CONTENTS

THE ARCHITECTURAL FORUM

MARCH 1929

Church Reference Number

PART ONE—ARCHITECTURAL DESIGN

PART TWO—ARCHITECTURAL ENGINEERING AND BUSINESS

PARKER MORSE HOOPER, A.I.A., Editor

KENNETH K. STOWELL, A.I.A., Associate Editor

Contributing Editors:

Harvey Wiley Corbett; Aymar Embury II; Charles G. Loring; Rexford Newcomb; C. Stanley Taylor; Alexander B. Trowbridge

Published Monthly by

NATIONAL BUILDING PUBLICATIONS

DIVISION OF NATIONAL TRADE JOURNALS, INC.

521 Fifth Avenue, New York

H. J. Redfield, President and Treasurer; Howard Myers, Vice President and General Manager; Joseph E. Browne, Vice President; John Thomas Wilson, Vice President; C. Stanley Taylor, Vice President; James A. Rice, Vice President; Henry J. Brown, Jr., Secretary.

Von Duprin

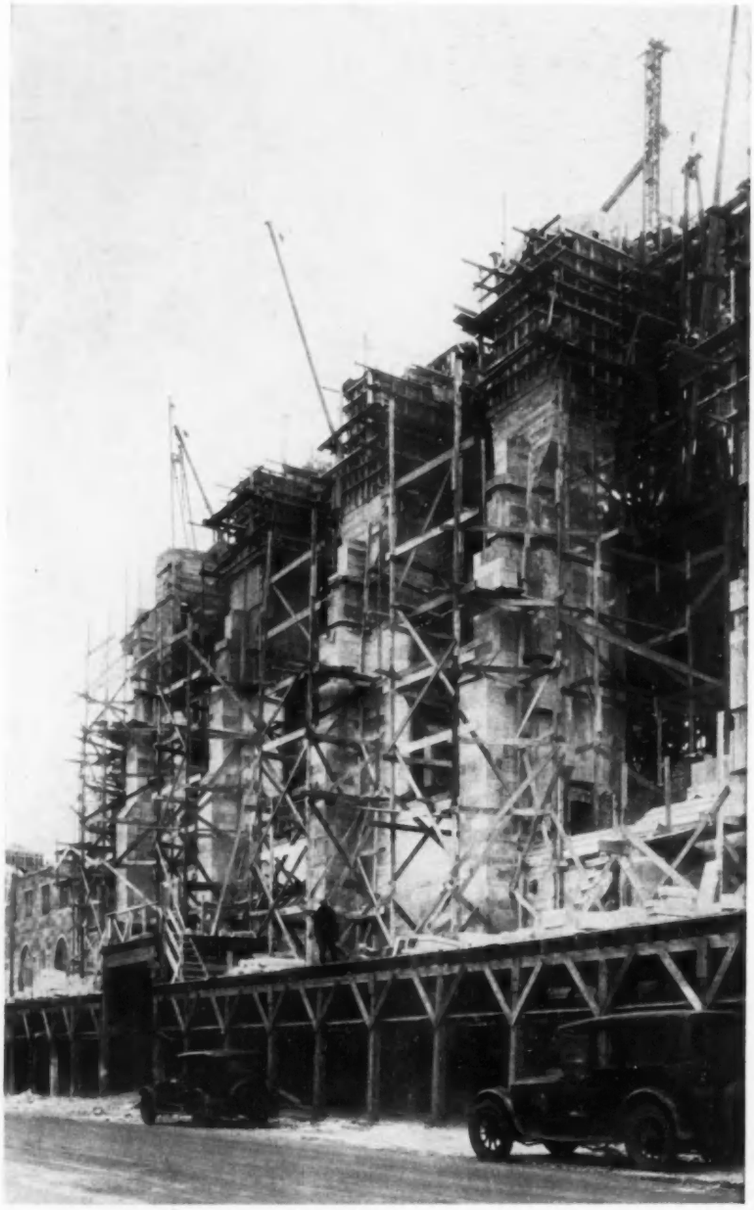
Self-Releasing Fire Exit Latches

Sweets, Pages B2036-2039

AIA 27c5

In panic devices, the difference between the cheapest that can be bought and the best that can be made, is pitifully little in terms of dollars, yet it means everything in case of panic.

VONNEGUT
HARDWARE CO.
Indianapolis, Ind.



MODERN CHURCH CONSTRUCTION

CHURCH OF THE HEAVENLY REST
CHAPEL OF THE BELOVED DISCIPLE

MAYERS, MURRAY & PHILLIP, ARCHITECTS

The Architectural Forum

THE
ARCHITECTURAL
FORUM

VOLUME L NUMBER THREE

MARCH 1929

FINISHING MATERIALS AND METHODS IN CHURCH ARCHITECTURE

BY

BRUCE C. WENNER

CHURCH architecture demands special study and knowledge of materials for the finishing of the various sections of the building, just as much as it requires special study and knowledge of planning and designing. Church buildings should be especially beautiful. Refinement and dignity are essential, and care must be used in choosing materials which will be harmonious with the style of the building. Gothic, even if treated with modern feeling, must have the requirements of the style considered in the use of finishing materials. Durability and service, which mean low upkeep and small replacement costs, are very essential items to consider, especially in the selection of flooring and materials which will receive wear and tear. Most churches have a minimum amount of money to expend, and it is essential that they get the utmost in value for a given price. This makes it necessary that materials be economical in their cost and durable in their wearing qualities.

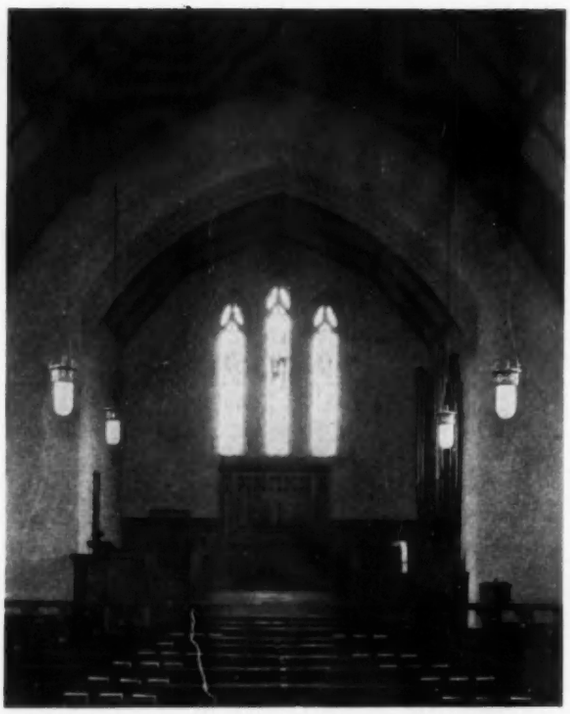
Since quiet is essential in a church, and since it is necessary that a speaker be heard easily, without echo interference, etc., either in the sanctuary, school section or in the entertainment room, materials which will aid in securing quiet and sound absorption generally should be considered. An acoustical analysis should always be made before the final plans and specifications are complete, since this may be quite a determining factor in the selection of finishes, especially for the church auditorium. Various materials for different uses will be considered here in their approximate order of cost, the most economical being given consideration first, though we are not endeavoring to cover all the possible materials or their uses.

Flooring

The Church Auditorium. First to be considered is material for use under pews. The flooring of the main portion of the church auditorium involves one of the most serious flooring problems for the whole church plant, for a material which is easily cleaned, economical, durable, and quiet under foot is needed. After having used various materials for this purpose, we find that one of the most economical and satisfactory floorings is wood. Selected oak makes an economical and pleasing floor, the better grades being desirable when funds permit. A waxing and polishing machine keeps the floor clean and in good condition. Cork carpet is often chosen for appearance and quiet. Linoleum and cork tile are excellent for this purpose. The use of an inexpensive grade of wood with a good carpet over it is very quiet and comfortable. Carpet also helps somewhat with acoustical correction, but it is not kept clean as easily as wood, and it is not as sanitary for a place of public assembly. Carpet is also expensive in first cost and requires comparatively frequent replacement.

Wood flooring should be put down over a heavy felt or other sound-deadening material. Linoleum, cork or cork carpet should be cemented down over felt by the manufacturer's authorized installation men. Waxing or varnishing these materials is a good method of preserving the appearance and finish, and it aids considerably in cleanliness. We usually recommend that shellac or oils never be used on finishing wood floors in churches. Paste filler, wax or floor varnish only should be used to secure a satisfactory floor.

Aisles, Narthex, Vestibules, Corridors, etc. The aisles of the church where cost is the determining factor may be floored with wood as has been suggested for the space under pews. A carpet runner down the aisle is often advisable for the wood floor, and this can easily be taken up for replacement or cleaning. Cork composition flooring materials can be used to advantage for aisles, chancel, corridors, etc., as they are pleasing in color, quiet, and harmonize well with most interior treatments. Rubber tile is a good material for flooring, but often the appropriation for the school section will not admit of its use. Quarry tile laid in some form of random ashlar with joints between tiles not over ½ inch wide makes a dignified aisle and vestibule treatment. Some small moulded or ceramic tile with ecclesiastical designs and color are interesting when interspersed here and there in the quarry tile field.



Lawndale M. E. Church, Philadelphia
Sundt & Wenner, Architects

The thing to be aimed for in this type of floor design should be interest and beauty, and the regular use of a square tile treatment with straight joints may be considered by some as being rather mechanical and severe. Terrazzo is useful for aisles, corridors, chancels, etc., especially when used with tile or mosaic tile, the terrazzo itself being used as a field and always laid with the use of brass strips to prevent cracks. Terrazzo should always be applied over a solid, rigid, structural concrete base.

One of the most satisfactory materials (and although we are considering it last, one of the most economical materials for church steps, vestibules, aisles, chancel, etc.) is slate. The use of mottled greens and purples with a moderately rough surface makes a non-slippery, beautiful floor. It is sanitary and quiet under foot and has durability and dignity. This type of floor can be laid very economically if so desired; slates of thinner roofing thickness can be used with success when thoroughly bedded in cement mortar. We generally use ¾-inch thick slates bedded in 2-inch cement mortar composed of three parts sand and one part Portland cement. After the surface of the cement is leveled up, it is sprinkled with pure Portland cement to perfect the bond between bed and slate. We thoroughly wet the slates before embedding and set them in firmly and to the desired level. Joints should be pointed with cement mortar of two parts well sieved sand and one part cement. We sponge off the slates as set with clean water, and upon completion, after the floor is finished and set, we rub down with three parts kerosene and one part of linseed oil well mixed.

Offices, Classrooms, Assembly Rooms, etc. For these rooms a wood floor is probably as satisfactory as any. Rugs can be added to give a comfortable and homelike appearance and to harmonize with draperies, wall finishes, etc. Linoleum, and various composition tile make a good floor finish for school and administration rooms. These materials are very good and economical for floor treatment over concrete floors in fireproof construction. The concrete floor can be finished smooth, and when strict economy is necessary the cement floor can be left as the finished floor for a time, and the floor finish can easily be applied as funds become available. Chairs and tables must be equipped for use on linoleum with proper castors or "shoes," since children using these furnishings are likely to give them rough treatment which may mar the floor.

Toilets, Locker Rooms, etc. For these areas a cement floor is probably most economical and can be given an attractive appearance with the use of integral coloring and hardener and the marking of the surface into squares. Magnesite composition flooring is adaptable for this purpose, and it is somewhat more resilient and less cold in appearance than concrete. A metal strip must be provided between this material and the plaster of side walls or it may stain the plaster. The magnesite floor must also be oiled or waxed, or water stains may result with certain colors. A tile finish for toilets, showers, etc., always seems to give the best results for both floors and walls. The new tile color treatments make possible a certain warmth and interest which was not possible with the use of white tile exclusively. The only disadvantage of this material when properly installed is its cost, and proper installation is essential to avoid there being loose tiles; an installation of tile work that is "cheap" is very unsatisfactory.

The Parish Hall and Gymnasium. The parish hall, fellowship hall or gymnasium,—by whatever name it may be known,—is frequently equipped with an oak, maple or gumwood floor. The latter material is likely to twist somewhat, but it comes in long length. A floor of edge grain yellow pine is satisfactory, but it may cost as much as oak. Select oak is economical and makes a good floor.

General Considerations. The construction under aisles, narthex, vestibules and corridors should be solid and firm so that there is no feeling of vibration when it is walked upon. It is very disconcerting and creates a bad psychological effect when one walks over a title or floor and hears a hollow sound or has the consciousness of there being movement or vibration. and a con-

crete slab should be used which is sufficiently thick and properly reinforced to prevent cracking and to make impossible the hollow sound when the floor is walked over. It is often an advantage to use a base of the same material as the floor for finish around the walls of a room. This is especially true in vestibules, halls, corridors, etc. Toilet rooms should have the floor material formed into a sanitary cove and base which should be high enough to protect the side walls from becoming soiled. This matter is sometimes governed by building codes, but when there are not definite regulations a good practice is to carry the base up for 15 inches upon the side walls.

Wall Treatments

Church Auditorium. The walls of the church auditorium, when strict economy must be observed can be treated simply with sand-float finish plaster tinted very slightly to a pale ivory or gray. For a building of the Colonial type this finish is in keeping with the style, and its use is perhaps the best solution of the problem. A Gothic church calls for more texture if the cost can be afforded. An "old English" treatment of the plaster is very interesting and in keeping with the architecture; a plasterer who is used to handling this finish can do it very reasonably. Textures which are suitable for cafes, hotel lobbies, etc., are not usually adaptable to church interiors, as the sanctuary needs a treatment quiet in color and texture. The auditorium may in some instances require the use of acoustical material on the side walls. Some such materials have a rather satisfactory texture for wall finish in their regular treatment; it is not always necessary, however, to require acoustical treatment on the walls of the church, since the ceiling treatment frequently takes care of this.

A church auditorium, when the amount of money to be spent warrants it, can be treated with variegated limestone or a cast stone veneer. Sandstone makes a very warm and beautiful interior, but it is somewhat expensive. When stone interior walls are used, care should be taken to get as much warmth into the interior as possible, through the use of warm glass in the windows and warm treatments elsewhere. In the more liturgical churches it may be permissible to have a colder interior than in the evangelical churches, but we do not feel that a cold interior is ever really desirable or inspirational. There are a number of possibilities in the use of slate, mosaic, marble, etc. for the decoration of walls, but as the use of these is largely a matter of design, they will not be considered here. The use of wainscots of wood or stone is good practice, and radiators or concealed heaters can be arranged behind the wainscot having the heat openings designed to tie in with the design and thus be as unobtrusive as possible. The use of paint on new church walls is rather unnecessary unless one of the patent textured wall finishes is used instead of the usual final coat of plaster. Old walls can be refinished to great advantage with this type of material. The use of some carefully placed and well designed painted decoration is permissible and desirable in certain cases.

Trainer M. E. Church, Trainer, Pa.
Sundt & Wenner, Architects

Organ Chambers. The walls and ceiling of the organ chamber should be plastered with Keene's cement troweled to a hard, smooth surface. Some organ builders prefer wood, but this material is not as vermin-proof or as fireproof as plaster, and some of the organs with the finest tones have been installed in plastered chambers.

School Rooms, Administration, Parlors, etc. The schoolrooms can be treated with simplicity to advantage, and usually this is necessary, since this portion of the work while being important and requiring good materials and finish must also be economically handled. Sand-float finish plaster with light tinting is very adaptable. If possible, painting in these rooms is recommended, and this should be done with flat wall finish of shades rather neutral and delicate in character. Sunny rooms can have a cool color treatment, while rooms which do not receive sun should have a warmer tone. Church parlors, lobbies, reception rooms, etc. can be treated with textured surfaces, and other materials such as wood paneling, etc. which will aid in carrying out the design and

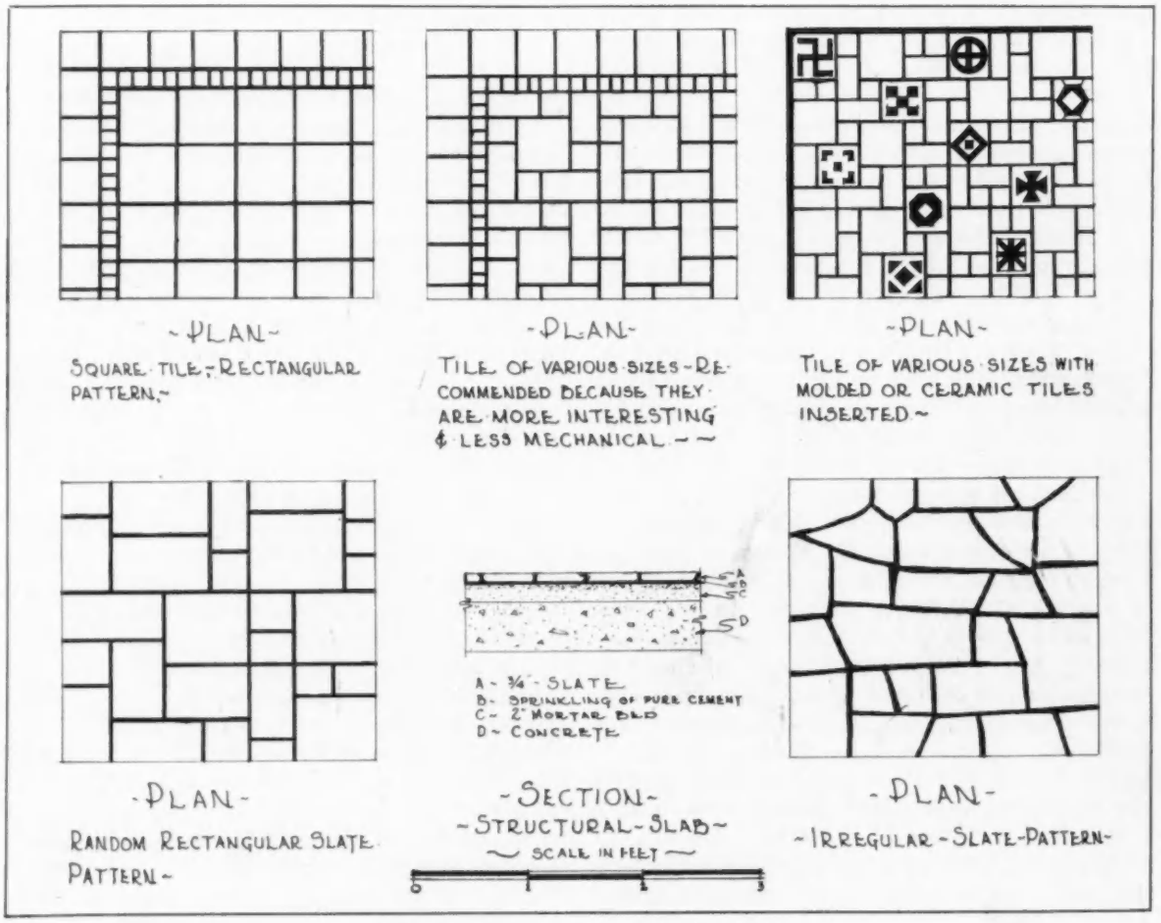
decorative effect are often desired. When the financial resources warrant it, these rooms should have a rich finish and should be made as attractive, intimate, inviting and comfortable as possible.

A chair rail is essential in the various rooms of the Sunday School, and the rooms for the younger children should be arranged to have a band of cork from 12 inches to 18 inches wide run around the room for the exhibition of pictures, handiwork, etc. All class and assembly rooms should have blackboards with cork panels at the sides or tops for use in exhibiting illustrations or posting notices. Definite study of the decorative treatment of the various school department rooms, club and classrooms, parlors, etc. is essential. The architect should, wherever possible, suggest the color schemes, help select rugs, furniture and draperies, as the importance of this in making the rooms of the school beautiful, homelike, comfortable and inspirational cannot be overestimated. Varnish which finishes with a flat surface is preferable to shining wood finishes.

Toilet Rooms, etc. These should either be tiled as discussed under "Flooring" or have a hard plaster wall finish of Keene's cement troweled smooth and hard and then painted with a hard-drying enamel capable of being washed. This treatment should be used at least 4 feet, 6 inches or 5 feet high and preferably over the entire wall surface. Toilet partitions, shower stalls, etc., may be of metal with baked-on enamel finish. The use of wood stalls is to be discouraged for sanitary reasons. Slate or marble are of course excellent for this purpose, but they are likely to be too costly as well as being subject to breakage, cracking, etc., when subjected to hard, careless usage.

Parish Hall or Gymnasium. It is usually economical and advisable in the modern church plant to have one room which will serve for gymnasium, entertainment room, banquet hall, etc. A separate gymnasium is sometimes desirable and possible, but the money available for the building fund often makes it absolutely necessary to double up functions so that one large hall will serve for many purposes.

In a small church the hall may be successfully lined with wood. A paneled wainscot stained to a darker tone can be used below with "German



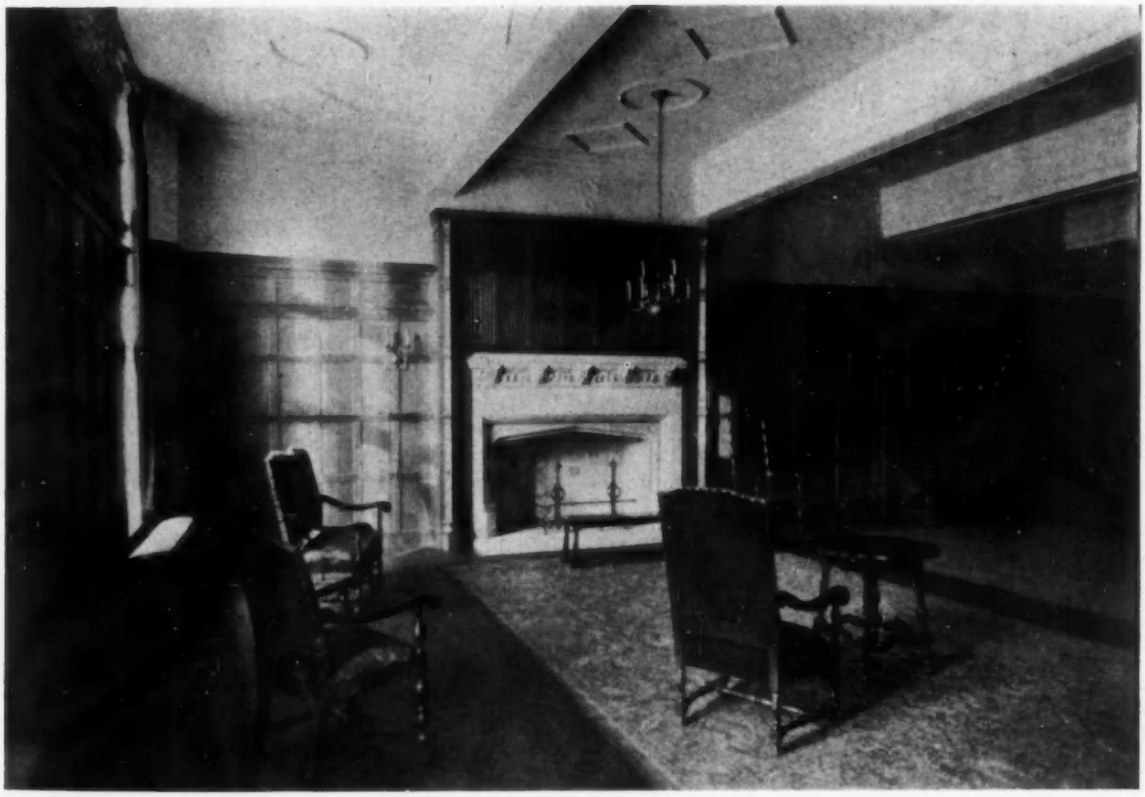
Various Types of Tile and Slate Flooring

siding," V-jointed boards, or other similar material above stained a light gray or some other light color. With some ingenuity this can be worked up into a very attractive, durable and reasonable finish. Jointing in the wainscot might be run vertically with a flat moulding treatment developed at the top of the wainscot, and the upper surfacing can have the joints run horizontally. Various other treatments are possible. In larger buildings a good treatment for the parish hall is obtained with brick of a light, warm tone with at least some range of color. Bands of headers, upright stretchers, etc. can be worked in, giving interest and pattern to this type of wall. If the proscenium arch of the stage is treated with a paneled and moulded wood casing, the severity of the brick is somewhat softened. Incidentally, we might mention that the stage front should have removable panels, and space can be provided beneath the stage floor for the storage of tables and chairs. These can be stacked on flat trucks with rollers which can very readily be pushed under the stage for storage. The parish hall may be plastered, but if it is used for gymnasium purposes plaster is not very durable unless cement plaster is used applied over furring tile instead of over lath. Of course where a separate gymnasium is planned or where the hall is to be used for nothing but assemblies, entertainments or suppers, a plaster treatment is satisfactory, especially when either a brick or wood wainscot is installed. The plaster can then be finished with any texture or surface desired to give the preferred treatment.

