Bach's Music and Church Acoustics
Author(s): Hope Bagenal
Reviewed work(s):
Source: *Music & Letters*, Vol. 11, No. 2 (Apr., 1930), pp. 146-155
Published by: Oxford University Press
Stable URL: http://www.jstor.org/stable/726344
Accessed: 02/01/2013 07:23

BACH'S MUSIC AND CHURCH ACOUSTICS

In Germany 'architecture' in the sense of *Raumkunst*, or the art of enclosed spaces, is closely linked with music. Behind the eighteenth century concert room tradition beginning about 1743[1] there lies the music that had as its home the Lutheran church with its peculiar acoustics.

At the Reformation changes affecting church acoustics were made in two kinds. First, German as a language took its place beside Latin in the office of the church, and secondly, side galleries were added to the churches in addition to the west galleries already existing, so that congregations were increased in proportion to air volume and therefore reverberation was correspondingly shortened.[2] Medieval Latin, as a language for song, provides a beautiful series of tones for a Gothic church with a long reverberation; it has massive open vowels with the most delicate consonant divisions; it is homogeneous in its refinement and strength. Consider in the B minor Mass the soprano word *unigenite* and then the shout of *Sanctus* by the whole choir. German, on the other hand, while retaining a grand series of open vowels has in addition a great number of contrasting consonants. Compare in the old carol the words *Puer natus in Bethlehem* with *Ein kind geborn zu Bethlehem*. The latter as a tone sequence is more vivid and more punctuated. All that seems harsh to English ears in the spoken German falls into focus in song or oratory; the language seems to have golden vowels and steel consonants. This is not fanciful. There is a particular sound quality that can be defined as 'carrying power.' It has not to do with intensity or amplitude, but arises from the fact that a particular range of pitch is more audible to the human ear than the rest of the scale. Now sounds having pitch components within that range can be heard better than purer sounds without such pitch components. It is this fact that causes the well-known carrying power of syren noises and explains why a staccato passage on a horn or reed instrument can be heard

(1) A society for secular concerts was founded in Leipzig in that year.

(2) Reverberation—the time taken for a sound to die away in any room after the source has ceased—can be measured in seconds. It varies inversely as the absorbing power and directly as the air volume.

