The Use, Manufacture, and Historic Preservation of Ornamental Electric Lighting Fixtures with the Work of Frederick C. Baker as a Case Study

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by

Barry J. McGinn

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APPROVED: Arthur W. Hawn

An Abstract of the Terminal Project of

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Title: THE USE, MANUFACTURE, AND HISTORIC PRESERVATION OF ORNAMENTAL ELECTRIC LIGHTING FIXTURES WITH THE WORK OF FREDERICK C. BAKER AS A CASE STUDY

Approved: ______________________

Arthur W. Hawn

In many restoration and rehabilitation projects today, there may be a lack of understanding of the central role historic lighting systems played in aiding architectural expression and spatially unifying interiors through luminaire design, lighting strategy, ornamentation and materials.

The goal of this project is to establish a deeper understanding of the role of historic lighting as an informant to sensitive lighting rehabilitation. A general understanding of historic lighting is first developed through a study of historic luminaire design precedent, developments in twentieth century material processes as applied to luminaire manufacture, and to developments in illumination science. This understanding supports a more specific case study of a long established Portland, Oregon, luminaire designer, Frederick C. Baker. The evolution of Baker's luminaire designs in response to changing architectural styles and attitudes, developments in material processing and advancements in illumination science is examined. Eleven case studies of Frederick C. Baker lighting installations are included in the appendix and support the chapter on Baker. The background chapters and Baker case study are intended to inform the drafting of a set of lighting rehabilitation guidelines in the final chapter.

VITA

NAME OF AUTHOR: Barry J. McGinn

PLACE OF A BIRTH: Regina, Saskatchewan, Canada

DATE OF BIRTH: September 14, 1958

UNDERGRADUATE AND GRADUATE SCHOOLS ATTENDED:

University of Regina, Regina, Saskatchewan
University of Saskatchewan, Saskatoon, Saskatchewan
University of Oregon, Eugene, Oregon

DEGREES AWARDED

Bachelor of Science in Mechanical Engineering, 1981, University of Sask.
Master of Architecture, 1989, University of Oregon
Master of Science, 1990, University of Oregon

AREAS OF SPECIAL INTEREST

Historic building service systems
Industrial Archeology
Integrated service systems in new construction

PROFESSIONAL EXPERIENCE

Building mechanical system design and related control system sales, 1981-1986

Historic Preservation Intern, Oregon Department of Transportation, Highways Division, Environmental Section, Cultural Resources Group, August, 1989 - January, 1990

Department of Architecture faculty Research Assistant appointment to the Center for Housing Innovation's Energy Efficient Industrialized Housing Research Program, January 1989-

AWARDS, HONORS AND PUBLICATIONS

Paper presented to the 1990 annual meeting of the Society of Architectural Historians in Boston - "The Use of Povey Brother's Stained Glass Windows in the Split-flue mantel pieces of Northwest Residences," requested and submitted for publication in Professional Stained Glass magazine, June, 1990

Student travel scholarship to attend the 1990 annual meeting of the Society for Industrial Archeology

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Chapter 1 Introduction

Electric lighting design was an indispensable part of the architectural design program of historic twentieth century buildings. By combining with architectural form and spatial conditions to contribute to a unified whole, it developed as a powerful force in determining the experiential qualities of these buildings. Early twentieth century luminaire design drew heavily on historical lighting fixture prototypes in order to harmonize with the predominant period-revivalist architecture. The low-intensity 16 candle-power carbon filament lamps allowed the simple design duplication of gas fixtures with their multitude of open flame nozzles. As stronger incandescent lamps were introduced and electric lighting became more popular with improvements in the electrical generating industry, illumination science developed to cope with the physiological concerns, luminaire design potential, and lighting scheme design. Throughout the 1920's, an underlying theme in the field was to exploit lighting for it's potential to aid architectural expression. This was done through a thoughtful sharing of ornamentation themes and materials with the architecture and by designing and locating luminaires to highlight the room surface textures and colors through the play of shade and shadow. Metal casting, forging and detailed sheetmetal work were the most common material processes used in order to obtain the ornamental relief detail that would harmonize with the architecture. Luminaire and lighting scheme design continued to evolve through the 1930s in response to changing architectural styles and attitudes, advances in illumination science and lamp technology, and to advances and improved economies in material processing. Throughout this period of rapid change in the building illumination field, the integration of lighting fixtures into architecture to achieve spatial unity was a dominant theme. After World War II, the preference for the higher illumination levels possible with fluorescent lighting schemes, and the elimination of ornament from architecture, largely brought an end to the use of ornamental luminaires in buildings.

In many restoration and rehabilitation projects today, there may be a lack of understanding, even by rehabilitation professionals, of the central role historic lighting systems played in reinforcing architectural design intentions and spatially unifying interiors through design, lighting strategy, ornamentation, and materials.

The goal of this project is to establish a deeper understanding of the role of historic lighting as an informant to sensitive lighting rehabilitation. In this project, an understanding of historic lighting developments in general is first presented in support of a more specific case study of a long-established Portland lighting fixture designer, Frederick C. Baker. Baker's prolific career as an ornamental lighting fixture designer and fabricator spans from before 1913 to his death in 1981, at the age of 94. Through his close collaboration with most of the prominent Oregon architects prior to World War II, he became a recognized regional leader in integrating high quality and original luminaires into their architectural settings. Eleven case studies of Frederick C. Baker lighting installations, drawn as representatives from the five discernible design periods of his career, are included in the appendix and support the chapter on Baker. The background chapters and Baker case study are intended to inform the drafting of a set of lighting rehabilitation guidelines in the final chapter.

The background chapters address three important areas necessary for the understanding of historic electric lighting. These include:

i) a brief study of the development of the four major lighting fixture types - candelabra/torcheres, suspended, wall bracket and lanterns - which provided the historic design precedents for many early twentieth century luminaires;

ii) a study of the predominant material processes used in the manufacture of luminaires;

iii) the development of illumination science and it's effect on luminaire and lighting design.

The following chapter on Baker explores how one talented lighting fixture designer's luminaires evolved in response to changing architectural styles and attitudes, advances in illumination science and lamp technology and his eventual move to machining processes from casting and forging processes. Of particular interest to the project, are the means by which Baker achieved the high level of luminaire integration, and thus, spatial unity, on so many of his lighting installations.

The author established periods in Baker's career, based on the design, illumination techniques and ornamentation of his luminaires, from which the eleven representative case studies are drawn. The periods selected were: Early Illumination (1910-1914), Beaux-Art (1918-1929), Decorative Art Deco (1929-1935), Planar Art Deco (1935-1940) and Modernist (1946-1965). A page footer identifies the case study by it's appendix entry.

The research methodology pursued for the background chapters was predominantly period literature in the form of textbooks, manuals, catalogues, tradebooks, popular books, and architectural and engineering journals. This provided an historic account of how designers were using and responding to changes in illumination science and material processing. The greatest resource to the Baker chapter were the actual existing Baker lighting installations. Many retain their original character and provided a excellent opportunity to examine luminaire design, construction and ornamentation, the overall lighting scheme, and the integration of lighting into architecture. Some of the drawings for the case studies were located among the 9000 Baker drawings bequeathed to the Oregon Historical Society, and provided valuable insight into design and construction. The drawings also gave some idea of Baker's skill as a draftsman and artist and his creativity and dexterity as a designer. Cassette tapes of two full length interviews of Baker, in the collection of the Oregon Historical Society, provided some valuable insights as well as a more personal connection to the man. Historical photographs of original spaces showing the Baker fixtures were also immensely helpful, again most of which are in the collection of the Oregon Historical Society and University of Oregon Archives and Special Collections. Most of the resource material in the area of historic lighting rehabilitation was from contemporary architectural journals, in conjunction with site visits to rehabilitation projects. The author had the good fortune to be able to compare a feature length article of a lighting rehabilitation of the Colorado State Office Building in Denver, which appeared in Architectural Lighting magazine, with the actual project. Another site visit was paid to the Portland Theatre, rehabilitated in 1981, after an interview with the original historic preservation sub-consultant, Judith Rees.

The project also attempts to explore the potential of a desk-top publishing approach and makes considerable use of current 'scanning technology.' Most of the drawings in the document were 'scanned' on to a computer disk and imported into the particular file. Although this approach, when combined with a double column format, provides for quite an interesting visual experience, it is not without it's difficulties. Scanned computer images consume considerable quantities of computer memory; in excess of twenty separate computer disks was required for this project.

Chapter 2

A History of Ornamental Lighting Fixtures

The Roman Period

The provision of artificial illumination, through artfully designed ornamental lighting fixtures, has been a preoccupation of humankind for over four millennia. The ornamental lighting fixtures of these early societies provided influential prototypical forms which continued to inform

Figure 1. Two-spout hanging Roman bronze lamp

fixture design through the ages. In order to fully understand the design intention, use of materials, lighting strategy and ornamentation of historic twentieth century electric lighting, it is important to understand the historic precedence set by earlier lighting forms. This chapter will provide an overview of the evolution of the four major types of ornamental lighting fixtures; suspended, candelabrum/torchiere, wall brackets and lanterns.

Pottery oil lamps were fashioned from clay as early as 3000 BC and provided the most common form of interior illumination during the period of the Roman Empire. They consisted of an oil chamber to hold the oil, which was

Figure 2. Roman sanctuary lamp

filled through a central filling hole, and a nozzle with a wick hole. A fibrous wick fed fuel to the flame by capillary action. Increased illumination was only possible by supplying more nozzles. This would continue to be a limiting factor for all open flame lighting fixtures until the advent of electric incandescen. lighting.[1]

The Romans, through the use of oil-burning lamps and torches, developed the four major types of lighting fixtures, hanging, wall

[1] Robert L. Smith, "Lighting Technology :from darkness to opportunity," Archectural Lighting, November 1986, p. 56

bracket, candelabrum/torchere and lantern[2], which would provide much of the inspiration for lighting fixture design through the ages. The Roman ornamental hanging lamp was usually cast in bronze, as were most ornamental lighting fixtures of the period.[3] Bronze was a material that lent itself well to the Roman penchant for decorative art suffused in rich high relief. The hanging lantern (figure 1.), with its extended nozzles, would be literally reinterpreted by nineteenth century French artists in an effort to strike an associative relationship between Imperial Rome and Napoleonic France.[4] One of the types of Roman fixtures which survived the 'dark ages'

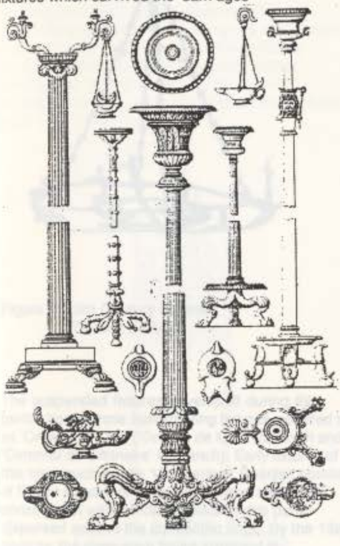


Figure 3. Ensemble of Roman lighting

Figure 4. Roman lantern (cast bronze frame)

through to the Renaissance period was the sanctuary lamp (figure 2.).

The classical candelabrum form, usually incorporating a column motif into its shaft, constituted the torchere fixture and was also given branches for the suspension of oil-burning lamps (figure 3.). It also became common to hang lamps from wall brackets; a precursor of the ubiquitous wall bracket fixture, common to all subsequent periods.[5] The lantern fixture type was also present in the Roman period, albeit in a fairly unpretentious form (figure 4.).

Candles of tallow or beeswax were used by the Imperial Romans, but were more common in the northern provinces where access to olive oil was limited.[6] As medieval society progressed, the smoking torch was displaced by ornamental lighting fixtures supporting candles. Candlemaking was a tedious process which involved the coating of the rush or linen wicks by dipping, pouring, or forming in molds. Because of this time-consuming process, candles were expensive and almost exclusively available to the wealthy or the ecclesiastics.[7]

The Gothic Period

Iron became the predominant ornamental lighting fixture material during the Romanesque and Gothic periods, except in Moorish Spain, where brass and bronze were common. Advances in metalworking techniques through the period

[2] Henriot Gabriel, "Tome I - Antiquite,"Encyclopedia du Luminaire, (Paris; Les editions Guerinet, R. Panzani, succ., 1934 - 1935.), plates 1 - 24.

[3] Ibid.

[4] Glen Gould, Period Lighting Fixtures (New York: Dodd, Mead and Company, 1926.), p. 158.

[5] Henriot Gabriel, "Tome I - Antiquite,"Encyclopedia du Luminaire, (Paris; Les editions Guerinet, R. Panzani, succ., 1934 - 1935.), plates 1 - 24.

[6] Donald Strong and David Brown, Roman Crafts (London: Duckworth , 1976), p. 93.

[7] Robert L. Smith, "Lighting Technology :from darkness to opportunity," Archectural Lighting, November 1986, p. 57

were accompanied by a move to more complex and ornate forms.[8] The fine wrought ironwork started to give way by the late Gothic to cast bronze; a material more amenable to embellishment with architectonic detail which became a central design theme in many fixtures.[9] The four major fixture types evolved quite independent of their Roman prototypes, primarily as candle-holders.[10]

Figure 5. 13th Century Spanish
'Corona de Lux'

The suspended fixtures developed during this period from simple hanging ring fixtures, referred to as 'Crowns of Light'('Corona de lux' in Spanish and 'Coronne de luminaire' in French). Early fixtures of this type, such as the 13th century Spanish corona of Figure 5, were of crude strap metal and chain construction with candle-sockets in drip pans dispersed around the concentric rings. By the 15th century, the rings were being arranged in expanding tiers, with a greater effort at

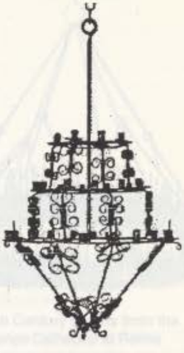


Figure 6. 15 th Century Italian
Tiered Corona

design and ornamentation (Figure 6.).[11] If the candles were not extinguished every five to twenty minutes, there was a risk of the valuable tallow pooling-off into the grease pan and dripping to the floor to become a fire hazard. The further inconvenience of always requiring a source of flame on hand required the rubbing of two sticks or flint and steel in tinder. Dry tinder was often carried about in a tinder box for this purpose and usually allowed a flame to be struck in a few minutes.[12]

By the late Gothic period, the corona form had evolved into the massive gilded cast bronze ecclesiastical coronas of the French Gothic Cathedrals. Like most of the sculpture in these cathedrals, these coronas, which symbolized the biblical walled city with its gate and tower structures, was intended to educate the illiterate masses (Figure 7.). They were suspended from a complicated system of ball and rods (Figure 8.). The casting in bronze facilitated the incorporation of sculpted massing and the architectonic

[8] Glen Gold, Period Lighting Fixtures (New York: Dodd, Mead and Company, 1928), p. 44.

[9] Henriot Gabriel, "Tome II - Moyen-age," Encyclopedia du Luminaire, (Paris: Les editions Guerinet, R. Panzani, succ., 1933-1934.), plates 42-59.

[10] Glen Gold, Period Lighting Fixtures (New York: Dodd, Mead and Company, 1928), pp. 39-42.

[11] Glen Gold, Period Lighting Fixtures (New York: Dodd, Mead and Company, 1928), p. 21.

[12] Robert L. Smith, "Lighting Technology: from darkness to opportunity," Architectural Lighting, November 1986, p. 57.

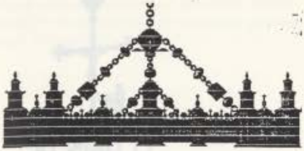


Figure 7. 15 th Century corona from the French cathedral Aix-la-Chapelle

detailing that was sought.[13] Elaborate Gothic chandeliers also developed during this later Gothic period (Figure 9.). These tended to exhibit a stronger connection to the prevailing Gothic architectural idiom through the use of such ornamental devises as pointed arches with cusped tracery and foliated detailing.[14]

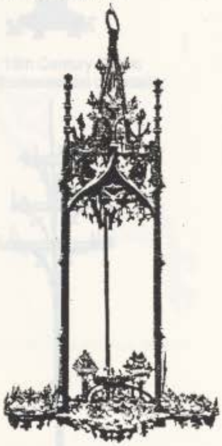


Figure 9. 15th Century Gothic chandelier

[13] Henriot Gabriel, "Tome II - Moyen-age," Encyclopedia du Luminaire, (Paris: Les editions Guerinet, R. Panzani, succ., 1933-1934.), plates 56-57.

[14] Ibid., plate 59.

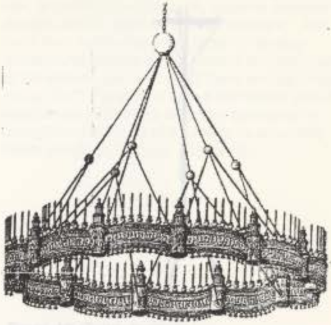


Figure 8. 15th Century corona from the French Cathedral at Reims

Figure 10. Early Gothic Spanish wrought iron candelabrum

The candelabrum (standing candle holder)/torchiere (torch holder) form evolved from rugged ironwork in the early Gothic period (Figure 10.) to a decorative object of impressive size and ornamentation (Figure 11.). As in the suspended fixtures, the later fixtures relied on architecture for

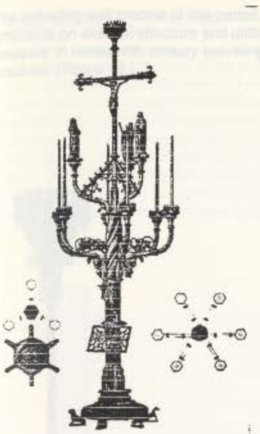


Figure 11. 13th Century Gothic
Ecclesiastical chandelier

Figure 12. Gothic tiered corona candle-holder

Figure 13. Gothic torchere

its design and ornamental themes.[15] The intervening mode between the two above saw the corona motif adapted to a standard supported on tripod feet (Figures 12. & 13.).

Wrought iron remained the preferred material for the wall bracket fixture form throughout the Gothic period and into the Renaissance period. The quality of workmanship in forging twisted multi-faceted bar and ornate foliated detail was very high.

Figure 14.

[15] Ibid., plates 42-59.

The swiveling wall bracket of this period, with its emphasis on skeletal structure and utility, would reappear in nineteenth century swiveling gas wall brackets (Figure 15.).[16]

Figure 15. Gothic Ecclesiastical bracket

The lantern form, either as hung, for hand use, or carried in processions, became common in the late Gothic period in Western Europe.[17] The basic form had four or more sides of identical architectural window motifs, vertical outrigger bars at the corners, and a sculpted base and top (Figure 14., p. 7.).[18] Toward the end of the Gothic period, cast bronze became an attractive alternative to wrought iron because of it's ability to accurately model architectural detail (Figure 16.).

Figure 16. Late Gothic French Lantern

[16] Denys Peters Myers, Gaslighting in America, (Washington D.C.: National Park Service, Technical Preservation Services Division, 1978), p. 171.

[17] Glen Gould, Period Lighting Fixtures, (New York: Dodd, Mead and Company, 1926.), p. 93.

[18] Ibid.

Renaissance Period

This period is marked by an embracing of the humanistic thought and values of classical Greece and Rome. Existing architecture and decorative art of the Roman period was re-examined for its design, proportions and ornamentation. The new classical aesthetic was quick to assert itself in the field of ornamental lighting fixtures, having its greatest impact on the candelabrum/torchiere and lantern forms.[19]

Figure 17.

The fixture form which underwent the most complete transformation during this period was the candelabrum/torchere. It's tripartite division of base, middle and top, lent itself particularly well to the borrowing of classical design and ornamental

Figure 18.

motifs. Although there is considerable variety in the bases, the center portion was generally composed of a collection of stacked classical vase forms, or was based on a classical column (Figure 17.) The limitless design potential of this fixture form attracted the artistic genius of such Renaissance men as Michael Angelo.[20]

[19] Glen Gould, Period Lighting Fixtures, (New York: Dodd, Mead and Company, 1926.), pp. 10-11.

[20] Ibid., p. 1[illegible].

Figure 19.

The revival of bronze work in the 13th century left only a slight mark on the sharp lines of the Gothic Candelabrum. This impressionable material, however, proved to be ideal for the graceful shapes and detailed surface ornamentation of the Renaissance candelabrum. The fine Roman bronze work that was being excavated and collected at this time provided superlative examples for study and emulation.[21]

Wrought iron continued to be used for candelabrums, but was handled with increasing freedom. The appearance of extra inner volutes on the tripod base in the late Gothic period underwent increased elaboration throughout the Renaissance period (Figure 19.).[22]

In this period of experimentation, carved and gilded wood, silver, cut glass, and ceramics were also acceptable materials for candelabrums. The Italian expertise in that lustrous ceramic ware known as majolica, is particularly notable. These ceramic candelabra lent themselves naturally to vase and bowl forms and featured beautiful painting on the smooth white slip coating which covered this ware (Figure 18.).[23]

Figure 20.