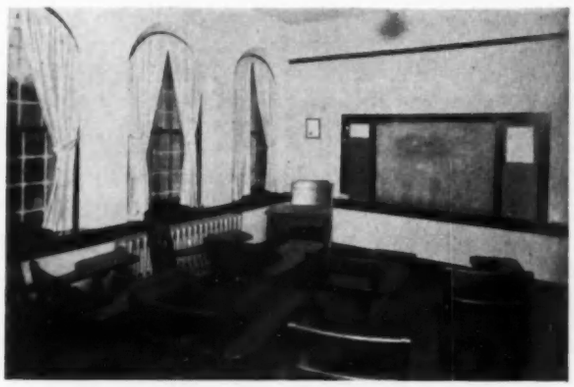
Ceiling Treatments

The Church Auditorium. The church ceiling treatment depends largely on the type of its architecture. If the Colonial style is used, the ceiling will probably be plaster, and in most instances coved. This type of ceiling usually requires the use of an acoustical plaster if the radius is not over twice the height of the room, and if it is desired to reduce the sounds from the congregation. An auditorium of this type without acoustical treatment may be satisfactory for the transmission of the speaker's voice, but the turning of pages of hymn books as well as the sounds of movements of the congregation is magnified to the point of annoyance. Acoustical plaster is satisfactory for this problem, and can be used to make a satisfactory architectural treatment. In the Gothic church usually very little acoustical treatment is needed, especially if it is of the clerestory type with which are included side aisles.

The ceilings of the side aisles need treatment more than any other portion of the auditorium,



Church Parlor. Oak Paneling, Textured Plaster Walls, Plaster Ceiling with Ornament in the Tudor Style



Classroom, Elm Park M. E. Church, Scranton
Albert N. Dobbins, Architect

Assembly Room, Elm Park M. E. Church, Scranton
Albert N. Dobbins, Architect

as a rule. An acoustical expert should analyze each project to check up on the kind and amount of material necessary to give the proper correction of echoes and absorption. Acoustical material can be used on ceiling panels between trusses and purlins. Our experience has been that a church auditorium with narrow nave, not over 38 feet wide, and side aisles of about 4 feet can be made very successful by the use of a wood ceiling which of course is really the most satisfactory thing for appearance in a Gothic church, unless vaulting of proper design can be used. We would not recommend the use of plaster vaulting, since this is a false use of this material. We include here an illustration of a church at Lawndale, Pa. which has an acoustically treated ceiling. This church is practically perfect in its acoustical properties. Some sound-absorbing materials are not very satisfactory in appearance for a church ceiling, but if properly stained this fault may be corrected in part. We are using cork about 1½ inches thick to advantage, and the appearance of this material in the ceiling panels is frequently very pleasing. All these materials are not only sufficient as a rule to correct the acoustical difficulties of most churches, but they provide insulation for the open timber roofs and make expensive false ceiling construction unnecessary. A vaulted ceiling can be built with acoustical tile when necessary, but real stone or cast stone gives a better result for appearance. The chancel ceiling should not receive acoustical treatment.

Vestibules, Narthex, Parlors, etc. The ceiling treatments for these may be plaster with an arched treatment, moulded work, etc. The use of wood beamed ceilings for these spaces is also very good. Adzed timbers left in their natural state or decorated in colors, stenciling, etc., help to make attractive ceiling treatments for smaller rooms. The main vestibule, narthex and church parlors, or reception room especially, deserve interesting and detailed ceiling treatment suitable and adaptable to the architecture and requirements of the various rooms and their functions.

Schoolrooms. The ceilings of schoolrooms are usually treated with smooth, white plaster for efficient lighting, economy and sanitary conditions.

Parish Hall. In fireproof construction an exposed concrete ceiling is very adaptable for this room, especially when it is used for gymnasium purposes. The concrete is capable of being stained or painted, the form marks of wooden forms being left to show. All fins and honeycombing should of course be removed and smoothed up. Also by the use of wire brushing a certain texture can be secured. Where the ceiling is high enough, plaster can be used. Smooth white plasters give the best lighting results, but a sand finish with a light buff tint usually gives the most pleasing results with brick.

A decided effort should be put forth to secure the use of good materials of durable and artistic qualities for church use. The American people are guilty of using very cheap and shoddy church construction. There is no type of public building that has been done quite as carelessly and cheaply as the church during the last 50 years. We need very strenuously to counteract the use of shoddy treatments and interiors of church buildings in color schemes and decorations, furnishings, etc. The architect must endeavor to educate the committee and congregation; he must safeguard them against allowing untrained persons to select floor coverings, colors for walls, furniture, lighting fixtures, and other decorative equipment. The "Ladies' Aid" means well, but usually its members have had very meager artistic training. It is the architect's duty to try to direct the furnishing and decorating of the entire church plant, and it is also his duty to familiarize himself with the latest approved methods and requirements for church and school usage as set forth by the church at large so that he can intelligently advise the local church as to what it should have.

THE CARVING OF A CHANCEL CRESTING

BY

THEODOR CARL MULLER

The history of the Episcopal Church, from its inception to the present day, reduced to the pictorial limitations of carving in oak forty-three feet long, seven inches high, and one and one-eighth inches deep, might shock some scholars, but has delighted all concerned with this reduction. In thirty-one chronological scenes it became the chancel cresting illustrated. To the right of the altar are incidents relative to English Church history, and those to the left relate to Church history in America beginning with Raleigh's colonies.

Beside the unity of time sequence there is only that of relative variance, each scene expressing an element in the life of the Church peculiar to itself. This is an exponent of Gothic idea, which appraises worth by that which the individual alone expresses, as opposed to an appraisal on a basis of approach to the ideal. Arbitrary and traditional conventions and symbols have been used throughout to simplify illustration, to wit: three are a crowd and where dominated by a single idea these three are alike. Elsewhere they may differ.

Chancel of St. Mark's Church, Mt. Kisco, N. Y., Showing the Cresting

Cram, Goodhue & Ferguson, Architects
Mayers, Murray & Phillip, Architects of the Additions

CHANCEL CRESTING, ST. MARK'S CHURCH, MT. KISCO, N. Y.

John Wycliffe and the Bible, 1384. Wycliffe was the first English scholar to repudiate Rome.

The Crusades, 1096-1271. The knights are shown worshiping at the shrine of their religion.

The Mendicant Friars. In the 13th-14th centuries, England was full of mendicant monks.

The Magna Charta, 1215. Among other things, this guaranteed political and personal liberty in England. Signed by King John.

Martyrdom of St. Thomas a Becket, 1170. Henry II instigated the murder of this "upstart priest" in Canterbury Cathedral.

The Battle of Hastings (or Senlac), 1066. The Norman cavalry and archers are shown in pursuit of the English peasants.

St. Dunstan, A. D. 950, a monk of some musical ability, at Glastonbury, was tempted by the devil in the guise of a woman. When seized with tongs, the devil reverted to his usual shape.

Bede, called the Venerable, A. D. 735. Bede was eminent in learning and piety, translated the Gospels into English. He died dictating the last of St. John to a young scribe.

Paulinus and the destruction of the Druidic shrine, A. D. 625. Paulinus was a missionary sent from Rome to assist Augustine. He is shown accompanying a Christian princess.

St. Augustine and the Bishops, A. D. 604. St. Augustine was sent by Pope Gregory as a bishop to England; called a conference of the bishops, receiving them seated.

St. Colomba, A. D. 520, an Irish scholar and priest, founded many monasteries in Ireland and Britain.

St. Patrick was carried as a captive to Ireland, which he evangelized. Called the "Apostle of Ireland".

Council of Arles, A. D. 314. The three English bishops were those of York, London and Lincoln.

St. Alban, A. D. 305, was the first saint and martyr in England. He prayed and a stream gushed forth.

The First Man to Bring the Gospel to England. St. Paul, St. James and Joseph of Arimathea are each mentioned as being the first to preach.

Joseph of Arimathea and the Glastonbury Thorn. Joseph was sent to Britain. At Glastonbury, he thrust his staff into the ground and it budded.

Pentecost, called the Birthday of the Church. which is set forth in Acts II. vs. 1 through 4. Also sometimes called "Whitsun-day."

CHANCEL CRESTING, ST. MARK'S CHURCH, MT. KISCO, N. Y.

The Church Today. The subject of the final panel, from which we start to retrace the history of the Anglican Church, is the symbolic procession of the Church onward.

The Cathedral Era. Washington Cathedral is on the right and Baltimore Cathedral is on the left, although the tower of the Baltimore Cathedral is not yet built.

High, Broad and Low. This is an attempt to symbolize arbitrarily the three trends in the interpretation of the Church's doctrine, commonly known as High, Broad and Low.

The First American Bishop, 1784. Dr. Samuel Seabury, the first American bishop, was consecrated in England.

King's College. Chartered in 1754, the College, now Columbia University, is shown at the close of the eighteenth century.

Paul Revere, 1776. He was maker of church bells and one of the earliest designers of ecclesiastical silver in America.

The Settlement at Jamestown, 1607. One of the first English colonies to be permanent in America; survived under the able leadership of Captain John Smith.

Popham's Colony, 1607, Kennebec, Me. The surviving settlers became discouraged and returned to England in a ship they had built during the winter.

Sir Walter Raleigh, 1585-1590. Several groups of colonists were sent out from England under the direction of Raleigh, during the years 1585-1590.

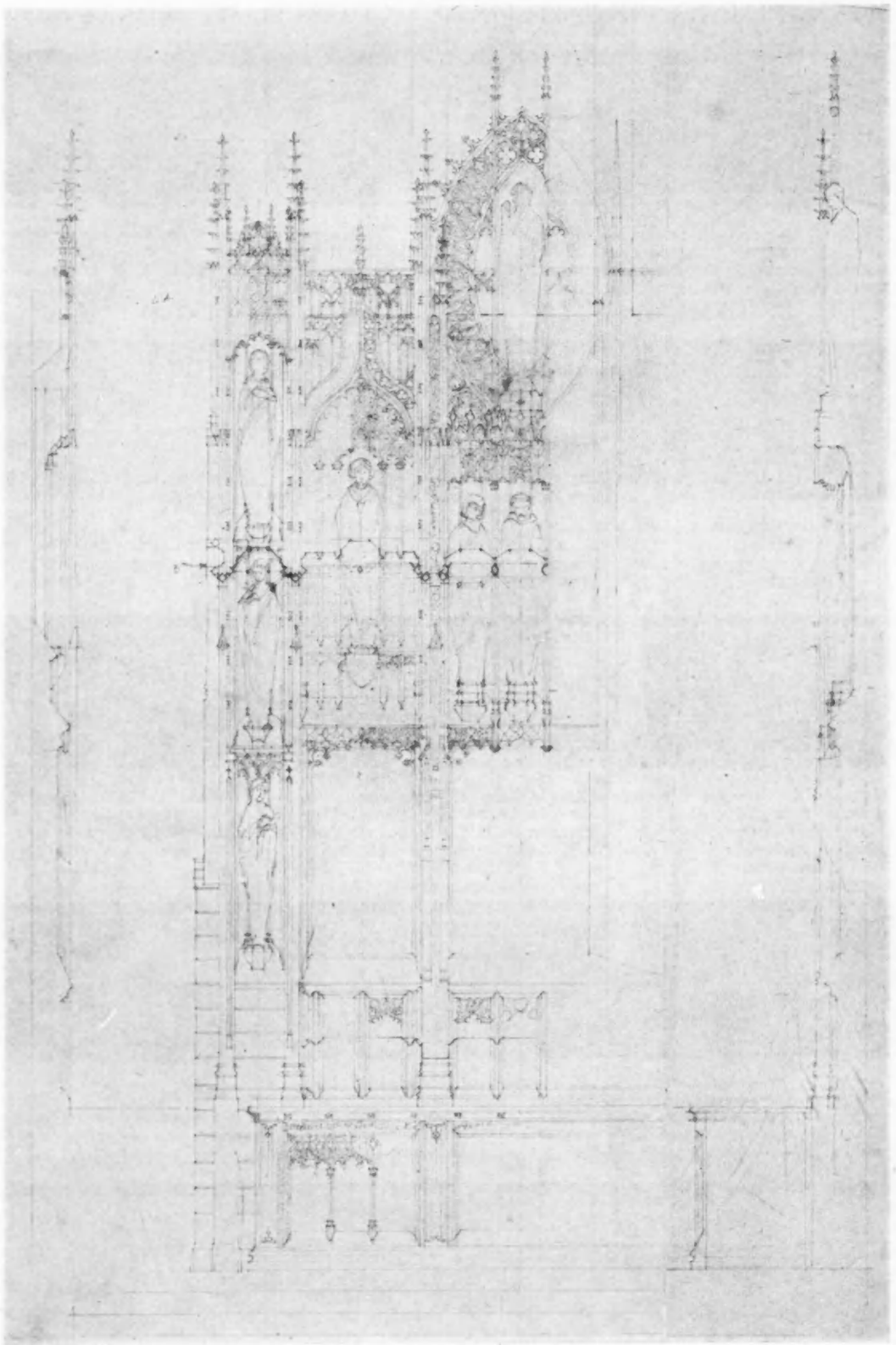
The Beheading of King Charles, 1649. He refused to accept the Covenant, which abolished the episcopate and disendowed the Church of England, and was condemned to die.

The Beheading of Laud, 1645. Bishop Laud was harsh and domineering in his effort to enforce reverence by regulation. He was convicted of high treason. He died preaching.

The Tale of a Tub, by Jonathan Swift, is a parable of the Reformation, indicating the divisions and the excesses into which the Church had fallen in interpreting the Bible.

The Defeat of the Spanish Armada, 1588. English vessels defeated the Spanish, and furthered the separation of the English and Catholic Churches.

Martyrdom of Cranmer, 1556, Archbishop of Canterbury. He died holding in the flames his hand, which had signed a recantation.



Detail by O. H. Murray

WORKING DRAWING FOR THE ALTAR AND REREDOS
CHRIST CHURCH, CRANBROOK, MICH.
MAYERS, MURRAY & PHILLIP, ARCHITECTS

CHURCH WOODWORK

BY

A. GORDON LORIMER

WOOD, as a constructive and decorative medium, has had an honored position among building materials in all ages and styles, but it is to the Gothic period that we must turn for woodwork in its most lavish and imaginative form. Many a humble little parish church in England owes its charm to the rich delicacy of its rood screens and chancel fittings, while in the larger churches and cathedrals, the stalls, tabernacle work, etc., are marvels of airy delicacy and splendor.

During the "Gothic revival" of the last century, much was written on the subject of church woodwork and many valuable records were made of surviving examples. The impulse of this movement, however, was literary rather than architectural, and it failed because "though rich in scholarship, it lacked in imagination." These efforts were expended mainly on a hard and fast classification of distinct periods and styles in existing work, to be used in conjunction with rigorously correct "period" churches. Fortunately the unimaginative archæology of the last century has gone,—we hope forever,—and in its place has come analysis of the essentials of the composition and the use of ornament only where the eye requires it to give full expression to the composition. "Decoration is the ritual of architecture,—it should emphasize, and not obscure the principles it seeks to glorify." Apart from its utilitarian aspect, woodwork serves a very necessary purpose in giving "human scale" to the church. The finer details and warmth of the woodwork constitute a foil to the impersonal masses of soaring masonry.

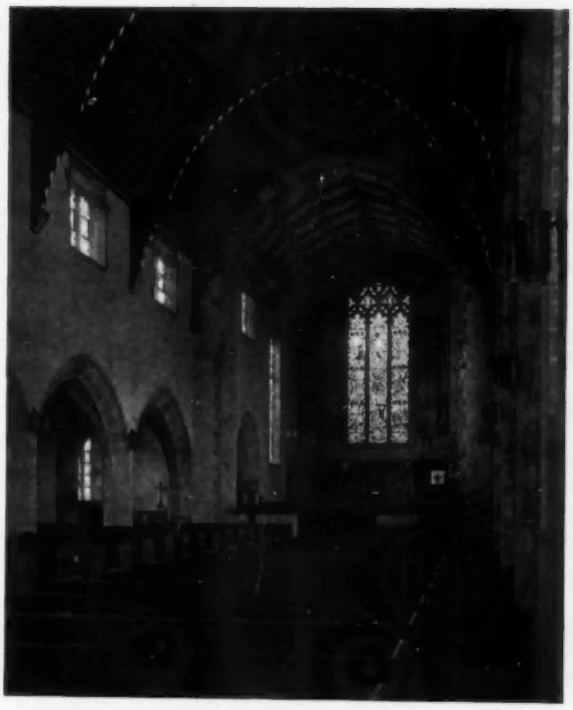
Timber Porches. On approaching the church, the first glimpse of woodwork is often found on the porch. Many parish churches of the fourteenth century have delightful open timber porches, giving that gradual transition from the open air to the interior which is so valuable architecturally. It is surprising that more use is not made of this feature in the churches of smaller American communities. Heavy barge boards with sturdy carving and overhanging eaves are features of this type of porch, which is essentially rural in character.

Exterior doors have been treated in a great variety of ways,—plain boarding, frames and boarding, bound paneling of all types, etc. Probably the most economical and satisfying type of exterior door is that of flush jointed oak boarding on a built-up core, with a studied arrangement of bolts, hinges, and other hardware of a decorative type, for which the plain oak surface provides an excellent background.

Narthex and Gallery. The narthex is usually low ceilinged because of the gallery above. There we have through the glazed and traceried screen a partial view of the church. This arrangement, in addition to giving the extra accommodation of the gallery, makes the passage into the church more gradual and renders the height of the church all the more impressive. The old rood lofts and screens of English west country churches afford an inexhaustible fount of inspiration for the design of narthex screens. In direct contrast to this convenient arrangement, the great overhanging side galleries which were introduced into churches following the Reformation, are nothing short of calamities. They break the height of the church in a most unfortunate manner, making it appear squat and uninspiring.

Roofs. Passing from the narthex, the eye is cast upwards toward the roof. Except in large churches and cathedrals, where stone vaulting was used, the roof was generally of wood, often complex in form and rich in gold and color. The restful yet rich combination of natural wood and applied color ornament has become so valued that in our large cities, where timber roofs are prohibited, one finds concrete roofs designed in timber form and decorated as such. The wood roof of St. John's Church, Buffalo, is an excellent example of simplicity in form and richness in texture, the gleam of gold on the edges of the trusses giving just the right note of interest to the dark timber. A good example of the more elaborate Westminster Hall type of hammer-beam truss may be seen in the Graduate Hall of Princeton University. A modern timber roof of great possibilities which has already been used with considerable effect in European churches, is that of a comparatively new type, shown in the chapel illustrated on page 438. This is exceedingly economical, being built from short lengths of light timber, the net-like mesh construction being tied in joints by bolts and washers. Though built of small units, this roof has great unity of form, which gives it dignity and repose. The Gothic arch, or hinged roof, the segmental arch, and the broach roof are the most common forms of this construction.

Pews and Seating. Whether built-in wooden pews or movable individual chairs are most convenient for the average church is an open question. Chairs give a greater sense of spaciousness, as the floor surface is visible throughout, while on the other hand, pews afford more privacy. At one time the Anglican Church published rules definitely limiting the measure of comfort with which pews could be endowed, but these rules



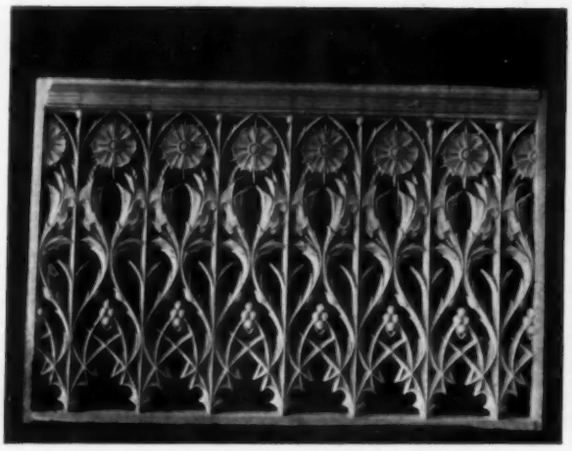
St. John's Church, Buffalo
Mayers, Murray & Phillip, Architects

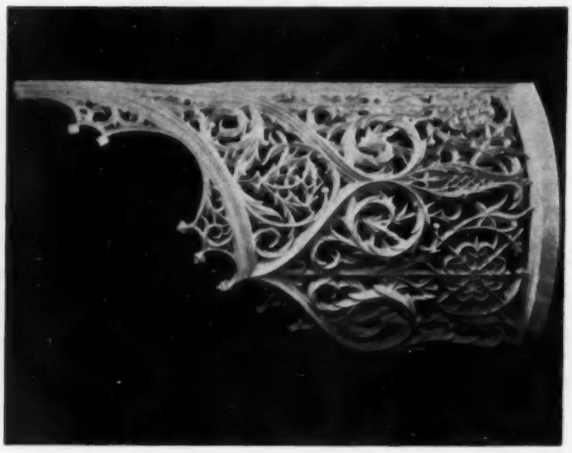
Choir Organ, Chapel, University of Chicago
Mayers, Murray & Phillip, Architects

have fallen into abeyance. Elsewhere in this article will be found data giving dimensions which have proved comfortable without departing radically from traditional appearance. The dimensions allow of the use of a 2-inch cushion, which should be of a quiet, neutral colored, serviceable material. Book racks or receptacles are best kept sufficiently low, so that books, etc., are not visible in a general view of the church.

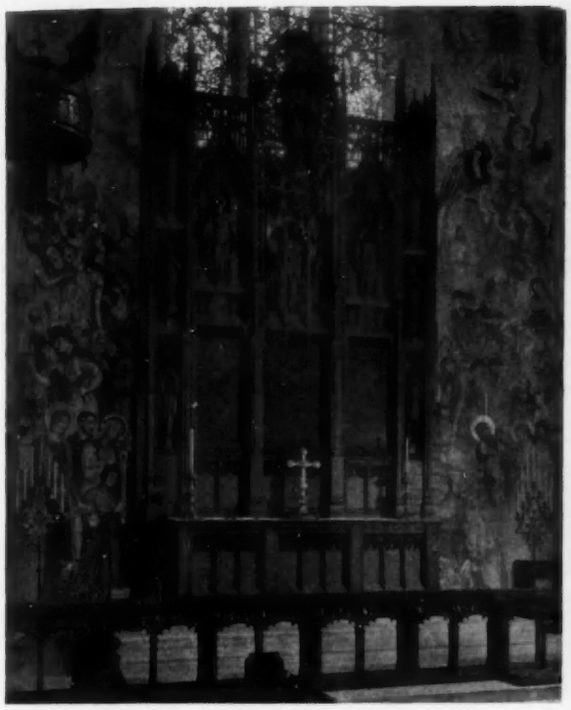
So far our imaginary church might belong to almost any religious body. Space does not permit of a full discussion of the various types of chancels adopted by the many denominations of today. The Anglican or Episcopal plan expresses fully and clearly basic principles of design in a place of worship and will well repay careful study. The plan illustrated is a fairly typical layout for a church of medium size. The traditional orientation has been taken throughout, the nave running east and west with the chancel and altar at the east end.