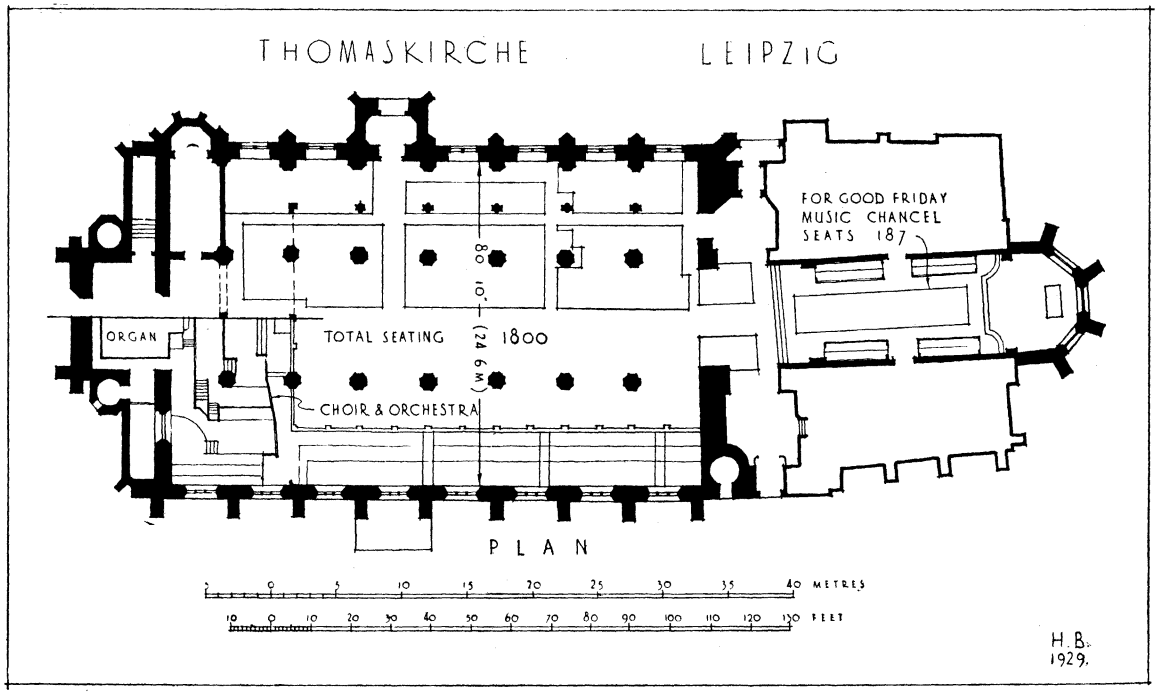

Fig. 1. Leipzig. Plan of the Thomaskirche.