The hanging sanctuary lamp was the only Renaissance lighting fixture whose descendancy from the Roman period was uninterrupted. The Roman-style low basin shapes were common during the Renaissance and were elaborated to include narrow-necked round-bellied vase forms. These lamps were of bronze, brass and frequently silver, which was decorated in elaborate repousse work.[24] An interesting variation developed during this period, the lampadario, having a central bowl surrounded by branching candle sockets. This form (Figure 20.) likely served as inspiration for the baluster-stemmed branching

[21] Ibid., p. 11.

[22] Ibid., pp. 55-59.

[23] Glen Gould, Period Lighting Fixtures (New York: Dodd, Mead and Company, 1928), p. 13.

[24] Ibid., p. 23.

Figure 21.

brass chandelier which developed in Flanders in the late Renaissance.[25] These Flemish chandeliers had a solid brass core of stacked vase forms and were extremely heavy. They were very

Figure 22. Late Renaissance Wall Bracket

popular, however, and were exported to France and England in great numbers to serve as a basic model for elaboration during the Baroque period.[26]

The wall bracket remained primarily the domain of the blacksmith working in wrought iron.

[25] Ibid. p. 23

[26] Ibid., p. 45.

Building on the scroll form so popular during the Renaissance (Figure 21.), there was a progression toward more naturalistic forms (Figure 22.).

Italy and Spain were the hotbeds of lantern development during the Renaissance. Italian lanterns became essential embellishments to the Italian urban palazzi. The cast bronze lanterns tended to carry a Renaissance architectonic theme, while the wrought iron lanterns were generally based on the quatrefoil, a decorative motif rooted in the Gothic tradition.[27]

Most of the cast lanterns employed a free mix of Gothic and classical ornament, such as Gothic spikes and arched openings supported on classical columns (Figure 23.). The Renaissance artist cast their lanterns in bronze, not only to achieve the fine detail, but to make an associative connection to the Roman period, when bronze was the most prevalent ornamental material for lighting.[28]

[27] Gerald K. Geerlings, Wrought Iron In Architecture, (New York: Dover Publications, 1929.), p. 30-32.

[28] Glen Gourd, Period Lighting Fixtures (New York: Dodd, Mead and Company, 1928), pp. 10-11.

Figure 23.

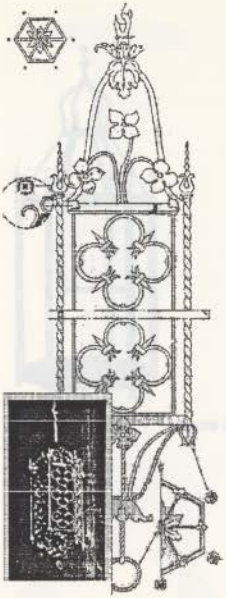


Figure 24.

The quatrefoil (four-lobed motif) was the most pervasive motif of Italian wrought iron work throughout the fourteenth, fifteenth, and early sixteenth centurys. At their inception in the fourteenth century, they were made by piercing sheets of iron. The individual quatrefoil units were then linked together by rings, similar to medieval chain mail armor. This labor-intensive technique was replaced in the fifteenth century by the banded C-scroll quatrefoil (Figure 24.). A modified and characteristic form of this C-scroll had spear-headed accents banded together.[29] The quatrefoil is an example of the pervasive influence of religious symbolism on Gothic period architectural ornament; the four lobes actually symbolize the four evangelists.

[29] Gerald K. Geerlings, Wrought Iron In Architecture, (New York: Dover Publications, 1929.), p. 30-32

The Spanish lantern of the Renaissance exhibits a strong reliance on the Moorish tradition. Mosque architecture, with its stylized domes and arched openings, supplied the architectural model for quotation. They were usually constructed of gilded or polychromed tin or brass in the traditional Moorish pierced metalworking style (Figure 24.).[30]

A variation on the exterior hanging lantern, the hall lantern, made its appearance during the Renaissance. These were simple functional lanterns for use in vestibules, halls and stair landings, but would become the subject of considerable elaboration during the Baroque (Figure 26.).[31]

Figure 25.

Figure 26. Hall Lantern

[30] Glen Gould, Period Lighting Fixtures (New York: Dodd, Mead and Company, 1928), P. 67.

[31] Ibid., pp. 69-76.

Baroque and Rococo Periods

The sumptuous elaboration of Renaissance forms, so characteristic of Baroque architecture, was also reflected in decorative art of the period. A greater emphasis on the use of lighting fixtures as decorative elements to reinforce interior architectural themes developed during this period. The most significant product of this trend was the development of wall appliques and varied wall brackets as well as the crystal chandelier. Although technical advances were made in gas lamp fixtures during this period, candle fixtures continued as the predominant ornamental lighting fixture during this period.[32]

Figure 27.

The mutation and transformation of Renaissance forms is apparent in the candelabrum designs of this period. The three dimensionally

Figure 28.

curvilinear planar surfaces, and the over-emphasized and attenuated scroll, vase, foliated, and gadrooned motifs are among the repertoire of characteristics (figure 27.). Gilded copper and bronze were common choices of material for their malleability and surface luster. Improvements in wood sawing techniques allowed thinner veneers to be cut. This resulted in an increased use of inlaid hardwood veneers, which were molded to the bowing profiles typical of decorative art of the period. These veneered pieces were often set with cast metal mounts of gilded copper and bronze or of ormolu. Ormolu was the process of mercury gilding and was quite hazardous. It's use on lighting fixtures helped integrate it with the rest of the

[32] Glen Gould, Period Lighting Fixtures (New York: Dodd, Mead and Company, 1928), pp. 120-127.

room's furnishings featuring ormolu mounts.[33]

A similar trend to elaboration of established Renaissance forms is also evident in the wrought iron work of the period. The knobbed detail on the

Figure 29.

standard of the wrought iron candelabrums of Figure 29. are called knops and were quite common on this type of fixture.

Even though Baroque artists transmuted Renaissance forms, they abided by the law of symmetry. The later stage of Baroque, the Rococo, was marked by a decorative ornament of swirling curves and crimps based on rocaille, water worn rockery, shell forms and flowing foliation. These were usually interpreted through dissymmetrical compositions for a more natural effect (Figure 28.).[34]

Figure 30. Baroque baluster-type chandeliers

[33] Glen Gould, Period Lighting Fixtures (New York: Dodd, Mead and Company, 1928), P. 112

[34] Ibid., p. 117.

It was during this period that the suspended chandelier assumed it's role as a spatial focus. Using the Dutch Renaissance solid brass baluster-type chandeliers as a model, the Frenchexplored the full limits of this fixture type's possibilities. Most of the fixtures in this vein were of gilded bronze with branching arms extending from a central vase or baluster shape (Figure 30.). Rococo chandeliers were marked by the same dissymmetry and vigorous naturalistic ornament as the candelabrum forms (figure 31.).[35]

Figure 31. Rococo chandelier

The form of sanctuary lamps generally remained unchanged through the Baroque period, but were swathed in voluptuous detail (Figure 32.).

Figure 32.

[35] Ibid., pp. 122-124.

Figure 33.

They were usually built of silver or brass and incorporated high relief repousse work.[36] The process of repousse work has changed little from the Baroque period. First the rough shape

Figure 35. Baroque Spanish lantern

[36] Ibid., p. 29

Figure 34.

is pounded out on a hollowed-out stump with various ball-peen hammers. Then the piece is sunk into a heated bowl of pitch (tar) and is allowed to cool. The design is then lightly hammered out from the inside, against the surrounding pitch, with a mallet and punch.

During the Baroque period, France asserted the dominant influence over the prevailing lighting fixture designs, as well as over architecture in general. The applique, or decorative interior wall fixture, emerged as this period's most important contribution to the history of ornamental lighting fixtures.[37] They were often dispersed about a room in order to integrate with a central suspended fixture of a similar character or with the furniture. Developing from the wrought iron bracket fixtures of the Gothic and Renaissance periods, appliques took on innumerable forms in cast metal and carved wood (Figure 33. and 34.).

The lantern retained it's importance as

[37] Ibid., p. 121.

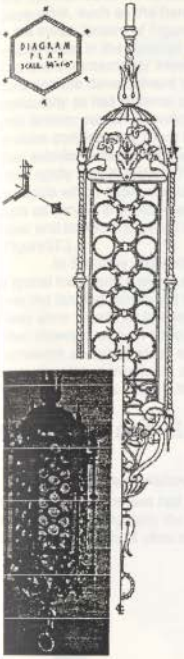


Figure 36. Baroque Italian wrought iron lantern

exterior and loggia lighting during the Baroque period, albeit in more elaborate forms. Both Italian and Spanish lanterns tended to incorporate fine glass-work, such as the hand-spun rondels present in the Italian lantern of Figure 36. and the detailed leaded glass in the Spanish lantern of Figure 35. The use of lanterns for interior lighting enjoyed considerable development during this period, particularly as hall lanterns and pole lanterns. The pole lantern was an invention of this period and evinces considerably more freedom in conception

Figure 37.

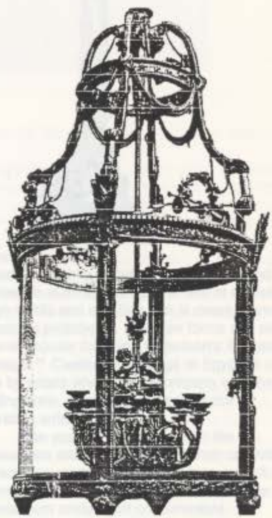


Figure 38. Baroque French hall lantern

and Spanish lanterns tended to incorporate fine glass-work, such as the hand-spun rondels present in the Italian lantern of Figure 36. and the detailed leaded glass in the Spanish lantern of Figure 35. The use of lanterns for interior lighting enjoyed considerable development t during this period, particularly as hall lanterns and pole lanterns. The pole lantern was an invention of this period and evinces considerably more freedom in conception than exterior lanterns, whose general form was more rigidly cast in history. They were built of materials which allowed exuberant ornamentation, such as carved and gilded wood, cast and chased silver and brass, and gilded cast bronze (Figure37.).

In Baroque architecture, stairhalls assumed a spatial focus and a grand suspended hall lantern over the landing reinforced this role. Because these were meant for interior spaces, they were often crowned with an open lacework. The light framework and clear glass surround encouraged a more decorative treatment of the interior candle holding apparatus (Figure 38.).

Directoire and Empire Periods

With the establishment of the study of archaeology in the last half of the eighteenth century, and particularly the discovery of household decorative artifacts at sites such as Pompei

Figure 39.

and Herculaneum (Figure 3.), a cult of antiquity pervaded the decorative arts. During the reign of Louis XVI, there was a return to symmetry and a more accurate and obvious use of classical motifs and details. This is also apparent in the work of the Adam brothers in England. Napoleon nurtured and patronized this cult, with its illusions to Imperial Roman might and grandeur, in order to legitimize his own regime through association. Directoire Style ornamental lighting fixtures of this period are

Figure 40.

marked by a clarity in design composition and boldness in outline, through the use of classical design motifs and detailing that is clearly derivative of classical prototypes. Egyptian forms and details became popular following Napoleon's Egyptian campaign.[38] Careful engravings of Egyptian ruins, made by artists who were in company with the invading army, were a valuable resource for decorative artists.

The associative connection the Renaissance artists made with Roman candelabra form was resurrected with more vigor, exactitude, and imagination by the Directoire artists. The candelabrum underwent considerable development during these periods and attained a

[38] Ibid., p. 152

Figure 41. Directoire chandelier

Figure 42. Empire Style sanctuary lamps

Figure 43. Nineteenth century crystal chandelier

spatially dominant scale. Many of the candelabra of these periods are based on the form of an Egyptian column with a bulbous rounded base and slightly flaring lotus capital (Figure 39.).[39] The branching candelabrums flanking the entrances to so many North American Neoclassical and Renaissance Revival buildings of the late nineteenth and early twentieth century, were a direct descendant of the classically-inspired branching candelabra of these periods (Figure 40.).

The central baluster-style stem of earlier chandeliers was replaced by a central classical vase motif, clearly derived from the hanging sanctuary lamps of ancient Rome and Renaissance Italy and Spain. The branches extending from these central forms were typically of a simple C-scroll shape, as opposed to the more elaborate S-scrolls of the previous period (Figure 41.). With the re-establishment of the roots of the hanging sanctuary lamp in ancient Roman culture, through archaeological discoveries, this form was

[39] Henriot Gabriel, "Tome VI - XIX siecle," Encyclopedia du Luminaire, (Paris: Les editions Guerinet, R. Panzani, succ., 1933-1934.)

reinterpreted with impressive antiquarian exactitude (compare Figure 2. and Figure 42.).

Although glass pendants or natural Bohemia quartz crystals were employed with some of these cast bronze chandeliers, they were most common on the brass tiered-corona type crystal chandeliers that remained popular in England. Strings of glass pendants were draped from the various sized corona rings to form bowl-like shapes (Figure 42). The glass pendants magnified the candlelight and thereby made it possible for these imposing fixtures to light their typically cavernous spatial settings.

Appliques continued to be a critical interior architectural element and were characterized by a similar use of bold classically-inspired forms (Figure 44.).

Figure 44. Empire Style appliques

Nineteenth Century Gas Lighting

1815-1830

Gas lighting became commercially available around 1820 in England. Ornamental gas-lighting fixtures generally took their forms from the established repertoire of candle fixtures - candelabrum, chandelier, wall-bracket and lantern

Figure 45. 1815 gas fixtures

(Figure 45.). Gaslight fixtures still required multiple burners to increase the overall illumination level; so the adaption of accepted candle fixture forms to gas lighting was quite easy. Technology advanced quickly, and by 1830 swivel extendible jointed connections in wall brackets were common.[40]

1840 - 1860

By the early 1840s ornamental gas lighting fixtures were being manufactured in the United States. The fixtures of this period are notable for their exuberant Neo-Baroque/Neo-Renaissance

Figure 46. bronze gas chandelier 1840 - 1860

[40] Denys Peter Myers, Gaslighting in America, (Washington D.C.: National Park Service, Technical Preservation Services Division, 1978.), pp. 11-15.

Figure 47. rod gas fixture 1840 - 1860

character and striking contrasts of juxtaposed surface finishes. The suspended fixtures illustrated in Figures 46 and 47 are of cast bronze with contrasting applied ornament in burnished gilt (yellow tint) and matte gilt (orange tint).[41] The bronze was often given a slight deep green patina for a different effect. Gas tubing would have run down the center of each of the suspension rods to supply the burners. Although the fixtures shown in Figures 48. and 49. are also of bronze and gilt, they were also often constructed of spun and lacquered brass with cast and gilded bronze for accenting. Pendant lights cantilevered on brackets, such as that of Figure 49, were referred to as toilets when located adjacent to dressing mirrors.[42] The hall lantern forms common in the Baroque period were radically reinterpreted as gas hall pendants (Figure 50.). The examples shown would have, again, incorporated gas tubing into the suspension rods. They usually had glass or porcelain smoke bells, which had to be regularly removed and cleaned, so clean electric incandescent lighting was a welcome invention. It was during this period that the

Figure 48. Neo-Baroque gas fixture 1840 - 1860

Figure 49. toilet gas bracket 1840-1860

candelabrum form became institutionalized as the gas pillar. Either as the pillared candelabrum or as the branched candelabrum, they became popular in commercial/retail establishments as counter-top fixtures (Figure 51.). 'Gas stands' as figural

[41] Denys Peter Myer, Gaslighting in America (Washington D.C.: U.S. Department of the Interior, Technical Preservation Services Division, 1978), p. 55.

[42] Ibid., p. 63.

Figure 50. hall pendants 1840 - 1860

Figure 51. gas pillar 1840 - 1860

compositions were also classified as gas pillars during this period. 'Gas stands' were smaller portable desk lamps which connected to a special gas connection on a suspended gas chandelier with a flexible hose.[43]

1860-1880

Gas fixture design during this period was heavily influenced by English Aesthetic Era design based on conventionalized geometric and natural forms. A stylized outline was often sought in the chandeliers, wall brackets and hall pendants (Figures 52., 53., and 54.), which were typically composed of radial branches of a simplified angular character.[44] Although cast and gilded bronze continued to be popular, cast iron, which was widely used as a structural and building facade material during this period, also became common.[45] Tubular, spun, stamped, and cast brass were often simultaneously combined in fixtures. The frosted shades of most of these fixtures were etched in conventionalized geometric and natural designs. Fixture design reflected the various styles prevalent in architecture of this time, such as the polychromed brass Gothic Revival wall bracket of Figure 54. It was common to leave the gas jets exposed in the 'Gothic style' in these fixtures.[46] These fixtures would have integrated nicely into the polychromed interiors of Gothic Revival

Figure 52. hall pendant 1860 - 1880

[43] Ibid., p. 111.

[44] Ibid., p. 171.

[45] Ibid., p. 135.

[46] Ibid., p. 171

Figure 53. Eastlake-inspired chandelier 1860/1880

buildings.

Gas reflectors underwent considerable development during the 1870s. They were designed to be either suspended from the ceiling or inserted into the ceiling. "Reflectors were lined with either mirrored glass or silvered metal and were used wherever intense light was required. They were made in various sizes, depending on the area to be illuminated."[47] When ordering these reflectors, customers would send in the room dimensions and the manufacturer would select the appropriately sized fixture to provide the required illumination level. Inserted reflectors, such as the one in Figure 55., were connected to vents to draw off the heat and fumes. As a measure to increase reflection in this fixture, the striations on the inner cone are horizontal, while the striations in the outer cone run radially.

Figure 54.

[47] Ibid., p. 197.

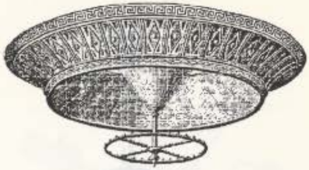


Figure 55. gas reflector

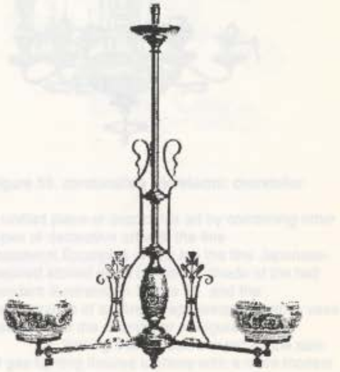


Figure 56. Aesthetic Era gas chandelier

1880-1910

The angular Eastlake-inspired branched - baluster type fixtures of the previous period were simplified and refined with an emphasis on stylized natural and Japanesque forms.[48] Tubular, spun, wrought and cast open-work brass were common f materials because of the delicate lightness they made possible. There was also an effort to create

[48] Ibid., p. 197.

Figure 57. Aesthetic Era hall pendant

Figure 58. catalog gas fixture

Figure 59. combination gas/electric chandelier

a unified piece of decorative art by combining other types of decorative art with the fine metalwork.Examples of this are the fine Japanese-inspired etched glass cylindrical shade of the hall pendant illustrated in Figure 57. and the incorporation of an Ango-Japanesque ceramic vase baluster into the chandelier of Figure 56.[49]

A thriving market also existed for the sale of gas lighting fixtures to those with a more modest income. This was often done through fixture manufacturer catalogs or through general merchandise catalogs, such as Sears Roebuck and Co. During the early twentieth century these were typically feebly modeled on the major architectural styles, such as the 'Empire' fixtures illustrated in Figure 58.[50]

Because of the frequency of power outages by the fledgling electrical generating industry, combination gas/electric lighting fixtures were common during this period. They were generally based on the popular gas lighting fixture designs except the flaring gas light shades were set vertical and the the smaller electric light shades pitched down at forty-five degrees. The

[49] Ibid., p. 197.

[50] Ibid., p. 215.

combination fixture illustrated in Figure 59. is just a standard branched baluster type gas chandelier with alternate branches given over to an electric light socket and bulb. Pierced repousse work on the stem and branches in brass or iron was common, as was the fluted canopy or 'ceiling plate'.[51]

Electric Lighting 1890-1900

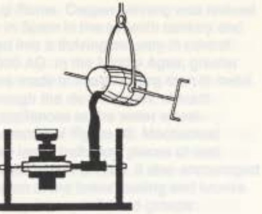
The early Edison-style incandescent sixteen Watt lamps had free-blown bulbs with seal-off tips (the pointed nib at the end of the bulb resulting from the evacuation process).[52] The low surface intensity of these bulbs allowed their use as exposed design elements in early electric lighting fixtures. This was particularly the case with the free-flowing Art Nouveau fixtures which were seeking a conscious aesthetic break with established gas lighting fixture design. A freedom from the constraints of open-flame lighting led Art Nouveau designers toward an entirely new aesthetic in lighting fixture design which encouraged the integration of the exposed bulbs into the design composition. (Figures 60. and 61.)

Figure 60. Art Nouveau fixture

Figure 61. Art Nouveau applique

[51] Ibid., p. 223.

[52] Robert L. Smith, "Lighting technology: from darkness to opportunity," Architectural Lighting, November 1986, p. 58.



