the 1980s Louis Huivenaar and Jan de Bruijn constructed conical pipes of the kind described by Theophilus, placing them on a chest based on Zarlino's 1558 description of a chest from Grado, Venice, believed to date from the 11th century, having 15 keys, two ranks of pipes, and spade-shaped keys not unlike those in fig. 24 [not available online]. This experiment suggests that the conical pipes had a strong and complex overtone content, producing an extraordinary vocal quality and seemingly well suited for playing a chant melody.



Organ with sliders and a conflatorium: drawing from the Bible...

In his section on forging Theophilus described bellows, and from other sources of the period it seems that such bellows were large, capacious, and planned to compensate for leaks between feeder and pipe. The feeders direct wind into a *conflatorium* or receiver, shown in some 11th- or 12th-century miniatures such as the Harding Bible (fig. 23) and Cambridge Psalter. In the Berne Codex the valve preventing the return of wind when the bellows are refilled is placed in the collector, while Theophilus's valve is in the head of each bellows. The main duct can be curved or straight (but perhaps not mitred) and is usually shown as generously proportioned. The keys of the Berne Codex organ closely resemble Hero's, consisting of a 'square' depressed at one end, pushing in a perforated slider

(to which it is attached) at the other, and pulled back by a horn-spring to which it is tied. By the 13th century, according to a miniature in the Rutland Psalter (fig. 24 [not available online]), organists were using their fingers separately (and rather elegantly) to depress the keys, which in this miniature were broader and more substantial than some reproductions of it suggest.

5. Medieval organ theorists.

In the absence of any known organ remains between the 3rd-century organ of Aquincum and the (?) late 14th-century positives of Sweden (see §6 below), historians must turn to the body of 'medieval organ pipe theory', readings of which have led to some misleading ideas about medieval organs. The many sources have been seen as 'treatises on organ building' (Frotscher, D(i), 1968; Mahrenholz, C1938; Fellerer, D(i)1929) or 'treatises on pipe measurement' (Perrot, D(i)1965); but after 1966 researches into the now completely collated texts (see K.-J. Sachs, C1970–80) have led to a new assessment of their purposes.

The texts, in some cases only a few sentences in clerical Latin, fall into three main categories. The largest group (about 30 texts in 155 sources from the 10th century onwards) are those concerned with the length of organ pipes calculated by ratios from an 'initial' pipe, itself of no specified length; most of the length measurements take account of **END CORRECTION** which, in the case of a row of pipes of the same width and mouth shape, is constant. A smaller group of texts (11, in 11 sources) is concerned with the width or diameter of organ pipes, ignoring end correction in calculating the length; some of these discuss the relationship of mouth width, cut-up and foot-hole to the pipe diameter; none dates from before the 14th century. Neither of these two groups covers the whole subject, since in fact variable pipe-widths and quasi-Pythagorean demonstration of end correction are mutually exclusive. The third group of texts (three only, all 11th-century) deals with technical pipe making. These texts are Theophilus's *De diversis artibus* (bk 3, pp.81ff), *Cuprum purissimum* (the Berne Codex), and the section 'Sicut fistulae' on pipe making from Aribo's *De musica*. Some aspects of the organs described in this last group of sources have received attention in §4 above.

The 'pipe-length treatises' rarely offer concrete usable measurements, nor do they outline any pattern of values in which practical experience may have had a hand. Instead, the scalings concern proportional values corresponding to the Pythagorean ratios known from monochord theory. On the one hand, it is obviously possible to make an organ without determining the acoustical phenomenon of pipes; on the other, no careful measuring of pipes leads to usable

pitches without proper tuning. Many treatises so resemble the numerous scaling texts for the monochord and *cymbala* that the significance of their pipe-scalings should not be interpreted in isolation; for pipes, strings and bells might have been cited primarily as examples of Pythagorean ratios according to which a pipe approximately half as long as another will sound the octave above, one approximately two-thirds as long the 5th above, and so on. Comprehensive instruction treatises covering such matters include the works of Notker Labeo, Aribo, Engelbert of Admont, Hieronymus de Moravia, Walter Odington and Giorgio Anselmi; an important branch in the tradition was the widely known *Scolica enchiriadis* of the late 9th century. In no way were such sources recipes for making instruments; rather, they outlined the kind of number theory which theorists since Boethius had applied to music.



Organ with sliders and a conflatatorium: drawing from the Bible...