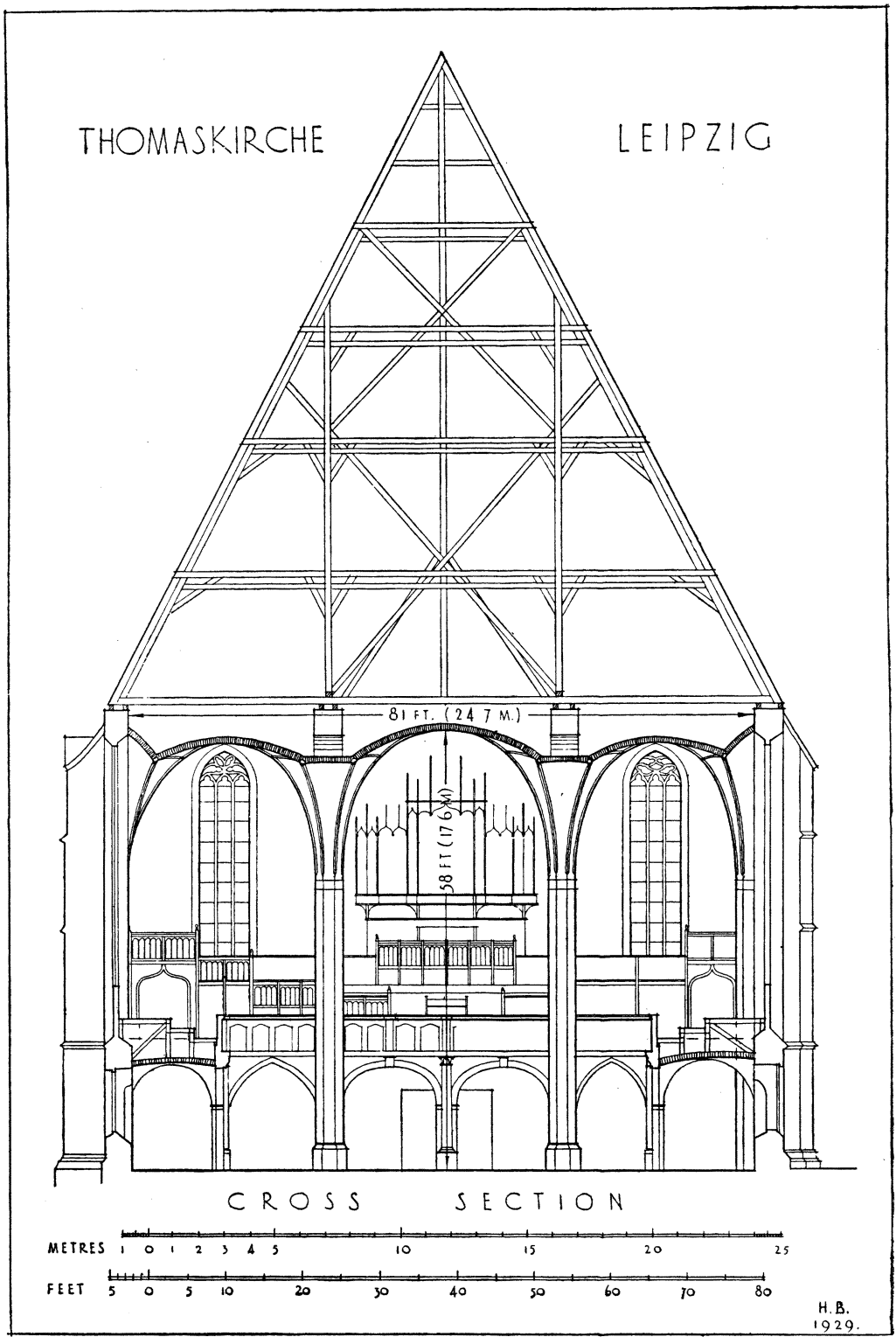

Fig 2. Leipzig. Thomaskirche Cross Section showing West Gallery as existing.

Fig 3. Leipzig. View of the Thomaskirche from the North West.

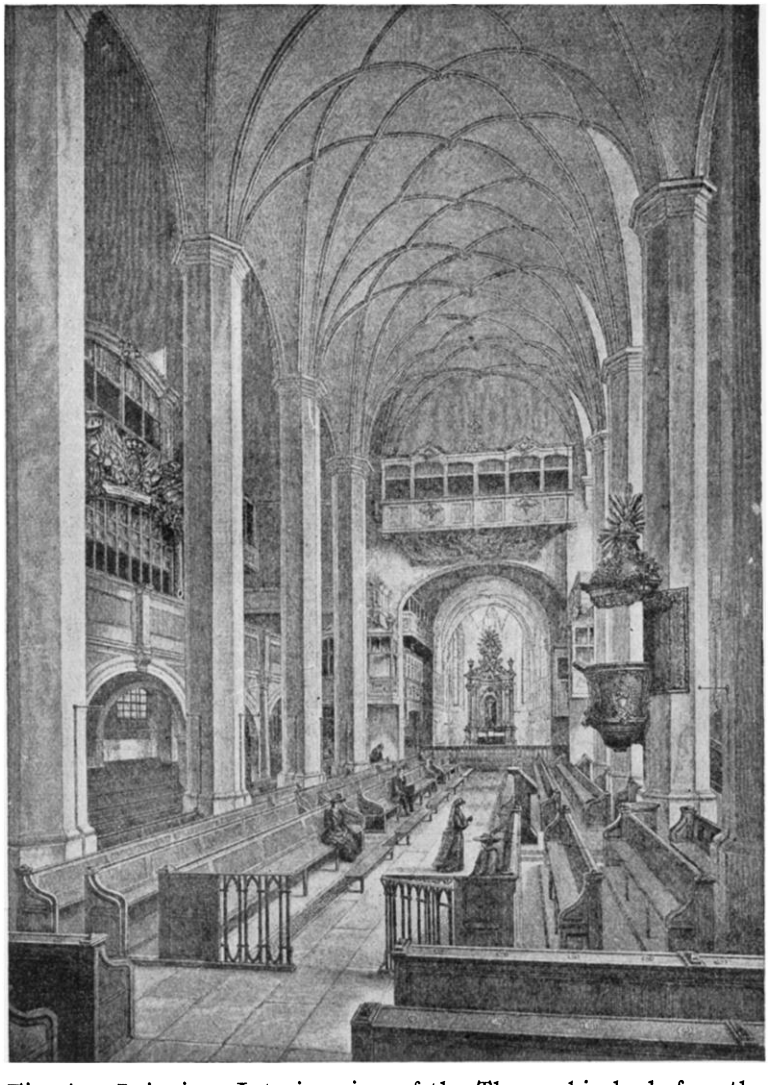

Fig. 4. Leipzig. Interior view of the Thomaskirche before the alterations in 1877. (After an engraving in the Stadtmuseum.)