Chapter 3

Materials and Processes

Introduction

This chapter will provide a basic understanding of the key materials used in historic ornamental lighting fixtures, as well as the principal means of working those materials. Frederick C. Baker's choice of materials and processes during the evolution of his remarkable career will provide the model for this chapter. His early luminaires utilized the same ornate classical vocabularies as their Beaux-Art architectural settings. Cast bronze lent itself particularly well to intricate classical detail, and where the budget allowed, it was Baker's preferred choice. Cast and wrought Monel Metal, wrought iron, sheetmetal working, spun and tubular brass, cut glass pendants, and a variety of different pressed glass shades were also typical of this period in Baker's career. From the mid 1930s on, however, Baker made greater use of machining processes in the fabrication of his fixtures, in particular, lathe turning and lathe spinning. These developments are closely related to advancements in illumination science as well as developments in the architectural styles of the period and will be discussed in detail in later chapters. This chapter will provide the context for a more specific discussion in a later chapter of Baker's use of materials in the fabrication of various ornamental lighting fixtures.

Materials

Bronze

True bronze, such as that employed in ancient Egypt and in the Greek statues of the Periclean period, was a copper alloy consisting almost uniformly of 88 parts copper to 12 parts tin. The Greeks perfected a means of soldering bronze in the early seventh century B.C.; a development which dramatically improved its formal possibilities. As mentioned in chapter one, the Romans made extensive use of bronze for ornamental lighting fixtures and would occasionally add lead to improve the sculptural workability. Any copper alloy that contains zinc is classified as a brass. During the reign of Emperor Augustus and later, zinc was often added as well to create a brass which allowed pounded-out 'repousse' work in plates and sheets.[1]

With the fall of Rome, the Byzantine and Arab empires revived and enhanced Roman bronze-working techniques. Damascening (ornamental incisions filled with precious stones) and cloisonne work (raised cells filled with baked enamels and natural oxides) on bronze and brass were introduced to western Europe by returning crusaders and Venetian traders.

Based on sheer tonnage, copper and its alloys were the most plentifully produced metals in the world until the beginning of the fifteenth century, when iron became predominant. European copper production was severely curtailed, or in some areas, ceased all together

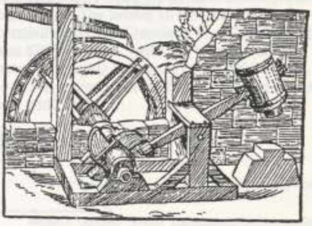


Figure 62. Water wheel powered tilt hammer

[1] Gerald K. Geerling, Metal Crafts in Architecture (New York: Bonanza Books, 1927), p.7.

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Materials

Bronze

True bronze, such as that employed in ancient Egypt and in the Greek islands in the Neolithic period, was a copper alloy containing almost uniformly of 88 parts copper to 12 parts tin. The Greeks perfected a means of achieving bronze in the early sixteenth century B.C., a development which dramatically improved its casting capabilities. As mentioned in chapter one, the Romans made extensive use of bronze for ornamental lighting fixtures and would sometimes add a little zinc to improve the sculptural workability. Any copper alloy that contains zinc is classified as a brass. During the reign of Emperor Augustus and later, zinc was often added as well to create a brass with improved pounded-out ... work in plates and sheets.

With the fall of Rome, the Byzantine and Arab empires revived and enhanced Roman bronze-working techniques. Damascening (ornamental incisions filled with precious metals) and cloisonne work (raised cells filled with enamel) enamels and colours ... were introduced to western Europe by returning crusaders and Venetian traders.

Based on sheer tonnage, copper and its alloys were the most plentifully produced metals in the world until the beginning of the nineteenth century when iron became predominant. European copper production was primarily ... or in some areas, ... of ...

Figure 3d. Water wheel powered tilt hammer

[illegible]

after the fall of Rome. Copper-winning was revived by the Moors in Spain in the seventh century and had developed into a thriving industry in central Europe by 1000 AD. In the Middle Ages, greater advances were made in metalworking than in metal extraction through the development of such mechanized appliances as the water wheel-powered tilt hammer of Figure 62. Mechanical forging allowed larger individual pieces of cast bronze and brass to be handled. It also encouraged the diversification of the brass casting and bronze founding industry into specialized groups fabricating brass pots, household items, bell-casting, gun-casting and architectural monuments. Although there was a revival of work in architectural bronze initiated by Bishop Bernward of Hildensheim around 1045, it was the Italian Renaissance artists who exploited bronze's true plastic potential in the cast panel figures of monumental bronze church doors.[2]

True bronze is admirably suited to casting because of its fluidity and its dense non-porous composition. Bronze also lends itself to rolling, extrusion and forging processes.

Numerous alloys of bronze were developed in the early twentieth century for specifically improved performance; Phosphor Bronze (0.8% phosphorous content) for increased hardness and resistance to wear, Manganese Bronzes (6% ferro-manganese) for added strength at high temperatures and Aluminum Bronzes (2-10% aluminum) with enhanced color qualities for art castings. Ornamental bronze of this period typically consisted of 89% copper and 11% tin. Current metal marketing has capitalized on bronze's noble history and has labeled a number of commercially available brasses as bronzes. Architectural Bronze, ostensibly used on Mies Van der Roh's Seagram Building in New York, is actually a leaded brass composed of 57% copper, 40% zinc and 3% tin. Commercial Bronze is a brass composed of 90% copper and 10% zinc while Statuary Bronze consists of roughly 97% copper, 2% tin and 1% zinc.[3]

Bronze can be chemically treated or electroplated for a variety of surface finishes. In order to effect full adhesion of the electroplated metal or for a uniform surface finish in an oxidizing pickle, the casting must be perfectly clean. The casting is dipped into a cleaning solution of potash, nitrous acid or sulfuric acid and water, which restored its natural luster.

Bronze can be electroplated with gold or silver, but it was more common to give it a patina by immersion in an oxidizing bath (pickle). "Almost any shade from brown to red can be obtained by timing the immersion in a solution of nitrate of iron and hyposulphite of soda, afterwards washing in water and drying in sawdust. To bring out the finishes, mechanical treatment is given, such as scouring with sand and pumice, using various types of brushes and polishing with a lathe and dolly. For a green or antique bronze, a solution may be used composed of acetic acid, carbonate of ammonia, or sal-ammoniac and common salt, cream of tartar and acetate of copper. Light touches of ammonia impart a blue shade to the green parts."[4] Bronze was also tinted with the fumes of chloride of lime over which a small portion of hydrochloric acid had been poured.

Although during the early twentieth century it was common to give architectural bronze a protective lacquer coating of shellac mixed with methyl hydrate, it was understood even then that it would wear off in a couple of years under wear and environmental exposure. It would then require re-lacquering after total removal of the original coat. The preferrec care of exterior bronze was a weekly wiping with a dry cloth, followed by another moistened with crude oil, lemon, or linseed oil, or wax, to clean it and prevent excessive oxidation.[5]

Ornamental bronze casting has always been an expensive venture. A casting in bronze cost about three times the same in cast iron earlier this century. The twelve 10 foot bronze lamps installed in the San Francisco Post Office (1903) cost $950.00 each, while the fourteen bronze lanterns (roughly 2'0"X8'0") cost $600.00 each. In 1912 the estimated cost of a bronze lamp standard was $600.00.[6]

Brass

The quantity of zinc in brass can vary from

[2] Leslie Aitchison, A History of Metals v2, (New York: Interscience Publishers,Inc., 1960), p.326.

[3] Margot Gayle and David W. Look, "Part I. A Historical Survey of Metals," Metals in America's Historic Buildings (Washington D.C.: Preservation Press, National Trust for Historic Preservation, 1976), p.118.

[4] William A. Newman, "Bronze," The Architect and Engineer April 1912, p.98.

[5] Gerald K. Geerling, Metal Crafts in Architecture (New York: Bonanza Books, 1927), p. 28.

[6] William A. Newman, "Bronze," The Architect and Engineer April 1912, p. 101.

5-45%, depending on the color desired; 10% for a bronze color, 15% for a golden color, 20-38% for yellow and above 45% for a silvery-white. From the Middle Ages through to the eighteenth century, brass was made by the old Roman method of reducing calamine (an ore containing zinc) with charcoal in the presence of molten copper. An attempt to create differing grades of brass on order was made, but was necessarily quite difficult to do with calamine. Zinc was not isolated as a separate metal until 1721; Champion's patent for the distillation and condensation of zinc for industrial production did not appear until 1738.[7] As noted in the previous chapter, there was a marked increase in the use of brass in ornamental lighting fixtures during the eighteen century, particularly in crystal chandeliers.

Brass is as easy to cast as bronze and in exactly the same manner and is easier to form as the copper content increases. It will anneal for ease of forging (heating to make soft and workable after becoming hard and brittle from hammering), and will take on a high polish. If left finished in its natural state, brass will take on a blackish tarnish in reaction to the environment, and needs to be either constantly polished or given a protective electroplated surface finish. Brass can be electroplated with gold or silver. One advantage brass has over bronze is that it can be stamped to achieve fine embossed detail. It can also be pounded out by the repousse method for higher relief. Brass can be chemically treated to take on special color effects, such as blue, black and shades of green.[8]

Monel Metal

Monel Metal is a registered trademark name for a nickel-copper alloy developed by the International Nickel Company in 1905. It consists of 68% nickel, 27% copper with the remaining five percent iron, manganese, silicon and carbon. After considerable use in the industrial sector, it gained popularity during the 1920s and 1930s as an architectural decorative metal; one of the new modern 'white metals'. It is capable of taking a high polish finish or a dull matt finish, affording the possibilities of a contrasting surface appearances in the composition. Like, bronze, it can be forged, drawn and cast as well as worked in a sheetmetal form and spun into shapes on a spinning lathe. It lends itself to annealing, welding and soldering and brazing.[9]

When exposed to the elements, it takes on a silver-grey patina which halts further corrosion.

Aluminum

Aluminum became common as a architectural decorative metal during the 1930s. Being a light metal (about half the weight of iron, copper or brass) with a low melting point, it is easily worked by most of the metalworking techniques noted for Monel Metal. Aluminum alloys used for casting usually contain silicon, silicon and copper, or silicon and magnesium.

Most architectural aluminum was left unfinished. A transparent and tough natural oxide patina forms instantaneously to effectively protect the metal from any further corrosion.[10] Electroplating with nickel or chromium was also practiced. Baker spun aluminum into a variety of shapes as reflectors in indirect luminaires.

Iron

Iron, in its pure form, is a relatively soft and malleable grey-white metal and has seen extensive historical use, in its various alloy forms, as an architectural decorative and structural metal.

Wrought iron is almost pure iron, having a carbon content of less than 1% (usually 0.02 - 0.03%). It has a characteristic laminated quality because it consists of slag (iron silicate) fibers entrained, but unbonded, in a ferrite matrix. Steel differs in composition as well as its method of processing. "Steel is cast at a white heat into ingots; wrought iron is removed from the furnace at a lower temperature in a semi-molten plastic condition together with slag, then is formed into bars with most of the slag hammered out. The presence of slag in the composition of wrought iron distinguishes it from steel".[11] Because wrought iron is malleable, fatigue resistant, and easily forged,

[7] Leslie Aitchison, A History of Metals v2, (New York: Interscience Publishers,Inc., 1960), p. 482.

[8] Gerald K. Geerling, Metal Crafts in Architecture (New York: Bonanza Books, 1927), p. 97.

[9] Ibid., p. 185

[10] Margot Gayle and David W. Look, "Part I. A Historical Survey of Metals," Metals in America's Historic Buildings (Washington D.C.: Preservation Press, National Trust for Historic Preservation, 1976), p. 150.

[11] Ibid., p. 130.

rolled and drawn, it has been employed as an ornamental lighting fixture material from the Middle Ages right through to the mid-twentieth century.

Cast iron is an iron alloy with a high carbon content which can vary from 1.7% to 3.7%. Being

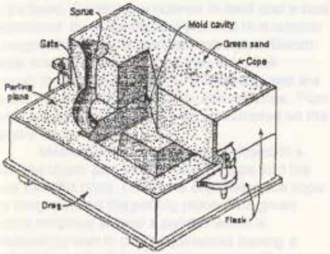


Figure 63. Green sand mold with cope sectioned to reveal interior

highly fluid in its molten state, it is easily poured into molds for ornamental or structural castings. The composition of cast iron is distinguished by the presence of free graphite in the form of flakes. This is what accounts for cast iron's extreme brittleness and high compressive strength. Cast iron was a common choice of material for larger exterior lighting luminaires, as well as less expensive gas chandeliers.[12]

Steels contain less than 2% carbon and can be alloyed to numerous other metals to

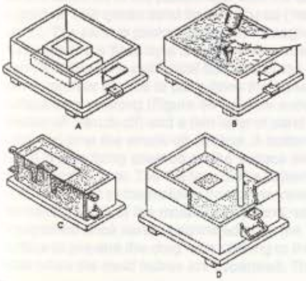


Figure 64. One-piece flat-back casting

[12] Ibid.

enhance such characteristics as strength, resistance to abrasion, weldability, machinability, and corrosion resistance.

Iron alloys, with the exception of stainless steel, oxidize rapidly when exposed to a damp atmosphere. Historically, painting was the necessary preventative measure.

Processes

Casting

Drawing on a rich heritage, casting processes continue to involve a large segment of the metals industry. Prehistoric humans fabricated tools by pouring molten metal into open molds of baked clay or stone. As evidenced by archaeological finds, metal casting was practiced over 4000 years ago by the Egyptians, Assyrians

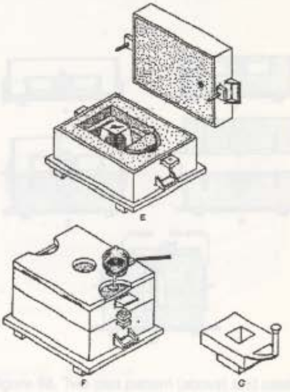


Figure 65. One-piece flat-back casting

and Chinese.[13]

Simply stated, the process of sand casting involves pouring molten metal into a preformed mold or cavity. Metal die casting is suited to rapid production of many identical castings and has little application to the manufacture of historic

[13] John Neely and Richard Kebbe, Modern Materials and Manufacturing Processes (New York: John Wiley & Sons, 1987), p. 145

ornamental lighting fixtures, and will not be discussed. Sand casting played a major role, however, and will be covered in detail.

Of all the methods of producing castings, green sand casting is the most common. The sand is called green because it depends on moisture for it's bond. Casting is a science in itself and is best understood by reviewing the process in a number of progressively more complex examples. Bench molds are so named because they are small enough to be manipulated by one person and are usually set on a short bench for convenience. Floor molds are larger and have to be constructed on the foundry floor.[14]

Medium sized casting are enclosed in a flask, the upper part of which is the cope and the lower part the drag. The plane separating the cope and drag is called the parting plane. The green sand is modeled around a pattern which is withdrawn (drawn in casting parlance) leaving a cavity into which molten metal is poured. The vertical passage into which the molten metal is poured is called the sprue, which connect to similar horizontal passageways at the parting plane, called gates, which convey the molten metal to the cavity (Figure 63.).

The easiest and most economical casting are bench molds of one-piece flat-back patterns on a straight parting in the mold; that is, the pattern does not bisect the parting plane. The molding process begins with placing the drag half of the flask in an inverted position on the smooth flat molding board and placing the pattern within the flask (Figure 64 A.). A 1/4 inch coating of green sand is sifted on to the pattern and then the drag is topped off with green sand from the heap ('heap sand'). The sand is packed uniformly throughout the depth of the flask by a technique known as peenramming. The cylindrical butt end of the bench rammer is used to pack down the loose surface after peening (Figure 64 B.). The surface is leveled off (struck-off) and a thin layer of sand scattered over the struck-off surface. A bottom board is then firmly pressed on the surface and the drag is flipped over. The flat face of the pattern which was next to the molding board now rests in the parting plane of the mold. Parting sand, which is fine-grained silica sand, is sprinkled on to the surface to prevent the drag from sticking to the cope when the mold halves are separated. The cope half of the flask is then placed in position on the drag and a slightly tapered wooden sprue pin is located near the pattern where the gate will be constructed (Figure 64 C.). The cope is then filled with sand, peenrammed, and struck-off the same as the drag. A small venting hole for escaping gases is poked through to the cavity with a wire. The sprue

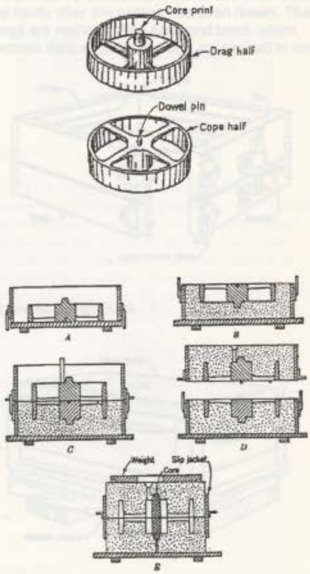


Figure 66. Two-part pattern (above) and casting

pin is removed and the top of the opening enlarged in the shape of a funnel to expedite pouring (Figure 64 D.). The cope is then carefully lifted off and set on its side near the drag. A thin stream of water is applied to the edges of the pattern to lessen the chance that edges of sand next to the pattern will break away during removal of the pattern. The pattern is then rapped a few times to loosen it from

[14] Clarence T. Marek, Fundamentals in the Production and Design of Casting (New York: John Wiley & Sons, 1950), P. 2.

the clutches of the sand and then it is drawn vertically out of the mold. The mold has been fashioned with a slight flaring taper with respect to the parting line so that it will draw easily out of the sand. The gate is then cut from the bottom of the sprue to the mold cavity. The mold cavity is then dusted with graphite or talc to reduce the tendency of the molten metal to fuse with sand of the mold (Figure 65 E.). After the mold has been closed and screwed tight, a weight is placed on top to prevent the cope from being raised by hydraulic pressure

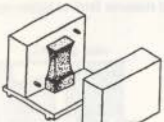


Figure 67. Two-piece core box

due to the column of molten metal in the sprue. The mold is then poured and when it has sufficiently solidified the flask is emptied on the foundry floor and the casting removed. The gates, vents, and other appurtenances of the casting process are then cut off with a metal saw and the casting is ready for inspection and finishing (Figure 64 F & G.).[15]

This type of one-piece flat-back pattern would have been used to cast the lower band of relief ornament on the Knight Library lanterns (appendix - Knight Library).

There is always an attempt in a more complicated molding to split the pattern with the parting plane along a center line, so that the cope and drag halves can be molded similarly and the mold parting remains flat. Prime candidates for this type of casting are symmetrical objects such as a candelabrum standard or a simple pulley, such as the one for which the patterns are illustrated in Figure 66. The drag half of the pattern contains the dowel-pin-hole and is molded with its flat back down on the molding board similar to the one-piece flat back pattern (Figure 66 A.). After being molded in sand, the drag is flipped over on to its bottom board (Figure 66B.).

The protuberance at the bottom of the hub will leave a core print cavity which will serve as a guide for the insertion of the dry sand core into the mold cavity when the pattern is removed. Parts of a mold that are difficult to model or may experience excessive erosion during the pour, are made independently as dry sand cores and inserted into the cavity after the pattern has been drawn. These cores are made of silica sand and bond, which become hard when baked and are molded in box-

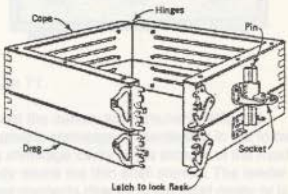


Figure 68. Snap Flask

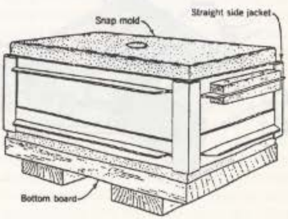


Figure 69. Slip Jacket

like forms called core boxes (Figure 67.).[16] Each core has a protuberance, called a core print, which mates to the core print cavity left by the pattern.

The cope half of the flask is then set in place on the drag, exact placement aided by the dowels of course, the sprue pin located, and the sand molded (Figure 66 C.). The cope and drag are then separated, and the slightly tapered patterns

[15] Ibid., pp. 25.-30.

[16] Ibid., p. 3.

are drawn (Figure 66 D.). The core is then set in place after providing for a small vent hole that is inserted to channel off gasses caused by the core's burning bonding agents (Figure 66E.).