Both Theophilus and the writer of the Berne Codex were dependent on ancient accounts, namely those of Vitruvius and Hero. Aribo's account probably refers back to a manuscript tradition around the uncertain figure of Wilhelm of Hirsau, who seems indeed to have been concerned with actual pipe measurement. Most of the copies of a text ascribed to him are provided with drawings showing the scale of the first pipe (not unlike the measure line in Schlick's *Spiegel*, 1511). But in other writers, end correction, the very factor 'disturbing' the neat theory of Pythagorean ratios, was itself determined proportionally, calculated as a fraction of the diameter. For such calculation the diameter was assumed to be constant; hence the frequently repeated conclusion that the medieval organ

builder made a rank of pipes all to the same diameter. Optimistically interpreted iconography has been seen to support this idea. But it should be remembered that the general medieval approach to making things (i.e. before print technology brought craftsmen gradually to depend on visual models) weighs against the practical significance of written-down treatises. Only two of the texts cover organ building as such, and they are partly derived or even (in the case of Theophilus) the result of a compilation. Moreover, practical details such as the remark in the Berne Codex that pipes follow the modern diatonic genus ('si ... sit diatonicum genus quo maxime decurrent moderne cantilene') do not necessarily indicate an actual organ such as might be used in liturgical music. The Sélestat manuscript (11th century) and the Berne Codex describe pipe-chests of seven notes, and the former seems to make it clear that its three ranks are unison, octave, unison; at the same time, an 11th- or 12th-century miniature, in the Harding Bible, shows a keyboard of C, D, E, F, G, A, B \flat , B \natural , a set of keys showing one each of the known notes (see [fig.23](#)). But it is not known whether these treatises and miniatures reflect more than certain literate, second-hand and even non-empirical traditions passed on, perhaps indirectly, to their scribal 'authors'.

6. The church organ, 1100–1450.

Rarely in music history is conjecture taken more confidently as fact than in this area. Despite bold and apparently plausible modern assertions that playing in 4ths and 5ths was known by 9th-century clerical organists, that *alternatim* chants were known in the Mass during the 11th century, or that large organs played the *puncti organici* (and even the quicker upper parts or *voces organales*) in the Île-de-France organa of the 13th century, there is no irrefutable evidence to support them. It may be reasonable to assume that in the larger Benedictine abbeys (St Gallen, Metz, Benevento) polyphony, organ playing and troping of plainchant were all linked; but it is not known during which century the more cosmopolitan of the abbeys may have begun to use the organ more integrally during Mass than they were ever to use their other expensive mechanical equipment such as bells or clocks. Nor are technical matters concerning the structure of organs any more certain. There is no evidence that, between the 10th and the 12th centuries, octave- and 5th-speaking ranks were used in abundance, or that reed and stopped pipes were also known, as more than one modern writer has claimed. Much later still, basic assumptions are unreliable. Iconography by no means establishes that organists had to use all of each hand to thump the keys, at this or any point in organ history. Nor are archives less equivocal; church accounts do not prove that the 'little organs' sometimes mentioned from about 1390 onwards were second manuals of large organs or that, if so, such manuals were placed together or had the same pitch. The use of multiple organs in large churches is well documented from this period onward, and

the 'little organs' usually prove to be separate instruments from the 'great organs'. Possibly the second keyboard, up until at least the time of the Innsbruck Hofkirche organ (1550; the oldest extant two-manual organ), should be seen rather as an extension to the compass of the first. Organ research from about 1960 has been directed towards a circumspect interpretation of the evidence, and a new period of re-examination concerning the evolution of the organ is inevitable.

Certainly the period 1100–1450 was one of great activity. During the 11th century more organs are known to have been in monastic churches throughout western Europe; they were played at ceremonies (probably outside the liturgy) and succumbed to the fires that frequently swept medieval cathedrals (Canterbury 1114, Freising 1158, Merseburg 1199) – which suggests perhaps that they were fixed in place. Some literary sources imply that the organ was played during Mass, for instance the *Roman de brut* (c.1155, Normandy):

"Quant li messe fu commensie ...
Mout oissiés orgues sonner
Et clercs chanter et orguener"