more clearly in a cathedral than the same passage on strings. It is quite possible to impart a reed tone to the voice, as in the case of the Vatican choir, and such a tone increases the audibility of the direct sound besides causing a less reverberation.(3) The effect of the German *z* and *sch* sounds is something similar; not only do they carry the sense in a large building but they also modify vowel tones and influence what Byrd calls 'the life of the words.' Thus they have considerable instrumental value and must have contributed to the development of oratorio and cantata in the church.

But Latin was not superseded in the Lutheran church services. Luther, unlike Knox and Cranmer, was a musician, and preserved much of the Holy Office in Latin, namely, Kyrie and Gloria, the Credo, the Horae and Magnificat. 'Latin' and 'Music' were the two important subjects taught in the schools. Latin was the language of manners and of public address, and the monumental Latinity of the German educated classes can be seen, well on into the eighteenth century, in Bach's own letters. This meant that congregation and musicians were accustomed in church to both sets of vowel tones—the German and the Latin—and also that choral works were composed in both. Bach wrote comparatively little to Latin words as compared to German, but that little contains the B minor Mass in which the great Latin choral tradition of the Middle Ages seems to culminate. In Bach's work and in St. Thomas' Church the Latin Mass and the German cantata existed for a while side by side. But the dramatic value of German and also the whole development of orchestral instruments tended to reinforce the cantata and oratorio. Orchestral instruments had invaded the German church probably with the early Gospel or new style motet music, but owing to acoustic causes they were able to remain there and take their place in a rapid co-operative development that culminated in the west gallery of the Thomaskirche under Bach. The orchestral introduction to the cantata was probably the earliest purely orchestral composition.(4) But in the choruses and hymns the instruments were not mere accompaniments to voices: they were true parts and had to be heard distinctly. The character of Bach's compositions as works of art lies in a close thematic intercourse between voices and instruments. In his double choruses with instrumental accompaniment each voice has a melody, each chorus is complete in itself, the instrumental parts together form a unit and the whole is a grand harmony.

(3) A less reverberation is caused because high pitch-components are relatively more absorbed by ordinary wall surfaces than are low pitch-components; this is shown by the Sabine curves.

(4) Bitter. *Life of Bach.* Abridged translation by J. Kaye Shuttleworth (1873). p. 45.

Also instruments were developing technically and were the object of attention. Master musicians were often skilled instrument makers and builders. As an instance of this I can only mention here Bach's own practical craftsmanship in organ building and organ specification, and his designing of new instruments such as his viola pomposa and lute clavicembalo. The significance of this is that instrument makers, especially organ builders, inevitably acquire some knowledge of room acoustics, and Bach himself had a reputation in this respect. On a visit to the Berlin Opera House in 1747 he is said to have remarked upon the whispering gallery of the *salon* and foretold its effects.

That Bach was sensitive to acoustics is also suggested by Dr. Sanford Terry as a reason for his strong preference for the Thomaskirche as compared to the Nicolaikirche.(5) He conducted music in each on alternate Sundays over a period of twenty-seven years and wrote roughly a new cantata every month. Bach ' composed at least 265 Cantatas during the twenty-seven years of his Cantorship.'(6) More significant still, Dr. Terry is of opinion that most of, perhaps all of, his large works were composed for production at St. Thomas'. The reaction of the church as an instrument upon the composer is obvious and more especially so when we remember that the works for the most part were performed as soon as written.

What kind of building therefore was St. Thomas'?