This casting was done in a snap flask. The diagonal hinge and latch arrangement expedites removal of the completed casting (Figure 68.). A slip jacket is slipped down over the snap flask to ensure against swelling or bursting when the mold is poured (Figure 69.).[17]

As the size of the casting increases, more effort is directed at controlling the purity of the molten metal as well as controlling the flow of molten metal to limit erosion to the sand mold. A

Figure 70.

pouring basin is often constructed adjacent to the sprue which slopes upward toward the sprue connection (Figure 70.). The molten metal is poured fast enough to keep the basin full, so that the denser molten metal flows at the bottom and the lighter slag impurities float on top of the pool where they are skimmed off.[18]

Like most liquids, molten metal expands when it is heated and contracts when it is cooled. Molten metals will continue to shrink through their solidification range. The shrink rate is a characteristic of each metal (cast iron -1/8 inch/foot, brass - 3/16 inch/foot) and is reflected in the patternmaker's shrink rule in production casting work.[19] Custom casting, such as specialty lighting fixtures which are often modeled outside of the foundry, utilize a secondary system, called feeders, for introducing molten metal after shrinkage has occurred. As metal cools in the mold cavity, a thin shell of solid metal forms next to the surface of the cavity. As the thickness of this shell increases

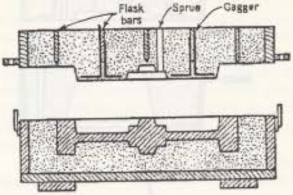


Figure 71.

toward the center, the cumulative effect of volumetric shrinkage is manifested in the formation of a shrinkage cavity at the exterior of the mold cavity where the thin shell started. The feeder either connects directly to the mold cavity or is connected by a feeder gate. The feeder is constructed large enough so that its center is kept in a molten state well after the pour in order to feed

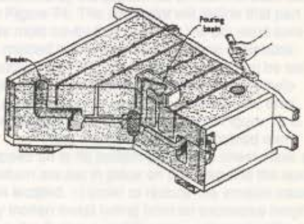


Figure 72.

that last bit of molten metal necessary to fill the shrinkage cavity (Figure 72.).[20]

Because of the larger size of floor molds, the copes are often fitted with cross bars called flask bars to support and reinforce the sand. The pattern is set in the flask so as not to interfere with the flask bar system. If additional support is

[17] Ibid., p. 31.

[18] Ibid., p. 39.

[19] John Neely and Richard Kebbe, Modern Materials and Manufacturing Processes (New York: John Wiley & Sons, 1987), p. 149.

[20] Clarence T. Marek, Fundamentals in the Production and Design of Casting (New York: John Wiley & Sons, 1950), p. 39.

pattern is set in the flask so as not to interfere with the flask bar system. If additional support is needed, L-shaped rods called gaggers are wired to the flange bars. Figure 71. illustrates an alternative means of casting a two-piece pattern with the help of flask bars and gaggers. Sometimes the arrangement of flask bars can interfere with the construction of the pouring basin, in which case it can be built in a rectangular frame on top of the

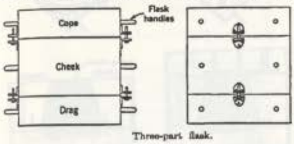


Figure 73.

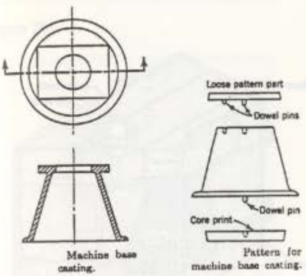


Figure 74.

cope after the mold has been closed (Figure 72.).[21]

Figure 72. illustrates a common type of flask used, where the cope and drag are clamped together by pounding wedges under a clamping bar.

Many castings are complicated enough to require more than one parting. When this is the case, the requisite number of intermediate flasks, called cheek flasks, is sandwiched between the cope and drag flasks (Figure 73.). The cheek pattern is fitted to the cope and drag patterns (referred to in this situation as loose pattern parts) with dowels. The cheek is so arranged as to minimize the number of partings needed, as

[21] Ibid., p.39.

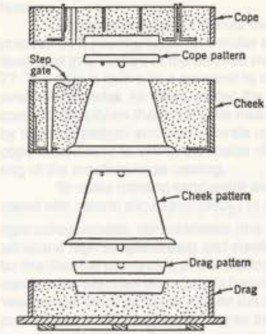


Figure 75. Three-part molding

illustrated by the pattern for a machine base casting in Figure 74. The core print will define that part of the mold cavity that supports the dry sand core and is molded in the drag flask similar to a flat back pattern mold (Figure 75 A.) Gaggers can be set along the perimeter of the cheek flask to help support the green sand, as shown in the drag parting plane horizontal section of Figure 75 B.

After the drag has been molded and flipped on to its bottom board, the cheek flask and pattern are set in place on the drag and the sprue pin located. In order to reduce the erosion caused by molten metal falling from an excessive height, the cheek sprue and the cope sprue are offset in what is called a step gate (Figure 76.). The parting plane between the cope and cheek is riddled with dry facing sand, in the usual manner, to avoid the sections from sticking when they are separated to draw the patterns. The cope flask and the top loose pattern part are then set in place on the cheek, the offset sprue fitted in, and the cope molded. The flasks are then separated and the pattern drawn from the direction corresponding their designed taper (Figure 76.).

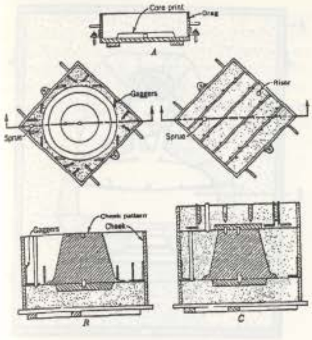


Figure 76.

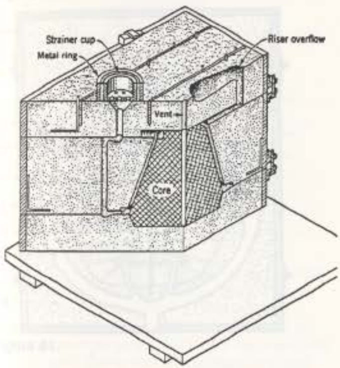


Figure 77. Three-part mold sectioned to reveal riser and off-set sprue

Risers are installed in large molds to relieve mold pressure caused by the displacement of air in the mold cavity by molten metal. "When pouring a mold, the operator watches the riser to know when the mold is about filled, thus preventing the overflow of metal and avoiding excess strain on the mold."[22] If of sufficient size, riser can also serve as a feeder.

A strainer cup, which serves the same purpose as a pouring basin for smaller pours, is illustrated in a section of the finished mold of Figure 77. The riser is built with a reservoir to control the overflowing metal. As noted earlier, the dry sand core sits directly on that part of the mold cavity left by the drag pattern and also extends up into the cope mold cavity to define the inside of the upper ring of the machine base casting.

To make molding sand,water and clay is mixed with natural silica sand (SIO_2) to achieve the right cohesiveness, refractoriness (the ability to withstand high temperatures) and elasticity to allow for the thermal movement of the casting.[23] Bonding sand grains with clay and water is based on the 'wedge and block principle'. When the sand is packed in a mold, the clay coating on the grains acts a wedge which locks the sand grain together to other sand grains.[24] The sand is mixed and conditioned in a mulling machine similar to the one illustrated in Figure 78.

Cores are a mixture of high silica sand with a low clay content and a binder. A typical formula for brass and bronze castings might be 900 pounds of sand to 4 quarts of oil. The baking of a core will progress through three phases: evaporation,

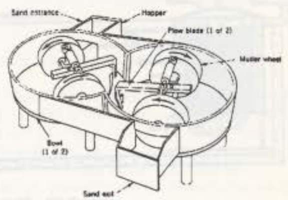


Figure 78. Sand Muller

[22] Ibid., p. 4[illegible]

[23] John Neely and Richard Kebbe, Modern Materials and Manufacturing Processes (New York: John Wiley & Sons, 1987), p. 146.

[24] Clarence T. Marek, Fundamentals in the Production and Design of Casting (New York: John Wiley & Sons, 1950), p. 57.

overflow of metal and avoiding excess weight on the mold.[16] If of sufficient size, riser can also serve as a feeder.

A smaller flask, which serves the same purpose as a pouring basin for smaller pieces, is illustrated in a section of the finished mold in Figure 77. The riser is built with a reservoir to accommodate overflowing metal. As noted earlier, the dry sand core sits directly on that part of the mold shaped by the drag pattern and then extends up into the cope mold cavity to define the inside of the inner ring of the machine base casting.

To make molding sand, water and clay is mixed with natural silica sand (SiO_2) to achieve the right cohesiveness, refractoriness (the ability to withstand high temperatures) and expansion to allow for the thermal movement of the casting.[17] If viewing sand grains with clay and water at [illegible], the 'wedge and block principle.' When the sand is packed in a mold, the clay coating on the grains acts as a wedge which locks the sand grain together to other sand grains.[18] The sand is mixed and conditioned in a mulling machine similar to the one illustrated in Figure 78.

Cores are a mixture of high silica sand with a low clay content and a binder. A typical core mix for brass and bronze castings might be 100 parts of sand to 4 quarts of oil. The baking of a core will progress through three phases: evaporation, [illegible]

igure 76.

igure 77 - Three-part mold positioned to reveal riser and off-set sprue.

Risers are installed in large molds to relieve the pressure caused by the displacement of air to be forced easily by molten metal. When pouring a mold, the operator watches the riser to know when the metal is about filled, thus preventing the

Figure 78. Sand Muller

[16] Ibid., p. 41.

[17] John Harry and Russell Heine, Metals and Alloys and Manufacturing Processes (New York: [illegible], 19[illegible]), p. [illegible].

[18] Clarence F. Baker, [illegible] of [illegible] (New York: [illegible], 19[illegible]), p. 37.

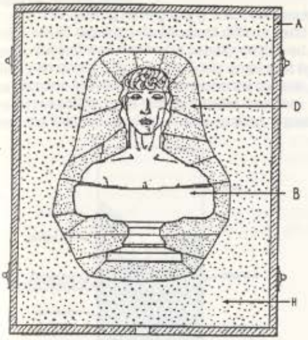


Figure 79.

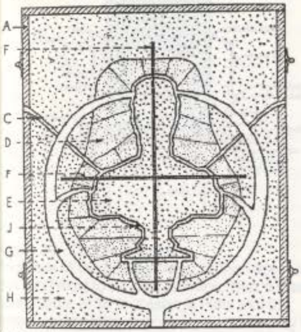


Figure 81.

oxidation and polymerization. The baking process is timed so that full polymerization, which results in core disintegration, is achieved in the mold, only after the metal has solidified.[25]

Bronze and brass high relief ornament and statuary, containing undercuts such as that illustrated in Figure 79, are molded with a different sand through a different technique. The sculptor's

[25] Ibid., pp. 112-116.

Figure 80.

plaster model is set in the flask and separate interlocking blocks of core molding sand is packed around it. Special attention is given to molding the undercuts, which may require numerous cores to accurately model the undercut areas (Figure 80.). The plaster model is then removed and the external core blocks are baked. Earlier in this century this core sand was a special import commodity from the French village of Fontenay-aux-Roses and was noted for its extremely fine texture and low shrinkage rate.[26] A duplicate of the plaster model is then made in core sand with integral iron bar reinforcing bars as shown in Figure 81. Roughly a 1/4 inch of sand is removed to create a cavity for the molten metal. The inner core is then baked and suspended in the flask. The outer core of baked French sand blocks is carefully assembled around

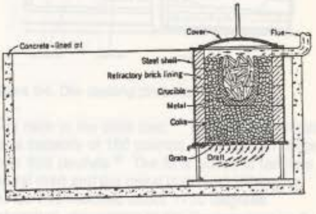


Figure 82. Pit Furnace

the shaved inner core and green sand is packed into the remaining area of the flask. Finally matching sprue, gate and vent troughs are hollowed out of the drag and cope molds and the halfs are clamped

[26] Gerald K. Geerling, Metal Crafts in Architecture (New York: Bonanza Books, 1927), p. 23.

together for the pour.

For casting having many small undercuts, which would require a multitude of difficult sand cores, the lost wax method is usually employed. This is an ancient technique widely employed by the Romans as well as the Renaissance Italians. A model in sand is made slightly smaller than the intended finished product. A wax coating, equal in

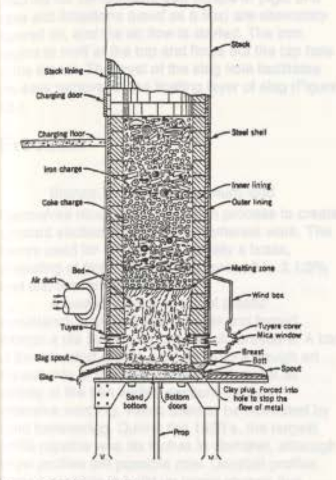


Figure 83. Cupola Furnace

thickness to the desired metal, is then applied over this sand mold to take up its image. Next a cream coat mixture of 50 % plaster of Paris with the balance being brick dust and mashed dry clay is applied in multiple layers. When this has been built up into a fairly strong coat, it is wrapped in a thick layer of coarse sand and the whole thing is reinforced by rods and bands to withstand the pressure of the pour. The ensemble is dried out and baked, which melts out the wax to leave a mold cavity for the molten metal. The inside of the plaster coating has of course taken on the exact impression of the wax, which is an exact impression of the original sand model.[27]

[27] Ibid., pp. 23-26.

Most bronze, brass and aluminum was melted in foundry pit furnaces during the first four decades of this century. The pit furnace has its origin in the earliest metallurgical efforts of humanity. The furnace consists of a cylindrical steel shaft with an interior refractory brick lining, closed at the bottom with a grate and covered at the top with a removable lid. A crucible containing the metal is embedded in the burning coke bed within the shaft (Figure 82.) To initiate a melt, the deep bed of coke is kindled and allowed to reach maximum combustion. Coke is a derivative of coal and will sustain a steady high combustion temperature. The crucible, which is of a clay and graphite composition, is charged full of metal and buried up

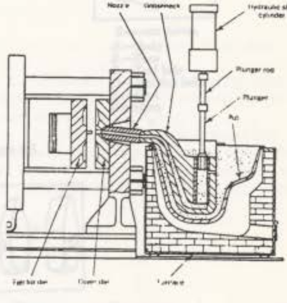


Figure 84. Die casting process

to its neck in the coke bed.[28] The average crucible has a capacity of 150 pounds, but they can range up to 900 pounds.[29] The lid is closed to facilitate a natural draft and the metal is melted. When the bronze has reached about 1700 degrees Fahrenheit, discernible to the Foundryman by its color, it is removed from the pit with special long-handled tongs that are designed to grasp its contour.

The cupola furnace has been the most common furnace for cast iron work. The cupola

[28] Clarence T. Marek, Fundamentals in the Production and Design of Casting (New York: John Wiley & Sons, 1950), p. 254.

[29] Gerald K. Geerling, Metal Crafts in Architecture (New York: Bonanza Books, 1927), p. 24.

Most bronze, brass and aluminum was melted in foundry pit furnaces during the first decades of this century. The pit furnace has its origin in the earliest metallurgical efforts of humanity. The furnace consists of a cylindrical steel shell with an interior refractory brick lining, closed at the bottom with a grate and covered at the top with a removable lid. A crucible containing the metal is embedded in the burning coke that rests on the grate (Figure 84). To initiate a melt, the [illegible] is kindled and allowed to reach maximum combustion. Coke is a derivative of coal and can sustain a steady high combustion temperature. The crucible, which is of a clay and graphite composition, is charged full of metal and [illegible]

Figure 84. The casting process.

to be melt in the coke bed.[illegible] The average crucible has a capacity of 150 pounds, but may [illegible] up to 600 pounds.[illegible] The lid is closed to [illegible] natural draft and the metal is melting. When the bronze has reached about 1700 degrees Fahrenheit, [illegible] by the color, it is removed from the pit with special [illegible] handled tongs that are designed to grasp the crucible.

The cupola furnace [illegible] common [illegible]

[illegible]

[illegible]

[illegible] together for the pour.

For casting having many small undercuts, [illegible] requires a multitude of difficult sand [illegible], the lost wax method is usually employed. This is an ancient technique widely employed by the [illegible] as well as the Renaissance Italians. A [illegible] in sand is made slightly smaller than the [illegible] finished product. A wax casting, equal to

Figure 85. Cupola Furnace

[illegible] to the desired metal, is then applied over [illegible] to take up its shape. Next a cream [illegible] mixture of 50 % plaster of Paris with the [illegible] being brick dust and washed dry clay is [illegible] in multiple layers. When this has been built [illegible] a fairly strong coat, it is wrapped in a thick [illegible] of coarse sand and the whole thing is [illegible] by rods and bands to withstand the [illegible] of the pour. The assemblage is dried and [illegible] heated, which melts out the wax to leave a mold [illegible] for the molten metal. The inside of this plaster [illegible] of course return to the exact [illegible] of the wax, which is an exact impression [illegible] the original sand model.[illegible]

[illegible]

consists of a 20 - 35 foot refractory lined cylindrical steel stack on a stand. The wind box serves as a circular duct to introduce pressurized combustion air into the base of the shaft through small openings called tuyeres. The melting process is started by building a wood fire at the base on top of the sloping sand bed. A bed of coke two to four feet thick is then placed on top. When this has reached full combustion, iron scraps or pigs, and coke and limestone (used as a flux) are alternately layered on, and the air flow is started. The iron begins to melt at the top and flows out the tap hole in the breast. The level of the slag hole facilitates the easy removal of the floating layer of slag (Figure 83.).

Extrusion

Bronze, brass and aluminum lend themselves nicely to an extrusion process to create constant section lengths for ornamental work. The bronze used for extrusion is actually a brass, consisting of from 54 to 57% copper , 2 to 2 1/2% lead and the remainder zinc.

A heated billet of metal of plastic consistency is placed in a cylinder and forced through a die by very high hydraulic pressure. A bar of the intended profile extrudes into a trough on the exit side of the die. The relatively quick air cooling of the thin walled sections causes extensive warping, which used to be corrected by hand hammering. During the 1920's, the largest profile capable was six inches in diameter, although larger profiles are possible now. Dovetail profiles made it possible to build up larger shapes that would fit together perfectly. The process also allowed a certain amount of undercut detail.[30] Extruded brass tubing, varying from 12 to 18 gauge, was used extensively in the manufacture of ornamental electric lighting fixtures. Because of the expense of the steel alloy dies, die casting saw only limited application to custom designed luminaires, but was used more extensively for production lighting fixtures. Figure 84 illustrates a die casting process.

Wrought Iron Work

Two distinctive qualities of wrought iron work are it's clear impression of hand wrought labor and the beauty derived from structural integrity. Each chiseled twisted bar in a lantern is subtly different from its neighbor and is usually part of an obvious structural logic. An astonishing array of ornamental wrought iron work is a product of the smith's fairly simple work shop; an anvil, forge fire with a water trough, tool rack and a vise. The anvil, with its pointed prow and tool hole at the heel end, is the most important tool

ENGLISH ANVIL
A.—Body
B.—Face
C.—Tool hole
D.—Pritchel hole
E.—Heel
F.—Horn

Figure 85.

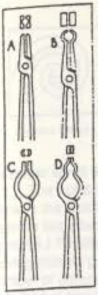
HAMMERS

Figure 86.

(figure 85.). Hammers are of key importance in forging welds, bends, flattening, repousse work, and a multitude of other tasks. Two of the most necessary are the cross-peen and straight-peen hammers (Figure 86.). The ball-peen hammer is

Figure 87.

[30] Ibid., p. 33.



TONGS
A.—Flat-jawed
B.—Link
C.—Hollow bit
D.—Anvil or pick-up

Figure 88.

useful for sculptural tasks, while the set-hammer is best for forming sharp shoulders (Figure 87.) The sledge hammer is indispensable for welding, straightening , cutting off and sundry heavy work and is usually wielded by the smith's helper. A variety of tongs with specially shaped jaws are used to grip different shaped bars for forging operations (Figure 88.). The top and bottom fullers (Figure 89.) are indispensable in drawing operations (repeated blows of a red-hot bar to increase its length). The top and bottom swages are used in a similar fashion but to mold a bar to a particular profile (Figure 90.). The bottom fuller, swage and hardie (Figure 91.) fit into the tool hole of the anvil. When a hot or cold metal bar is placed across the tempered steel cutting edge of hardie and struck from above, an indentation will result. This is repeated on the top and bottom of the bar for a full sever. The smith has a whole range of punches at his disposal; round, square and flat.

Figure 89. Fullers

Holes are made by punching 2/3 of the way through on one side, turning it over on the tool hole and punching out the burr.[31]

One of the most popular wrought iron forms through the ages has been the scroll. The end of a hot bar is beaten around the end of a scroll starter and then graduated through a succession of

Figure 90. Swags

Figure 91. Hardie

[31] Gerald K. Geerling, Wrought Iron in Architecture (New York: Dover Publications, Inc., 1929), pp. 13-15.

SCROLL FORM

Figure 92. scroll form

ever tighter scroll forms such as that in Figure 92.