– but such references are vague and merely image-evoking; poets' sources were usually other poets. More authentic sources of the 9th and 10th centuries suggest, however, that sequences as well as the *Te Deum* were the most open to polyphonic vocal treatment, just as later they were the movements most closely associated with the organ. A small portative and a psaltery are shown in a 12th-century miniature but no ecclesiastical function is implied, any more than for the portatives illustrating psalms in earlier psalters (e.g. the small organs hanging on willow trees at Psalm cxxvii in the Stuttgart Psalter, 10th century). But by the 13th century all instruments other than the organ were excluded from various churches in Spain, Italy and France. The phrase 'great organs' is found in church documents (e.g. Erfurt Peterskirche, 1291), and by 1296 one French bishop referred to the organ sounding five times in connection with the Sanctus – perhaps as a signal rather than for music as such. There is no evidence that it played the tenor in Sanctus movements or in any motet following at that point during Mass. But by the end of the 13th century secular cathedrals from Exeter to Prague, Barcelona to Lübeck, were as likely to have organs as the larger abbey churches. Whether erected on screens (as in England) or hanging on an upper wall of nave or quire, the organs were usually located near the *cantores*, i.e. no longer near the west or south entrances nor specifically near the main altar. It is not known, however, when large organs were fixed in Theophilus's manner, and illustrations for psalm texts usually show much smaller organs in ensemble. The phenomenon of the smaller fixed organ attached to, associated with, and in some cases paid for by specially bequeathed chapels belongs to the 15th rather than the 13th century.

The large organ seems to have been an exclusively ecclesiastical instrument from the 9th-century Western Church to 17th-century Italy. Probably by the late 13th century the cathedral or abbey organ was occasionally used in *alternatim* music with the *cantores*, though presumably not with the congregation itself. Jovannes de Florentia referred (c.1350) to performance 'partim organo partim modulatis per concentum vocibus'. Early 15th-century keyboard repertory extant in the Faenza Codex (*I-FZc* 117; see [SOURCES OF KEYBOARD MUSIC TO 1660, §2 \(i\)](#)) complements such explicit references as the mid-15th-century Castilian rubric 'the organs played one verse and the clerics sang the other'. 14th-century documents usually suggest that whatever the organ played, it did so on traditional church or local feast days, for example at Halberstadt Cathedral on Christmas Day, for Easter Week, Sunday after Easter, *Kreuzerfindung*, Reliques of St Stephen, Ascension, St Peter and St Paul, Dispersal of the Apostles, Mary Magdalene, St Stephen and St Sixtus, Assumption, Patron, Nativity of Mary, St Michael, St Gall, All Saints and 12 other feast days including Trinity and Annunciation. For three centuries organs were used only on feast days. But by the end of the 13th century some churches had decreed against other instruments (Milan, 1287); by the 14th, *alternatim* performances took place, especially in the Office; by the early 15th, many areas, such as the Upper Rhineland, north-central Germany, some English and Italian cities, and the stretch from Rouen to Utrecht, had organs in most of their larger churches, and the future of the instrument was completely assured.

It is impossible to trace this history step by step, despite a certain amount of archival, musical and iconographical evidence. But certain general points can be made about the 14th and early 15th centuries. Organs became known in cathedrals less as an exception and more as a norm; by

1425 the large positive (with front pipes arranged from left to right) was usually distinct from the fixed church organ (with front pipes in mitre form with a set of larger pipes to each side, thus requiring a rollerboard). All the evidence suggests that only open metal flue pipes were known, though some commentators have seen such references as 'plom ... per las horguenas' (church of the Cordeliers, Avignon, 1372) as evidence that lead pipes were used for distinctive tone-colour; lead was in fact the most common pipe metal in all countries during this period. Larger organs in certain areas (Normandy and later the Netherlands, possibly England also) occasionally had Trompes during the period 1390–1450 (i.e. a set of ten or so large open metal Bourdon pipes, possibly played by a separate manual or pedal keyboard and placed to one side, or both sides, of the main organ). Presumably they also had a **BLOCKWERK**, although apart from the number of pipes in a few famous examples (e.g. 2000 at Amiens in 1429) little is known in this regard before 1450. Presumably the pitch of their compass, whether from (apparent) *B* or any other note, was roughly equivalent to men's voices, the total compass perhaps divided up and distributed over more than one keyboard. However, so many significant unknowns are raised by such summaries that describing the church organ before its more clearly defined types of 1450 is mostly a matter of citing facts about individual instruments.



Organ, c1380 (pedal pipes 1718), perhaps from Abondance Abbey (Savoy),...