The church has considerable character. It is as large as a small cathedral. The plan and section are given in figs. 1 and 2, and views in figs. 3 and 4. The acoustic analysis is given at the end of the article. The church is a late Gothic, three aisled building, of Augustinian foundation with level vaults, no transepts, and a narrow altar piece or chancel set not in the same straight line as the nave. It was dedicated in 1496 and in 1539 was taken over by the Reformers, who removed choir screen and side altars and made of it a parish church under the Leipzig Municipality. Engravings of the middle sixteenth century show it externally much as it is to-day and the shell of the church, with the major interior dimensions, has remained unchanged, giving an air volume of some 640,000 cubic feet. The vaulting under the galleries suggests that the church was originally planned with a west gallery which was prolonged one bay down each aisle.(7) This is likely, since a west gallery in German churches goes back into medieval times and may have developed naturally out of the

(5) The latter was a smaller building with a cramped organ gallery on the south aisle, and from an executant point of view, though not necessarily from a hearer's point of view, would certainly have been less satisfactory.

(6) Terry. *C. S. Bach: a Biography.* p. 177.

(7) See Gurlitt, C. *Bau und Kunstdenkmaler des Konigreichs Sachsen.* Leipzig. Vol. I, p. 45.

Romanesque tribune galleries which are occasionally found at the west end. The existing gallery fronts, however, both on the west and all along the sides, are of an early Renaissance design in red sandstone dating from the end of the sixteenth century. In 1707 there were further alterations and yet more galleries were built together with small boxes and numerous staircases. A drawing in the church archives shows at the west end two tiers of galleries—the upper one holding the choir and organ, the lower used evidently as a kind of *loge*. Above the existing side galleries the same drawing shows an upper tier. This tier was probably used for private boxes. An interior view in the Stadtmuseum (fig. 4) shows the numerous private boxes or 'swallows' nests.' These boxes were comfortably furnished and within them on high festivals important Hofraths and Bürgermeisters —connoisseurs in Passion music—reclined at their ease behind curtains that could be slightly drawn so as just not to hide the crowds below.(8) From these 'nests' also various members of the school council kept a critical eye on the boys of the Thomaschule in the gallery and on old Bach rising from the clavier for the choruses with a tight roll of music for baton. The encroachment of galleries and boxes in this way was due to the Lutheran system of church government which placed the church under the town council. But it also showed the importance and popularity of the church as a building, and we must remember that it created the acoustic conditions that made possible the seventeenth century development of cantata and Passion. The building became, in fact, a kind of religious opera house. In Bach's time the gallery at the east end of the nave held an extra organ. The 'swallows' nests' and upper tier of side boxes were swept away in 1877, at which time the present arrangement of west gallery and organ was made. But the seating in Bach's time would have been less dense, and reverberation would have been only slightly less with a full congregation than at present. The reverberation figure for a festival congregation of 1,800 under present conditions works out at $2\frac{1}{2}$ seconds. This figure represents acoustically a compromise between cathedral and concert room conditions. An English Gothic church of this size would have some four or five seconds reverberation, whereas a concert hall seating 1,800 would probably have not more than $1\frac{1}{2}$ seconds. At St. Thomas' also the source of sound is well placed. The position of the choir and orchestra in the west gallery enables them to make use of the level vault as a reflector, and tone is, in fact, directed down on the congregation without noticeable echo paths. In Bach's time the choir were slightly higher. A third point is the large amount of resonant wood area present, as much as 15,200

(8) Good examples of these boxes still surviving can be seen in the town church at Weimar.

square feet. Fourthly, the church has no ' note ' or fixed tonality. The note of a large church—generally treble A—gives a preference to works in the key of A and makes unaccompanied singing in any other key more difficult. The ' reciting note ' or ' Collect note ' in any large church is generally treble A or A flat for the same reason, and this fact has profoundly influenced medieval music. But in the Thomaskirche there seems to be no special region of ' response,' probably due to the unicellular nave, the absence of transepts, and to the comparatively short reverberation. And we find that Bach was not restricted, but wrote his works in all kinds of keys. Also he was able, owing to the moderate reverberation of the Lutheran church or chapel, to write fugues for the organ with rapid bass parts. Many of the fugues, owing to their *tempo*, are lost in cathedrals, the bass parts becoming nothing but a confused roaring. If Bach had had to play in King's College Chapel, Cambridge, instead of in a Lutheran building, he would not have composed fugues with such parts. But though exact phrasing is possible in St. Thomas', the full singing tone of voices is not sacrificed. On any Friday or Saturday the visitor may hear the boys of the Thomasschule singing motets and Latin psalms by Palestrina and Vittoria.