The hot and cold chisels (Figure 93.) are used with the hardie for cutting but are also used for simple but effective chisel mark ornamentation (Figure 94.) Twisting bars is a simple operation involving muscle power and a long-handled bar with a number of different shaped holes at the center which the hot bar is threaded through. Twisted bars were a popular and effective ornamental devise, with the four left bars of Figure 95 being the most common.[32]

Figure 93. chisels

The technique of welding is central to wrought iron work. Two pieces of iron at white heat are pounded together until they fuse as one. A variety of different welds are possible, such as lap welds and butt welds. A traditional and in many cases a more 'honest' means of joining two members is by collaring and threading. In a collar joint, a thin piece of metal is wrapped around the two bars to be joined and lap welded (Figure 96.) The first operation in threading is to pierce the heated bar with a chisel or punch on the anvil at the

Figure 94. Chisel mark ornamentation

point to be penetrated by the other bar. An aperture is quickly opened and the bar threaded through before the aperture has a chance to cool and tightly contract around the bar (Figure 97.) The pronounced swelling that occurs at the pierced joint is an attractive characteristic of this joint.[33]

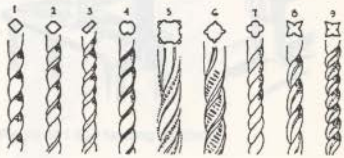


Figure 95. Decorative twisted bars

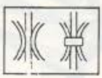


Figure 96.

[32] Ibid., pp. 13-21.

[33] Ibid., pp. 13-26.

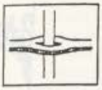


Figure 97.

Wrought iron can also be worked cold with the help of a few simple bench tools. A scroll is started in the tool illustrated in Figure 98 by squeezing a bar between the 'comma' shaped templet and a die by a hand operated lever. The first convolution of the spiral is completed in this machine

Figure 98. Bench scroll machine - step 1

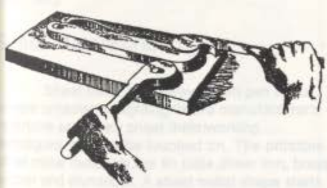


Figure 99. Bench scroll machine - step 2

(Figure99.).The spiral is then hooked in the center portion of the volute attached to the rotating disk of the machine illustrated in Figure 100. Because the shaft connected to the disk is screw threaded , the advancing disk maintains the

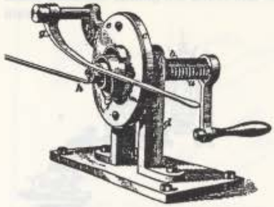


Figure 100. Scroll volute machine

spiral in the same plane as the upper lever pressing down on it as it is twirled through the volute. The twisting of ba:s is facilitated by the machine illustrated in Figure 101. A flat bar is inserted into the slot in the crank face, an appropriate length of pipe set between the two faces (to limit transverse movement of the twisting bar) and the slotted piece

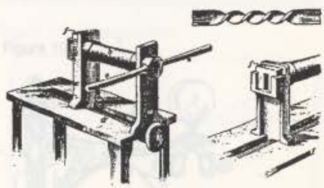


Figure 101 Bar twisting machine

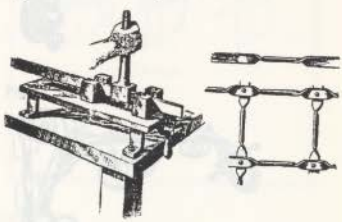


Figure 102. Bar kinking machine

dropped into the pocket in the left face to secure the bar protr ɪding through. The more the revolutions of the crank, the tighter the twists.

Figure 103.

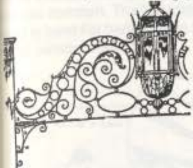


Figure 104. Wrought iron gate lantern

When twisting is completed, the slotted piece is removed and twisted bar is removed out of the end. Another machine (Figure 102.) makes short work of making half twists, useful in making light grille-work.

Wrought iron continued to be a popular material for lanterns in the era of incandescent electric lighting, either as brackets (Figure 103.) or integrated into wrought iron entry arches (Figures 104. and 105.). The material also lent itself admirably to the nature-inspired brackets that were partially derivative of the American interpretation of the European Art Nouveau movement (Figures 106 - 107).

Sheet Metalworking

Sheet metal has always been part of the electric ornamental lighting fixture manufacturer's repertoire and a few sheet metalworking techniques need to be touched on. The principle sheet metal materials are tin plate,sheet iron, brass, copper and aluminum. A sheet metal shape starts with a pattern etched on to the sheet. The pattern is either cut out with a pair of hand snips or with the aid of a squaring shear (Figure 109.). Gauges on the bed of the shear allow positional adjustment of the sheet with respect to the cutting blade plane. When the foot treadle is depressed, the upper blade simultaneously descends while the lower blade ascends, cutting the sheet that has been inserted.[34]

Figure 105.

Figure 106.

Figure 107.

Figure 108.

[34] Jeannette T. Adams, Metalworking Handbook (New York: Arco Publishing Company Inc., 1976), pp. 107-109.

machine used to make both sharp and rounded angle brakes or folds. The piece is clamped in place on the bed by the upper jaw and the bending leaf is raised to make the fold. Curved shapes (Figure 111.) can also be made on the brake by clamping molds (Figure 112.) to the bending leaf. The brake can also be used to make interlocking seams, which are the principal means of connecting sheet metal sheets, although interlocking tabs and rivets are also common. The bar folder (Figure 113.) is used to bend flat bars used in frame and sheet metal constructions.[35]

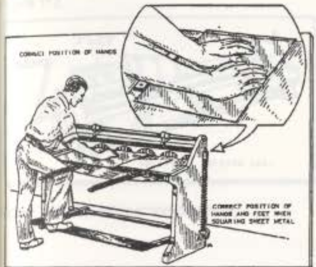


Figure 109. Squaring Shear

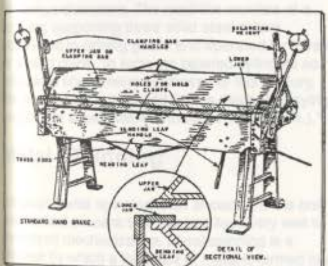


Figure 110. Hand Brake

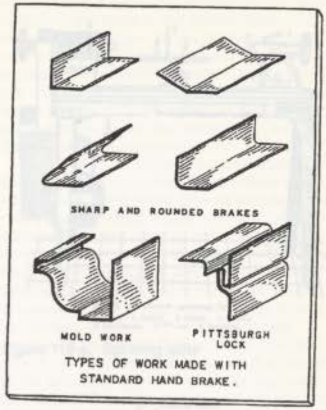


Figure 111. Brake profiles

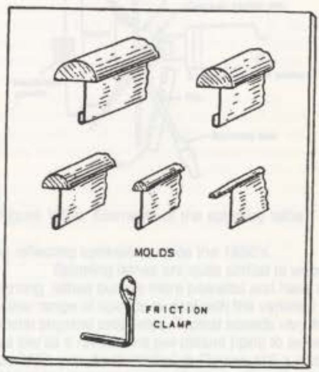


Figure 112.

[35] Ibid., pp. 130-131.

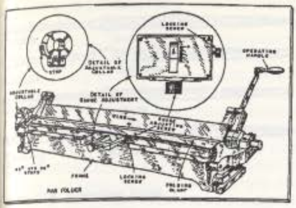


Figure 113.

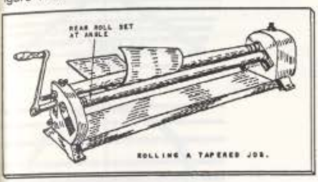


Figure 114. Slip roll forming machine

Slip-roll forming machines are extensively used for curving sheet metal or forming cylinders and cones of various diameters. The machine consists of a housing supporting three solid steel rollers connected to driving gears and operated by means of a hand crank. To form the tapered cylinders so popular in sheet metal luminaires of this century, the rear roll set is adjusted for the desired splaying angle, and sheet cranked through (Figure 114.).[36]

Metal Spinning

Although metal spinning is an ancient art, it is one mechanical process that has lent itself very well to motorized mechanization. Metal spinning is a process by which a flat piece of metal is formed to a desired shape by the application of pressure with a spinning tool on the piece against an attached wooden form, called a chuck, while rotating on a spinning lathe. The most efficient forms tend to be radially symmetric circular and cylindrical shapes.Spun shapes have been used extensively

[36] Ibid., pp. 147-149.

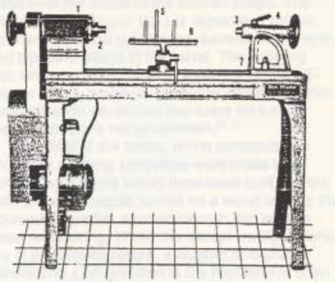


Figure 115-a. Spinning lathe

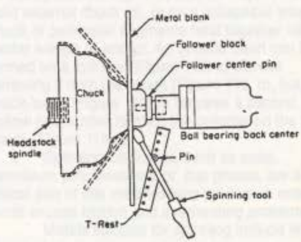


Figure 115-b. Elements of the spinning lathe

in reflecting luminaires since the 1930's.

Spinning lathes are quite similar to wood-turning lathes but are more powerful and have a wider range of speeds to deal with the variation in metal physical properties. Typical speeds vary from as low as 6 revolutions per minute (rpm) to as high as 3500 rpm. As illustrated in Figures 115-a and 115-b, the lathe is equipped with a tailstock; the metal blank is held against the chuck by a follower which is attached to a revolving center attached to the tailstock.[37]

The spinner manipulates the spinning tool

[37] Roger W. Bolz, ed., Metal Engineering Processes (New York: McGraw-Hill Book Company, Inc., 1958), p. 109.

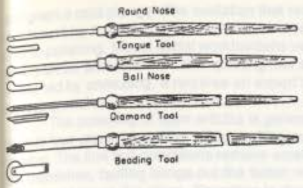


Figure 116. Spinning tools

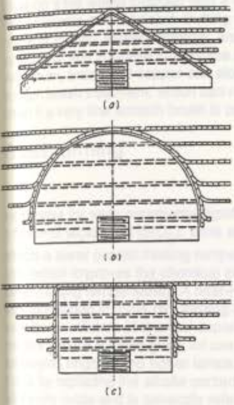


Figure 117. Progressive spinning of basic shapes

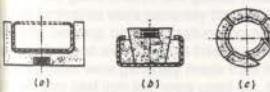


Figure 118.

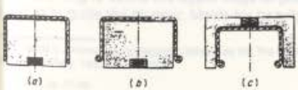


Figure 119.

with the arms, hands and body in order to flow the metal over the chuck to the desired shape. The choice of tool (Figure 116.) is dependent on the spinner's personal preference, severity of the spin, and type and gauge of the metal. The spinning tool, which is usually levered against a pin on a T-rest for steady pressure, is usually about 18 inches long, although seven foot monsters for turning huge shapes are not uncommon.[38]

Most of the forms, which constitute the chuck, for spinning luminaires were made from wood. These forms would have been built up from solid pieces of maple, turned on a wood lathe to the appropriate profile, sanded smooth and oiled to resist weathering. When the design configurations are of an extreme nature, a number of chucks constituting a progression to the final form is often necessary. Even the basic spun shapes of cone, hemisphere, and cylinder require a staged progression on the same chuck to the final form (Figure 117.). A reentrant flange, such as the one on the cylinder of Figure 118, can be spun on a solid external chuck (a), or on a collapsible internal chuck of perimeter segments held together with a center wedge (b and c). An outside bead can be formed on a cylinder (Figure 119. a) without removing it from the chuck (Figure 119. b), but an inside bead (Figure 119. c) requires a second hollow chuck after forming the cylinder on the first chuck (Figure 119. a).

Spinning lubricants, such as soap, petroleum jelly, beeswax, or cup grease, are a critical part of this metalworking process in order to avoid excess friction and overheating problems.[39]

Metals suitable for spinning include Monel Metal, aluminum, copper, brass, stainless steel, sterling silver, cold-rolled steel, and Britannia metal (modern pewter). Aluminum, copper, and brass tended to be the most common choice of spinning material. Aluminum's ductility and resistance to workhardening (hardening of a metal in response to mechanical working) make it a particularly favorable metal to spin. Copper, stainless steel, brass, Monel Metal, and cold-rolled steel workharden as the spinning progresses and and need to be annealed during the process. Brass tends to become hard and springy in response to spinning and is annealed by smothering in oil before heating, burning off the oil and then plunging it into a cold water bath. Copper is heated to a iridescent hue

[38] Ibid., pp.109-110.

[39] Ibid., pp. 110-111.

with the arms, hands and body in order to flow the metal over the chuck to the desired shape. The choice of tool (Figure 116) is dependent on the spinner's personal preference, severity of the spin, and type and gauge of the metal. The spinning tool, which is usually levered against a pin on a T-rest for steady pressure, is usually about 18 inches long, although seven foot monsters for turning huge shapes are not uncommon.[28]

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Spinning lubricants, such as soap, paraffin, tallow, beeswax, or cup grease, are a critical part of the metalworking process in order to avoid excess friction and overheating problems.[29]

Metals suitable for spinning include Monel Metal, aluminum, copper, brass, stainless steel, sterling silver, cold-rolled steel, and Britannia metal (modern pewter). Aluminum, copper, and brass tended to be the most common choice of spinning material. Aluminum's ductility and resistance to workhardening (hardening of a metal in response to mechanical working) make it a particularly tolerable metal to spin. Copper, stainless steel, brass, Monel Metal, and cold-rolled steel workharden as the spinning tool passes and need to be annealed during the process. Brass tends to become hard and springy in response to spinning and is annealed by smothering in oil before heating, burning off the oil and then plunging it into a cold water bath. Copper is heated to a transient blue

[28] Ibid., [illegible]

[29] Ibid., [illegible]

...ure 116. Spinning tools.

...re 117. Progressive spinning of basic shapes.

...ure 118.

...ure 119.

and given a cold plunge. The oxidation that results is removed by a soaking in 5% sulfuric acid solution prior to polishing. Monel Metal workhardens very rapidly under pressure from the spinning tool and is weakened by annealing. It requires an expert's long sweeping strokes to properly spin.[40]

The polishing of spun articles is generally done in four steps: roughing, oiling, buffing and coloring. The first two operations remove scratches and blemishes, buffing brings out the luster, while coloring enhances the gloss. Roughing is done on a muslin wheel coated with an abrasive grit. Oiling is done on a felt wheel charged with a finer abrasive and oil or wax as a lubricant. Buffing wheels are made of muslin, sewed together, and are used by applying a fine abrasive in a grease binder. Aluminum, brass and copper can also be given a scratch brush treatment, which can result in a satin finish if a very fine scratch brush is used.[41]

Glass forming

Most glass for early ornamental lighting fixtures was a fusion of slical sand (SiO_2), soda ash (which effects a lower overall melting temperature) and lime (which improves the chemical stability at the lower melting temperature). A heat-resistant glass was developed in 1935 by Corning-Steuben with a very low coefficient of thermal expansion[42], which made it a more suitable glass for use in luminaires employing brighter and hotter lamps. The glass was made by replacing the alkalie content (soda ash) with boric oxide and is generally referred to as a borosilicate glass.

The glass shades and globes used in historic luminaires were generally the result of pressing, blowing, or pressing/blowing processes, followed by hand trimming and finishing. Molds for pressing glass were generally made from fine grained gray cast iron and were used hot, often at temperatures approaching 600 degrees Centigrade. The molds were usually comprised of two or more sections in the body (Figure 120.), a base and a ring to define the upper edge of glass as well as to guide the plunger. Molds for heavily decorated pieces with multiple body sections were hinged to swing open and clear projections. Simple

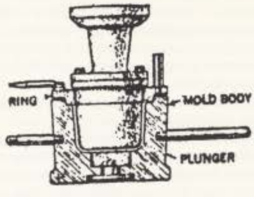

Figure 120. Glass pressing machine

pieces were pressed in one piece 'block' molds with a removable base from which to pull the finished piece. The machine operator would gather a blob of molten glass on to the ball-shaped end of a metal shaft and drip the required amount of liquid glass into the mold, shearing through the stream when a sufficient amount had been applied. Hand presses operated with a lever and crank, while mechanized presses operated a cylinder and piston with compressed air. The pressed piece would require a certain amount of cooling in the mold as an annealing stage to avoid the formation of an over-cooled tensile skin. Glass was also blown, by hand or by machine, into molds to effect globe-like shapes that would be difficult or impossible to press.[43]

After removal from the mold the shapes are touched up as needed with needle-point flames, ground on a fine-grit sandstone wheel or with abrasive water sprays, and fire-finished to remove the sharp ground edges by heating first with a soft flame and then a high intensity flame until fusion rounds the edges.[44]

Three major decorative techniques were used on historic globes and shades: decorative cutting, etching, and enameling. For glass cutting, the design is roughed out in water-resistant paint and then cut on abrasive wheels. A silicon carbide wheel of 80 to 100 grit was first employed, followed by a finer alumina wheel. The etching process required the design (or the negative of the design) to be masked out or painted with a resist. The piece

[40] Harold V. Johnson, Metal Spinning (Milwaukee WI: The Bruce Publishing Company, 1960), pp. 37-39.

[41] Ibid., pp. 57-58.

[42] Raymond McGrath Glass in Architecture and Decoration (London: The Architectural Press, 1961), p. 65.

[43] Encyclopædia Britannica, 1964 ed. s.v. "Glass Manufacture"

[44] Ibid.

was then immersed in a hydroflouric acid bath which ate away (etched) the exposed surface of the glass. To do enameling "a design cut in a brass or glass plate is charged with a mixture of enamel color and medium (lithographic varnish) and a sheet of transfer tissue paper is gently applied and peeled off from one corner to bring with it the design in enamel. This is applied to the clean glass surface and the paper is damped, leaving enamel only on the glass, which is then heated carefully till the enamel fuses to it. The same transfer method is used for applying wax resists to glass to be etched".[45]

[45] Ibid.

Chapter **4**

Development of Illumination Science

Introduction

This chapter will provide a basic framework for the understanding of the development of the science of electric illumination and its effect on lighting strategies and luminaire design during the early and mid-twentieth century. Although the use of lighting fixtures to reinforce architectural intentions and unify interiors was an underlying theme of fixture development during this period, this particular aspect of historic lighting will be explored separately in more detail in a later chapter. The development of stronger incandescent lamps and fluorescent lamps, material processing, as well as evolving architectural design and ornamentation attitudes, tended to be the primary forces driving fixture design. This chapter will be loosely based on a chronological documentation of the building illumination industry during this period to explore these issues.

Early Electric Illumination (1898 - 1914)

Up to the time electric incandescent illumination became common, it was general architectural design practice to arrange building configuration, room layout, and window size and location to optimize daylight as illumination and to assist this light level with artificial means or devises, such as exterior reflectors (Figure 124.), pavement lights, and gas lighting fixtures. This tended to lead to 'alphabet-shaped' buildings composed of wings embracing light courts to maximized their access to daylight and natural ventilation. In some building types, such as offices, the need for adequate daylight also limited the depth of an average office to about 16 feet and forced windows as close as possible to the ceiling for maximum light penetration to the rear of the office. Rules of thumb for the relation of window size and placement to daylight penetration were the most common illumination design tools.[1]

An understanding and application of basic optical theory led to the development of exterior light reflectors to bounce light off the ceiling and further into the room and prismatic pavement blocks to refract light from the sidewalk area further back into the basement. Because of their central role in development of illumination science, a n understanding of optical reflection and refraction is essential. Given a ray of incident light on a surface, the angle formed by its arrival and departure can always be bisected by a perpependicular to the surface at the point of impact of the ray. The angle formed by the incident ray and the perpendicular is called the angle of incidence, while the angle formed by the reflected ray and the perpendicular is called the angle of reflection and the two angles are always equal and in the same plane. If the angle of incidence of a ray on a surface is known, then the angle of reflection can be readily determined. Objects are rendered visible to the eye by the reflection of light rays impinging on them and the

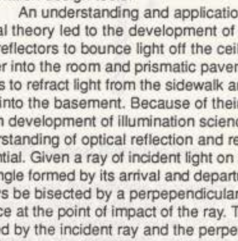

Figure 121. Refraction through a glass plate

[1] Henry Crew, "The History of Illumination Ideas," The American Architect and Building News, October, 1898, p. 3.

reflective powers of various materials are highly variable. The amount of light reflection also dramatically increases as the angle of incidence and a prisim ncreases. Most materials

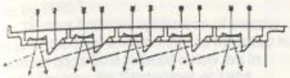

Figure 122. Prismatic Pavement Blocks

reflect little light when the incident ray is perpendicular to the surface, but when the ray strikes the surface obliquely, reflection is augmented. Using water as an example, at a perpendicular incidence, 18 % of the light is reflected, while at an incidence of 89.5 degrees, 72.1% of the light is reflected.[2] Reflection was the principle of operation of the gas lighting reflectors (Figure 54.) developed in the nineteenth century for more intense artificial lighting applications.