The chancel is separated from the nave by two or three wide steps, from 5 inches to 6 inches in height. This gives a better view and enables the





Details of Choir Organ Case in Oak, University of Chicago Chapel
Bertram Grosvenor Goodhue and Goodhue Associates, Architects

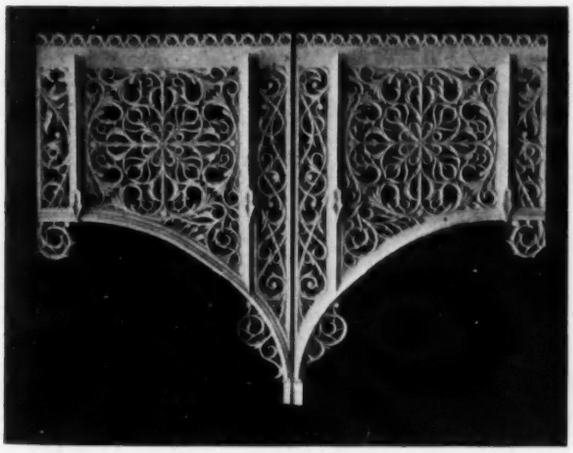


Altar and Reredos, Christ Church, Cranbrook, Mich.
Mayers, Murray & Phillip, Architects

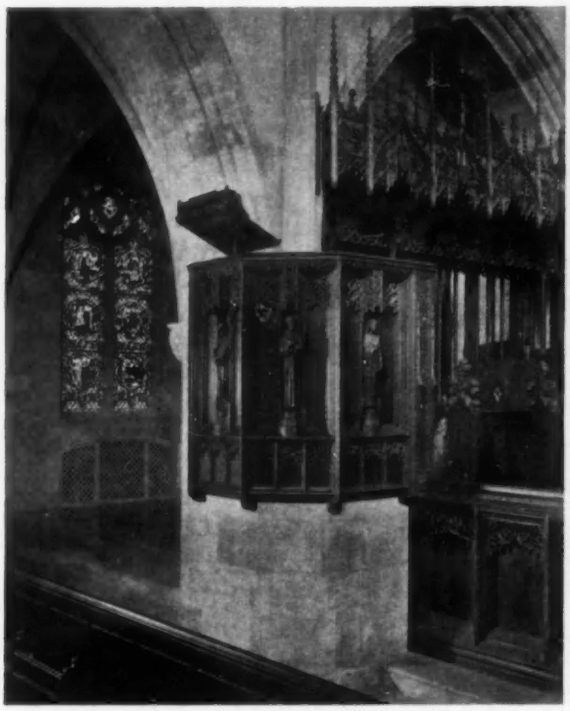
Chapel, Christ Church, Cranbrook, Mich.
Mayers, Murray & Phillip, Architects

clergy to be more clearly heard. It is desirable that these steps project into the nave rather than being recessed into the choir. A space at least the width of the center aisle should be left between the chancel steps and the nave seats. These steps run the full width of the open space between the front bookrests on either side of the choir, the remaining portion on either side being screened by a parapet of stone, marble or wood. This should be a solid screen to hide the feet of the clergy and choir, but should allow a good view of the chancel from the nave. A height of 2 feet, 6 inches from the chancel floor is generally adequate.

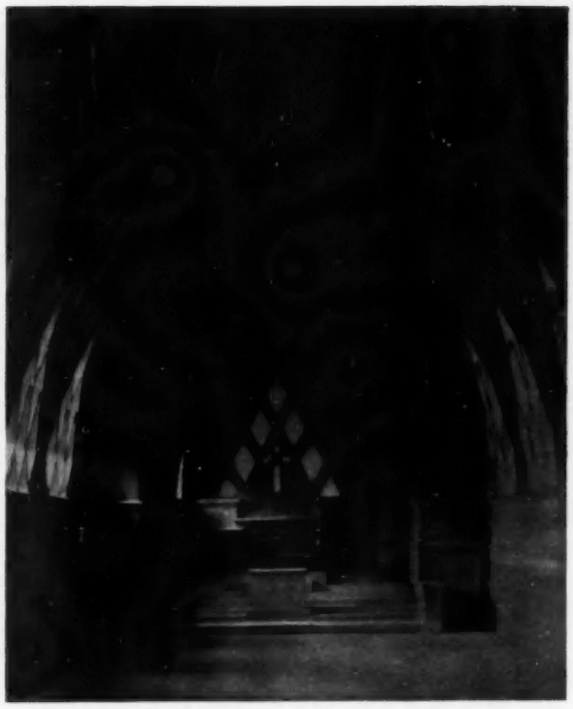
The Pulpit. There are no absolutely fixed liturgical positions for pulpit and lectern, but generally they are found just in front of the parapet on opposite sides of the chancel. Ecclesiologists long held the opinion that the only correct position for the pulpit was on the north or gospel side of the nave. This has been proved erroneous, and abundant precedent exists for placing it on the south side. It was not until the fifteenth century that use of pulpits became general. Many of these old pulpits are of exquisite proportions. This is due



Details of Choir Organ Case in Oak, Chapel, University of Chicago
Bertram Grosvenor Goodhue and Goodhue Associates, Architects

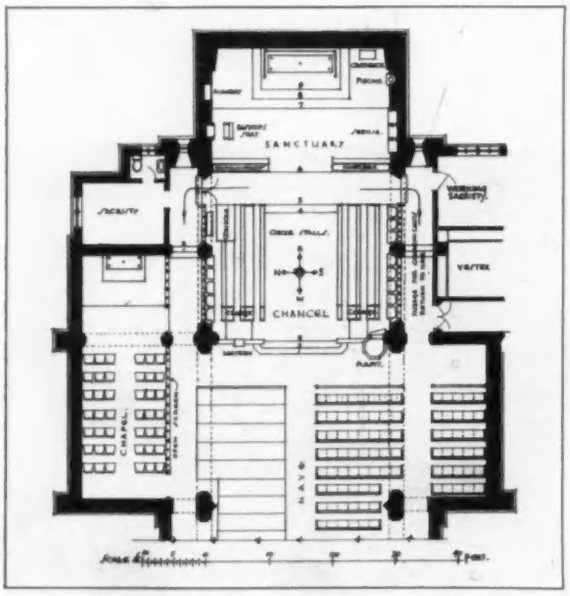


Pulpit and Corner of Choir, Christ Church, Cranbrook, Mich.



A Modern Timber Roof Built Up of Short Lengths Giving a Diamond Pattern

to their small internal dimensions, some of them being no more than 2 feet in their internal diameters. Rarely is the floor less than 4 feet above the nave, and it is often considerably more, one at Coventry, England, attaining a height of 7 feet, 6 inches. Concealed steps to the pulpit may save embarrassment. Steps should always be completely outside the diameter of the pulpit floor.



Typical Episcopal Chancel Plan, Showing Arrangement of Furnishings

With the large internal dimensions desired by modern preachers it is extremely difficult to design a pulpit of pleasing outline. A happy solution has been found at Christ Church, Cranbrook, Mich., where a sturdy stone base carries the wooden pulpit rail. The plain surface of the stonework forms an effective contrast to the richness and delicacy of the upper woodwork. Another interesting feature is the decorative band along the edge of the bookrest, concealing a striplight and acousticon microphone.

Lecterns. The gospel lectern, or lectern from which the lessons are read, may stand in any convenient place in the chancel, the rubrics merely ordering that the reader should so stand "as he may best be heard." The reader should stand on a reading platform at least 1 foot above the nave floor and should not be on a level lower than the floor of the chancel. The desk should be adjustable and of such a height that it does not come between the reader's head and the congregation. Sometimes the carriage for the desk is built as an integral part of the parapet. In almost all cases a hollow wooden reading platform is an advantage acoustically.

Choir stalls are usually placed on both sides of the chancel. There seems to have been no limit to the craftsmanship and expense lavished on mediæval stalls. Today decorative treatment is

Chapel of the Holy Spirit
Liverpool Cathedral

Bishop's Throne, Liverpool Cathedral
Sir Giles Gilbert Scott, Architect

usually reserved for the back row of stalls. Canopies, either individual or continuous, are customary. These protect the heads of the choristers from down-drafts from the walls. The back rows of stalls should be raised two or three steps above those in front. There again a hollow wooden platform has acoustical advantages. The open space between the front bookrests on either side of the chancel should be kept as wide as possible. The length of the altar may be taken as a minimum distance.

At the end of the choir and in front of the sanctuary step is a broad platform, giving room for communicants and allowing access to the sacristies, etc. This should never be less than 4 feet wide, and where possible it should be considerably wider. Also, where space permits, this platform can be separated from the choir by a change in level of from one to three steps. In larger churches it is desirable that communicants should return to their seats by way of side ambulatories rather than having to brush past those coming up.

The sanctuary is the most important part of the church. The demarcation from the choir is an elevation of one step. At least 14 inches back from the edge of this step is the altar rail or, better still, the communicants' kneeler. One advantage of a kneeling bench is that it allows the communicant to kneel on a somewhat higher level than that on which the clergy stand, and obviates much tiresome stooping by the officiating clergy. For a person of average height 2 feet, 5 inches above the kneeling surface is a convenient height.

In the sanctuary the central motive is of course the altar, which we will discuss later. On the south or "epistle" side of the sanctuary it is customary to place the sedilia (or seats for the officiating clergy), the credence, and the piscina, when it is used. The sedilia, consisting of three seats in connected form (never separate chairs), is often recessed into the side wall of the sanctuary, the credence and piscina frequently being joined to its eastern end. It is customary in American Episcopal churches to provide a fixed chair for the bishop on the north side of the sanctuary opposite the sedilia. The bishop's throne and clergy stalls at Liverpool Cathedral, though on a very much larger scale than is possible in the average church building, are nevertheless well worth studying, as perhaps nowhere in modern work is the woodwork more cleverly worked into the main structure. The main architectural frame is formed in masonry rigidly enclosing the richly carved oak backs of the stalls, while the kneeling desks are subtly tied to the marble floor by an integral marble base or plinth. The aumbry or cupboard, when it is desired, may be recessed in the sanctuary wall to east of the bishop's seat.

Altar. The early movable wood altars were abandoned centuries ago for those of more permanent material. It is interesting to note, however, that wood has made its reappearance in one or two recent churches. The earliest altars were not elevated on steps, being built flat on the pave-

CHURCH FURNITURE

Note: These dimensions are only approximate and may require variation in individual cases

DESCRIPTION	HEIGHTS from FLOOR		DEPTH of SEAT	SLOPE of BACK	SPACING of PEWS & STALLS		NOTES
PEWS	Seat at front 15"-16" Seat at back 14"-15" allows for cushion	Back of pew 30" to 33" to floor	14" minimum 16" excellent	1" in 10" height to 1" in 5" height (Very comfortable)	Back of pew to back of pew 32" to 36"	Allowance per person 19" to 22"	
WALL STALLS	Arms 42" Seat at front 16" Seat at back 15"	Back varies usually has canopy	Do. Do.	Do. Do.	36" minimum 39" common	Arms 26" to 28" on centers	Book boards 33" high above kneeler
OTHER STALLS (MEN)	Seat at front 16" Seat at back 15"	Height governed by stepping of choir platform	Do. Do.	Do. Do.	Do. Do.	Allowance per person 22"	
BOYS' STALLS	Seat at front 15" Seat at back 14"	Do. Do.	14" - 15"	Do. Do.	36"	Do. 20"	Book boards 30" high above kneeler
PULPITS	Floor of pulpit 42" above nave Floor (Min.) 48" average		Parapet 38" to 40" above pulpit floor	Internal diameter 36" sufficient	Book board adjustable size 13" x 16" approx.	These dimensions allow of concealed strip-light and acousticon microphone	
LECTERNS	Bottom of adjustable book board approx. 48" above reading platform		Reading platform at least 12" above nave floor	Not lower than chancel floor	Book board adjustable	Do. Do.	
CREDENCE	Approx. height 30" Approx. length 21" to 26"		Approx. depth 12" to 16"	May be set against east wall on south side of altar or against south wall of sanctuary			
COMMUNION RAIL OR COMMUNICANTS' KNEELER	Height 2'-5" above kneeling surface		Rail set back at least 14" from edge of kneeling step				

ment, but by the fourth century the custom had developed of raising them one step above the floor. Later the number of steps was increased, usually to three. For symbolical reasons it is customary to use odd numbers of steps. These steps are from 5 to 6 inches in height,—never more. The top step, footpace or predella, should extend if possible about 16 inches on either side of the altar, and a minimum distance of 2 feet, 6 inches in front of the altar. The other two steps giving standing room for the assistants must be at least 18 inches wide, and where possible they should be 2 feet in width. The last step may be carried across the full width of the chancel, the bishop's chair sometimes being placed on this level. This has the additional advantage of reducing the number of steps the minister has to descend to reach the credence and piscina. From this front step to the altar rail there should be a distance of at least 6 feet. Nothing detracts more from the dignity of the whole church than a crowded and cramped sanctuary.

Squatness in the proportion of the altar is another common source of architectural discord. Altars should be kept as long as the chancel will permit, the usual rule being to make them from one-third the chancel width, in wide chancels,—to one-half in narrow chancels, 7 feet being taken as a minimum. Other typical altar dimensions are 3 feet, 3 inches high, and from 2 feet, 6 inches to 3 feet, 6 inches deep. The background of the altar may take the form of a fabric hanging, or dorsal, or else be built as a permanent architectural surround known as the reredos. This may be of stone or wood, and often contains pictorial and symbolical panels either in relief or in color, and sometimes in a combination of the two.

An unusual yet charming combination of materials is to be found in the Chapel of the Holy Spirit in Liverpool Cathedral. The altar is of oak with ebonized top and ends. It is intended for use without a frontal, its plain severity being relieved by a slight accent of gold on the paneled front. The reredos over it is still more unusual. The panel is carved in English alabaster. The carved canopy and rich surround are partly of "yellow Rocheret" marble, and partly of wood.

We have now examined practically all the major articles of church furniture, with the exception of the organ woodwork. Organ cases are mainly of two types. First there is the case composed of decorative bases, bands and heads, carrying exposed pipes. The soaring verticals and the sheen of the pipes undoubtedly are most impressive. Secondly there is the enclosed type, the pipes being invisible, and pierced screens being used to permit the outlet of sound. These can be very decorative and have the advantage of being economical, their large areas of more or less repetitive piercings being easily handled by modern wood working machinery. In very large organs a combination of the two types is often employed.

Among the secondary details of woodwork in churches are various fittings such as bulletin boards, alms boxes, etc., while in the sacristies, vestries, etc. other details will be required.

THE INFLUENCE OF SHAPE AND MATERIALS ON THE ACOUSTICS OF CHURCH AUDITORIUMS

BY

F. R. WATSON

UNIVERSITY OF ILLINOIS

INCREASING attention is being paid to the acoustic adjustment of rooms, and numerous publications on the subject afford opportunity for architects and others to become better informed. Commercial companies have developed acoustic materials and have been active in the promotion of their use. Because of these advances, it is now easy to secure satisfactory acoustics, and to thus avoid the criticisms so frequently made in the past of defective auditoriums. The purpose of this article is to discuss the effect on the acoustics of the shape of the auditorium and the materials employed to deaden sound in several different types of churches.

Action of Sound in a Room. If auditors could receive only the sound coming directly from the speaker and have it sufficiently loud, the acoustic conditions would be ideal. This desirable condition is not found in auditoriums, because sound reflected from various surfaces combines with the direct sound to produce new effects. When walls are near the speaker, the sound reflected from them beneficially strengthens the direct sound for auditors, and has the further advantage that it allows the speaker to "hear himself." Reflection from distant walls produces echoes and blurring of speech; and, by repeated reflections, sets up a reverberation. It is thus evident that the acoustics of a room depend directly on the reflected sound, so that a study of the effects of the shape and materials of the reflecting walls should lead to important conclusions.

Effect of Shape of Reflecting Walls. In Fig. 1, the speaker utters sound which proceeds outward in spherical waves, reaching the auditor first as direct sound, then later by reflection from the various walls. Each reflected sound may be thought of as coming from an acoustic image of the speaker. The success of the acoustics in a room depends markedly on how the reflected sound combines with the direct sound. If the difference in time of arrival of these sounds is more than approximately .05 second, a blurring of speech is set up, forming what are called "dead spots." This means that the difference in path between the direct and reflected sound cannot be more than about 56 feet,—a smaller distance being preferred. (Ernst Petzold, *"Elementar Raumakustik."*) According to this rule, the success of the acoustics in a room is dependent largely on the sound reflected only once, which means that later reflections should be minimized by padding reflecting walls.

Inspection of Fig. 1 shows a fairly uniform distribution of reflected sound over the room so that each auditor gets his proportionate share. But consider now the unequal distribution given by reflection from a curved wall, as shown in Fig. 2. Here the reflected sound is concentrated in certain spots, with a corresponding deficiency in other spots. An auditor at E, for instance, would get an annoying reënforcement, while auditors in other positions are likely to get too little. Fig. 3 illustrates a curved wall at the back of a sanctuary. The reflected sound comes to a focus at C where it again spreads out. This arrangement forms an unequal distribution which may be thought of as the combined effect of the real speaker at S together with a second fictitious speaker at C. The auditor DD gets sound first from the real speaker, then an instant later from the image C, a double portion if the wall is a good reflector, while other auditors would not receive this strong reënforcement. Curved walls in an

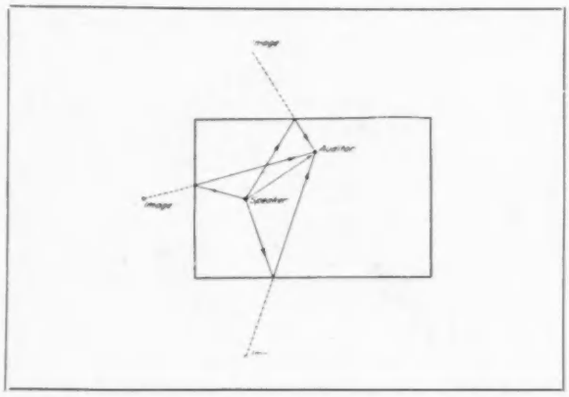


Fig. 1. Sound Reflections in a Rectangular Room

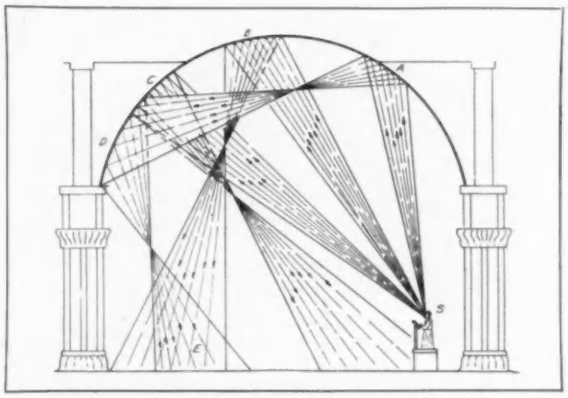


Fig. 2. Concentrating Effect of Sound on Curved Walls

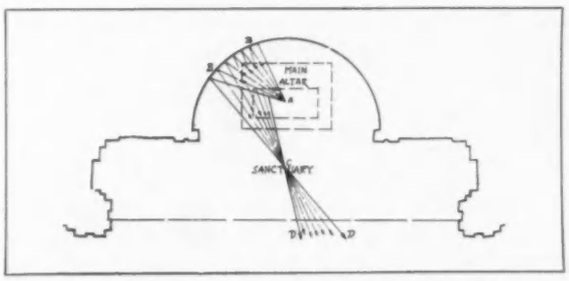


Fig. 3. Distortion of Sound by a Curved Wall

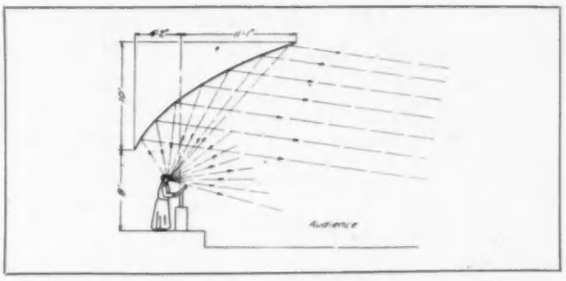


Fig. 4. Parabolic Ceiling Reflects Sound to Auditors

auditorium are dangerous for acoustics and should be flattened to approximately plane walls. If the difference in path of the two sounds is 56 feet or more, a blurring of speech is set up, while if the difference becomes 75 feet or more, distinct echoes,—or separate sounds,—are noticeable.

Parabolic Ceilings. A number of auditoriums have been built with parabolic ceilings, with the idea that the words of the speaker will be reflected uniformly to the audience. Such reflectors operate with surprising efficiency, as illustrated in Fig. 4. Auditors at considerable distances from the speakers hear and understand easily. But the arrangement has some disadvantages. The speaker is supposed to remain at the focus of the parabola, thus forbidding any marked moving about. It would not be suited for use where many people are to be heard as in an orchestra hall or theater, since only one performer could be at the focus. Such a reflector would not be suited for the usual stage arrangements with curtains and stage scenery. Furthermore, any sound originating in the room would tend to concentrate at the focus and thus disturb the speaker. To prevent the speaker's utterances being reflected back to him as echoes, it would be necessary to install highly sound-absorbing material at the rear of the room so as to practically eliminate any reflection. To have such a ceiling successful, it would appear necessary to limit the performance to that of a single speaker at the focus, with effective deadening of rear walls.

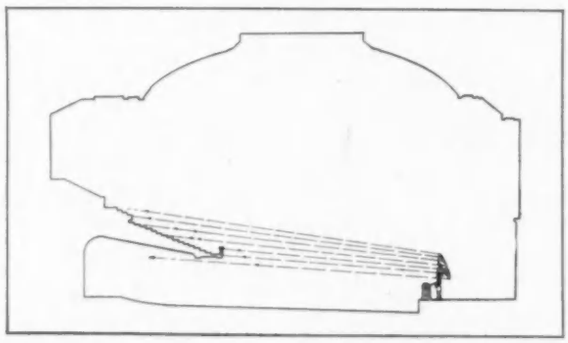


Fig. 5. A Parabolic Reflector Used Effectively at the University of Illinois

Sounding Boards. A plane sounding board placed obliquely over the speaker has much to commend it from the acoustic standpoint. It reflects sound efficiently to the audience instead of allowing it to go to the ceiling with the possibility of there being disturbing reflection; it does not require the speaker to remain in one position; it allows the speaker to "hear himself" and thus to adjust his speech for the best effect. It also amplifies the direct sound. A reflector of this kind could be used effectively as the ceiling of a stage room set, and thus accommodate a number of speakers. It has the possible disadvantage that it might not accord with the architectural design of the room. In the case of an elevated pulpit in a cruciform church, a flat canopy over the speaker acts beneficially as a sounding board. It has the advantages just described for a plane sounding board except that it does not reflect sound to the congregation. Fig. 5 illustrates a parabolic reflector that was tried as an experiment at the University of Illinois. It was effective in sending sound as predicted.