Having noted these things I attended the bicentenary performance of the ' St. Matthew ' Passion music with interest. The ordinary festival arrangements of the church were followed. The chancel was filled with seats facing west. Carpets were laid on gangways. The total congregation was about 1,800. The gallery contained a choir of 150 and orchestra of 60—far in excess of the forces employed by Bach. The *continuo* was taken on the organ and the recitative accompaniments on a large harpsichord. The performance under Dr. Straube was a revelation of tone full and powerful, but highly disciplined. The soloists had not to strain. The orchestra, though large, was grouped and trained for its parts, and the parts ' were heard like silken threads ' ; the tone of strings specially benefited from the large wood area. Strings and voices were complementary and thus the true architectonic design of the music was instantly perceived. Also there was no dragging. The new German church *tempo*, the fruit of an intelligent scholarship, was obvious and one recalled those words in the Bach necrology ' he was very accurate, and extremely sure in the *tempo* which he generally took very briskly.'[9] By the congregation seated in the nave facing east the choir was not seen; the high piers and fine proportions of the church alone presented themselves, and at times music and architecture combined to reveal the genius of pure structure.

[9] As quoted by Schweitzer in *J. S. Bach*. Vol. I, p. 210.

St. Thomas is in fact a home for the music, and this is soon realised when we try in England to find a suitable auditory either for the B minor Mass or the 'Matthew' Passion music. The concert hall performance with its Handelian technique has obvious disadvantages—the massed instruments have first to make themselves heard against the chorus and the chorus must shout against its own absorption. Yet a small choir and small orchestra in a crowded concert hall will not give the body of tone required. On the other hand, in a cathedral nave having a long reverberation although choral tone is enhanced, strings at ordinary *tempo* are only articulate in the upper registers, 'cellos and double basses are almost inaudible, staccato passages run together, brass is generally far too loud, and male soloists sound harsh. That this is not more recognised by musicians is due to the fact that conductors situated near their sound source get enough direct sound to steer by. But it is far otherwise to listeners in the body of the church. Thus, at the Canterbury festival in August, 1929, a velarium hung over the orchestra reduced reverberation locally to a point suitable for a microphone pick-up, but the *Observer* critic (Mr. A. H. Fox Strangways) reported as follows:—'Reverberation blurred all orchestral effects . . . the difficulty arose with any sort of filigree. Elgar's "Enigma Variations" and Bach's tripartite strings in the third Brandenburg were mostly chaos.'

The Bach Cantata Club had therefore a real problem in acoustics when they had to choose an auditorium and in St. Margaret's, Westminster, whether by accident or design, they found the satisfactory compromise between church and concert hall conditions which we have already referred to.

St. Margaret's, a perpendicular church with wood ceilings and without transepts, has had an acoustic history eventful as St. Thomas'. It, too, was re-formed not long after it was completed and its painted screen and altars were torn down. Its walls have heard Latin Mass, Anglican Liturgy and Independent sermon. As chapel extraordinary to the House of Commons it was a good preaching place and the scene of Dr. Usher's sermons. It received from Wren in 1681 an enormous centrally placed pulpit and galleries.(10) It had originally an apse at the east end. In the eighteenth century organ and choir were placed in a western gallery, but in the nineteenth century all galleries were swept away and the church was restored by Gothic scholars nearly to its medieval form.