Refraction is best explained by following an incident wave of light on a surface of a wavelength represented by the transverse lines in the left drawing of Figure 121. The front of the beam will be retarded at E by propagation through a denser medium before it is retarded at F. The beam only reaches G in the dense medium, while it travels to H in the rarer medium (air). This has the effect of deflecting the beam as it passes through the denser medium. Provided this denser medium is of uniform density and thickness, the reverse of the entering deflection phenomenon occurs as the beam departs and proceeds parallel to its incident

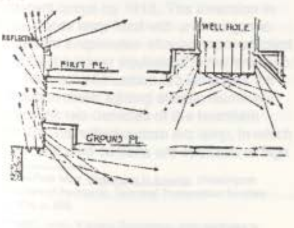

Figure 124. Early Daylighting Strategy

[2] Ibid., pp. 3-4.

direction. If the denser medium were a prism instead of a plate, as indicated in the right drawing of Figure 121, it is seen that the upper part of the beam travels a further distance through the denser medium than the lower part of the beam so that the emerging beam is permanently deflected. A constant relationship exists between the angle of incidence and the angle of refraction for each material. These constants, called the index of refraction, have been empirically derived for many materials and are useful in determining the refractive qualities of lenses used in illumination as well as light distribution patterns.

Figure 123. Vertical Refracting lens

Refraction was the principle of operation of prismatic pavement lights (Figure 122.) and the vertical refracting lenses (Figure 123.) that were developed in the nineteenth century to daylight basement areas (Figure 124.).[3]

Electric Lighting in its Infancy

Lamp development

Electricity did not assert its dominance over gas as the preferred illumination fuel until about 1914, when technical improvements in electrical generation finally secured reliable, uninterrupted power supply. Up to this time, combination gas/electrical fixtures (Figure 58.) were a popular means of dealing with the frequent power outages.[4] Von Welsbach's development of the gas mantle in 1884 revolutionized the gas lighting industry. The Welsbach lamp was first available in 10, and then later, in 15 candlepower per cubic feet. It was quite common to replace one of the standard burners on existing gas fixtures with a

[3] Ibid., pp. 4-5.

[4] "75 th Anniversary Issue," Electrical West, August, 1962, pp. 56-67.

Welsbach lamp to increase illumination levels. In an effort to compete with electric incandescent lighting with its light source pitched down, the inverted gas mantle was introduced to the market and commercially successful (among those with gas lighting) by 1906.[5]

Thomas Edison's application of electric current to a carbonized cotton thread mounted in an evacuated glass bulb initiated a new era in lighting technology. By September of 1882, Edison had 85 customers connected to his new electrical generating and distribution plant in New York City. The sixteen candlepower lamps had "free-blown bulbs with seal-off tips, a looped or hairpin shaped carbon filament, and any one of a dozen different bases that were filled with plaster of Paris."[6] The Edison screw base eventually became the industry standard.

The carbon filament lamp was improved upon in 1905 by General Electric's Metalized carbon filament, which consumed the same amount of energy and produced 20% more light. A French tantalum filament lamp entered the market in 1905 but failed to capture more than 3% of the incandescent lamp market because of its inferior performance when operated upon alternating current and by the invention of the tungsten lamp shortly after its appearance. The tungsten filament lamp, commercially available in 1907, was superior to all other lamps then on the market. The subsequent substitution of drawn wire mounted as a continuous filament greatly improved its ruggedness and bulb-blackening preventatives allowed its operation at higher efficiencies. With ensuing price reductions, the sales of tungsten lamps, referred to at the time as Mazda lamps, exceeded the sales of all other types of incandescent lamps by 1913. The invention in 1914 of a Mazda lamp filled with an inert gas to retard filament evaporation allowed more efficient larger bulbs of a power equivalent to the arc lamp.[7]

The enclosed carbon arc lamp was the most common street lighting electric illuminant during the first two decades of the twentieth century. The intensified carbon arc lamp, in which small diameter pure carbons are operated at high current density in a globe which partially restricts the air supply, saw considerable deployment indoors, particularly for store lighting and light industry. The low pressure mercury vapor lamp and the higher efficiency high pressure mercury vapor lamp (220 Volt, D.C.) were also in limited use before 1911.[8]

Fundamental Principles of Artificial Illumination

The arrival of the more powerful tungsten lamps hastened a more thorough understanding of illumination science in order to harness the full lighting and architectural potential of the new sources as well as to address physiological issues such as glare, intrinsic brightness, and contrast. The illumination principles developed in this early illumination period form a solid base which the later Beaux-Art, Art-Deco and Modernist periods built on and are critically important to understand. The field of illumination science includes the engineering aspect, issues pertaining to vision and esthetic considerations and can be dissaggregated as follows:

I. Flux of Light
II. Diffusion and Direction of Light
III. Quality or Color of Light

Considerations of the above include:

A. Intensity of Illumination
B. System of Illumination
C. Lighting Source Location
D. Glare, Brightness, Specular Reflection and Contrast
E. Lighting Fixture Design
H. Shadows
I. Esthetic Considerations
J. Economy and Efficiency

All of the above factors share a synergistic relationship and require due consideration in any artificial lighting application.[9]

[5] Denys Peter Myer, Gaslighting in America (Washington D.C.:Department of the Interior, Technical Preservation Services Division, 1978), p. 209.

[6] Robert L. Smith, "Lighting Technology: from darkness to opportunity," Architectural Lighting, November, 1986, p. 57.

[7] Preston S. Millar, "Recent Developments in the Art of Illumination," Annual Report Smithsonian Institution, 1914, pp. 612-613.

[8] Ibid., pp. 613-614.

[9] L.B. Marks, "The Lighting of Public and Semi-public Buildings," The Brickbuilder, Sep ember, 1913, p. 192.

I. Flux of Light

The flux of light is the adequate and suitable level of light to illuminate a space. The most important considerations are the intensity of light required for the purpose of the room, the system of lighting used and the control of the physiological factors (glare, reflection, contrast) to ensure visual comfort while occupying the space. As early as 1907, the general approach to determining the total flux required was to assume a certain intensity on a reference plane 2.5 feet above the floor for a particular application.[10] Empirically derived distribution of light curves and flux of light curves for particular types of lamps were used with tables estimating the dissipation of light flux with the increasing angle from the horizontal to then determine the total candle power required.[11] By 1914 it could be said that "the principles of physical optics and magnetic flux underlie many calculations made in illuminating practices. Marked impetus was given to calculations of illumination by the application of the idea of luminous flux in commercial illumination design. In recent years the mathematics of the subject has been set forth repeatedly, and it may be said that the calculations involved in illuminating engineering work are perhaps further along toward complete development than is any other branch of the subject."[12]

II. Diffusion and Direction of Light

The greatest hazard to ocular hygiene is the diminished visibility, discomfort and possible injury to the eye caused by glare due to exposed light sources. A major thrust of lighting design in these early years was the diffusion and redirection of light to control glare and jarring contrasts in light level in different parts of an interior.[13] Diffusing globes and shades and reflectors as well as semi-indirect lighting systems were developed to address the issues of glare and contrast.

[10] Ibid.

[11] Dr. L. Block, The Science of Illumination (London: John Murray, 1912), p. 71.

[12] Preston S. Millar, "Recent Developments in the Art of Illumination," Annual Report Smithsonian Institution, 1914, p. 621.

[13] L.B. Marks, "The Lighting of Public and Semi-public Buildings," The Brickbuilder, September, 1913, p. 192.

III Color of Light

The quality and color of light emanating from the source, and the color of interior surfaces that the source light reflects off of, effect the total flux of light required to provide an adequate level of illumination. The color of light in a room also has a direct bearing on visual processes such as shade perception, visual acuity and color perception[14] and is also an important design element in architectural expression.

It was observed that sunlight, reflected and modified by the natural environment was of a comparatively low intensity and of a decidedly bluish, yellowish or green tone. "These are the tints that generally produce pleasurable sensations, and hence better serve as a means of conveying the emotion of beauty in vision. It would therefore seem reasonable to surround ourselves during our indoor life with an environment having natural tints and transmitting to the eye an intensity of light approximately equal to the average intensity received by the eye when similarly exposed to natural surroundings".[15] The color and intensity of light reflecting off variously tinted interior decorated surfaces had to be carefully coordinated to result in a final reflected light of a pleasing natural tint. The most common means of modifying the color of light from a source was to select the desired quality or tint of the secondary reflecting source.[16]

A. Intensity

The intensity of illumination required for a space is most dependent on the intended use of the space. Tables were published at this time suggesting illumination levels for various building types (schoolrooms - 2 to 3 footcandles, residences - 1 to 2 footcandles, libraries - 1 to 2 footcandles in general and 3 to 4 footcandles on the reading tables), and also for different kinds of work (drafting - 5 to 10 footcandles, postal service - 2 to 5 footcandles). It was stressed, however, that such figures were only guidelines and that the special circumstances of each lighting application

[14] Preston S. Millar, "Recent Developments in the Art of Illumination," Annual Report Smithsonian Institution, 1914, p. 621.

[15] Bassett Jones Jr., "Indirect Lighting," The American Architect, December, 1909, p. 248.

[16] Ibid., p. 249.

also had to be considered. Besides the vagaries of personal preference in lighting level, the potential interaction of a daylighting component with artificial lighting can be difficult to asses because of the eye's ability to adjust to a very wide range of illumination intensities. Comfortable reading can occur with as little as 1 footcandle falling on the pages of a book and with as much as 500 footcandles, provided the latter is properly diffused and directed.[17] "In daylight under usual conditions, the eye works with a comparatively small pupillary aperture, because of the enormous flux of light. In artificial lighting, under good conditions of diffusion, direction, and contrast, the eye works with a comparatively large pupillary aperture, because of the relatively insignificant flux of light. Under these conditions we can therefore see well, and without visual fatigue, by artificial light at illumination intensities that are only a fraction of those which ordinarily obtain in daylight."[18]

As a valuable aid to illuminating engineering design during this period, laboratory measurement of total flux and light distribution for lamps and auxiliaries (globes, reflectors, shades), as well as illumination intensity and brightness in lighting installations, were disseminated throughout the industry. This was made possible by the development of portable photometers allowing the measurement of light intensities on actual lighting installations.[19]

B. Systems of Illumination

The introduction of the brighter tungsten filament lamps, and the attendant glare problems, was the catalyst driving the innovation of new indirect and semi-indirect lighting systems. The various systems fell into the following broad classification:

(a) General illumination by direct lighting

•lamps exposed to view, either in a fixture or studded into the architectural ornament or along the principle architectural lines as a design accent[20]
•lamps enclosed in globes or shades which diffuse and direct the light

(b) General illumination by indirect lighting

•lamps concealed in opaque reflectors suspended from and directed toward the ceiling, which serves as a larger secondary diffusing area
•lamps concealed in coves and located on the side walls near the ceiling
•high reflecting standards mounted on the floor and projecting light toward the ceiling.[21]

(c) General illumination by semi-indirect lighting
•when the suspended reflecting shade is translucent, a portion of the light is reflected offof the ceiling and a portion is transmitted as direct lighting through the diffusing translucent shade.
•the lamps can be mounted behind a transmitting screen, such as a sky light or art-glass panel, which becomes a secondary lightsource.[22]

(d) Local illumination

•This was a secondary lighting system in closer proximity to the particular task or area to be lighted

(e) Combinations of the various general and local illumination systems

C. Location of Lighting Fixtures

This aspect of illumination was most reliant on the intensity of illumination required in a room, the system of illumination employed, and the intended role of lighting as an aid to architectural expression. During the earlier period of direct lighting with carbon filament lamps, it was felt that ceiling fixtures were the most efficient method of providing general illumination. By lighting the upper

[17] L.B. Marks, "The Lighting of Public and Semi-public Buildings," The Brickbuilder, September, 1913, pp. 193-194.

[18] Ibid., p. 194.

[19] Preston S. Millar, "Recent Developments in the Art of Illumination," Annual Report Smithsonian Institution, 1914, p.619.

[20] Bassett Jones Jr., "Indirect Lighting," The American Architect, December, 1909, p. 246.

[21] L.B. Marks, "The Lighting of Public and Semi-public Buildings," The Brickbuilder, September, 1913, p. 194.

[22] Bassett Jones Jr., "Indirect Lighting," The American Architect, December, 1909, p. 246.

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[14] Bassett Jones Jr., "Indirect Lighting," The American Architect, December, 1909, p. 238.

[15] L.B. Marks, "The Lighting of Public and Semi-public Buildings," The Brickbuilder, December, 1910, p. 194.

[16] Bassett Jones Jr., "Indirect Lighting," The American Architect, December, 1909, p. 238.

[11] L.B. Marks, "The Lighting of Public and Semi-public Buildings," The Brickbuilder, December, 1910, pp. 193-194.

[12] Ibid., p. 194.

[13] Preston S. Millar, "Recent Developments in the Art of Illumination," Journal of the Franklin Institute, February, 1911, p. 115.

half of the room, they added to the sense of height of a room by leading the eye upward. They also tended to emphasize the horizontal lines of the room by casting downward shadows from projecting moldings. Wall brackets were most effective as local illumination. They tended to accentuate the perpendicular lines of the room by throwing the different wall planes into bold contrasts in shadow. Wall brackets used in conjunction with ceiling fixtures tended to eliminate all shadows and light a room evenly.[23] Although indirect and semi-indirect lighting systems utilized the ceiling plane as a secondary diffusing area, the above contrast characteristics still held true, but with drastically diminished shadow crispness.

D. Glare, Brightness, Specular Reflection and Contrast

It was understood during the Early Illumination Period that glare was largely a matter of contrast and it's suppression in order to promote ocular welfare was of primary concern to illumination engineers. Simply put, excessive brightness means excessive contrast with surrounding objects. A bright source may cause ocular discomfort amid dark surroundings but be innocuous in a bright environment.[24] The brighter light sources were quickly recognized as an ocular hazard by the medical community. They understood that too intense a light decomposed the visual purple in the retina faster than it could be replaced, and left a condition of retina exhaustion. It also compelled a constant extreme muscular contraction of the pupil in the effort to exclude the light, which is both fatiguing and painful.[25] Another manifestation of glare from a bright source, typically an exposed lamp, is specular reflection from polished surfaces in the room. When light strikes an object some is absorbed, some is transmitted (if the object is transparent or translucent), some is reflected diffusely, some is reflected regularly. This regularly reflected light is referred to as specular reflection and can be an annoying source of glare from such surfaces as polished walls and

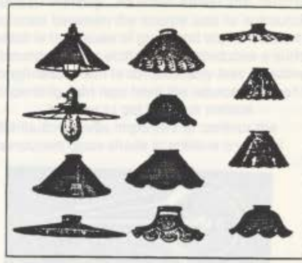

Figure 125. Typical Reflectors (1900 - 1907)

table tops or even the pages of a book. The suppression of contrast through the control of glare, brightness and specular reflection is what precipitated the rapid development of diffusing auxiliaries, semi-indirect and indirect lighting systems and a more thorough understanding of ocular physiology.[26]

E. Lighting Auxiliaries

A lighting auxiliary is any construction attached to the lamp source which attempts to diffuse or direct the light. Various types of auxiliaries were associated with direct, semi-indirect and indirect lighting systems.

Figure 126. Typical Reflectors (1907 -1914)

[23] David Crownfield, "Illumination and the Architectural Treatment of Lighting Fixtures," The Architectural Record, December, 1907, pp. 488-489.

[24] Preston S. Millar, "Recent Developments in the Art of Illumination," Annual Report Smithsonian Institution, 1914, p. 622.

[25] F. Lavrent Godinez, "What Do We Know About Lighting? - Introductory Note," Architectural Record, V. 33., 1913, p.257.

[26] L.B. Marks, "The Lighting of Public and Semi-public Buildings," The Brickbuilder, September, pp. 195-196.

Figure 125. Typical Reflectors (1860 - 1930)

[illegible] of the room, they added to the sense of height [illegible] by leading the eye upward. They also [illegible] to emphasize the horizontal lines of the [illegible] by casting downward shadows from [illegible] ceilings. Wall brackets were used [illegible] as focal decoration. They tended to [illegible] the perpendicular lines of the room, by [illegible] the cornices and planes into bold [illegible] in shadow. Wall brackets used in [illegible] with ceiling fixtures tended to eliminate [illegible] shadows and light a room evenly.[35] Although [illegible] and semi-indirect lighting systems utilized [illegible] ceiling plane as a secondary diffusing area, the [illegible] characteristics still held true, but [illegible] generally diminished shadow emphasis.

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Figure 126. Typical Reflectors (1897 - 1924)

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[35] David Crownfield, "Illumination and the Architectural Treatment of [illegible]," The Architectural Review, December, 1907, pp. [illegible].

[36] [illegible], "[illegible]," [illegible], 1914, p. [illegible].

[37] [illegible], "[illegible]," [illegible], 1915, p. [illegible].

[38] [illegible], "The Lighting of Public and [illegible]," [illegible], [illegible], pp. [illegible].

(a) Direct lighting fixtures

Prior to 1907, direct lighting fixtures often clustered exposed carbon filament bulbs to increase the flux of light (Figures 60-61.,106-108.) or amplified and directed the exposed bulbs in sectional mirror or glass reflectors (Figure 125.). The introduction of the tungsten filament lamp precipitated the development of translucent shades and reflectors that diffused and directed the light as well as shielded the brighter side portions of the bulb from direct view or concealed the entire bulb itself (Figure 126.). As illustrated in the typical light distribution pattern of a tungsten filament lamp, (Figure 127.) the vertical looping of the filament results in the greatest candlepower occurring on the horizontal. Consequently, rated candlepower values correspond to this horizontal

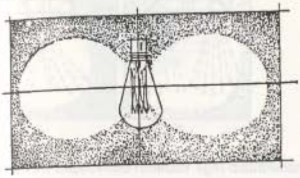

Figure 127. Tungsten lamp light distribution

maximum.[27] Shades and globes made of glassware having diffusing properties were fashioned to mitigate the ocular discomfort of exposed bulbs as well as to improve and control light distribution patterns.

Reflection from and refraction through opal glassware produces a dispersion of light rays to such an extent that the apparent intensity is nearly equal in all directions. Opal glass is composed of suspended microscopic particles within the structure of the glass. The rays of light are variously reflected and refracted by these particles as they pass through the thickness of the glassware, resulting in a condition approximating uniform luminosity (Figure 128.) This distribution of light rays throughout the glassware also tends to obscure the bright source and produce a luminous glassware surface of greater surface area and lower surface intensity . As noted earlier, this reduces the contrast between the source and its surroundings, which is the cause of glare and ocular discomfort. Ground glass or etched glass produces a surface roughness which is considerably less effective in dispersing light rays from the source (Figure129.).[28]

In order to get the best vertical distribution,it was important to contour the translucent glass shade to achieve a vertical

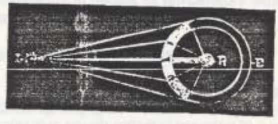

Figure 128. Diffusion through opal glass

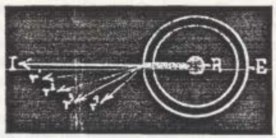

Figure 129. Ground glass light diffusion

reflection from the light source (Figure 130.). When the inner surface of these shades were depolished, through a combination of sandblasting and acid etching, the reflected light was of a diffused character which reduced the glare and the specular reflection off of room surfaces (Figure 131.).[29]

The purpose of opaque reflectors was to direct light, either in direct lighting (show window, industrial) or indirect lighting applications. By varying the contour of a mirrored glass reflector with a highly reflective inner surface and the location of the lamp within that reflector, a wide range of light distributions is possible (Figures 132. and 133.). To overcome the swirling pattern of uneven reflection characteristic of highly polished surfaces, the manufacturers of opaque reflectors "formed the inner glass surface of their reflectors in a series of ridges or spatulated circular indentations, which by virtue of their variously inclined surfaces slightly break up the reflected light rays and dispel these

[27] F. Lavrent Godinez, "What Do We Know About Lighting - Elements of the Technique of Lighting," Architectural Record, V. 33., 1913, p. 370.

[28] Ibid., p. 372.

[29] Ibid., p. 377.

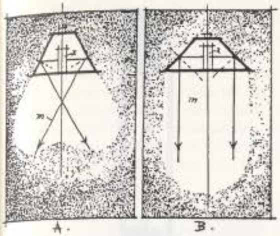

Figure 130. Reflector light distribution

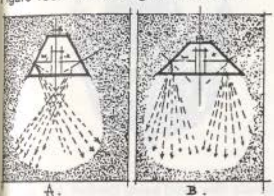

Figure 131. Depolished reflector light distribution

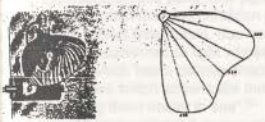

Figure 132. Metalic silvered opaque reflector

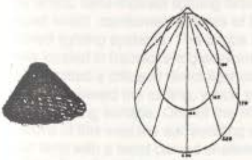

Figure 133. Metalic silvered opaque reflector

images without causing any material change in the effective distribution of the reflector".[30] The permanency of the reflective glass coating was of great concern to practitioners, as its depreciation caused a drastic diminution in the quantity of light distributed. The preferred coating was pure metallic silver deposited on the back of a thin glass mold. A second coating of enamel was applied over the silver and subjected to an extremely high temperature to negate its temperature expansion and protect the silver from tarnishing.[31]

(b) Indirect lighting fixtures

The most usual method of installing an indirect lighting system was to place the lamps in a continuous trough reflector mounted in a cove worked into an interior cornice, either above a high wainscot or just below the ceiling. The design of the reflector was carefully tailored to the form of the ceiling in order to properly project the light on the ceiling forming the secondary light source. This was necessary to avoid an intense light directly above the cove which would remove all sense of continuity between the ceiling and walls. A glass shield over the reflector aperture could be painted or etched in such a way as to graduate the light on the ceiling. It was thus possible to entirely conceal the location of the light source by preventing light from falling on that area directly above the cove and grading the light so it reached maximum intensity at the center of the ceiling. The ceiling necessarily had to be painted in some lighter shade for effective reflection. In some situations, the opaque reflectors served the same purpose as the light trough.[32]

The wide distribution of light from the light source across the ceiling resulted in an equal dispersal of light rays in all directions or a general diffusion of light. This resulted in a loss of shadow and of "perspective at distances greater than those where eye parallax is the controlling factor".[33]

(c) Semi-indirect lighting fixtures

This perfectly even illumination and loss of

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[30] F. Lavrent Godinez, "What Do We Know About Lighting? - on opaque lighting," Architectural Record, V. 33., 1913, p. 578.