Effect of Using Sound-absorbing Materials. Fig. 1 shows three acoustic images of the speaker, but there are many more under usual conditions,—as many images as there are reflections, sometimes 200 to 300 before a sound dies out. The auditor is thus surrounded by a great number of image speakers who say the same thing as the real speaker. Fortunately, the images far away have only a small effect. The control of this multiple reflection or reverberation is brought about by installing absorbing material in the room so as to confine the speaking as far as possible to the real speaker and several images near him. This arrangement will give sufficient loudness and will avoid blurring and echoes. The amount of material needed for each room may be calculated with certainty of success. This feature of acoustics is the vital factor. No room can have satisfactory acoustics until the reverberation is reduced to the value proper to the room. There is little danger of getting a room too dead, unless too much material is installed on surfaces near the speaker or musician. Usually rooms do not have enough absorption, but this can always be remedied.

Fig. 6. Good Acoustics Result from Shape and Materials
Second Church of Christ Scientist, Rochester, N. Y.
Gordon and Kaelber, Architects

Christian Science Churches. Fig. 6 illustrates the interior of a typical Christian Science Church. Fig. 8 shows the plan, Fig. 7 the section. In these churches speaking takes place not only from the usual platform position, but also from any position in the auditorium. The octagonal shape favors this requirement. Fig. 9 shows the plan with the speaker at S. Each of the eight walls reflects sound to the auditor at A, whereas in a rectangular room, there would be only four such initial reflections. A further advantage is found with the octagonal shape, in that it avoids the creation of the multiple reflections that occur in a rectangular room between the parallel side walls. In an octagonal room the diagonal walls to the right and left of the speaker reflect sound to the congregation instead of back and forth across the speaker's position. It might be thought that a circular shape would be better than the octagonal, but not so,—the circular wall would produce objectionable focusing of sound. The slightly curved ceiling shown in Fig. 10 has a slight advantage over a flat ceiling. The general effect of the curved wall is to concentrate the reflected sound, with benefit to the congregation, whereas a flat ceiling would spread it out. Also, the curved wall directly over the speaker's head reflects sound to the pews where the flat ceiling would send it directly back to the platform. It is to be noted that the ceiling is fairly low (31 feet), so that no echoes would be expected. There is a small possibility of blurring by reflection from the rear wall opposite the speaker, but it would not be noticeable. A speaker anywhere on the floor would have nearly the same advantage as the speaker on the platform. That is, sound originat-

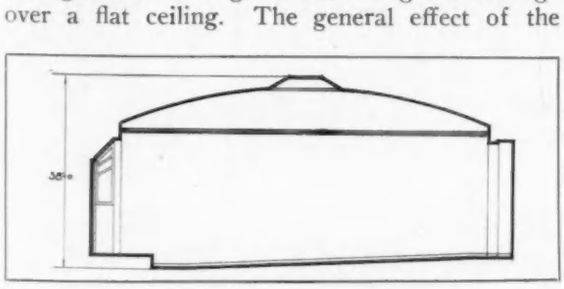


Fig. 7. Section Through the Auditorium

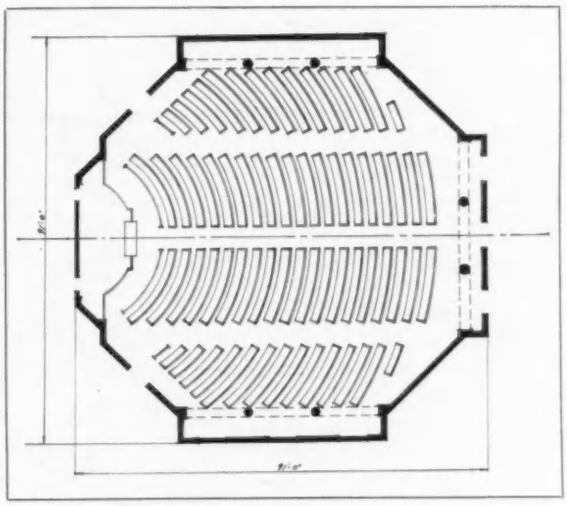


Fig. 8. Plan of the Church

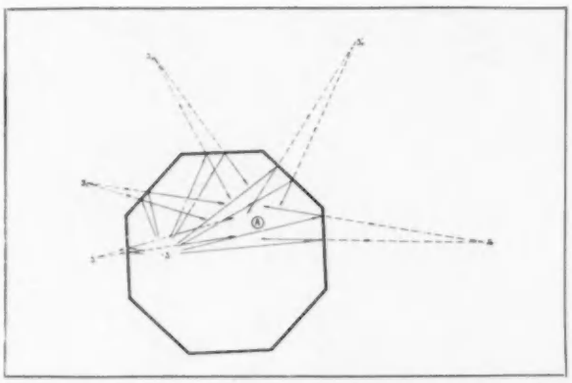


Fig. 9. Advantageous Reflections of Sound Produced in an Octagonal Church

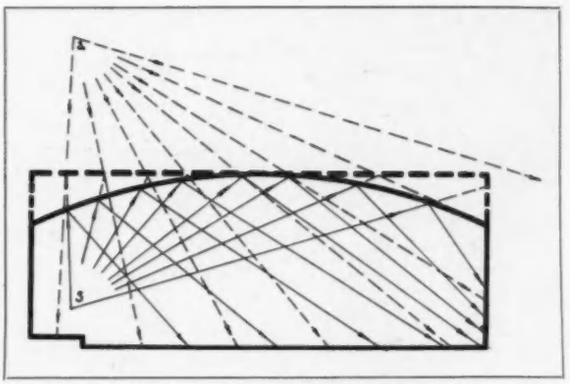


Fig. 10. The Slightly Curved Ceiling Has Some Acoustic Advantages

ing anywhere in the seated area would be reflected from side walls and ceiling so as to reach quite effectively the hearers in other positions in the room. The absorption needed to control the reverberation is found largely in the thickly lined carpet and the cushioned seats, with acoustic plaster on the side walls and ceiling panels. Grilles in the ceiling are of further advantage in absorbing sound. The acoustic results in this room have been very satisfactory.

A Classic Chapel. The chapel pictured in Fig. 11 has excellent acoustics. The original plan called for a flattened barrel vault ceiling which would have produced a noticeable concentration of sound at the center of the church. This curve was modified before construction of the building so as to be much flatter, thus avoiding creating defective concentration. There being large windows on either side, left no choice but to put absorbing material on the floor or ceiling. Accordingly, since the available area was limited, a highly sound-absorbent material was placed on the ceiling, both on the central portion and the side ceilings. The acoustics are such that a speaker in the sanctuary can be understood without effort by worshipers all over the church. Music is also very well heard.

The Moody Memorial Church in Chicago, shown in Fig. 12, is larger than the other three churches described here. Advice on the acoustics when the church was in the design stage led to two modifications of shape. To examine the possibility of there being echoes more exactly, a plaster model of the church was made, illustrated in Fig. 13. A strong light in the position of the speaker sent rays in all directions. Small mirrors placed flat against the wall surfaces reflected the light and indicated clearly what could be expected of sound. As a result of this analysis, the ceiling surface was flattened from the original curve with sharper curves at the side walls to maintain the height of the ceiling. Also the arch

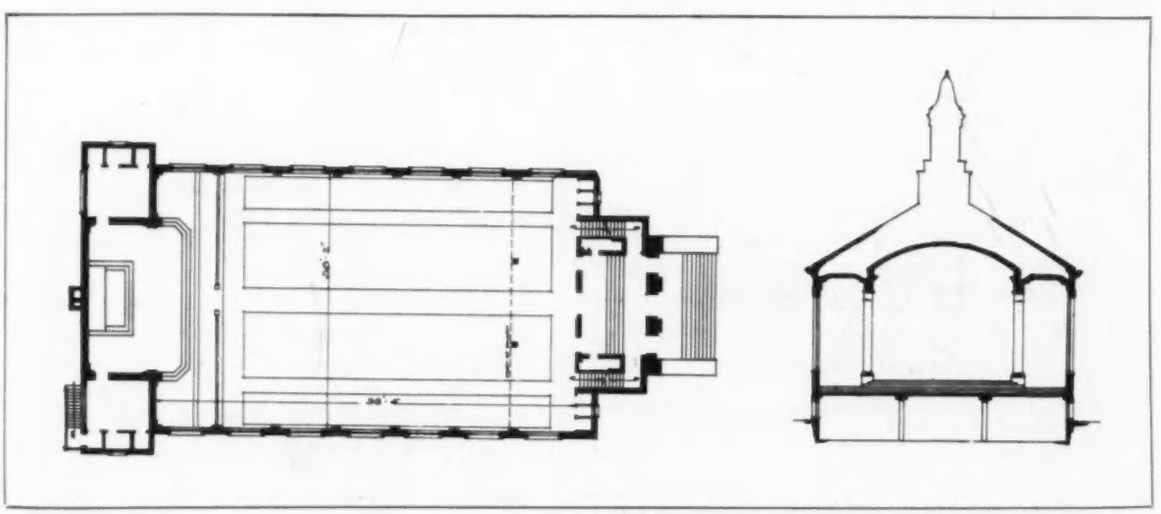


Fig. 11. A Flattened Curved Ceiling Avoids Echoes and Its Absorbing Material Controls Reverberation
Newman Foundation Chapel, Champaign, Ill.
Zachary T. Davis, Architect

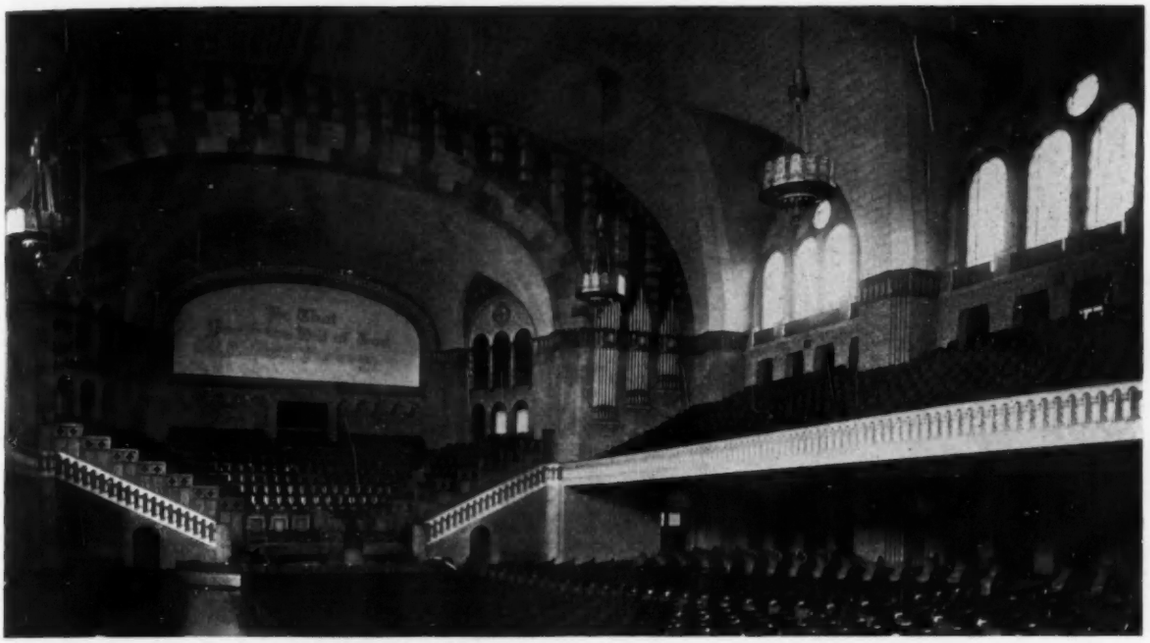


Fig. 12. Absorbing Materials on the Flattened Curved Ceiling Control the Acoustics Moody Memorial Church, Chicago
Thielbar & Fugard, Architects

over the choir behind the pulpit was modified so as to avoid there being concentration of sound at the position of the speaker. Absorbing material of rather low absorbing value was placed on the entire ceiling surface, with more absorbent material on the lunette surfaces, thus controlling both reverberation and echoes.

Gothic, Cruciform Churches. This type of church is different from the Christian Science type in that the speaking takes place only from the pulpit. The example illustrated has a wooden ceiling, except for plastered arches in the transepts. (Figs. 16 and 17.) The galleries in the transepts and at the west end of the nave accommodate 469 auditors, with 912 seats on the main floor. The reverberation is effectively controlled by absorbing tile placed on available wall surfaces, with absorbing cushions in the pews. The Gothic ceiling prevents direct reflection of sound. The acoustics are reported to be very good.

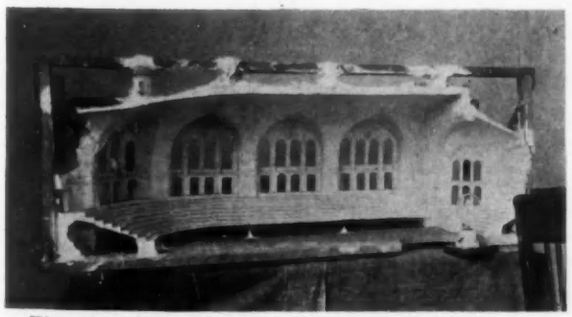
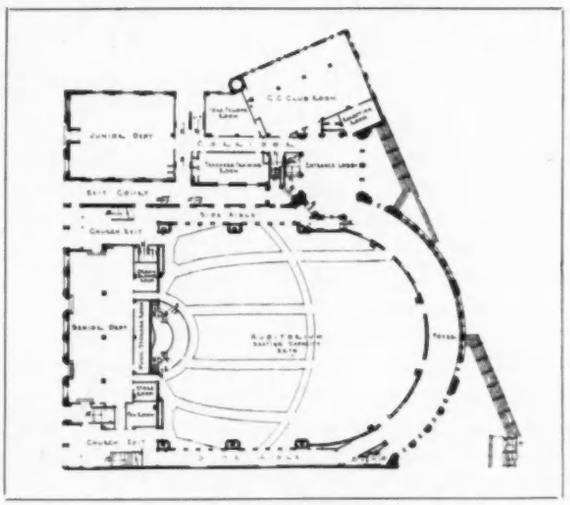
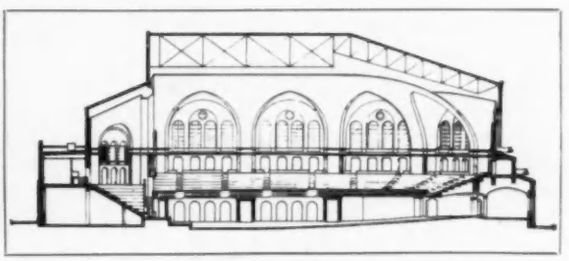


Fig. 13. Plaster Model of Moody Memorial Church Used in Determining its Acoustic Properties

This tabulation gives data for the four churches, showing the volume per auditor:



Plan of Moody Memorial Church

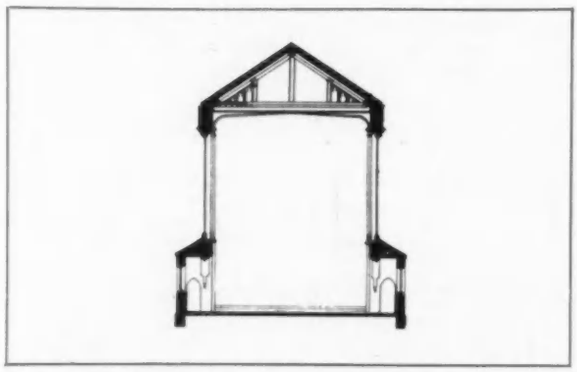


Section of Moody Memorial Church

Fig. 14. Cushions and Sound-absorbing Tile Control Reverberation
Bryn Mawr Presbyterian Church, Bryn Mawr, Pa.
Karcher and Smith, Architects

Church	*Volume cu. ft.*	*Audience*	*Volume per Auditor*
Catholic Chapel	188,000	800	235 cu. ft.
Christian Science	197,000	800	246 " "
Bryn Mawr Church	334,000	1,381	242 " "
Moody Memorial	686,000	3,746	183 " "

A word should be added about the value of the congregation in sound absorption. The clothing worn is an excellent absorber of sound, so that the size of a congregation is an important factor to consider. If the congregation is small compared with the size of the auditorium, as in the case of some churches with high ceilings, it is necessary to use considerable sound-absorbing material, whereas in a room with a low ceiling and a considerable number of seats, it is necessary to install only enough material to guard against there being defective acoustics with a small congregation, because a large congregation has sufficient absorption in itself. In practice, calculations are made to determine the amount of absorption needed with a one-third congregation present, with a subsequent check to make sure that the empty room will not be too reverberant,—in which case use of more absorbent is recommended. In conclusion, it should be noted that the four churches described are quite different in design, but are of types which are frequently used. The discussion illustrates the definiteness and certainty of securing good results that are made possible by the present-day study of acoustics, and affords a guidance for architects in the designing of similar churches.



Section of Bryn Mawr Presbyterian Church, Bryn Mawr, Pa.
Karcher and Smith, Architects

CHURCH ORGAN INSTALLATIONS

BY

EMIL PRAEGER

OF THE OFFICE OF MAYERS, MURRAY AND PHILLIP, ARCHITECTS

THE first organ of which we have record was that of Ctesibius of Alexandra about the year B.C. 200, but organs were probably known for some time before. Ctesibius used bellows operated by water pressure to supply the necessary wind, and this method was used as late as the ninth century A.D. From this time on the development of the organ has been constant and unbroken, up to its present state of almost unbelievable perfection.

In mediæval days, organs were not common, and the few existing instruments were quite small and usually portable. They were carried about from place to place as the occasion demanded, and this applied to churches as well as to places of amusement. Naturally, compared with the instruments that we know today, there were many defects. As the organ increased in size, its mechanism became more clumsy and heavy, until the player had to beat the keys down with his fists. The bellows were also a source of great difficulty, and constant or equal wind pressure was unknown. In some of the larger organs there were as many as 24 bellows! It was not until after the thirteenth century, when the use of the organ was prohibited in the Latin and Greek churches during worship, that the organ began to find its proper place in the church service. The controversy which followed this prohibition focused attention on the subject, and we find use of organs soon restored in the Latin Church attended by a rapid development; in the Greek Church it has never been reinstated. Since the fourteenth century improvements in the mechanism and wind apparatus have been continuous, and there now seems to be but little opportunity for further development. The organ is now being used in churches, in places of amusements and in homes, in the latter cases being generally of the automatic player as well as of the manually-operated clavier type.

A set-back in the development of the organ occurred in England between 1644 and 1660 when "to better accomplish the blessed Reformation," an ordinance was passed in the House of Lords requiring the speedy demolition of all organs, images and superstitious monuments, in all churches throughout the Kingdom of England. Many fine organs were ruthlessly destroyed, and the art of organ building was lost in England for nearly 100 years. Then organs became more popular than before and were found in nearly all parish churches. Today the organ takes its place in churches of practically all denominations, and its great influence is difficult to quite fully appreciate.

Modern Organs. The modern church organ is generally several organs in one,—the great organ, swell organ, choir organ, solo organ, echo organ and pedal organ. The great organ contains the pipes of largest scale and most powerful tone; the swell organ contains pipes of smaller scale which are inclosed in a box provided with movable shutters; the choir organ contains the flute tone stops and is used for soft accompaniment; the solo organ contains the orchestral stops; the echo organ is made up of stops of small scale and of soft tone; the pedal organ contains the pipes of more powerful tone. As its name implies, the pedal organ is controlled by the pedalboard, while all others are controlled by the "manuals," or hand-operated mechanism.

An organ may be divided into three main parts, —(1) the pipework, (2) the mechanism for blowing, and (3) the mechanism by which the wind is utilized. The pipes are arranged according to the stops to which they answer. Each stop includes a number of pipes which follow one another chromatically. There are some 20 or more different types and shapes of pipes, and the use of many different metals and woods is resorted to. Pipes are broadly divided into flue pipes and reed pipes, and these are again divided into different kinds and made in varying lengths from a few inches up to over 32 feet. Pipes of various stops stand upon wind chests which contain air channels through which air is admitted from an air chamber through a slide which is installed between this chamber and the air channel. The slide is controlled from the keyboard of the console. In the early organs the slide was directly connected to the key by means of a series of rods and levers. As the organs grew larger, improvements of this action were made, first by the introduction of compressed air, known as the tubular-pneumatic action, and later by the introduction of electricity, so that we now have the electro-pneumatic action. When the key of a modern organ is depressed, an electric circuit is closed, and this sets into action a series of operations which terminate in opening a valve and admitting air into the controlled wind chambers, thus producing the desired sound in the various pipes.

The provision of sufficient wind has been a serious problem. In the early organs an unvarying wind pressure was unknown, and while this condition was improved by the use of a weighted wind reservoir, it was not until the invention of the multiple fan that this problem was solved. The multiple fan consists of a number of fans

Organ in Choir, Christ Church, Bronxville, N. Y.
Bertram Grosvenor Goodhue and Goodhue Associates, Architects

mounted on a single motor-driven shaft, each fan occupying a compartment of its own, and all serving equally to raise the wind pressure to the desired point. The production of an effective tremolo with an unshakable wind pressure was a problem which organ builders had some difficulty in solving, but by means of some very ingenious mechanism, this has now been accomplished.

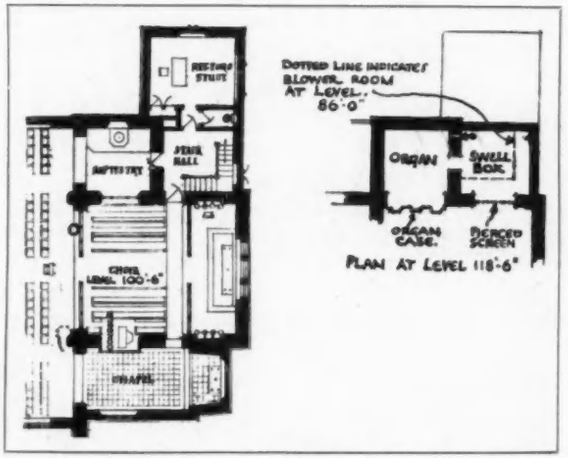
The design of the swell box and the mechanism to operate the shutters has been the object of careful study and much experiment, and here again practically perfect results have been attained. An effective swell box should be properly proportioned; it should be wide, high, and not more than half as deep as it is high. The shades should fit well and operate easily. In the present organs the shades are operated by electro-pneumatic control, a matter presenting more difficulty than the similar operation of the wind chest.

The console of the modern organ is an impressive instrument. It may also be a very handsome addition to the chancel furnishings, but in some cases, the console is entirely or partially obscured.

The specifications of an organ constitute a matter which should not be settled without the aid of an expert organist and organ builder. The larger organs have as many as 100 stops and seemingly countless pipes. Suffice it to say, however, that size is not the sole attribute to satisfactory installation, and installing an over-powerful organ in a small church is to be guarded against.

The location of an organ in a modern church is a subject which has caused architects and organ builders no end of controversy and, at times, bitterness. In contrast to almost every other unit of a church, there are no hard and fast rules governing the type, size and location of the various component parts of an organ. The reason for this is easily understood; with some notable exceptions, the majority of present-day churches have been planned following mediæval models, in which, because there were no large stationary organs, no special organ space was provided. Had the cathedral builders of the middle ages large organs to provide for, the views of present-day architect and organ builder might not be as conflicting as is now often the case.