It is without a marked 'note,' has a very large wood area and with a full congregation of 1,000 gives a reverberation of just under two seconds. The analysis in table form is given on p. 155. Both

(10) Westlake's *St. Margaret's, Westminster*. p. 68.

St. Margaret's and St. Thomas' have wood floors to the pews with air space beneath giving highly resonant areas.

The success of the church was clearly shown at the English bicentenary performance of the 'St. Matthew' Passion performed by the Club on November 27th, 1929, under Mr. Kennedy Scott. Comparing the two performances—the English and the German—in retrospect, each so scholarly, one is conscious not only of two techniques but also of two interpretations of the structure of Bach's music, of two languages with their underlying vowel scales each with a different emotional content, and modifying both, two church forms, each with its roots in a rich but distinct medieval culture. The Cantata Club had limited its forces to little more than those originally used by Bach. Mr. Kennedy Scott employed about thirty-five voices and twenty-seven instruments, including a harpsichord, and had this advantage that the instruments could make themselves heard without any effort against the voices; each instrument had to be as a soloist and the delicacy and incorporation of the performers in the dexterous counterpoint was obvious. Also the choir under the acoustic conditions of St. Margaret's had the 'fullness' though not the 'strength' of tone of the larger German choir, and this was helped not only by the right reverberation but by the longer sound path to the roof and down again, which is given by a floor position of the choir. The beautiful *cantabile* tone both of soloists and chorus was achieved by making use of the church as an instrument. Thus the chorales at St. Margaret's, unaccompanied, and sung with contemplation, had a beauty of escape, and were unlike the German chorales which came like great organic beats in the structure of the drama. On the other hand, at St. Thomas' the German choir position on a western gallery, with its tone delivery from the vault, gave an advantage in attack. There was nothing in St. Margaret's so shattering as the German rendering of 'Loose Him! Leave Him! Bind Him not!' and of the music that follows with its ordered instrumental conflict and shouting of gargoyles as though a Gothic roof had come alive. And this intense German quality was made possible by the language. Bach is supreme in his use both of the vowel scale underlying the music and of the penetrating German consonants. Just as Milton in English verse can take a word and summon into it a whole world of experience, so can Bach when he breathes the word *bete* or sings *Schmerzen*. Without this first music of the language the English version was cold and by comparison colourless. But this was inevitable. And this very elimination left a marvellously clear musical profile—a universality of artistic effect. Thus in more ways than one the English was the rendering of the sanctuary with its few consecrated voices, the German the rendering of the nave with its breath as of the people. We have

seen indeed that the masses by invading the German church created the tone conditions under which such music was made possible, and in Germany the people, whether silent or quietly following the chorales, seem a part of the performance, while the music is known intimately to a very great number. At St. Margaret's we were listeners only, in a church restored to its medieval forms, and attentive to our singers who were making use of the original acoustic conditions much as they had been made use of in medieval times. In both it was made evident that in such supreme musical works personal Christianity is likely to be preserved more safely against attack than formerly behind the walls of monastic fortresses.

HOPE BAGENAL.

Reprinted through the courtesy of the editor of the *Journal of the Royal Institute of British Architects.*

LEIPZIG THOMASKIRCHE

REVERBERATION TABLE

Volume 640,000 cu. ft. Seating, 1,800 (Congregation). Cube per seat, 355 cu. ft.