The organ at Sion, Switzerland, is usually dated about 1380 (although it may in fact be later) and has been much rebuilt. Despite opinions expressed on its tone, and although some of the original pipework seems to be incorporated in the present organ, nothing is certain of its original sound, disposition, compass, pitch, voicing, pressure, bellows, position, purpose or provenance. Nevertheless, its case ([fig.25](#)) shows interesting elements: it has the typical shape for such instruments, with the central mitre lines (like Arnaut de Zwolle's organ at Salins); the castellated 'towers' to left and right overhang the sides; and the wings (painted and perhaps made about 1434–7) enclose the pipes completely. At Bartenstein in East Prussia parts of an organ dated about 1395 existed before World

War II. The organ had a large chest for 27 keys (?FGA–a') with three divisions for a large chorus of nine (bass) to 21 (treble) ranks, case-pipes of 16', and Principals 8' + 4'. An ingenious reconstruction of the chest was sketched by Karl Bormann (D(xv)1966) but little is certain, particularly the stop mechanism whereby wind was admitted to chorus and principals at will; perhaps the device was made not in 1395 but one or two centuries later. The organ at Norrlanda (c1380), now pipeless and in the State Historical Museum, Stockholm, is a large positive with a putative *Blockwerk* of three to six ranks. A set of 12 rollers conveys not only both pedal and manual key-travel to the larger pipes held in small side towers but also the action of certain pairs of keys (C#/c#, D#/d#, F#/f#, G#/g#) to a single pallet. This is so sophisticated an arrangement, not least in its resulting chromatic keyboard of nearly two octaves (C–a or c–a'; [fig.26](#); for a close-up view of the keyboard, see [KEYBOARD, fig.](#)), that doubts too must arise about the age of the organ – which in any case appears to have case-work constructed out of panels from some older choir stalls. An organ of surprisingly similar appearance is depicted in the mid-15th-century stained glass of the Beauchamp Chapel, St Mary's, Warwick.

Extant 12th- and 13th-century church accounts merely record the presence of an organ; about many areas of Europe, curiously little is known. Only during the 15th century were the great Gothic churches of some areas constructed (e.g. in the Netherlands), but many were immediately provided with an organ as part of the regular furniture. The first real details of church organs occur in such documents as builders' contracts from about 1390 onwards, when for reference purposes the anonymous scribe would distinguish the 'opus maius' from the 'parvum opus organum' (Utrecht Cathedral, suggesting either two separate organs or an organ with a *Rückpositiv*) or the 'principaux' pipes from the Bourdons (Rouen Cathedral, suggesting Trompes and other major Furniture ranks), or even by 1420 'cinch tirants', suggesting five separate stops in a large positive (Aragonese royal chapel). Otherwise it was enough for an organ to be entrusted to the craftsmen concerned, who had merely to see that it was 'decent, good and to the honour' of the church (S Giovanni Evangelista, Venice, 1430).

Henri Arnaut de Zwolle, writing in the 1440s, described several organs he knew, including those at Salins (c1400, *Blockwerk* of 6–15 ranks) and Dijon (c1350, 8–24 ranks); an account of his treatise is given below (§V, 1). The most famous 14th-century organ is that of Halberstadt Cathedral (c1361, rebuilt 1495), described in some detail by Praetorius (*Syntagma musicum*,

2/1619). The four keyboards were as follows: I, called *Diskant* by Praetorius, playing the *plenum* (case pipes + Hintersatz Mixture; see [FULL ORGAN](#)), *B–c'* (14 keys); II, also called *Diskant*, playing case pipes (Prinzival) only, same compass; III, called *Bassklavier*, *B–a* (12 keys, long protruding levers perhaps worked by the knee, playing the 12 large bass pipes); IV, pedal keyboard, same compass as III, used with (perhaps pulling down the keys of) the top manual. The largest rank of pipes was at the equivalent of 32' pitch, the total number about 1192, from 16 ranks at pedal *B* to 56 at top manual *a'*.

Praetorius by no means understood the historical nature of such old organs, nor is it clear from his report what in the Halberstadt organ dated from 1361, what from 1495. But it is probable from his account that the *Blockwerk* had multiple ranks of octaves and 5ths such that the manual disposition was approximately as follows: [not available online]. From the details given, the pitch level seems to have been *a' = c505*. Praetorius also described the sound of this *Blockwerk* (see [BLOCKWERK](#)). 20 bellows supplied the wind, all presumably needing to be operated for the *plenum*, though his drawing shows only two operators (see [Keyboard](#), fig.).