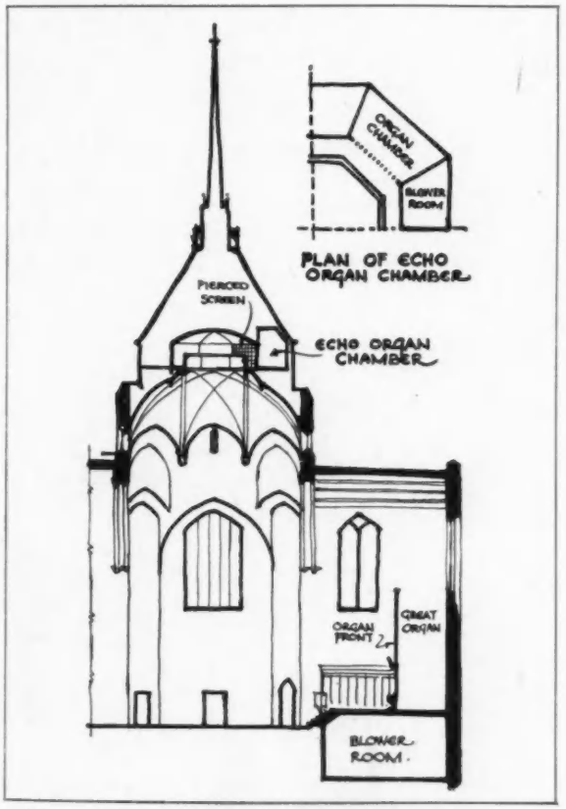
In considering the layout of the various parts of an organ, there are several interests to be considered,—those of the clergy, the singers in the choir, the organist, the organ builder, the congregation and the architect. Each of these has interests conflicting with the interests of the others, and it is not difficult to realize that differences of opinion, jealousies and quarrels have only too often cropped up. The mediæval organs, being small, were almost always installed in the choirs so as to be in close relation with the singers. After the twelfth and thirteenth centuries, as churches and cathedrals became longer and higher, the necessity of appropriate locations of the organ parts became apparent. During the fifteenth century we find organs being installed in elevated positions, either bracketed from the walls of the choir or placed at the west end of the nave. In some instances we find organs placed in transepts and again in intermediate bays of the choir. There are instances of organs being placed on rood screens, and again cases of several organs being installed in different parts of the church.



Layout of Organ Installation, Christ Church, Bronxville, N. Y.
Bertram Grosvenor Associates, Architects

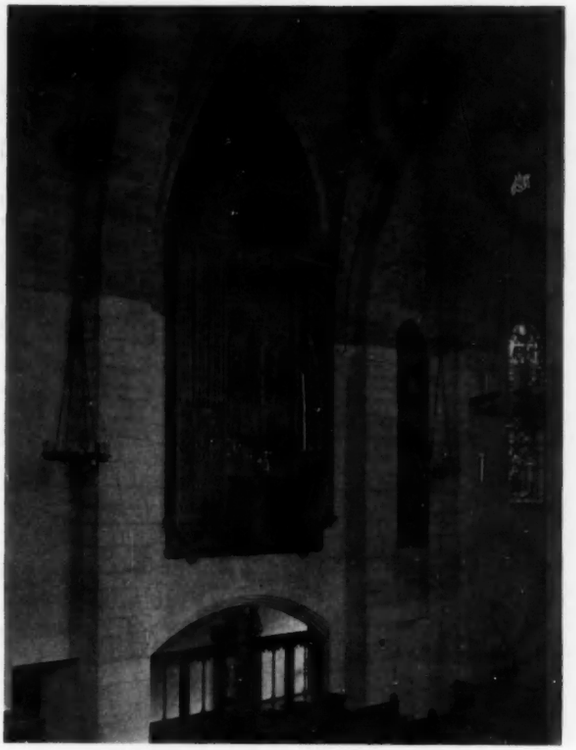
In the church of today, there are many factors affecting the proper location of an organ, one of the most important being the nature of worship to which the particular church in question is devoted. Churches in America may be divided into three main groups: (a) the Latin Church; (b) the Anglican Church; (c) the several churches dissenting from the other two groups. Of these groups, some prescribe musical services as part of the ritual, while in others instrumental music is of a congregational and voluntary character. In Roman Catholic churches, the music is of a liturgical character, and the position of the organ is almost invariably at the west end of the nave, in a gallery which also accommodates the singers. As the music is part of the services, the fact that it comes from behind the congregation is not considered objectionable. In some churches the great organ has been placed in a space behind the altar and the musical effects have been satisfactory.

It is quite generally agreed that the organ used to accompany the choir should be placed as close as possible to the singers so that a unity of musical effect may be obtained. An accompanimental organ should not be large and need never contain "speaking" stops. Probably the ideal arrangement for the present-day church is to install the great



Plan of Organ Installation, Epworth-Euclid M. E. Church, Cleveland

Mayers, Murray & Phillip and Walker & Weeks, Associates, Architects



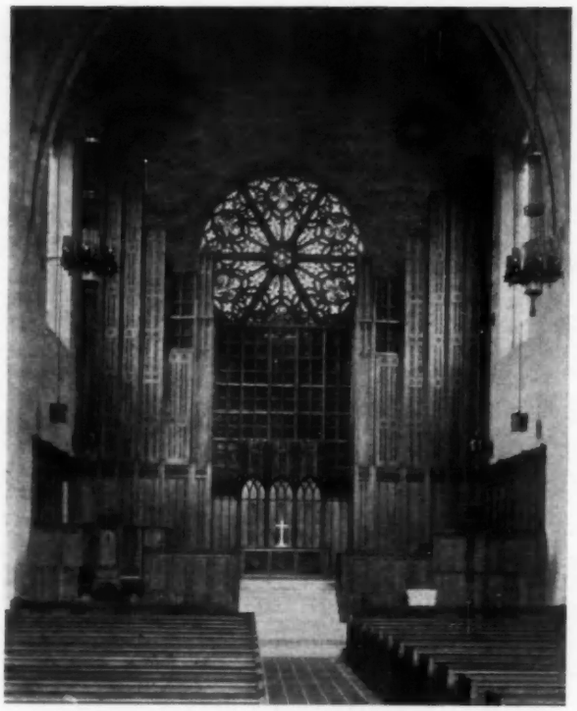
Echo and Choir Organs, Epworth-Euclid M. E. Church, Cleveland

Mayers, Murray & Phillip and Walker & Weeks, Associates, Architects

organ at the west end of the nave and to place the accompanimental organ in the most advantageous location with respect to the position of the choir. In the English cathedrals and churches we find many organs placed over the choir screen, and while this location is not good from an architectural point of view, it is excellent in many churches from a musical standpoint because there is a free space all around the organ, and it fits in well with the grouping of the singers.

When the size of the organ becomes so great that it is not practical to place all the pipes in one chamber, it becomes necessary to use a divided organ. An excellent example of use of a divided organ is found in St. Thomas' Church, in New York, where one of the finest modern church organs is installed. In a divided organ the pipes should be placed so that their sounds will be perfectly unobstructed, and the sections should be balanced as an accompanimental instrument. The console should be so located with respect to both sections of the instrument and the vocal choir that the organist will at all times be able to realize exactly the effect of his accompaniments.

For undivided organs, authorities seem agreed that the best location is at one side of the choir or chancel, immediately adjoining the choir stalls, with the console at the side of the chancel oppo-



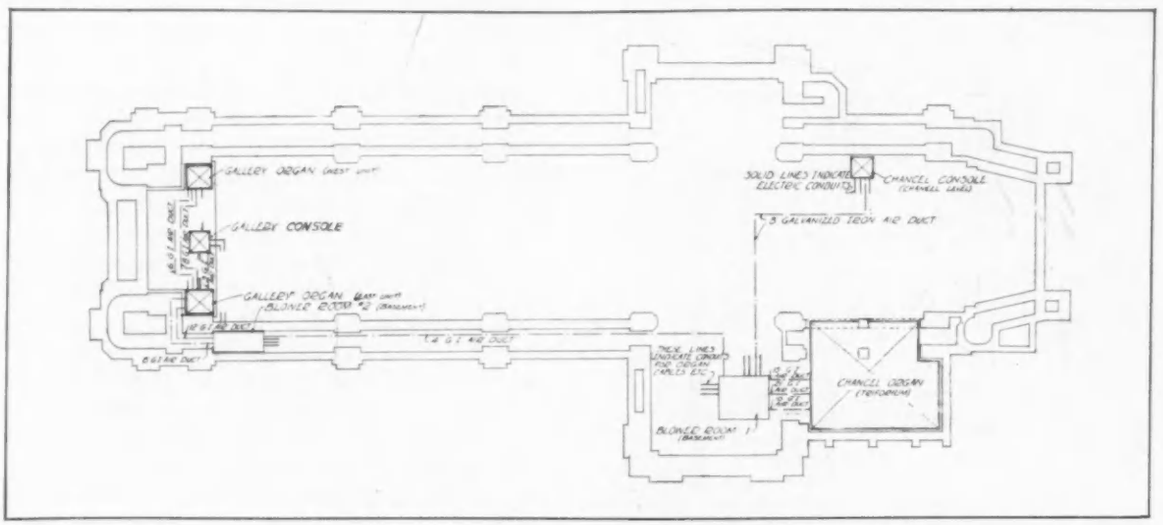
Pipes Not Exposed, Trinity English Evangelical Lutheran Church

Bertram Grosvenor Goodhue and Goodhue Associates, Architects

site the organ chamber. There have been instances of organs placed in the transepts, but for modern churches this location should be avoided. The organ should be close to the singers; it should have plenty of space around it and ample height above the top. The organist should be able to hear the organ and choir equally well, and he should be able to see the choir and clergy. He should also be able to hear the congregation and have a view down the nave. Where side chapels exist, the organist should be able to use the organ in connection with services held in these chapels, but this is frequently difficult of accomplishment.

The lower part of a tower adjoining the chancel should not be used as an organ space, especially in a small church where the tower is of small area and the openings are considerably lower than the ceiling of the nave. There have been instances where the organ has been placed in the basement below the nave floor level, but this scheme is not recommended, except in the case of a small echo organ, where the results may be very effective. From the standpoint of the congregation, there are objections to placing the organ at the back of the nave, as it is of course more agreeable to face the music than to have it come from behind. It is well to elevate the organ above the level of the congregation, but at the same time the great and accompanimental organs should not be placed too high above the level of the nave floor.

In regard to the organ space itself, there are certain conditions which should be effectively met. The temperature should be kept constant, at approximately 70° Fahr. For this reason the north side of a chancel is more desirable than the south, because of the fact that this side is more constantly in the shade. There should be no windows to the exterior, thus avoiding air currents and the infiltration of dust. An organ chamber should preferably be twice as wide as it is deep and should be high enough to easily accommodate the tallest pipes. The opening between the organ chamber and the church proper should be designed to avoid a "pocket" between the chamber ceiling and the wall over the opening. The walls and ceil-



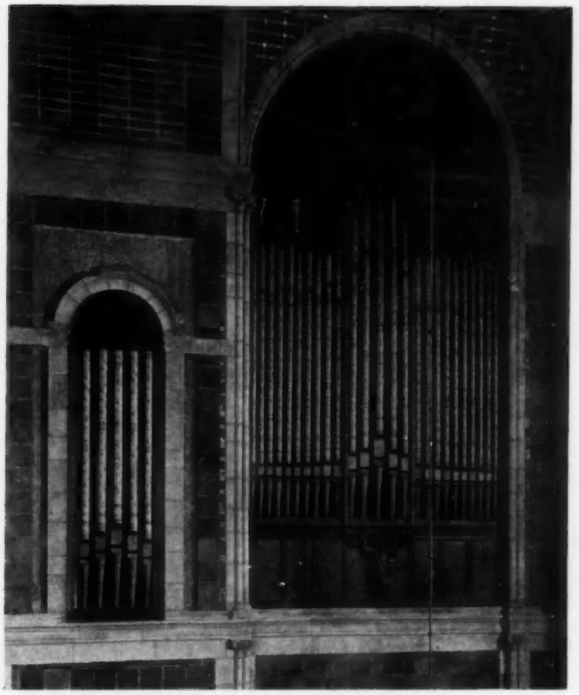
Diagrammatic Layout of Air and Electrical Conduits, Chapel of University of Chicago

Bertram Grosvenor Goodhue and Goodhue Associates, Architects

ing of the organ chamber should be plastered with a hard wall plaster so as to reflect the sound to the best advantage. In some cases it will be found advisable to slope the ceiling from the rear to the front of the chamber, but this will not be necessary if the depth of the room is not too great.

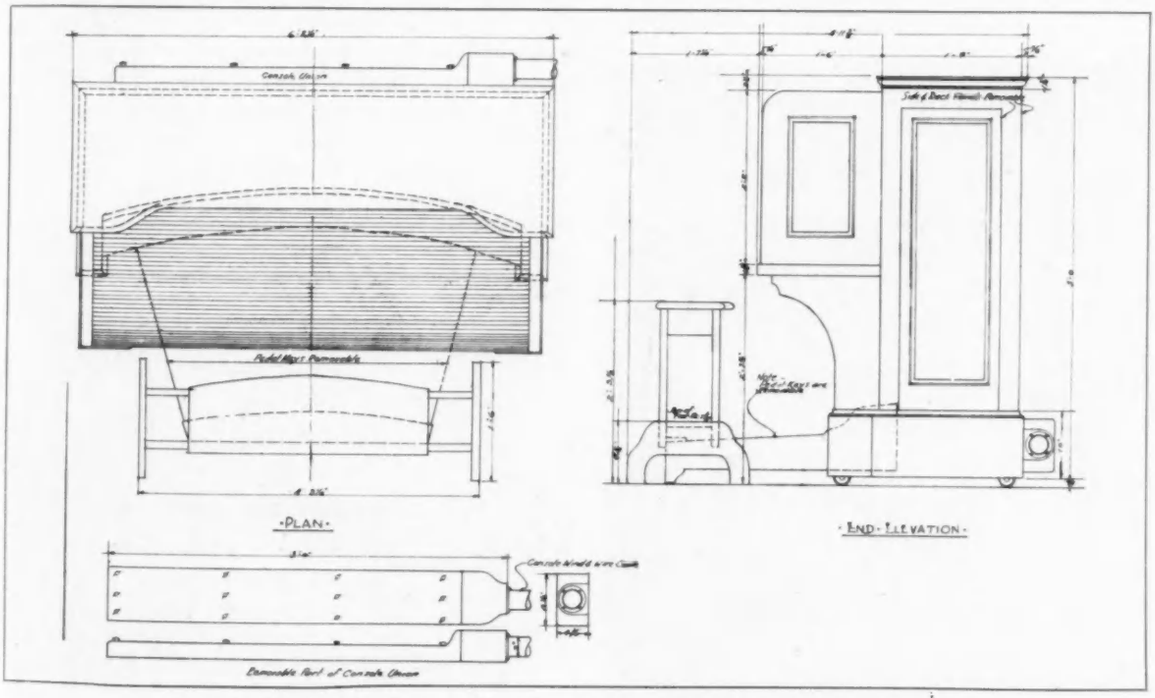
The blowing mechanism may be placed in the basement, but it should be in a room which is perfectly dry, which has proper ventilation, and which is carefully insulated from dust, dirt and drafts. An enclosure of wood is better than brick, since it is less resonant and less subject to condensation than a brick wall would be. In order to prevent the noise of the blower from traveling to the organ, an air reservoir should be placed next to the blower within the blower room. Air then passes from the blower through an automatic gate which closes when the reservoir is filled, preventing the noise of the fan from traveling through the main trunk.

Organ Pipes. The question of whether or not exposed pipes should be used has been the cause of much difference of opinion between architects and organ builders. Some organ builders have contended that decorative display pipes that do not "speak," but which complete the symmetry of an organ case design, are as "honest" as any other decorative features incorporated in a church. Where exposed pipes are not used, use of carved organ screens has been resorted to, and here the opportunities for displaying originality of design



Choir Organ, St. Bartholomew's Church, New York
Bertram Grosvenor Goodhue, Architect

are limitless. The screen, moreover, offers less obstruction to the tone of an organ than do the front pipes, as the total percentage of opening can be made larger when a screen is used than is possible with display pipes. Although organ



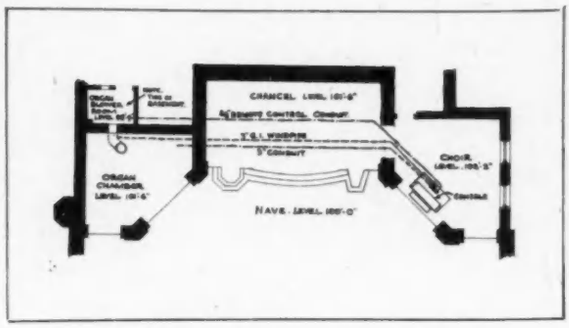
Details of Movable Console of Choir Organ, Chapel of University of Chicago
Bertram Grosvenor Goodhue and Goodhue Associates, Architects

The Great Organ, St. Bartholomew's Church, New York
Bertram Grosvenor Goodhue, Architect

screens have ordinarily been made of wood, various other materials may also be used if desired.

In making provision for the installation of an organ in a modern church, the services of an expert organ builder and organist cannot be enlisted too soon. There have been only too many instances where makeshift arrangements have had to be resorted to at the last minute in order to in any way accommodate the necessary equipment. In these cases the results are never as satisfactory as they might have been, had proper provision been made at the inception of the project. Indeed instances are not lacking where making no provision for an organ installation in the first place has resulted later on in the marring of an otherwise fine church. An organ need not necessarily be made the most important architectural detail of a church, but it possesses great architectural possibilities which should not be overlooked.

Organ Installation, Chapel of University of Chicago
Bertram Grosvenor Goodhue and Goodhue Associates, Architects



Plan of an Organ Installation near Pulpit

LIGHTING FIXTURES FOR CHURCHES

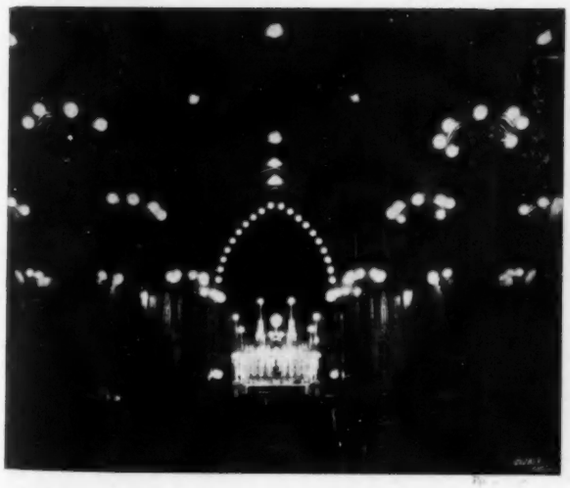
BY

THEODOR CARL MULLER

As architecture discards the illustrative nature of imitative styles for forms based more directly upon human reaction, in this revival of the visual sense, it follows that light should not be considered merely as a means by which we see, but as a medium which controls the manner in which we see. Today, when night hours and the urban interior are so closely related to life, the controllable manner of seeing is more prevalent than ever before. The dependence of architecture on illumination is well exemplified in the fact that bad light can ruin good architecture, while well controlled light,—or better, its component, well controlled darkness,—can save us from bad architecture. Hence, that illumination is bad which fails to fulfill the architectural necessity.

Electrical progress in illumination has developed along two distinct lines, the one striving to perfect incandescent units as a utility, the other exhaustively striving to reproduce the exposed flames of the past. The cold hearth that simulates in glass a living grate of coals, the facility with which the electrician can wire an antique fixture reproduction, and the real wax candle wired to bear a tiny, flame-shaped, flame-tinted bulb which stands even upon the altar of a church, all these are the most damning evidences of the dearth of contemporary design in lighting fixtures. Rousing manufacturers to better lighting design is the architect's responsibility, but even greater is the need to study light as a most vital element, from the earliest conception of a building to its final adjustments and furnishing.

The progress which lies in the adaptation of the incandescent unit to form an integral part of architecture is slow, and its protagonists are at variance in practice more than in theory. While each individual building may present a separate problem, the understanding of light lies in the simple generalities of its action on the optic nerve, its own associational effect upon the mind, and the manner in which it affects the form and color of objects which reflect it. Comfort, due to the physical structure of the eye and lid, demands that a major light source be about 45 degrees above the plane of sight, and that glare due to strong contrasts be eliminated, but not to such an extent that our appraisal of light by contrast with darkness is destroyed. It is the danger of indirect lighting that it leaves one confounded as to its value. Adequate indirect light may soon appear dull to the weary eye that has no darkness to rest upon. The lack of shadow tends to steal one dimension from our normal conception of space, forcing us to rely wholly upon the more difficult definition of space by perspective. The loss of high light and glitter destroys the sense of surface and material; mosaic and metals might as well be paint, jewels might be paste, and our own faces masks with dead eyes. Take from light the color of warmth, and some of the human satisfactions which gave rise to fire worship are denied, such as our pleasure in flame and sunshine. Psychological effects have been produced in the name of scientific lighting that could not have arisen from nature's dreariest day. With such considerations as these, very real attempts



Effect of Carbon Filament Bulbs Distributed over a Church Interior

More Recent View. Showing Simplification and Flood-lighted Altar

Chapel, University of Chicago
Bertram Grosvenor Goodhue, Bertram Grosvenor Goodhue Associates, Architects

in church illumination have been made to re-create the desirable human reaction peculiar to good antique illumination without the attendant slavishness to antique forms, and without compromising the virtues of modern artificial light. With the continued development by the engineers, these attempts may soon appear as primitive as the latter-day indiscriminate distribution of exposed bulbs and the decorative use of these as large and luminous pearls from natural delight in the display of novelty.

It was a sincere expression, superseded by the greater practicability of using less numerous but more powerful units. The lighting fixtures illustrated here are but a few types which arose out of this transition and out of the growing understanding of light. Bad design led to the desire among some architects to create a church without lighting fixtures, as were the mediæval churches, but to do this it has seemed necessary to adopt methods even more harmful to architecture than the use of mediocre lighting fixtures. Certainly there is nothing more destructive to the normal concept of architecture than indirect lighting which emanates from such unnatural sources as are sometimes resorted to in many cases. Indirect illumination seems to demand new architectural forms, whose organism would express this new light source, in a sense, as a fixture. It might seem natural to force artificial light as daylight through the windows, but, fortunately, the expense is enormous. Creating the illusion of daytime over and above the human knowledge that it is not, certainly should be a magic foreign to the sincerity which should be an attribute of the Church.

Rightly conceived, the fixtures constitute but an added element with no greater limitation than that of any other part of the building. Their interior quality is one worthy of expression and often mistaken by the use of shapes originally intended to weather the elements. Stability in a hanging feature is as necessary as that of the general structure. Low centering of gravity, width of base and design of chains can effect this. Into the decorative treatment there may enter the sense of scale and a very emphatic stylization, due to the dominance of the unavoidable contrasts. An appreciation of the stylistic beauty of Romanesque and Gothic metalwork, the finest examples of which are found in the lantern and candelabra type, known as the *corona lucis,* led to a desire to use this as a base for the design of modern fixtures. Misunderstanding brought about the appearance of a dozen or more gorgeously decorative chandeliers completely dominating the interior. The *corona lucis,* which often was a veritable metal cathedral in miniature, was generally hung alone or with two others at great height before the chancel or in the transept and was never used for illumination alone. It was

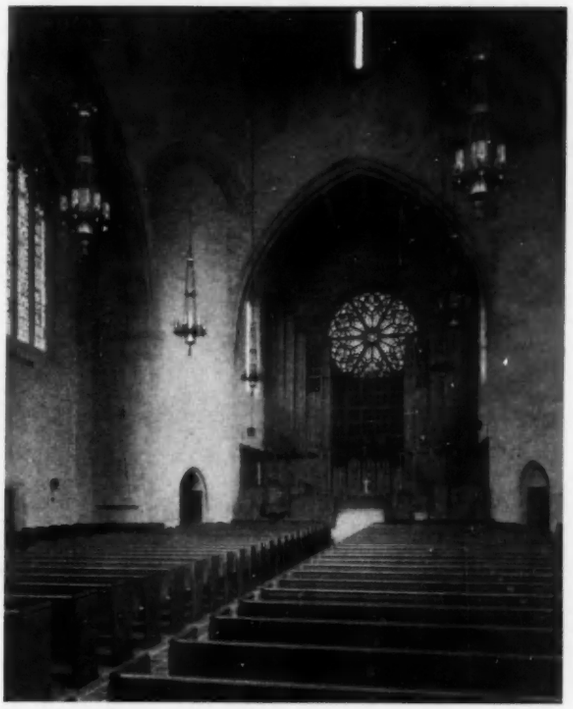
St. Vincent's Home Chapel, Brooklyn
McGill & Hamlin, Architects

lighted but several times during the year, and then only when it formed an important ornament for some ceremony.