Absorbent.	Remarks.	Area or Number Sq. ft.	Co-efficient.	No. of Units.	Adjustment.	Net No. of Units.
Plaster on rubble, stone walls and brick vaults	Lime plaster distempered	38,000	0·025	950	[Adjustments made in the separate items]	950
Stone gallery fronts and piers	Red sandstone, slightly porous	4,000	0·03	120	Add 10% for breaks and mouldings	132
Marble floor to Sanctuary		1,500	0·01	15		15
Window glass in lead and iron frames	Responds to middle pitch	3,400	0·027	918	Add 25% for transmission	1,147
Wood panelling in aisles and Sanctuary	Oak. Responds to low middle pitch	3,000	0·1	300		300
Wood panelling in galleries	Oak. Responds to high middle pitch	1,900	0·1	190		190
Wood floors to pew areas	Air space 1 ft. under deal boards. High middle pitch. Very resonant	5,100	0·1	510	Less 10% for shading	459
Wood floors to galleries	Responds to high middle pitch	5,200	0·1	520	Less 10% for shading	468
Lino.on remainder gangways	No undermat	4,000	0·04	160		160
Carpeting, nave and Sanctuary	Exposed No undermat	520	0·15	78		78
Wood pew ends and exposed desks	Oak varnished	2,000	0·06	120		120
Curtains in Sanctuary	Heavy tapestry	390	0·2	78		78
Curtains in galleries and over nave door	Thick wool	1,000	0·15	150		150
Brocade panels and canvases in Sanctuary		840	0·1	84		84
Organ chamber and opening	Wood and pipes	550	0·08	44		44
Pew seats in nave and galleries plus few chairs	Large deal tip-ups in nave. Gallery pews. Cane chairs. No cushions	1,613	Average 0·3 per seating	484		484
TOTAL PERMANENT ABSORPTION						4,859
Full congregation	On pews and seats as above	1,800	4·7 less 0·3=4·4 per person	7,920		7,920
One-third congregation	On pews and seats as above	600	4·7 less 0·3=4·4 per person	2,640		2,640
Choir & orchestra	Neglect seats	210	4·7	987		987

t = Full congregation (1,800) .. .. 2·5 seconds.
One third congregation (600) .. 4·3 ,,
Rehearsal (210) .. .. 5.8 ,,
Empty .. .. 6·6 ,,

ST. MARGARET'S, WESTMINSTER

REVERBERATION TABLE

Volume 257,000 cu. ft. Average seating, 1,000. Cube per seat, 257 cu. ft.

Absorbent.	Remarks.	Area or Number Sq. ft.	Co-efficient.	No. of Units.	Adjustment.	Net No. of Units.
Masonry. Rag-stone not plastered	Friable and slightly porous	10,900	0·03	327	Plus 5% for breaks, Monuments, etc.	343
Stone and tile flooring		2,600	0·02	52		52
Glass in lead panes	Responds to middle tones	4,000	0·027	108	Add 25% for trans-mission	135
Glass panes in choir screens	Responds to middle and middle high	112	0·027	3		3
Wood ceilings		7,250	0·06	435		435
Wood panelling in chancel	Responds to middle tones	300	0·1	30		30
Wood pew floor-ing	Responds to low middle tones	4,620	0·06	277	Less 10% for shading	250
Elm pews. Back and end panels	Responds to middle tones	5,250 sq. ft.	0·06	315		315
Elm pew seatings	With a number of seat mats	1,000 seats	0·2 per seat	200		200
Hassocks	10 × 15 × 5 in.	No. 1,000	0·5 each	500	Less 10% for shading	450
Organ case	Wood and pipes	504	0·08	50		50
Curtains. Flags. Altar carpet		250	Average 0·12	30		30
	TOTAL PERMANENT ABSORPTION					2,293
Choir		30	4·7	141		141
Congregation full	Coeff. 4·7—0·2 =4·5	1,000	4·5	4,500		4,500
Congregation, one-third	Coeff. 4·7—0·2 =4·5	330	4·5	1,500		1,500

Reverberation .. t= Congregation, full .. .. = 1·9
Congregation, one-third .. = 3·3
Rehearsal .. .. = 5·3
Empty .. .. = 5·6

$t = \frac{V}{A} \times 0{\cdot}05$. t is the period of reverberation after the sound source has ceased, measured in seconds; V is the air volume of the hall included within its bounding surfaces in cu. ft.; A is the total number of units of absorption provided by all the surfaces and objects in the buildings as set out in detail in the tables; the figure 0.05 is the Sabine constant for buildings measured in foot units.