[31] Ibid.

[32] Bassett Jones Jr., "Indirect Lighting," The American Architect, December, 1909, p. 247.

[33] Ibid.

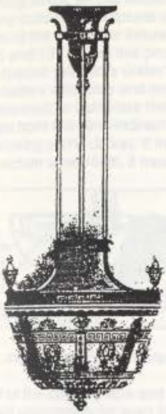


Figure 134. Indirect glass bowl with stensiling

shadow was recognized as a fault of indirect lighting. Expanding on this point, one period writer noted; "some maintain that this condition produces a restlessness almost indefinable, due no doubt to our eyes being accustomed to light whose source we can see and which has a definite direction, producing shadows which accentuate the outline of objects, making them easier to see".[34] It was even suggested that prolonged exposure to this type of light was a source of eye strain.

In response to the above concerns and in an effort to control glare and contrast from the new brighter lamps, semi-indirect lighting fixtures were developed which combined features of both direct and indirect lighting systems. The lamps were generally located in translucent glassware bowls, which transmitted a diffused direct light as well as reflecting light toward the ceiling, which served as a secondary lighting surface. One of the first applications of this was the surrounding of the the tungsten lamp with a hand carved shallow alabaster dish. The soft mellow light transmitted, supplemented by the reflected indirect light,

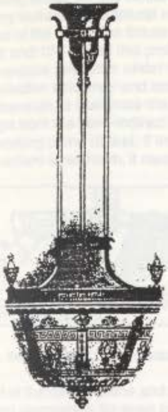
[34] Harry Pickhardt, "The New Lighting," The Architectural Record, V.33, February, 1913, p. 153.

Figure 135. Indirect bowl with sculptural relief

Figure 136. Indirect bowl with opaque reflectors

proved immensely popular with practitioners of the day. A type of dense translucent glass resembling alabaster was subsequently created to simulate the soft mellow light of alabaster at a fraction of the cost. Attractive pressed glassware bowls with surface stenciling and sculptural relief ornament rapidly became part of the repertoire of semi-indirect lighting fixtures (Figures 134. and 135.).[35] It was important with such fixtures to avoid installing too many or too high a wattage lamps to increase the

[35] Ibid., p. 154.



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[34] Harry Pickhardt, "The New Lighting," The Architectural Record, V.33., February, 1913, p. 153.

[35] Ibid., p. 154.

indirect lighting effect, as this would overlight and obliterate any surface or sculptural ornamentation that was part of the bowl. The fixture illustrated in Figures 136 and 137 solves this problem by employing opaque reflectors under the bulbs to increase reflective efficiency and one bulb positioned beneath to illuminate the bowl. Before reflected light from the semi-indirect fixture can reach the working plane (2 feet, 6 inches off the floor) in a medium sized room, it must be

Figure 137. Indirect bowl with opaque reflectors

reflected off of the ceiling plane and the wall plane. Since it is not uncommon for even lighter shades to absorb 75 percent of incident light, the importance of light interiors to the efficiency of indirect lighting strategies is apparent.[36]

Beaux-Art Period (1918-1929)

The illumination principles developed during the early illumination period continued to provide the core of knowledge during this period. Tremendous research strides were made in the area of illumination engineering, particularly in a more thorough understanding of physiological optics, more effective lighting auxiliaries to direct and diffuse the higher efficiency lamps, and the development of more complex lighting control systems. There was an understanding on the part of the building design community of the role of artificial lighting as an integral element in the architectural ensemble. This deeper understanding of illumination engineering and the architectural implications of lighting also supported the continued evolution of the design of luminaires.

Illumination Engineering

By the third decade of the twentieth century, the period referred to as the Beaux-Art period in this study, electrical illumination was well established as an essential element in building design. As an aid to international trade and illumination science, the International Commission of Illumination defined a set of standard illumination units in 1920. "One foot-candle is the illumination, produced at a point on a surface, which at the point is normal to the direction in which a source, located at a distance of one foot, has an intensity of one candle. One foot-candle is one lumen per square foot."[37] The lumen is the unit of luminous flux . The determination of flux was possible mathematically if the source intensity (candle-power) and source characteristics (light distribution curves) were known, or assumed.[38]

Improved lamps and means of describing lamp characteristics also occurred. The practitioner needed to understand the fundamental difference between incandescence and luminescence. Incandescence, or temperature radiation, was defined as "that type of emission in which the radiation is due to, and stands in a definite quantitative relation to the temperature of the source."[39] A prime example of this is the ordinary incandescent lamp filament. This type of radiation normally gave a continuous spectrum in which all the wavelengths were present. Luminescence, on the other hand, is an emission that bears no strict relationship to source temperature. An example of this is the mercury vapor lamp.Luminescent sources typically produced light having distinct bright line or bright band characteristics. As an aid to understanding and selecting appropriate incandescent sources, the concept of color temperature was developed. The color temperature of a source is defined as that temperature of a black body having the same spectral distribution of radiation as the source. Many luminescent sources, whose emission is unrelated to temperature, could not be assigned color temperature values.[40] The source of radiation of the mercury vapor lamps in use at this period were a result of electron excitation in the isolated

[36] F. Lavrent Godinez, "What Do We Know About Lighting? - On Direct Lighting," Architectural Record, V. 34., 1913, pp. 264-266.

[37] Francis E. Cady, editor, "Illuminating Engineering, (New York: John Wiley and Sons, 1925),p. 171.

[38] Ibid., pp. 169-171.

[39] Ibid., p.1[illegible]

[40] Ibid., p. 1[illegible]

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[illegible] Francis E. Cady and [illegible], *Illumination Engineering* (New York: John Wiley and Sons, 1925), p. 171.

[illegible] Ibid., pp. 169-171.

[illegible] Ibid., p. 17.

[illegible] Ibid., p. 1[illegible].

...ect lighting effect, as this would overlight and ...hasize any surface or sculptural ornamentation ...ral part of the bowl. The fixture illustrated in ...igures 136 and 137 solves this problem by ...loying opaque reflectors under the bulbs to ...ease reflective efficiency and one bulb ...itioned beneath to illuminate the bowl. Before ...ected light from the semi-indirect fixture can ...ch the working plane (2 feet, 6 inches off the ...or) in a medium sized room, it must be

...igure 137. Indirect bowl with opaque reflectors.

...ected off of the ceiling plane and the wall plane. ...ce it is not uncommon for even lighter shades to ...orb 70 percent of incident light, the importance ...ight finishes to the efficiency of indirect lighting ...hniques is apparent.[?]

...aux-Art Period (1919-1929)

The illumination principles developed ...ing the early illumination period continued to ...w the core of knowledge during this period. ...nificant research strides were made in the ...d of illumination engineering, particularly in a ...e thorough understanding of physiological ...ts, more effective lighting appliances to direct ...d utilize the higher efficiency lamps, and the ...elopment of more complex lighting control ...tems. There was an understanding on the part ...e building design community of the role of ...ical lighting as an integral element in the ...ctural environment. This deeper understanding ...f illumination engineering and the architectural ...lications of lighting also supported the ...tinued evolution of the design of luminaires.

...mination Engineering

environment of a gas-filled tube.[41] As the temperature of a tungsten filament increased, the luminosity increased from the red end through to the blue end of the spectrum, which was the typical color of mercury-vapor lamps. Only the gas filled tungsten filament lamps could approach the blue spectrum area. Tungsten filament lamps were the preferred source for interior illumination, while mercury-vapor lamps saw fairly limited application in industrial and exterior lighting.[42]

Enormous advances were made in the area physiological optics by 1925, which tended to substantiate intuitively held notions of physiological optics as well as make new discoveries which informed illumination science. An understanding of the anatomy and operation of the eye was central to this effort. Referring to Figure 138, the light impression is refracted through the exterior coat, called the cornea, and the transparent lens body, on to the retina. The retina is the sensitive surface composed principally of three sets of nerve cells with their fibers, connected to the brain through the optic nerve. The iris is the muscular diaphram that contracts with an increase in light intensity and

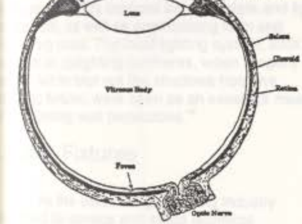

Figure 138. Elements of the eyeball

dilates with an decrease in light intensity. This results in a general change in the illumination of the retinal image. Because less of the eye's imperfect refractory surfaces are utilized with a contracted pupil, a lighter environment supports improved visual acuity. The ciliary muscle contracts on the lens to change its curvature in order to focus on nearer objects if necessary.[43]

As seen in Figure 139, there are two types

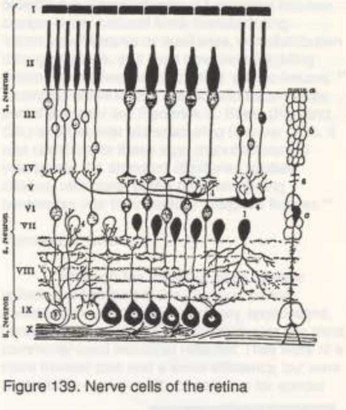

Figure 139. Nerve cells of the retina

of light receptor neuron cells that make up the first of the three sets of retina neuron cells. It was thought that the cone cells (center) and rod cells (ends) functioned differently, based on the following facts. Cone cells are most profuse at the center of the retina, with hardly any occurring at the periphery, while rod cells are located in both areas. The rod cells contain a light sensitive substance known as visual purple, which aids in night vision. The eye is generally color blind in the peripheral areas and a condition approaching color blindness is evident at low light intensities. Based on the above, it was ascertained "that the rods are excited at light-intensities too low to excite the cones, and that the cones are organs which mediate all phenomenon pertaining to the color sense".[44] This understanding of the visionary process was the basis to theories concerning color contrast (colored surfaces influencing juxtaposed surfaces in a complimenta.y color direction and after-images of color patterns seen in negative and the complimenta y color) and generally took the position that these phenomena were the result of unequal fatigue of the color processes in the

[41] Ibid., p. 24.

[42] Ibid., p. 115.

[43] Ibid., pp. 229-232.

[44] Ibid., p. 235.

ble to change its curvature in order to focus on nearer objects if necessary.[illegible]

As seen in Figure 135, there are two types

Figure 135. Nerve cells of the retina.

of light sensitive nerve cells that make up the first of the three sets of retina neuron cells. It was thought that the cone cells (center) and rod cells (sides) functioned differently based on the following facts. Cone cells are most profuse at the center of the retina, with hardly any occurring at the periphery, while rod cells are located in both areas. The rod cells contain a light sensitive substance known as visual purple, which aids in night vision. The eye is generally color blind in the peripheral areas and a condition approaching color blindness is evident at low light intensities. Based on the above, it was surmised "that the rods are excited at light intensities too low to excite the cones, and that the cones are the organs which mediate all discrimination pertaining to the color sense."[illegible] This understanding of the visionary process was the basis to describe phenomena color contrast (colored surfaces influencing juxtaposed surfaces in a complementary color direction) and after-images of color patterns seen in negative and the complementary color, and generally took the position that these phenomena were the result of unequal fatigue of the color processes in the

[illegible] Ibid., [illegible]

[illegible] Ibid., p. 356.

[illegible]sisted of a gas-filled bulb.[illegible] As the [illegible] of a tungsten filament increased, the [illegible] emitted from the red end through [illegible] end of the spectrum, which was the typical [illegible] incandescent lamps. Only the gas filled [illegible] filament lamps could approach the blue [illegible] Tungsten filament lamps were the [illegible] source for interior illumination, while [illegible] lamps saw fairly limited application to [illegible] lighting.[illegible]

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[illegible] 136. Diagram of the eyeball

[illegible] with an increase in light intensity. This [illegible] a general change in the illumination of the [illegible] image. Because less of the eye's dispersed [illegible] surfaces are utilized with a contracted [illegible] a brighter environment appears improved [illegible] The ciliary muscle connects on the

[illegible]

retina.[45]

To aid calculations of light distribution and intensity with indirect lighting systems, reflection factors for a whole range of interior surface colors were published.[46] The potential for more theatrical effects in artificial lighting was made possible by the introduction of opaque reflectors fitted with colored glass lenses for modifying the color of light and dimmer switches for controlling light intensity. It was not uncommon to wire various fixtures in a room or even various lamps on a fixture in separate circuits and control them individually from a centralized location.[47]

Architectural Lighting

Period writers emphasized the early consideration in the design process of lighting fixtures that would accentuate the architectural scheme. The design of a lighting system which brought out the shades and shadows of an architectural space was considered by some to be the principal means of accomplishing this. Careful consideration of the lighting system and location of lighting fixtures was necessary to bring out the shade from recesses and the shadow from projections, that were apart of interior architecture of this period. This contrast between dark and light lent interest, as well as emphasizing form and stimulating color. The local lighting system, such as brackets or uplighting torcheres, when properly spaced not to blot out the shadows from the adjoining fixture, were seen as an excellent means of highlighting wall projections.[48]

Lighting Fixtures

As the electrical generating industry expanded its service and made technical improvements to limit electrical service interruptions, electric artificial illumination became an architectural standard. The new powerful tungsten lamps freed architects from their timeless duty to provide daylighting and promoted an enthusiastic attitude toward providing artfully designed lighting fixtures well suited to their architectural settings. The tremendous growth of the illumination industry at this time tended to polarize the manufacturers of luminaires into two camps; larger national firms manufacturing 'commercial' fixtures or auxiliaries, with distribution through dealers, and local ornamental lighting fixture companies manufacturing 'artistic fixtures'.[49] Examples of the former are GE and Laco-Philips and of the latter are Frederick C. Baker (Portland, OR.) and Sechrist Manufacturing (Denver CO.). It was common for these local manufacturers to incorporate the standard auxiliaries (globes, shades, reflectors) of the national lighting companies into their custom designed fixtures.[50]

Commercial fixtures

Although the mirrored glass opaque reflectors described in the previous period continued in use for high efficiency applications, porcelain-enameled steel reflectors were the most commonly used industrial reflector. They were of a more modest cost and a lower efficiency, but were made in the same variety of contours for special

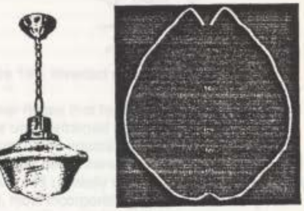

Figure 140. Flattened globe

light distributions that the mirrored reflectors were.[51]

Opal glass enclosed units evolved beyond the simple globe stage, although these remained a fairly efficient stand-by. Stalactite or long globes were developed for a maximum horizontal distribution, while the flattened reflecting top unit of Figure 140 was developed for a maximum vertical

[45] Ibid., p. 237.

[46] Ibid., p. 306.

[47] Kenneth Curtis, "Artificial Lighting in Churches," The American Architect and Architectural Review, December, 1924, p. 612.

[48] "The Design of Lighting Fixtures," The American Architect, April, 1925, p. 221.

[49] Harold W. Rambusch, "The Problem of Light in Fixture Design," The American Architect, January, 1927, pp. 749-750.

[50] Charles Digregoria, "Taped interview of F.C. Baker on December 2, 1977," Oregon Historical Society cassette 720.979 II

[51] Francis E. Cady, editor, "Illuminating Engineering, (New York: John Wiley and Sons, 1925, p. 262.

To aid calculations of light distribution and ...ect and indirect lighting systems, reflection ...ed for a whole range of interior surface colors ...nd materials.[45] The potential for more theatrical ...ry effects in artificial lighting was made possible by the ...tion of opaque reflectors fitted with colored ...ments for modifying the color of light and ...ces for controlling light intensity. It was ...possible to wire various fixtures in a room or ...ous lamps on a fixture to separate circuits ...ntrol them individually from a centralized ...[46]

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[45] Ibid., p. 121.

[46] Ibid., p. 365.

[47] ... "Artificial Lighting of Churches," The ... Architectural Review (December 1914), p. 512.

[48] "The Design of Lighting Fixtures," The American Architect, April ... 1914.

designed lighting fixtures well suited to their architectural settings. The tremendous growth of the illumination industry at this time tended to polarize the manufacturers of luminaires into two camps: larger national firms manufacturing "commercial" fixtures or luminaires, with distribution through dealers, and local ornamental lighting fixture companies manufacturing "artistic fixtures."[49] Examples of the former are GE and Lado-Phelps and of the latter are Frederick C. Baker (Portland, OR.) and Bechtel Manufacturing (Denver CO.). It was common for these local manufacturers to incorporate the standard auxiliaries (globes, shades, reflectors) of the national lighting companies into their custom designed fixtures.[50]

Commercial fixtures

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Figure 140. Flattened globe

light distributions that the mirrored reflectors were.[51]

Opal glass enclosed units evolved beyond the simple globe stage, although these remained a fairly efficient stand-by. Shades of long globes were developed for a maximum horizontal distribution, while the flattened reflecting top unit of Figure 140 was developed for a maximum vertical

[49] Harold W. Rambusch, "The Problem of Light in Fixture Design," The American Architect, January 1927, pp. 169-175.

[50] ... "Superb Examples of U.S. Royal ... Decorative ... 1915," Oregon Historical Society, Accession ...

[51] Francis E. Cady, editor, "Illuminating Engineering Practice, New York: New York ... 1923, p. 302.

distribution. The flattened top increased reflection downward.[52] A semi-enclosed unit, similar to Figure 141, consisted of a diffusing glass bowl ringed by a metal reflector at the top, suspended beneath a lamp. The broad reflector also assisted in diffusing direct light. Semi-indirect fixtures remained popular, with some incorporating clear glass tops to avoid the depreciation problem associated with dust collection in the opal glass reflector (Figure 142.).

Figure 141. Translucent bowl with reflector

Figure 142. Semi-enclosed indirect pendant fixture

[52] Ibid., p. 268.

An interesting commercial fixture at this time was one which employed an inverted enameled-metal reflector with an open bottom, a short distance below which was suspended a diffusing glass plate of a greater diameter. A small amount of light was reflected upward to illuminate the reflector as well as being directly diffused through the plate (Figure 143.). Prismatic-glass reflectors operated in the same capacity as mirrored-glass reflectors, coming in various contours to produce a wide range of light distributions. The prismatic

Figure 143. Inverted reflector with disk

diffuser ridges that formed the inner surface of these units refracted and reflected up to 75 percent of the source light downward, with the remainder being transmitted above the horizontal (Figure 143.). Totally indirect units were also widely used, most incorporating interior mirrored glass reflectors (Figure 144.). It was understood that the shadow suppression associated with these units could make the perception of objects in their three dimensions less satisfactory than with direct lighting.[53]

It might be noted that the planer quality of many of the commercial fixtures dating from the mid 1920's, with their extensive use of spun metal and flattened disk reflectors, could have exerted a design influence on the 'artistic' fixtures of the later Art Deco period, which also have this character

[53] Ibid., pp. 268-272.

Figure 144. Prismatic glass reflector

Figure 145.

Artistic Lighting Fixtures

With exception of suspended ceiling fixtures, the historic lighting fixture types of the wall bracket, lantern and candelabrum were fitted with appropriate diffusing shields, shades, globes or panes and adapted to electric illumination. These types of 'period' fixtures often supplied the appropriate historical character for the Neo-Renaissance, Neoclassical, and Gothic-Revival architecture of this period.