The single unit fixture type is advocated by many because of the greater efficiency of high-wattage bulbs, the simplicity of construction, and the diminution of replacement effort. The segmental sphere, such as used in the Church of St. Boniface, Pittsburgh, tetrahedron and other bi-symmetric forms, were designed to distribute the excessive glare over larger luminous surfaces. The components of light are equal in all directions. The parallel-sided fixture with open bottom and closed top sufficed for the church which demanded downward light for the prayer book or hymnal with relative darkness at the ceiling, which remains mystical. The difficulty encountered was a bowing of the sides caused by the greater brilliance in the glass and the rotation about opaque material nearest the light source. The metal *corona* ring attempted to hide this destroyed area, as may be seen from the illustration of the "Little Church Around the Corner," in New York.

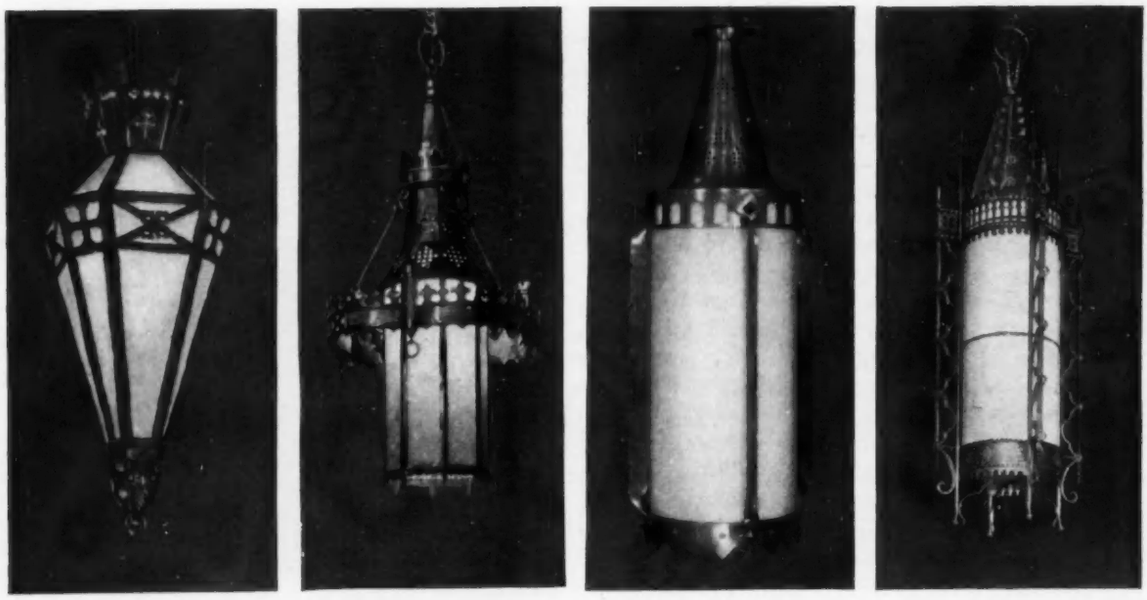
Covering the glass surface with metal filigree work of fairly regular pattern helped to retain the form of the fixture when lighted. Another expedient was to spray the inside with an enamel, carefully graded to equalize the exterior light distribution. Finally, a diffusing glass was perfected which could contain a high-wattage bulb without distortion, even in cylindrical form. Until but a few months ago this glass of light amber hue was obtainable only in sheet or limited cylinder sizes. Particularly interesting are the fixtures hung in the Friars' Chapel of the Church of St. Vincent Ferrer in New York. To obtain length, two cylinders were joined together. The obscuring surface of the supporting members, running from top to bottom, has been minimized, and they are built out like fins to give actual strength as well as the appearance of strength. A modern Gothic fixture in the character peculiar to the architecture of the English Lutheran Church of the Redeemer, Brooklyn, embodies the latest development in light amber diffusing glass. Except for an acid-fumed finish with lacquer preservative, the brass is left free from hammer marks or other effects, to express the rolling, spinning, and cutting machines which formed it. All of these will be rendered obsolete when a light source is produced of greater intensity and without filament concentration, contained in glass undefined by the passage of light through it. Then they shall be considered as their forerunner,—decent, limited solutions, replaced perhaps, and let us hope never resurrected in some future century as antiques to be illuminated by some science beyond that which produced electricity, though that possibility seems remote.

The shielded or reflector type used in St.



Epworth Euclid M. E. Church, Cleveland
Mayers, Murray & Phillip, Walker & Weeks, Associated, Architects

St. John the Evangelist's Church, Brooklyn
McGill & Hamlin, Architects

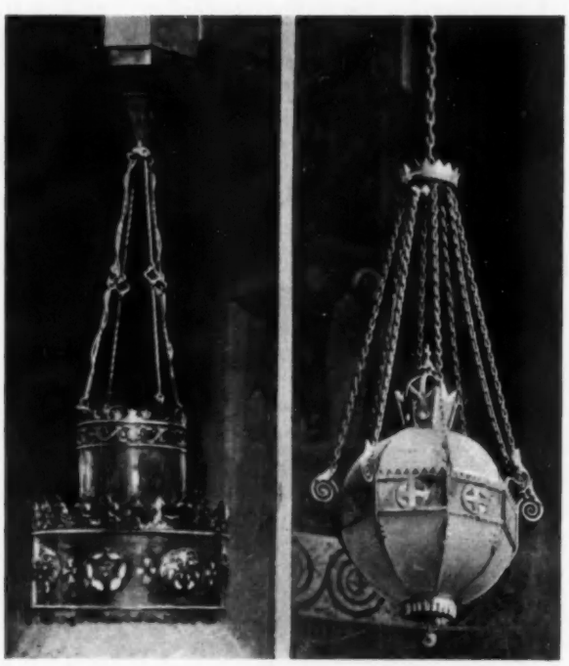


Chronological Development of Diffusing Class

St. Pancras', Glendale, N. Y.
"Little Church Around the Corner"

Church of the Redeemer, Brooklyn
Chapel, St. Vincent Ferrer's, New York

Agnes' Church, West Chester, Pa., is valuable in a church with light-absorbent dark walls and wood ceiling where light not directed downward is lost. One standard reflector is placed in the top; the bottom widens to hold a large area of diffusing glass through which the intensity of the reflector spreads. The lower metal ring is pierced and glazed to obtain interest of motive and sparkle. The danger with this type lies in focus, so that the plan is not broken into circular areas beneath the fixtures. Exaggerated ceiling height and mysticism are gained, and the darkness of the surroundings promotes concentration upon the prayer books or illuminated chancel. The tendency, however, is for people to orientate themselves toward a single fixture, which from some seats may be quite awkward. The better general illumination of large luminaires is sacrificed for the special virtue of the reflector type.



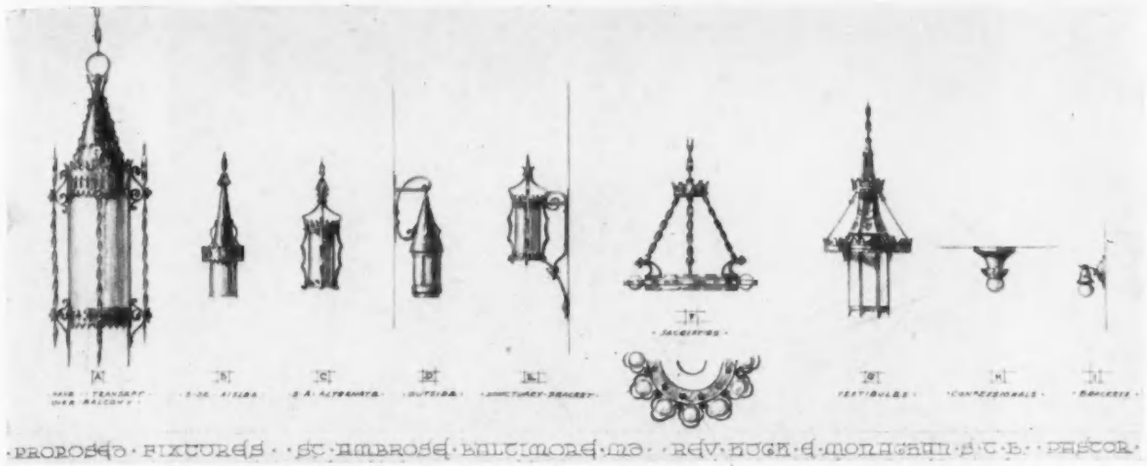
Directional Fixture and a Globe Fixture

St. Agnes' Church,
West Chester, Pa.

Church of St. Boniface,
Pittsburgh

The multiple-unit fixture type is the outcome of lighting very large churches, where the single bulb is not adequate for the fixture which retains the scale of the interior. When the nave is extraordinarily wide, an even distribution of light demands that the source be placed at about the usual height, which in the average sized church approximates 12 feet. It has been found practicable to decrease the replacement difficulties of inaccessible fixtures by using a great number of medium-sized bulbs, wherein the failure of a single bulb is of negligible importance.

The fixtures of the Epworth Euclid M. E. Church, Cleveland, were designed almost wholly for their decorative advantages. The distribution of electrical units is complicated but answers the lighting requirements as well. The lower portion of the central cylinder is occupied by a powerful reflector, and throughout the remainder of the central cylinder small bulbs are distributed, purely for the pleasing luminosity of the glass. The surrounding ring of small cylinders not only increases the mass to attain a scale corresponding to that of the church but also

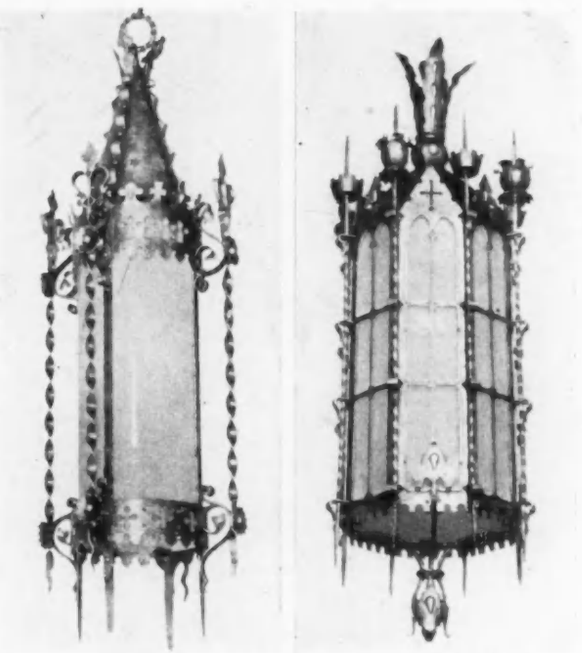


"Presentation Strip" Showing Fixtures for an Entire Installation
Maginnis & Walsh, Architects

effects the necessary illumination for the walls and ceiling. A four-cylinder design having a vertical dimension proportional to that of the nave of the chapel of the University of Chicago exemplifies the impossibility of avoiding point brightness on the glass by any means other than the distribution of bulbs within the cylinders. Likewise, in a fixture where the form is controlled by its symbolic meaning,—as at Christ Church, Cranbrook, Mich.,—it seems well worth while to sacrifice light as a utility in the strict sense for so fine an ecclesiastical expression. However, it is only a small economic loss when many small bulbs are substituted for few of a high wattage and of longer life. The quality and efficiency of the light depend upon the excellence of the diffusing glass.

Another example of religious form adapted to modern lighting is illustrated in the fixture which uses a mediæval sanctuary lamp prototype such as in St. John the Evangelist's Church, Brooklyn. The central bell contains a stock reflector which sheds light directly to the readers and is surrounded by a ring of exposed lamps placed on the inner circumference so that they are chiefly screened from the eye by the ring and by the bell. They may be readily replaced and, as the architects express it, they frankly make no pretense of being anything but frosted bulbs. Ostensibly, this ring of light counteracts the violent contrast between the bell reflector and its illuminated bottom. The added general illumination was not so much the object of this ring, however, as were the many high-light possibilities which the profusion of bulbs afforded.

The subject of sanctuary lighting is even more specialized than that of the nave. Light enters into the treatment of such features as the altar, pulpit or choir to give emphasis. Perhaps the most common weaknesses lie in the realm of theatricality or in the grave error of considering the reactions of the congregation to the neglect of those of the clergy. When so much of the finest church craftsmanship has been dedicated to the sanctuary, where it manifests itself in fine detail and nuance of materials, tradition would seem to give even greater importance to the sanctuary than to portions without. It would seem only just, therefore, to avoid the suggestion of mechanics from the point of view of the clergy even more than from the point of view of the people.



Typical "Parallel" Church Fixtures
St. Ambrose, Baltimore Church, Bernardsville, N. J.

A MODERN STAINED GLASS WINDOW SHOWING THE IRON FRAMEWORK CONFORMING TO THE LINES OF THE DESIGN

HENRY LEE WILLET, DESIGNER

THE PRACTICAL CONSIDERATION OF STAINED AND LEADED GLASS

BY

HENRY LEE WILLET

HAVING to meet legitimate demands is often a boon to any art or craft; it is especially true in the case of stained and leaded glass. The mediæval glass workers, limited as they were by their materials, palette and sizes of their sheets of glass, and hampered by the crudeness of their tools, realized the architectural limitations of their medium and wrought triumphs of color which have been the glory and the inspiration of succeeding generations. As the workers in glass became more skilled they lost sight of these limitations and stained glass deteriorated, until during the seventeenth and eighteenth centuries churches were filled with windows whose only claim to excellence lay in the ingenuity which directed their making. In this country, in the latter part of the last and the beginning of the present century, the lowest depths were reached through the rise of what might be called the "opalescent" school, whose pride and glory was to see how pictorial and realistic a window could be made. Leaded glass (by that I refer to an ornamental design, usually a geometrical pattern without any painting, such as is used in houses, banks, stores, etc.), being for the greater part mechanical work, went the downward path even more quickly, considering the length of time during which it was used.

Architects are most particular in knowing all about the foundations of their buildings, the concrete, stone, or steel that is being used, but when it comes to stained or leaded glass, through a lack of technical knowledge of the subject, the contracts are very often awarded to the lowest bidders, "regardless." Instead of the conscientious craftsman, the clever bidder is frequently selected, and the more clever the latter is the more the windows bag and leak, the more the paint and enamels peel off, and the more the glass comes out of the narrow-gauge leads. Such windows are in constant need of repair, all because there are no architectural specifications to force the unscrupulous glass man to toe the mark. That the conscientious craftsman has not gone the way of the dodo has been due to the fact that some architects are exercising careful discrimination and are demanding work that is not only well designed, but also properly made.

Specifications for Stained Glass

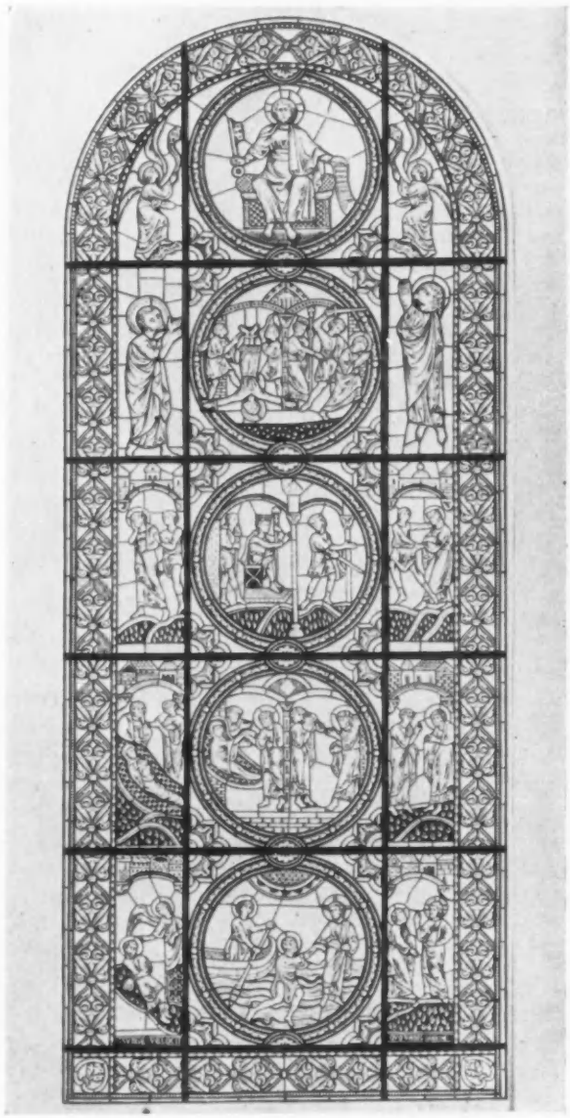
By requiring that these specifications be filled, the architect will insure that the materials and craftsmanship are what they should be.

Glass. Statement of type of glass required; antique, imported or domestic; cathedral, double-rolled or hammered; seedy flint; crystal plate or double-A window glass. The finest colored glasses are the hand-blown pot metal English antiques and Norman slabs, having more life and sparkle than the German antique glass, which is generally very even and flat, or the domestic, the quality of which is not always the best. The cathedral glasses, being rolled instead of blown, have a rough surface which helps diffuse the light, and they are therefore used with success in diamond or quarry work where one has large pieces of glass. Seedy flint, a very "bubbly" glass, is also good for the same purposes.

Lead Cames. Milled lead cames should be required. The heart and inside of the flange, being milled like the edge of a coin, makes a better surface for the cement to adhere to. The width of the flange should be specified; except in special cases no came under ¼-inch size should be used. Where there are large fields of diamond quarries and such repeating shapes, ⅜-inch or ½-inch cames are the best. Cames with strong, heavy flanges should be required. Thin flanges cut down on the lead cost, but they also cut down on the rigidity of the window, the glass works out of the lead, and the flange gives way just beyond the soldered joint. As the joints are the weak points, they should be floated and not skimped.

Reinforcements. First of all, I should like to call attention to a fallacy of using reinforced lead cames. The metal bar in the heart of the lead can hardly be made of sufficient size to obtain the desired rigidity; it cannot be anchored to the groove or rabbet as securely as a supporting bar, and in many places where it is used it does not extend without a break the entire width of the light and so is quite useless as "reinforcement." Windows should have horizontal supporting bars at least every 2 feet. For openings of up to 2 feet in width, use should be made of round bars ⅜-inch in diameters or flat bars ⅜ x ⅛, of course soldered at right angles to the surface of the light and not flat, such as I have seen in some cases. Openings between 2 and 3 feet in width should have ½-inch bars. Lancets over 3 feet in width should be equipped with an iron framework planned to suit the design of the window, such as is suggested in the sketch.

Cementing. The cement, which in this case is a semi-fluid putty made of whitening, boiled linseed oil, litharge, red lead, dryers and lamp black, should be of the best materials properly mixed, carefully forced under the flanges of the lead on both sides. The lights after cement is applied



Window, Lyons Cathedral. Heavy Lines Show Iron Supporting Frame

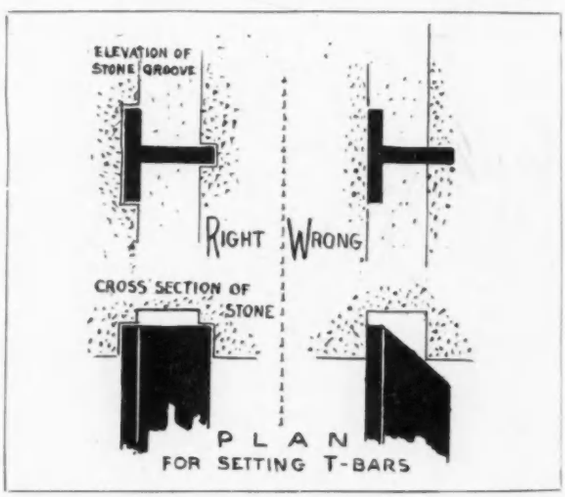
should be allowed to stand and harden for at least a week before their installation.

Setting. If the panels go in a stone groove or rabbet and are to be set with putty, which I personally advise, the groove or rabbet should be painted with a white shellac, or, if they are to be set in cement, the stone should be dampened with water. In all cases the panels should be bedded in putty or cement and not placed first and then have the putty or cement put in around them. The best linseed oil putty should be used, and in the use of cement, care should be exercised not to mix in too much plaster of Paris in a desire to make the cementing smooth, for this tends to make it draw away from the stone, causing the window to leak. The panels should be plugged to hold them rigid in the groove while the putty and cement are hardening. The stone or wood should be notched to hold the supporting bars in place.

Metal. Condensation gutters are very helpful, especially for windows that have large openings. They are placed at the bottoms of the lancets, and any moisture that forms on the inside of the window is caught in this gutter and passes out through small openings to the outside, thus keeping the stone and plaster on the inside from being stained.

Ventilators. The stained glass man hopes for the day when forced ventilation shall be universal and "saints and sich" will not be cut in half, their parts left dangling in the air with no visible means of support, when the window ventilators are opened. The designer of the glass should provide for the necessary ventilators, so that the value of the design is not ruined when the ventilators are open. This can often be done by the use of medallions. Till then only such ventilators having the detachable inside frames should be used. For some reason, people refuse to open and shut ventilators in the manner for which they are equipped; they insist on pushing on the glass and slamming the ventilator open or shut, with the result that all ventilators in time need repairing which can be done much more expeditiously and cheaply if the inside frame is removable. Ventilators should be equipped with horizontal supporting bars at least every 8 inches. When casements are installed, use should be made of those with slip pin hinges, where possible, and these should be equipped with horizontal bars adapted to the design of the glass.

Design and Cost. Preferably, there should be given a statement of the price limit, or else a general description of the type of design desired. The reason for this will be quite obvious, if one will picture going to a dozen architects of varying



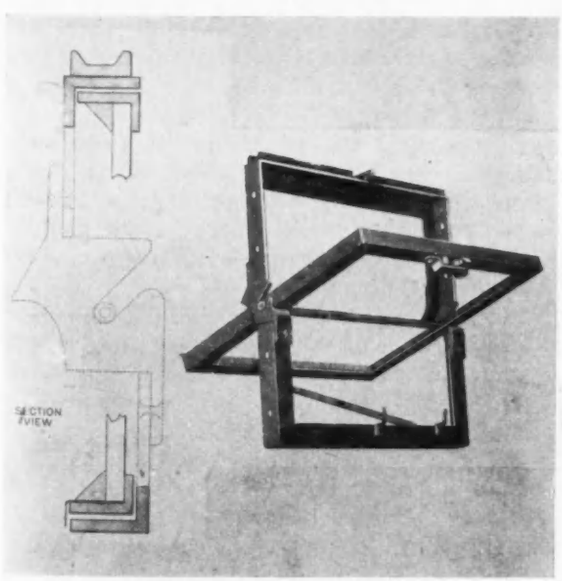
The Right and the Wrong Methods of Setting T-Bars

ability with a blue print of a plot of ground and asking them at their own expense to submit sketches of their ideas of the proper kind of Tudor house for that plot. One might design a $200,000 house, the next a house for half that sum, and so on down to a $15,000 house. Fortunately, the American Institute of Architects keeps architects from being so foolish, but this is exactly the amount of information given stained glass artists by 90 per cent of the architects, and about 99 per cent of the artists are foolish enough to go ahead blindly and make sketches on such an insufficient basis.