Praetorius gave other details about organs he described as old, and his suggestions could be the starting-point for organ historians. For example, he guessed that semitones appeared in keyboard compass from about 1200 and pedals from about 1220, that by 1450 only open pipes were known, but that spring-chests had been built by about 1400 and separate stops by about 1250. The first date is late by two centuries if it is a question of *B♭* only, perhaps a reasonable guess if intended to refer to the first *facta* semitone (i.e. other than *B♭*), but early by at least one century if all five semitones were meant. The date for pedals must be about a century too early. The date for open pipes is probably correct, and that for spring-chests could be correct but is probably a little early. The date for separate stops seems early by at least two centuries if it refers to a full-size church *Orgelwerk*. Other details given by Praetorius are more certain, for example that some keys were as broad as about 60 mm, that some keyboards had a compass of *B–f'* or *c–a'* (diatonic only) and the curious-seeming statement that some early pedals played only the bass notes. Obvious though the last may appear, the large Bourdons or 'teneurs' (Notre Dame, Rouen, 1382) may in fact often have been operated by a keyboard played by the hands or even by the knees. The term 'teneur' is evocative, but what it signifies is uncertain; perhaps the keys played the long notes of a vocal composition or an *Intavolierung*; perhaps 'teneurs' meant merely large pipes as distinct from small ('menus' at Rouen, 1382, 'Diskant' in Praetorius). Certainly the playing of a cantus firmus *en taille* on the pedals is a later speciality of the 16th century. But whatever 'teneurs' was meant to imply, builders of the period knew well how to fashion pipes of various sizes and scale, according to Praetorius.

At the end of the 14th century, then, a large organ within the area Rouen–Utrecht–Magdeburg–Orvieto might be presumed to have had a *Blockwerk* of anything up to 80 or more ranks with open cylindrical pipes of metal, played by a broad-keyed manual of 16 to 22 notes, possibly with a further keyboard playing Trompes with or without their own chorus mixture, and exceptionally with a second smaller organ in some way connected with the first. Smaller but independent organs may have had, by custom, a longer compass, smaller keys, and a *Blockwerk* of fewer ranks. Not enough is yet known for generalizations to be made about the organ of about 1390 outside the region specified above.

7. The 15th-century positive and portative.

Although the [POSITIVE](#) and the [PORTATIVE](#) each form virtually separate subjects, they offer a useful gloss on organ history at this point because each demonstrates a striking uniformity unknown to the larger fixed organ, and each demonstrates the limitations of iconographical evidence. Portatives were small portable organs blown by bellows (often single but sometimes a pair) operated by one of the player's hands (usually the left), and played by his other hand on a keyboard of up to two octaves, composed often of touch-buttons; the instrument would have one rank of pipes arranged in one or two (very rarely three) apparent rows. Such are the highly detailed and prettily finished portatives depicted by such painters as

Positive organ; engraving of an organist and his wife by...

Memling (three examples, that at Bruges being the clearest: for see [not available online] [PORTATIVE](#)) and the Master of St Barthélemy (two examples). Positives were blown by a pair of larger bellows operated by a second person ([fig.27](#)), and were played by both of the organist's hands on a more or less chromatic keyboard exceeding two octaves (usually beginning at *B*) and composed of short finger-keys; two rows of pipes would form one complete rank, often with Bourdon (or drone) pipes pitched in the bass, perhaps an octave below. Some portatives also had (shorter) Bourdon pipes. In all known cases the pipes were open and of metal; the scaling is progressive and the diameters diminish, at least in the better depictions; cut-ups often appear low and the scale narrow; unless chords of more than two notes were played, the wind supplied by the hand bellows must have been quite adequate, though presumably low in pressure.

That paintings always leave problems of interpretation may be demonstrated by one of the best-known of all organ paintings, the Van Eyck altarpiece at Ghent (1432). Despite the beauty and apparent precision of the picture, the pertinent section of which is reproduced in [fig.28](#) [not available online], there are several puzzles. The front pipes, though painted well, are not placed naturally; the tips of the feet rest right at the front of the chest top-board, while each pipe corpus, whatever its diameter, passes behind the supporting brace, itself, however, of constant thickness. The feet of the inner row of pipes are placed almost without depth of perspective, all exactly in the middle of those of the first row – despite the latter's perspective. Unless the keyboard ran no higher than appears (blocked by the player's hand and arm) the two rows of pipes must produce only one rank; yet if the keyboard continued up symmetrically (as far to the right as the bass goes to the left) the organ would have at least 35 keys, implying a unique pipework of two non-chromatic ranks. The line made by the pipe-tops corresponds neither quite to a diatonic nor to a chromatic tuning, and the pipes in the bass seem unnaturally narrow in scale. Apart from these problems of depiction, the painting gives no information at all on certain points, such as the purpose of the latch-key on the lower left; if it is for a Tremulant, one might expect other evidence of the period for such stops; if it is a stop mechanism operating a valve to the rear chest, one must assume that there are other pipes not seen but making up the second rank; if it is a key to operate Bourdon or drone pipes, the pipes should be in evidence. Such questions can be answered plausibly enough, but only by conjecture, for comparisons with other instruments are too distant to be useful.

Barbara Owen, Peter Williams