Stained Glass

By stained glass is meant windows stained and etched after the manner of the mediæval glass artists, usually containing figures or groups of figures. This type of work should not be included in the general specifications, but should be handled directly by the architect and his client. In church work this does not mean a committee of eight individuals including the Mrs. John Smiths who studied art appreciation in the finishing school days back in the gay nineties and then promptly forgot everything except that Titian became a moral degenerate after his second marriage,—"or was it Rembrandt?" Instead there should be appointed a committee of not more than three individuals who will take time to reasonably inform themselves and study the work *in situ* of not more than half a dozen stained glass artists, whom the architect has recommended, retaining the man they feel is most capable of handling their problem and having him make sketches and propositions. If satisfactory the committee should give him the commission to execute the work; if not, the committee should retain another in the same manner. This will call forth an artist's best efforts, this dealing with him as an individual; but if a competition is required, after studying the work of the various men, selection should be made of three to prepare designs, giving them all the same information, and setting a time when the competition definitely closes. Extension of the time is usually to allow one of the competitors an opportunity to complete designs for another commission, which the other competitors had passed up, really believing that they had to have the designs for a particular competition in at the time set. The unsuccessful competitors should receive a reasonable remuneration for their efforts.

A Modern Example, Iron Framework
H. L. Willet & A. L. Willet, Associate Artists



A Type of Ventilator Having Detachable Inside Frame

All the specifications under leaded glass are applicable for stained glass, but should be supplemented in this way:

Under-glass. Where flash glasses are necessary for etching, specify that they be antique. Flash glasses are obtained by the glass blower dipping first in a white or other colored glass and then in another color. When blown, this gives a thin layer of the second color over the white or other color. This thin layer can be eaten off with hydrofluoric acid where desired to form designs, etc., of two colors in the same piece of glass. It is especially useful in heraldic work. Domestic flash glasses are very flat, and the white glass used being perfectly clear, is often somewhat lifeless.

Under-leading. By varying the widths of the lead cames, the design can be brought out. The proper use of wide leads aids greatly to the virility of the design, as the blacks in stained glass give that jewel-like quality to the other colors.

Reinforcements. T-bars should be introduced at least every 2 feet; for lancets of up to 2 feet in width, ¾-inch T-bars should be used; for lancets between 2 and 3 feet in width, 1-inch T-bars. The stone or wood should be cut out so that the vertical flange is flush with the stone or wood, with at least a ¼-inch catch on either side.

Painting. It is best to allow no enamel colors to be introduced, as they are not permanent. The only legitimate color is the opaque mineral stain, used to make the trace lines, such as the features of faces, drapery lines, etc., and also used as a mat over the glass for shading. There is also a silver stain, which when applied to certain "white glasses" colors them gold and is permanent and especially useful in canopied windows. These mineral colors must be fired in the kiln with sufficient heat to fuse them into the surface of the glass.

The height at which the window is to be placed should not only be taken into consideration in connection with the design, but also in regard to the trace lines which should be made of sufficient width to carry distinctly to the beholder's eye when the glass is in place. That does not mean that they must be grotesque. Copying the archaisms of the twelfth and thirteenth centuries is not necessarily art.

Other matters which the architect controls that relate to stained glass need careful attention. One is the regulation of the size of the groove in which the glass is to be placed. The ideal way is to have the groove up one side of the lancet 1 inch deep and ½-inch wide, and on the other side ½-inch deep and the same width. The glass sections can then be bound with a ½-inch lead, allowing a full ½-inch catch on both sides and bringing the glass flush to the edges of the stone. By placing the panel in the inch groove first, there is no need to force or bend the panel, which of course weakens the leading. In Gothic window frames with cusped heads, the groove in the cusp should be cut back as deep as the widest part of the opening above the cusp, to allow the free passage of the head of the section. A piecing joint through the glass at this point very often does not fit in with the design of the window and always destroys the vertical uplift of the lancet and the gracefulness of the cusp. The grooves in the cusp of the tracery openings should also be cut back.

Avoid the use of protection glass if possible. As a protection it is a poor insurance premium . . . considering the original cost and the cost of replacement. If the money were put in a fund and left at interest, there would be more than enough to cover any breakage that might not have happened had protection glass been used. As the largest proportion of the breaks to windows are in or around the ventilator sections, which the protection glass would not prevent, there would then be funds to repair these. Finally, the outside appearance of a building is marred when protection glass is used. Wire guards are so horrible, both from the effect outside and also the shadow on the glass inside, that I shudder even to mention them. There are, however, two advantages that are obtained from use of protection glass; it does help to keep the noise of the street out, and the heat in, but if it must be used for these causes, it should be called "storm glass" or "glass silencer,"—anything but "protection glass," and if at all possible, the architect should consult the artist who is to execute the stained glass, so that the dividing lines and ventilators can be placed to work in with his composition.

It is usually best not to divide the work in one building among half a dozen stained glass artists, for I have yet to see any building that has benefited from having the work of many. I believe the architects who now advise it refer to the windows in the cathedrals of France and England, but as yet I have failed to learn that these same architects, with the precedents of these same cathedrals, are turning over the transepts of the cathedrals on which they are pouring out their souls to other architects,—much less dividing the nave among three others to design the side aisles, triforium and clerestory.

Finally, the architect should give the glass craftsman at least as much time to execute his work as is needed by the stone man and plasterer. Instead of waiting until the building is well under way, the architect should acquaint his client from the very beginning, when the cost of the building is being discussed, with the cost of the windows they have in mind will be. Then they will be able to change their idea, or at least be in a position to get what they want, and not expect to get costly figure windows at the price of leaded diamonds,—or, worse yet, (which very often happens) find some stained glass man who will offer to do that.

CHURCH HARDWARE

BY

JOHN R. SCHOEMER

THE sources of modern designs in church hardware are the ring handles, rim locks, studs and strap hinges of mediæval churches. We have many of these models on view today in our museums and private collections, and there are excellent books illustrating the work of these early craftsmen.

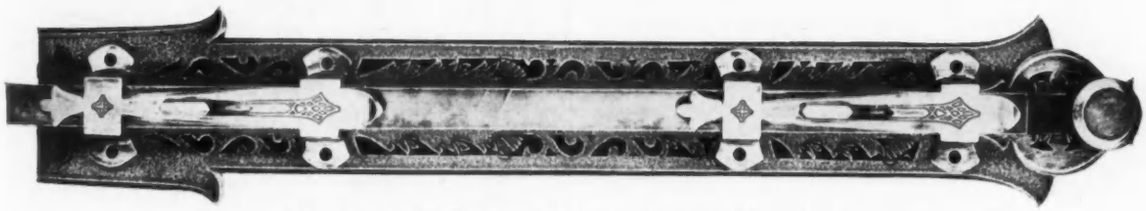
Ring handles were first used as pulls or door knockers. Later it was found possible to connect the ring handle with a rim lock to actuate a dead bolt or a latch bolt. Infinite time and patience were spent on the intricate mechanism of these rim locks, and they defied the skill of the pilferers and marauders of that time. They were wrought with great care in box-like shapes with fine incising and delicate appliques. Strap hinges, in those days, were actual supports for the door, terminating in pintles which fastened to the stone or wood jambs, being forged of heavy gauge iron. Their function is the same today in high class work, but a false strap hinge is now in vogue which adds nothing to the strength of the butt.

We are emerging from a period of outer darkness in the design of church hardware, and we owe our gradual enlightenment to the efforts of architects of the type of Ralph Adams Cram and the late Bertram Grosvenor Goodhue. Twenty-five years ago, ready-made hardware marked "Gothic" at the whim of the manufacturer's designer was the only thing available. Elongated vertical escutcheons with door knobs of brass, bronze or cast iron were the fashion of the day, and the finishes embraced verde antique, statuary bronze, dull brass, and cast iron in the now familiar Bower Barff finish. A later development brought us white metal or white brass, which when treated with black oxide and buffed presents a fair imitation of iron. For beauty of form and softness of texture, there is no substitute for Swedish iron or high grade American, wrought by hand in the forge. The metal itself is so workable that blurred outlines can be brought out by filing; buffing will impart any degree of polish.

The archenemy of iron, of course, is rust. Design and line are soon obliterated by exposure to the elements, and damp or seaboard climates work particular havoc. This, however, should not discourage the would-be user, for if the iron is lacquered at the forge, and after permanent placing is treated with applications of boiled linseed oil or according to some good oil formula, rusting can be postponed indefinitely. These oil treatments may be made with decreasing frequency as the metal begins to absorb the oil. Various methods of rust-proofing are now in use, but nothing has been discovered which will preserve the appearance of natural iron and permit polishing. Experimenting with stainless steel and various alloys has proved unsatisfactory, as they will not weld in the forge. Dipping the metal while warm in oil produces a black finish, but neither this nor the use of acid paint to simulate rust is appropriate for the finer forms of iron.

The burden of designing wrought iron hardware, which was formerly borne by the manufacturer alone, is now shared by the architect, and draftsmen are showing increasing skill in the adaptation of old models to present-day conditions. One phase of the genius of the late Bertram Grosvenor Goodhue was the rapidity with which he could create, on paper, designs of great beauty and intricacy. This interest in hardware on the part of the architects is very desirable, and while there are no hard and fast rules for the preparation of special hardware drawings, a few suggestions may prove helpful in reducing the cost of both manufacture and application.

Detailing Hardware. Before completion of the scale and full-sized details of the doors, it is wise to secure the criticism of an expert in hardware and incorporate on the details any resultant notations. Careful consideration should be given to door stiles, and if blocking (sometimes referred to as a "Dutchman") is necessary, its size and location should be indicated. The draftsman preparing the hardware drawings should have some knowledge of the forms best suited to iron. Labor costs may be reduced by slight and unimportant



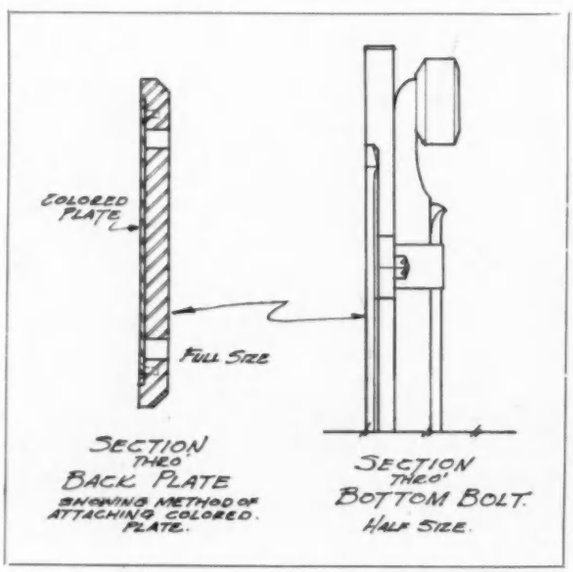
Wrought Iron Rim Top Bolt, Church of the Heavenly Rest

Mayers, Murray & Phillip, Architects

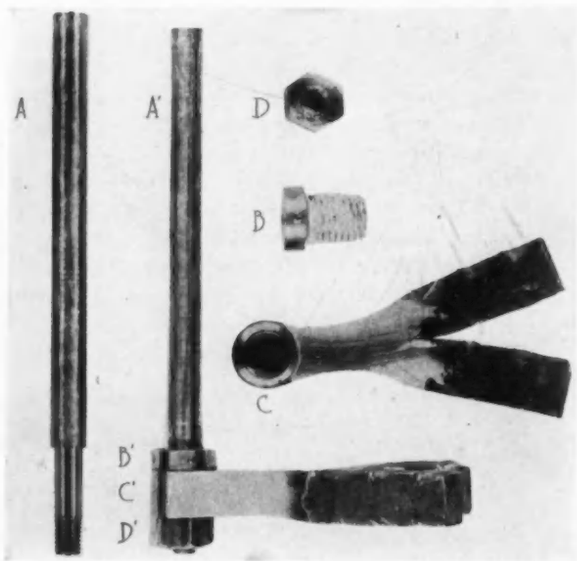
Working Drawing, Strap Hinge, Main Door, Church of the Heavenly Rest
Mayers, Murray & Phillip, Architects

changes in the design by one who knows. Rim locks and escutcheons have cylinders, ring handles and thumb pieces in certain fixed positions to properly operate the mechanism of the locks. The proper location of these should be indicated on the design, but only after consultation with one familiar with lock construction, who will assist in the addition of figured dimensions. While it may seem useless repetition of detailing, it is well to indicate in full size the door stiles and jambs on the hardware details. Errors will frequently be detected in this way, and as the blacksmith consults the drawing while forging, an intimate knowledge of actual conditions is helpful. Hardware drawings should also be sent to the woodworker, as they assist him in the use of the material.

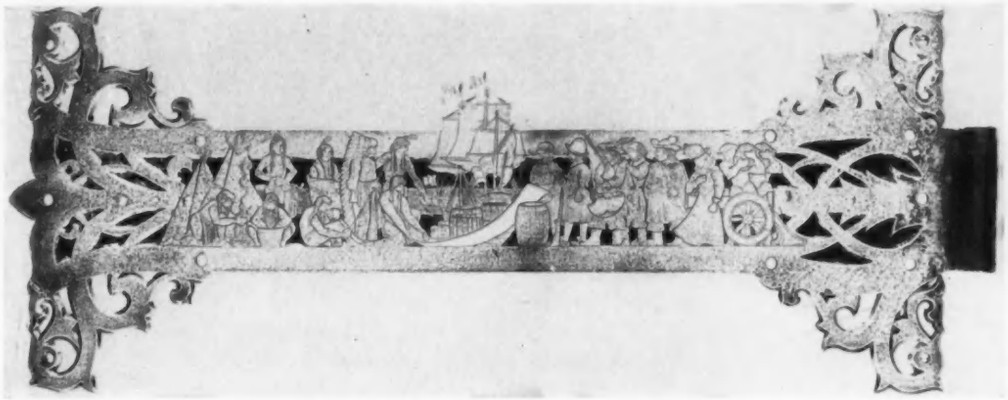
On the wrought iron hardware for the Church of the Heavenly Rest in New York (Mayers, Murray & Phillip, architects), the addition of color was used to emphasize the delicacy of the design. Red leather was first considered as a background under the pierced metal, but was abandoned as impractical, and red pyroxolin lacquer applied to a removable back plate was adopted. The main plate was routed for the color plate, and the slight additional thickness in the metal is not offensive or apparent. Models frequently assist in securing a desired effect in wrought iron. For the Church of the Heavenly Rest, the strap hinge "Sale of Manhattan Island" was chased and incised to portray the picture. The result was a flat and uninteresting surface with no emphasis on foreground figures. To obtain a different effect, objects were then cut out of cardboard, colored to match the iron, and glued to the hinge. The result was most gratifying, and the finished strap will have an additional plate welded to it containing the figures and ob-



Detail of Routing for Color Plate which Shows Through Piercing in Back Plate



Adjustable Hinge Pintle for Stone Jambs Facilitates Door Hanging and Operation



Finished Strap Hinge, Church of the Heavenly Rest
Mayers, Murray & Phillip, Architects

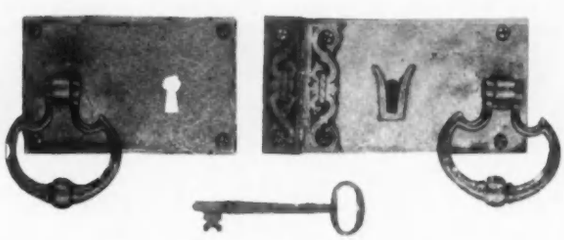
jects of the scene. This idea could be further developed in strap hinges by the use of three or more plates welded together and associated as: A—color plate; B—main plate containing background objects; and C—foreground plate.

Hinge pintles were formerly installed when the church was nearing completion by removing stones in the jamb or drilling large holes for insertion of the pintle leg,—a costly and unsatisfactory procedure. This can be avoided by preparing a pintle location drawing, indicating pintle heights and projections for the stone mason. A recent development is the adjustable pintle with all parts easily assembled. The leg is set in hot lead in a stone course during construction. The pin is removable, and the adjustable threaded washer forms the knuckle bearing. The locking nut at the bottom securely fastens the pin and washer to the leg. The advantages are easy installation and assurance that all pintle legs are carrying their share of the door, an important consideration because of the weight and width of all outside church doors.

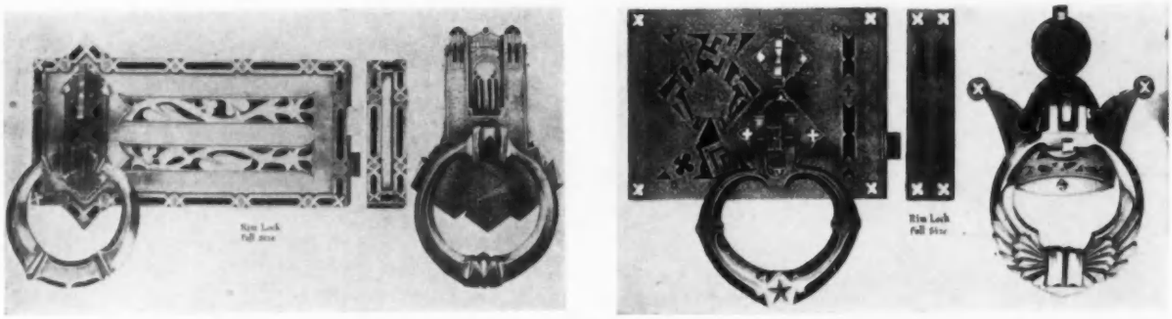
Appropriate hardware for various church doors is governed somewhat by actual conditions, but generally is identical as to type and function. The suggestions offered here are suitable for Gothic churches, but slight alterations in the text will make them apply to all styles. Main entrance doors are usually heavy and somewhat difficult to operate, and too frequently the hardware does not relieve the situation. Two or more strap hinges are suitable for each door, the considerations being the lateral pull as affected by the door width, door height, and thickness. Rim locks with cylinder operation are most effective for use on the main doors,—the cylinder on the outside concealed by a cylinder cover attached to the escutcheon or applied as a separate unit. The dead bolt in the lock should be operated by the key from the outside and by a thumb piece on the lock. The latch bolt is operated by the ring handles from both sides. The use of the dummy ring handle is discouraged,—it is unnecessary, expensive and deceptive, as it retards one in operating the door. In former days two ring handles were used on the outside, but they were then placed in the center of the door for use as pulls. On less important outside doors it is sometimes desirable to substitute horizontal mortise cylinder locks which blend with the appearance of the rim locks on the outside. The inactive door is usually locked by top and bottom rim bolts, or, on minor doors, top and bottom mortise flush bolts. Ornamental door stops and hooks of wrought iron are attractive in appearance as well as necessary.

Reverting again to the size and weight of church doors, one concludes that not enough consideration is given to the large feminine proportion of the church-going public. It is frequently impossible for women or children to open such doors. For that reason, entrance doors should

Strap Hinge for Minor Exterior Door

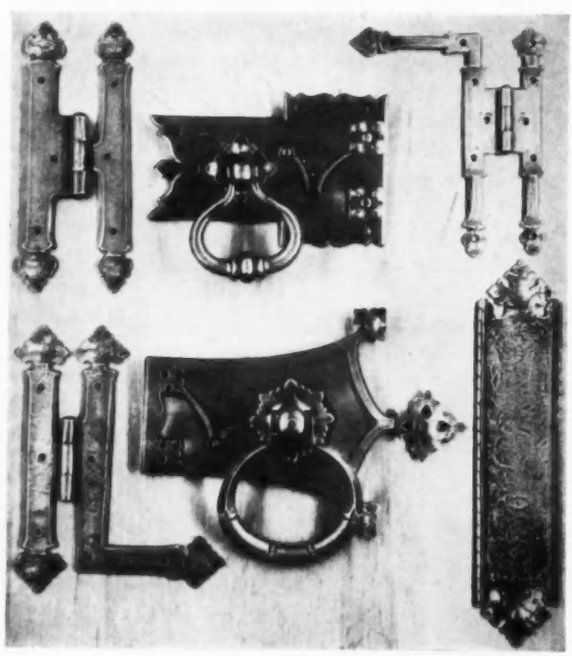


Stock Rim Lock and Ring Handle



Rim Locks and Rim Handles for Main Exterior Doors. Church of the Heavenly Rest
Mayers, Murray & Phillip, Architects

be hooked open at the beginning of services and closed only when the church is not in use. Secondary storm doors should be provided immediately within the entrance doors, thus serving to keep the vestibule or narthex warm in cold or inclement weather. At the Church of the Heavenly Rest, sufficient space is provided so that the storm doors form one side of a small vestibule, but actually very little space is required for their installation. A single-acting checking floor hinge is recommended for each inner door with ornamental push plate, door pull, and foot-operated door holder. Where the inner door is hung close to the outer, double-acting checking floor hinges are more desirable, and by the addition in the head of an adjustable metal stop they can be made single-acting, swinging into the narthex. This permits of a rather flexible operation and, if necessary, compliance with local fire laws.



Rim Locks, Ring Handles, Surface Hinges and Push Plate. Parish House, St. John of Lattingtown, Locust Valley, N. Y.
Henry W. Rowe and Waldemar H. Ritter, Associated Architects

Narthex screen doors and nave aisle doors may be hung on single-acting floor checks and equipped with door pulls, push plates and foot door holders. If the narthex forms a passage to other parts of the building when the church is closed, it is suggested that cylinder dead locks be incorporated as part of the hardware. Again conceal the cylinders with a cover, and the thumb piece may be made ornamental and attractive. Minor doors to sacristy, chancel, or rector's study may be treated to suit the taste of the architect and the funds available. However, if the door opens into the nave, strap hinges, rim locks and ring handles can be made to blend into the general design in a most attractive way. An illustration is shown of an inexpensive rim lock with escutcheon and ring handle. If economy requires the use of a mortise lock, select the horizontal type with its correspondingly placed escutcheon and knob or ring handle. Convenience and utility recommend the use of cylinder locks. They are flexible as to master key requirements, and on both the rim and mortise types they offer security and easy operation. Old rim locks in our museums have keys from 6 to 12 inches long, and it was considered necessary until recent years to design locks in like fashion. Master-keying is most desirable and useful for the sexton or rector and should always be a part of the hardware equipment, as the additional cost is slight. The whole question of church hardware resolves itself into the intelligent selection of appropriate high grade material, with due regard to both use and beauty.

The character of almost any building, of course, is largely given by its hardware, but this is true in a particular degree of a church. After all, the most costly hardware likely to be used for a church represents but a small proportion of the building's total cost, and yet there are few details for which adequate expenditure is more amply justified in giving a high architectural character.

HEATING AND VENTILATING OF CHURCHES

BY

ALFRED J. OFFNER, M.E.

OFFNER & McKNIGHT, CONSULTING ENGINEERS

WHEN man became conscious of the existence of a Supreme Being and started to bring offerings to his God, he piled up a few stones on which he placed his sacrificial gifts. Then, to protect his offerings against the elements,—the hot sun, the winds and rains,—he placed his altar in a cave or erected a rude covering over it. So, no doubt, the first house of God was built. As mankind developed in knowledge and increased in numbers and became tribes, and tribes became nations, and as groups of people became villages and villages became cities, so caves containing sacrificial altars became tabernacles, and tabernacles became temples. As the people and nations grew in sizes and riches, so the temples became larger and more elaborate.

While houses of worship have been built from time immemorial, the modern heating and ventilating systems as applied to church buildings are of comparative recent development. Nearly all of the world's famous churches and cathedrals, built throughout Europe during the past centuries, have no means of artificial heating or ventilating. But as man demands more and more convenience and comforts, he naturally insists on his houses of worship being properly heated and ventilated. The complexity of modern church construction, the beauty of design, and the uses and arrangements of this type of building, all present unusual problems in the designing of the heating and ventilating systems.

Methods of Heating Churches. Church buildings may be heated by three methods,—stoves, warm air or radiators. Any one of these methods may be used alone or in combination. The type of heating to be used and the method of employing it depend on building conditions and on the amount of money that is available for this work.

Heating by Stoves. With the exception of very small rural churches, this type of heating is rarely used in houses of worship. Heating by this method is not only likely to be uneven but presents a certain fire hazard.

Heating by Warm Air Furnaces. The heating of a church building can be accomplished by warm air furnaces, either by gravity or fan. Heating by warm air furnaces is used in many small churches. In this system the air is taken in from outdoors, passes through the furnace where it is warmed, and then is conveyed to the rooms to be heated by means of galvanized iron ducts and flues. With this system, the distribution of heat is likely to be affected by wind conditions, and the results are therefore not so positive as with radiator heat. While the initial cost of installation of a warm air furnace system is lower than that of either steam or hot water systems, the cost of operation is usually higher, especially if the air is taken directly from outdoors. Therefore, for economy in the use of fuel, a by-pass should be provided to permit the taking of the air direct from the building in very cold weather. This arrangement also permits quick reheating. With a warm air furnace there is nothing to freeze should the heating be discontinued during the week. In larger churches, where furnace heat is desired, a number of furnaces may be located in different portions of the building, thereby reducing the length of the galvanized sheet metal pipes. Electrically-driven blowers may be used in connection with warm air furnaces. Such an arrangement insures positive heat distribution and permits quick reheating.

Heating by Radiators. Heating by radiators may be done by either steam or hot water. In either system, the heat is generated in a boiler and is conveyed through pipes to the radiators located in the various rooms to be heated. Heating by water permits central regulation at the boiler; that is, the water temperature at the boiler can be either raised or lowered according to the weather. This type of heating would not be adapted to those church buildings which are heated only part of the time, as there is the possibility of freezing in cold weather. As a general rule, churches are best heated by steam. This system is especially adapted to those buildings where the heat is interrupted during the week. With this type of heating, portions of the system may be shut off for any desired length of time. It is also well adapted for quick heating up after the building has been without heat for some time.

Arrangement of Piping. If a church has, in addition to the church proper, social rooms, pastor's study, etc., it is always a good scheme to separate, arrange and valve the piping so that the building may be heated in sections. If the space under the nave is a cellar, the distributing pipes are located there. If this space is used for Sunday School rooms, social rooms or other purposes, and there is no space under these rooms, the distributing pipes must of necessity be located in these rooms. Unless the piping is extensive, it is nearly always possible, with a little study, to locate the mains in these rooms and still have them invisible. Fig. 1 shows an arrangement for a one-pipe steam system where the steam main is concealed in a false beam located at the

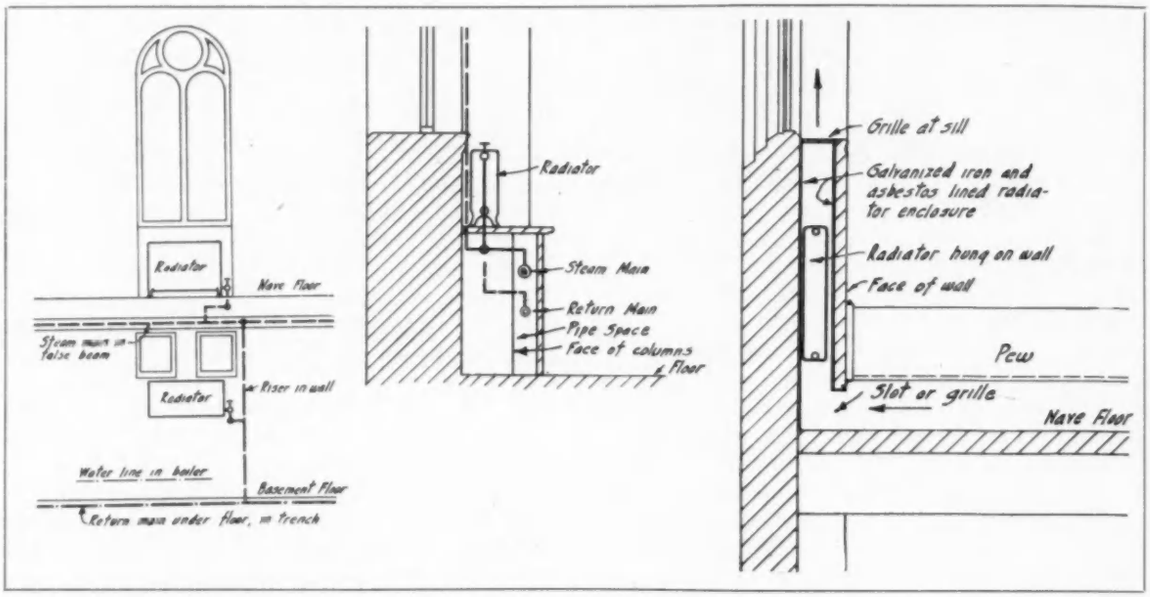


Fig. 1. One Pipe Steam System

Fig. 2. Two Pipe Steam System.

Fig. 3. Method of Concealing Radiators with Pens Along Outside Walls

ceiling, close to the outside wall, the return main being run in a trench located under the floor. Fig. 2 shows an arrangement for a two-pipe system. Here both pipes are located in furred spaces located along the walls, the radiators being placed on top of the shelf formed by these furred spaces.

Locations of Radiators. For lowest cost of installation, highest economy in operation, and for ease in cleaning, radiators should be exposed and be located under windows. When the radiators are to be concealed, proper openings must be provided for the air inlets and outlets. The enclosures should be so arranged that they can be removed for cleaning and repair purposes, and means must be provided to give access to the control valves. In churches which have aisles along the outside walls, either exposed or concealed radiators can generally be located under the windows, preferably in recesses to conserve space. In cases where pews are located along the outside walls, radiators located under the windows should be enclosed to protect those sitting next to them against the heat. Such an arrangement is illustrated by Fig. 3.

Heating by Air. When for structural or other reasons it is impossible to place radiators in the nave, the radiators may be placed under the nave floor, the air being led to and from these radiators by galvanized iron ducts and flues. This arrangement is more expensive to install than either exposed or concealed radiators. The air to the stacks containing the radiators may be taken from outdoors or it may be re-circulated direct from the room. With the first arrangement the cost of operation would be much higher than when the air is re-circulated from the room or when radiators located in the room are used, due to the fact that a large amount of cold air, which must be heated is being taken in. Fig. 4 shows an arrangement where the air is re-circulated. In very large churches, heating by warm air blown into the nave, chancel, etc., by electrically-driven blowers is practically necessary. This method is best suited for heating rooms having large air volumes. It also makes quick reheating possible. While Fig. 5 shows one method of heating a church by air, there are various means by which this type of heating can be applied, depending on the design and arrangement of the building.

Special Treatment of Sanctuary. Due to the sacred use to which the sanctuary is put and to the beauty that is desired, it is nearly always objectionable to place exposed radiators there. In such cases the heating of the sanctuary presents special problems which can be worked out in a number of ways. It is sometimes possible to place radiators in the walls near or adjacent to the altar, the radiators being covered by ornamental grilles which can be made of various designs and materials. If the altar is so arranged that there is a space behind it, radiators may be placed there. Such an arrangement is illustrated by Fig. 6. In this case the radiator is placed in a galvanized iron box placed in the wall back of the altar. The air supply to this radiator comes in through openings, covered by grilles, located on each side of the sanctuary, the warm air being discharged at the sill level of the chancel

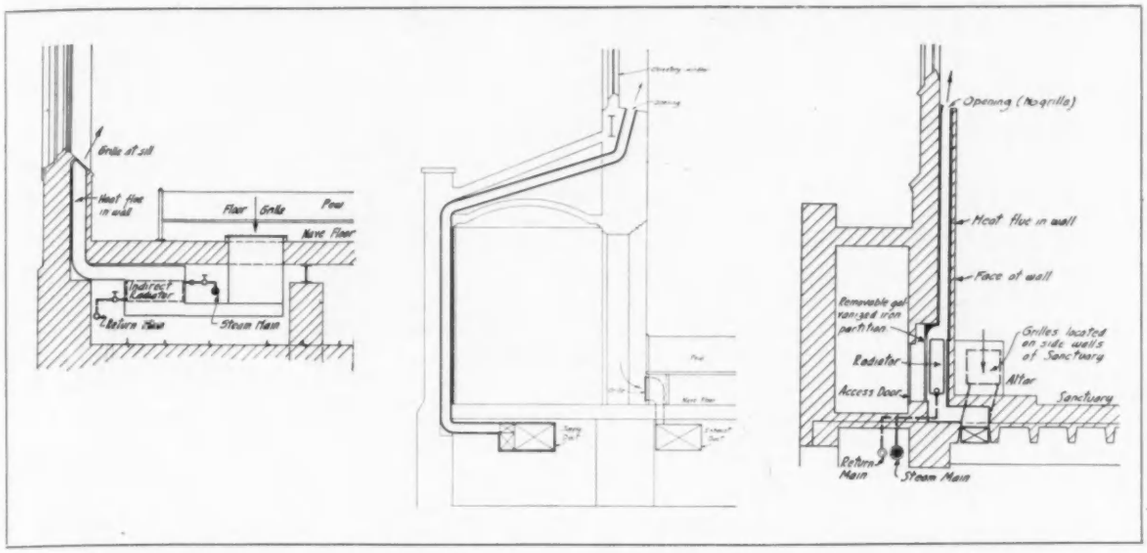


Fig. 4. Method of Indirect Heating for Nave

Fig. 5. Heating Large Church with Air

Fig. 6. Method of Concealing Radiator in Back of Altar

window. If there is no space in back of the altar available for a radiator, the radiator may be placed in a galvanized iron box located in the cellar below the sanctuary, and the air to the radiator may be taken in through two floor registers, one located on each side of the altar. The warm air discharge is then carried up concealed in the wall behind the altar and discharged at the sill of the window over it. Fig. 7 shows this arrangement.

In cases of existing buildings in which a new heating system or systems are being installed, there are often strong objections to cutting open the walls or otherwise disturbing the arrangement of the interior. Under such conditions, the heating may be accomplished by using two floor registers, one being used for the air intake, the other for the discharge of warm air. Such an arrangement is illustrated by Fig. 8.

Automatic Heat Regulation Desirable. The radiators in the nave or other parts of a church building can be put under the control of thermostats which will automatically keep the room at any desired temperature, preventing over- or under-heating, and resulting in a saving of fuel. In smaller churches automatic heat regulation is less frequently used than in larger buildings because of the higher costs of installation. In large churches, automatic heat regulation is almost a necessity as well as being always very desirable, and it should by all means be provided if the funds are available.

Is Ventilation Necessary? The question is sometimes asked if a supply of properly conditioned air and the removal of vitiated air by the use of fans is a necessity in church buildings. In smaller churches, especially where the windows are so arranged that they can be easily opened and are located to give cross ventilation, mechanical ventilation is not necessary. The natural air changes obtained in such cases will generally be found to be sufficient. If the windows are fixed or poorly located for natural ventilation, use of a few ceiling openings for the removal of air may be advisable. In larger houses of worship it is often found that the windows, especially those of the clerestory, have very small portions that can be opened; if not, the entire windows are fixed. In such cases the doors giving access to the church provide the only means of admitting air. As this generally is not sufficient, some type of mechanical ventilation must be provided, if only enough to move the air in the building. Such a ventilating system can sometimes be combined with the heating of the church (see Fig. 5).

Churches that have large congregations and long services should have some form of mechanical ventilation. It has often been found in actual practice that, after installing a mechanical ventilating system, air conditions were so improved that a marked increase in attendance was noted. Drowsiness and sleepiness cannot always be blamed on poor preaching, as they are very often caused by inferior air conditions.

Cooling of Churches. The most important problem in producing comfortable conditions during the hot and humid summer months is that of the de-humidifying of the air. The cooling of large rooms during this period of the year, so successfully applied in theaters and buildings in-

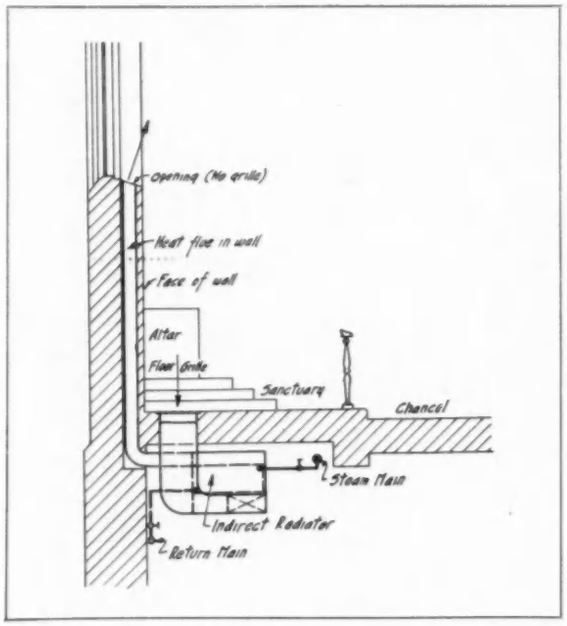


Fig. 7. Heating of Sanctuary with Indirect Radiator

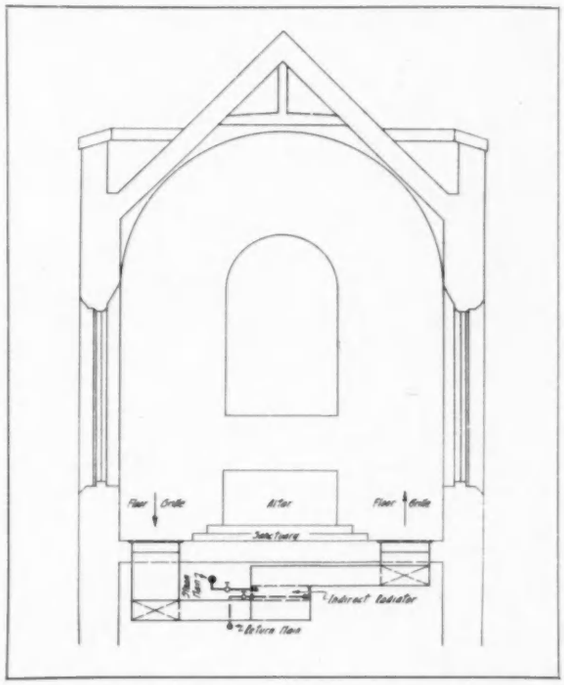


Fig. 8. Indirect Heating of Sanctuary Adapted to an Existing Church Building

tended for certain industries, can also be applied to church auditoriums. So far, however, with the exception of a few isolated cases, churches have not adopted use of cooling systems, due to the high cost of installation and operation.

Fuels for Church Heating. The selection of the best fuel for a particular church depends upon the type of fuels available. Gas, coal, oil or wood may be used, the choice depending on the cost of the fuel and the possibility of obtaining it easily. Gas, of course, is the ideal fuel for heating boilers, its only drawback being its comparatively higher cost of operation in many localities where natural gas is not available. Gas is clean and noiseless in operation. The size of the flame can be controlled conveniently and automatically and it can be turned on and off at will. Gas requires no labor of handling. When oil is the fuel to be used, the heaviest grades that will burn without pre-heating should be selected, permitting the use of the cheaper grades of the light oils. While the heavy oils are much cheaper in cost, they require pre-heating and a more expensive and complicated oil-burning equipment, and consequently more skilled attention. The type of attendants generally found in churches necessitates use of the simplest system. In selecting an oil-burning system, care should be taken to choose a well serviced burner of reliable make and quiet in operation. As with gas, it can be controlled easily and automatically, and there is no refuse to remove. Oil burning requires very little labor, but it will require servicing from time to time. Coal is the fuel most used in church heating boilers. While it requires storage space, considerable more handling and the removal of ashes, it is generally found to be the cheapest so far as cost of fuel is concerned, although consideration should be given to the saving in labor, saving in space, ease of control, cleanliness and convenience presented by use of the other two fuels. Where bituminous coal must be used, precautions should be taken to reduce the amount of smoke to a minimum to prevent defacing the outside of the building.

In General. In conclusion it should be said that no fixed methods or arrangements can be given for the heating and ventilating of churches. Each building must be studied to determine the system best suited to meet its particular requirements. A system correctly designed and installed will not only give proper results, but will also be low in cost of installation and economical in operation. Pastors and members of building committees should not show favoritism or cater to the whims of certain members of the congregation in the appointment of architects and contractors, but should consider only those who have proved by their work in churches already erected their ability in doing this special kind of work. The designing of the heating and ventilation systems should be planned and supervised by capable and skillful engineers. To have the work done properly will pay in the long run, even if in the beginning the fees for professional services, whether for architect or engineer, may seem high.

WORKING SUCCESSFULLY WITH CHURCH COMMITTEES

BY

C. STANLEY TAYLOR

ONE of the advantages of specializing in architectural practice lies in the accumulation of experience in dealing with a specific type of client. The professional relationship which is an element of architectural practice necessarily involves constant personal contacts and places a premium on the architect's ability to work with all types of personalities and to constantly adapt himself to his clients' points of view. There is a certain similarity between the reactions of clients interested in basic types of building operations. The architect working in the industrial field finds the economic phase of the project of paramount importance and is constantly discussing the dollar side of his designs with every client. The architect working in the small residence field deals to a great extent with worthy housewives whose ideas generally prevail over those of their husbands. The architect working on hospital projects must deal with medical men whose requirements and interests are bound up in sanitation, administration, and related problems.

The architect who works either as a specialist or on occasional contracts in ecclesiastical architecture deals with a different type of client, whose peculiarities and special interests are the subject of this brief discussion. The first distinctive feature about the typical client on church work is that he is not an individual, but a committee of more or less active churchmen who have been selected or appointed to represent the parish or church body. The committee normally includes the head of the church unit itself, whether he be pastor, minister, or bishop; a group of the chief laymen, generally the trustees or deacons or their equivalents, and often a few other members of the parish who are selected because of their knowledge of building operations and success in raising money. Out of this committee there soon emerges a smaller group which shows an active interest and a fair knowledge of the problem, and these members usually constitute the body with which the architect has most of his dealings.

This conglomerate body represents the architect's client. In many respects a church committee resembles any other type of committee responsible for the development of institutional buildings, such as schools, hospitals, or even of clubs. There is one particular in which they generally differ, and that is that the church committee normally recognizes the importance of the purely design aspects of the problem, and at the same time usually acknowledges that these matters are entirely within the province of the architect and that the committee can contribute little to their development. This statement is made without implying in any way that the architect has an entirely free hand in working out his basic designs, for no matter how ignorant committee members may be, there are always some who will profess to have a knowledge of architecture or a sophisticated taste founded upon European travel and will feel themselves competent to impress their views upon the architect's work.

A second characteristic of the typical church committee is that it has a certain amount of money to spend, or possibly only a prospect of securing a predetermined fund, and that when this is spent it has no other money unless additional campaigns are undertaken to meet the deficit. In other words, there is usually a very definite dollar limitation on church work which must be taken seriously by the architect if he wishes to leave his clients at the end of the undertaking in a satisfactory frame of mind. As soon as there is a fixed budget on any type of project, the architect must acknowledge responsibility for adjusting the physical requirements of the structure to the amount of money available. The committee members are not competent to do this; it is distinctly the architect's work.

At the very beginning of the project,—often before the architect is actually engaged,—there is considerable discussion as to the type and size of the church structure, its general accommodations, materials of construction, and the features of its equipment. These matters may be discussed long before cost limitations are finally established, in which case it is comparatively easy for the architect to establish a budget which will allow sufficient funds for completing a structure of the type the committee has in mind. More often, however, the amount of money the parish can afford to put into a church is quite well fixed, but there is no limitation upon the ideas of the more enthusiastic members of the building committee. Then the architect must display both tact and ingenuity in bringing about an adjustment of the requirements and the budget until the two are so related that further work can proceed with reasonable prospect of its successful consummation. There are various ways in which an adjustment can be reached between excessive physical requirements and a limited budget. The first opportunity lies in the adoption of an architectural scheme which is relatively inexpensive to execute because of its compactness, simplicity of plan, ease of construction, and the appropriate use of relatively low cost structural materials. The second opportunity lies in the substitution of

inexpensive methods of construction for the finer craftsmanship which ecclesiastical precedent normally demands; and the third opportunity is in developing the project in various stages by planning future units to be erected when funds are subsequently made available through bequests or additional fund-raising campaigns.

The first two methods of keeping within budget limitations involve as definite an appreciation of construction costs as may be required to successfully handle commercial and industrial building projects. They require also an up-to-date knowledge of new materials and methods which are adaptable to church construction, because from day to day experience is proving the worth of new materials for age-old purposes. While both architect and client might desire the floor of the nave to be of fine marble, it is quite possible and entirely logical to achieve the same effect at a fraction of the cost, through the use of marbleized linoleum or cork composition tiles, or the newer forms of rubber flooring which faithfully reproduce the color and pattern of the finest Italian marbles. It is, of course, a fortunate circumstance when an architect is permitted to create a perfect architectural work with carte blanche orders to use the finest materials and the best of craftsmanship, regardless of cost. Only great cathedrals or endowed memorial churches ever present this ideal client situation. The majority of commissions for church work call for restraint and economy without sacrificing beauty.

These practical considerations extend throughout every part of the church structure, but are more particularly important and most easily recognized in the utilitarian items of equipment.

The appointments of a church center may be as complex as those of a Y. M. C. A. building, including a swimming pool, gymnasium, bowling alleys, handball and squash courts, shower rooms, lockers, lounges, and even card and game rooms. Naturally, the architect of such projects is expected to relieve the building committee of much of their responsibility for the solution of technical problems. In these matters, the committee very properly outlines the facilities they desire to incorporate in the structure and the general organization of these facilities for convenience of control and operation. The committee, however, is likely to overlook one important problem which the architect may properly point out to them, and that is the necessity of minimizing subsequent maintenance costs. This matter is quite as important as keeping within a fixed construction budget, for, in fact, maintenance costs are elements of annual budgets that go on from year to year to burden the financial resources of a parish. No material should be employed or no type of construction accepted which will not withstand use and the ravages of time with a minimum of upkeep and maintenance expense.

When all things are analyzed, it will be found that a church problem is not much different from the development of a school building, an office structure, or an intelligently planned factory. There are certain facilities to be provided, certain results to be secured, a definite amount of funds with which to pay for them, and a very real limitation upon subsequent overhead charges. Reconciling these various factors is a problem for the architect to solve in each type of structure. The economic aspects of church construction projects are no less important, though frequently disguised or overlooked, than in the creation of a successful hotel or apartment structure. Perhaps the emphasis that has been placed on the economic aspects of a church project may seem to be unwarranted. The economic factor, however, comes home to the architect very directly when it affects his own fee. Who is the architect really working for? Where are the funds coming from to pay his fees and expenses? With whom is the builder going to contract for the erection of the church? These are very practical questions which the architect must occasionally help to answer.

When first formed, the building committee is an irresponsible body having no legal standing, except the individual liability of its members. Fortunately, most church bodies are incorporated, and the corporate entity appoints the building committee to function as its representative. When such a corporate structure exists, the architect can measure its financial responsibility, can know very definitely its authority for engaging his services, and can seek redress through the courts for any failure to meet its contractual obligations. When there is no such corporate structure in the church body, the architect should endeavor to create a responsible unit which will underwrite all of the expenses and obligations of the project, and standing personally liable for the actions of the building committee. Lacking such underwriting of its expenses, the committee can only function by concurrent action of the church membership, introducing an unwieldy and uncontrollable factor into all negotiations and contracts which are involved during the entire project. The church client must be made legally responsible.

Working successfully with church committees seems to require, therefore, an appreciation of the varied points of view of the important members of the building committee, possession of sufficient tact to reconcile conflicting views, an appreciation of the budget limitations and the subsequent maintenance costs which the church body can afford to carry, and finally, a very practical understanding of the necessity for dealing with a responsible body under a definite understanding.