These fixtures normally adopted the same ornamental vocabulary of the architecture of which they were a part. The tendency toward profuse applied ornamentation on fixtures provoked comment from period writers who emphasized ornamentation's subservient role in reinforcing the structural lines of the lighting fixture and in effecting "a closer relationship between the design of the lighting fixture and its setting".[54]

An article by Harold W. Rambush, of Rambush Decorating Co., a very successful lighting fixture manufacturer in New York during this period, indicates a general lack of communication and understanding between illumination engineers, concerned with the illuminating value of fixtures, and artistic lighting fixture manufacturers, whose prime concern was historic ornament, metal craft, and the artistic value of the fixture. He emphasized that both points of view were essential for a successful fixture and that patience and cooperation were needed to harmonize the divergent viewpoints.[55]

Art Deco Period

This period was characterized by a rejection of the constraints of architectural historic precedent, and an embracing of a more rational approach to architecture and architectural lighting. A conceited confidence in the supremacy of this new progressive era seems to assert itself in period literature on architectural lighting. This new attitude is well illustrated by the following quotes from a leading architectural journal: "Only in the last few years have the fetters of the past been sundered from their hold on lighting. Architects and designers have discovered new ways to use modern sources. They are beginning to light the things to be seen instead of letting the light source command first attention. They are literally 'designing in light'; making light compose and organize their interior compositions rather than unbalance them as often has occurred in the past."[56] "It is being realized that only by forgetting the past in lighting fixtures can full benefit and efficiency in lighting be obtained. Lighting has resolved itself into a definite problem of illumination, with the design forms following the lines of utility and practicality, rather than setting the

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[54] "The Design of Lighting Fixtures," The American Architect, April, 1925, p. 222.

[55] Harold W. Rambusch, "The Problem of Light in Fixture Design," The American Architect, January, 1927, p. 750.

[56] "Modern Interior Lighting," American Architect, November, 1934, p. 58.

pace as in the past".[57]

As the above progressivist rhetoric suggests, there was a shift in emphasis from the 'ornamental lighting fixture as an aid to architectural expression', to the use of light as an architectural expression. This changing attitude to the use of light in architecture was accompanied by a replacement of the classical vocabulary in architectural ornament, with a flattened, conventionalized, linear based one. Light was used to highlight the plane, breaking plane and unbroken line, which became dominant architectural elements. The Beaux-Art interest in interior architectural projections and recesses creating plays of shade and shadow, gave way to an Art Deco interest in the "elimination of dark shadows and sharp contrasts while preserving soft shadows for roundness and relief, and lighting emphasis on those parts which command first attention".[58] Although a concern for glare continued from the previous period, advances in lamp technology encouraged a general increase in light intensities, with one period writer noting "that there can be no such condition as over-illumination from artificial sources, provided there is no glare".[59] There seems to be less interest in physiological issues related to artificial illumination, such as the part shadow plays in aiding visual perception, and more interest in the psychological power of artificial illumination to influence human behavior and temperament. It was suggested that "worship, introspection, contemplation, and physical relaxation are aided by relatively low lighting levels. Gaiety, keen thinking, and great mental and physical activity are favored by high levels. In theaters, houses, and some types of restaurants, it is particularly important to control lighting for mood: in stores and shops and in some institutional buildings it is necessary to employ the amount of light that will produce the most favorable psychological reaction".[60] In regards to the retail industry, it was suggested that the " brightness of the show windows determines the minimum desirable level of illumination in the store. Stimulating windows will fail to entice customers into the store if the latter is dim by comparison. The store should therefore be lighted to at least 10 percent of the show window level.[61]

Lighting Approaches

New types of indirect, semi-indirect and direct lighting strategies were developed in response to new and more powerful lamps and an attempt to integrate lighting fixtures into the surface planes and lines of the architecture.

Semi-indirect lighting fixtures adopted more complex techniques of diffusing and directing the light from stronger lamps (Figures 146. and 147.). A flashed opal glass (A glass-blower gathers a blob of molten opal glass on the end of his blow pipe, and blows a bubble into the form of a thin cylinder, slits the cylinder along its length and lays it on a clear glass sheet. The two sheets are then allowed to slowly cool and fuse together in an annealing lehre.) was preferred over the earlier solid opal glass because of its higher light transmittance with comparable diffusion. Vertical layers of multiple reflecting louvers and concentric rings in the horizontal plane, were used to direct and diffuse light (Figure 148., 149, and 151.). It became common to use prismatic refracting lenses, focusing and parallel lenses, and even Fresnel (lighthouse type) lenses to control light distribution for the direct portion of semi-indirect lighting.[62] A translucent plastic, called Lucite, was developed by Du Pont Company and excelled as a light diffusing lens for artificial illumination. One celebrated installation was the lounge of the St. Francis Hotel in San Francisco, where an entire luminous ceiling of overlapping Lucite panels is backlit by lamps. The Lucite came in 36 inch by 48 inch by 1/4 inch sheets, was cut to fit the dies made according to the architect's blueprints, subjected to a special heat treatment and pressed in a die to the required shape and relief. Various shapes were welded together and all of the panels hung from bars that were suspended from the ceiling.[63]

Direct and semi-indirect lighting was subsumed into the fabric of the architecture in the form of luminous panels, beams, pilasters, boxes, skylights, domes, coffers, and boxes, as well as

[57] Walter W. Kantack, "Fundamentals in Providing for Good Lighting," American Architect, September, 1931,p. 48.

[58] "Modern Interior Lighting,"American Architect, November, 1934, p. 59.

[59] Ibid.

[60] Ibid., p. 61.

[61] Henry L. Logan, "Store Lighting," Architectural Lighting, July, 1935, p. 286.

[62] "Modern Interior Lighting," American Architect, November, 1934, pp. 59-67.

[63] Nathan H. Graves, "Lighting an Integral Part of Good Design," Architect and Engineer, February, 1940,p. 42.

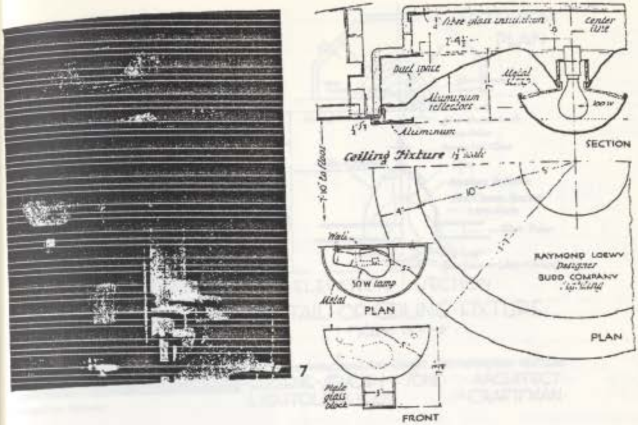

Figure 146. Recessed indirect fixture wall light

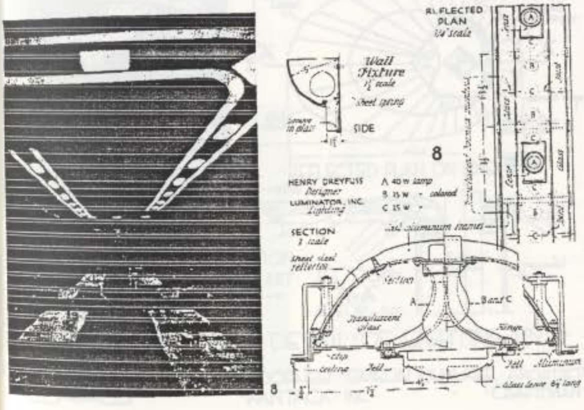

Figure 147. Linear recessed indirect and direct lighting system and wall light illustrated above

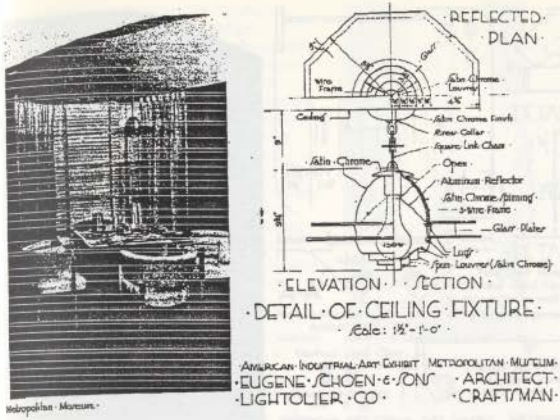

Figure 148. Suspended luminaire

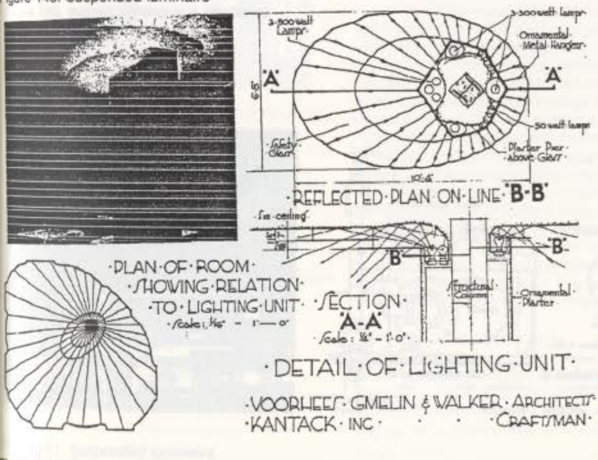

Figure 149.

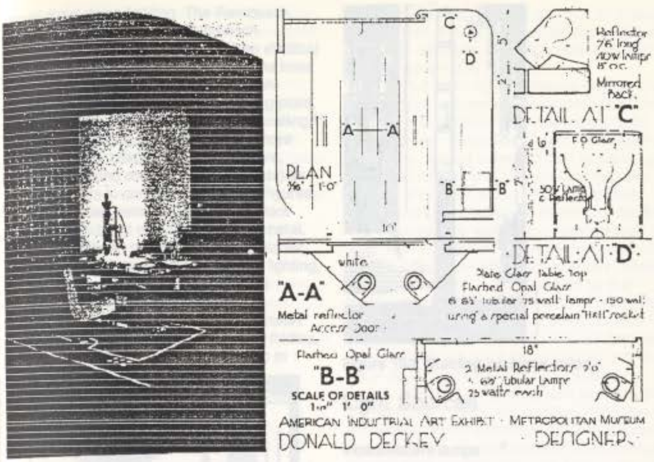

Figure 150. Indirect lighting in a residence

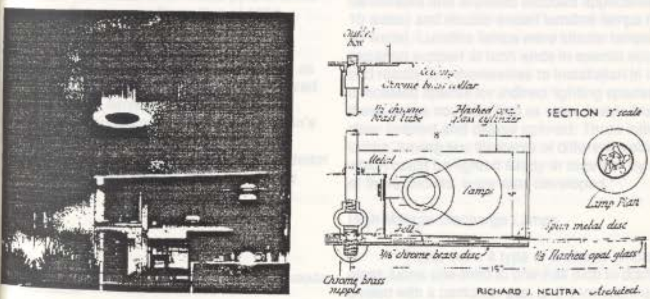

Figure 151. Suspended luminaire

recessed direct down lighting. The Rambusch Downlite, patented in 1934 by Rambusch Decorating Company, consisted of a deep elliptical polished reflector with a powerful lamp at the base projecting through a control lens in the flush-mounted ceiling plate. Except for the ceiling plate, the entire assembly was recessed into the ceiling.[64]

Indirect lighting systems became more complicated in their placement (cornice cove, behind bench seating cove, and vertical slots) as well as their efforts to conceal the source (Figures 150.).[65] Suspended semi-indirect and indirect fixtures tended to be of machined or spun metal, with a concentric linear or vertical linear character.

One form of interesting landscape lighting, which influenced entrance lighting, was the luminous pylon. This form of lighting was introduced as promenade and pavilion forecourt lighting at the large expositions of the early thirties, such as the Century of Progress Exposition in

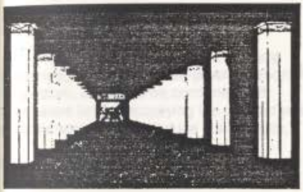

Figure 152. Promenade of luminous pylons at the Copenhagen Exposition of 1931

Chicago and the French Colonial Exposition in Paris (Figure 152.). Their marketing advantage as beacons to passing motorists was quickly realized by the automobile service industry, often incorporating luminous pylons in the gas station's advertising. They also saw service as building entrance lighting, sometimes incorporating exterior building illumination lamps, as in Figure (Figure 153.).[66]

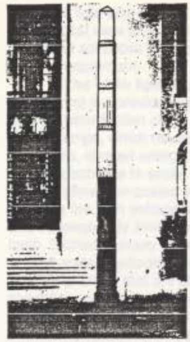

Figure 153. Building luminous pylon

Light Sources

Incandescent lamps

In addition to the standard 'A' lamps (15 to 100 watts) and the 'PS' (pear-shaped, 150 to 1500 watts) were a range of lamps more suited to decorative or indirect lighting applications. These included tubular lamps (25 to 150 watts), round lamps (25 to 40 watts), low wattage lamps for candelabra and exposed studded applications (3 to 10 watts) and double-ended lumiline lamps (40 to 60 watts). Lumiline lamps were tubular lamps requiring support at both ends in special sockets and readily lent themselves to installation in narrow concealed spaces for indirect lighting spaces. All these lamps could be had as clear, inside frosted, clear colored and diffuse colored. Three intensity lamps, having two filaments of different wattages which could be lighted singly or together by means of three circuits, were also developed.[67]

High Voltage Discharge Lamps

These were a type of arc lamp employing glass tubes one-third to one-half inch in diameter sealed with a particular gas, and a transformer to step up the voltage across the electrodes. The

[64] "The Rambusch Decorating Company," The Journal of Decorative and Propaganda Arts, Summer, 1988, p. 36.

[65] "Modern Interior Lighting," American Architect, November, 1934, pp. 59-71.

[66] W.M. Potter, "The Luminous Pylon as an Architectural Element," Architecture, June, 1935, pp. 305-310.

[67] "Modern Interior Lighting," American Architect, November, 1934, p. 64-65.

[illegible] indirect street lighting. The Rambusch [illegible], patented in 1934 by Rambusch [illegible] Company, consisted of a deep elliptical [illegible] reflector with a powerful lamp at the base [illegible] through a conical lens in the fluted ceiling slab. Except for the ceiling glass, [illegible] apparatus was concealed over the ceiling.[38]
[illegible] indirect lighting systems became more [illegible] than translucent columns were [illegible] lamps, reading room, and vertical sticks as [illegible] standards to conceal the source (Figure [illegible]). Integrated semi-indirect and indirect [illegible] similar to those of machined or spun metal, [illegible] in linear or conical fluted character.
One form of interesting landscape lighting, [illegible] semi-indirect lighting, was the [illegible] pylon. This form of lighting was [illegible] by amusements and parked interiors [illegible] in the large exhibitions of the early thirties, [illegible] the Century of Progress Exposition in

[illegible] 152. Promenade of luminous pylons at the [illegible] Exposition of 1937.

[illegible] and the Franco-[illegible] Exposition in [illegible] (Figure 155.) Their marketing advantage as [illegible] of passing motorists was quickly realized [illegible] automotive service industry which [illegible] luminous pylons at the gas station a [illegible]. They also had service as building [illegible] lighting, sometimes incorporating outdoor [illegible] lamps, as in many [illegible] (Figure [illegible]).

Figure 153. Building luminous pylon

Light Sources

Incandescent lamps

In addition to the standard "A" lamps (15 to 150 watts) and the "PS" (pear-shaped, 150 to 1500 watts) were a range of lamps more suited to decorative or indirect lighting applications. These included tubular lamps (25 to 150 watts), round bulbs (25 to 40 watts), low wattage lamps for candelabra and assorted ornamental applications (3 to 15 watts) and double ended lumiline lamps (30 to 60 watts). Lumiline lamps were tubular lamps requiring support at both ends in special sockets and readily lent themselves to installation in narrow concealed spaces for indirect lighting coves. All these lamps could be had as clear, inside frosted, glass colored and diffuse coatings. Three intensity lamps, having two filaments of different wattages which could be lighted singly or together by means of three circuits, were also developed.[39]

High Voltage Discharge Lamps

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[38] "[illegible]," [illegible] [illegible], [illegible] 19[illegible], p. [illegible]
[39] [illegible] Company, "[illegible]," [illegible] [illegible], 193[illegible], p. [illegible]
[illegible] [illegible] "[illegible] Lighting," [illegible] [illegible], [illegible] 193[illegible], p. [illegible].
[illegible] [illegible], "The Luminous Pylon as an Architectural Feature," [illegible], [illegible] 1933, pp. [illegible]

color of the low intensity light was dependent on the gas used. This lamp saw extensive decorative use as the familiar 'neon sign'.[68]

Hot Cathode Gaseous Conductor Lamps

This was a new type of low voltage neon light with a high lumen output per wattage input. They produced a very bright red light for decorative purposes and generally had to be concealed in reflectors for indirect lighting. It was possible to use these lamps in conjunction with mercury vapor lamps, which emitted a greenish blue light, in a specially designed reflector to produce a visually white light more economically than with incandescent/mercury vapor lamps.[69] The tubes were one inch in diameter and varied in length from 27 to 50 inches and required a transformer and control apparatus, measuring four inches across, at one end.[70]

Mercury Vapor Lamps

These were another type of arc lamp producing light rich in the blue-green position of the spectrum, and could be combined with incandescent lamps, occupying the red and yellow end of the spectrum, to produce a white light.

The 1940's

This period sounded the final death knell of the decorative lighting fixture, as expressed by two leading illuminating engineers of this period: "The illuminating engineer is departing from the primary emphasis on the lighting fixture as a medium for expressing the physics of light control. Along with the architect he now thinks of the interior as an integrated whole - a functional environment to serve specific needs".[71] Ornamental lighting fixtures gave way to "new equipment for planned lighting".[72]

This new approach to the strictly functional control of light was brought about by an equally functionalist view to architectural design in general, as well as advances in optical physiology and lighting equipment.

The white light source, so intently sought after during the previous period, was finally found with the introduction of the fluorescent lamp. "These lamps, which usually contain mercury and argon gas, convert energy to light by using an electric discharge to excite gaseous mercury atoms within a phosphor-coated tube. The ballast provides the high voltage to initiate the discharge and subsequently limits the current through the lamp. Excited mercury atoms decay back to the ground state, producing ultraviolet (UV) photons. The UV photons that are absorbed by the phosphor coating are converted into visible light as the phosphor fluoresces and emits photons in the physical spectrum".[73] Circular and semicircular fluorescent lamps were developed for domestic use in table lamps and kitchen luminaires.[74]

Because of the increased surface area of the fluorescent lamp, the surface brightness was decreased, which subsequently reduced contrast and glare. This reduced threat of glare prompted a general increase in the general lighting intensity: general illumination averaged 15 to 20 footcandles, while intensities for visually intensive activities ranged up to 50 footcandles. This might be compared with the suggested library intensities of 1 to 2 footcandles in general and 3 to 4 on the reading table during the early illumination period (1898 - 1914). Shadows played no role in architectural expression and were simply controlled by artificial and daylight as an aid in the visual perception of surfaces. In general, it was felt that an object's own shadows tended to clarify the form, while cast shadows tended to confuse it. "A very extended source of light, occupying about half of the perisphere, practically eliminates cast shadows, while it emphasizes plastic form by soft own shadows".[75] This environment of nearly indiscernable soft shadows could be provided by a grid of fluorescent fixtures or lamps set above reflecting louvered ceilings.

The integration of lighting in architecture

[68] Ibid.

[69] Eugene Clute, "Luminous Tubes for Lighting," Architectlure, February, 1935, p. 66.

[70] "Modern Interior Lighting," American Architect, November, 1934, p. 65.

[71] C.L. Crouch and R.W. McKinley,"New Equiptment for Planned Lighting," Architectural Record, December, 1947, p. 117.

[72] Ibid.

[73] M.A. Piette et all, Technology Assessment: Energy-Efficient Commercial Lighting (Berkeley California: Lawrence Berkeley Laboratory, 1988), p. 3-2

[74] C.L. Crouch and R.W. McKinley,"New Equiptment for Planned Lighting," Architectural Record, December, 1947, p. 119.

[75] Hans Blumenfield, "The Integration of Natural and Artificial Light," Architectural Record, December, 1940, p. 51.

[illegible] that intensity light was dependent on [illegible]. This lamp was extremely decorative [illegible] familiar "neon sign".[12]

[illegible] Cathode Fluorescent Lamps

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[illegible] Vapor Lamps

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1940's

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The integration of lighting in architecture

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[12] Ibid.

[13] [illegible] "[illegible] to Lighting," [illegible], [illegible].

[14] [illegible], [illegible], November, 1934.

[15] [illegible] "New Equipment for Planned Lighting," Architectural Record, December, 1943, p. 115.

[16] Ibid.

[17] H.A. Ross et al. [illegible] [illegible], [illegible] [illegible], 1993, p. [illegible].

[18] [illegible] "New Equipment for Planned Lighting," Architectural Record, December, 1943, p. 115.

[19] [illegible] "The Integration of Natural and Artificial Light," Architectural Record, December, 1943, p. [illegible].

tended to mean subsuming the lighting fixture into the ceiling space overtop of a louvered ceiling, or at the very least, setting a combination fluorescent fixture/air supply diffuser in the plane of the ceiling. It was thought that these luminous overall ceilings of translucent louver sections presented "a clean-cut appearance covering up all the structural non-uniformities and mechanical equipment"[76] and it was concluded that it "often gives the feeling of latticed daylighting".[77]

This period is also characterized by a rediscovery of the virtues of daylighting in architecture. Many of the strategies used to introduce and control daylight, such as refracting glass blocks and reflecting exterior surfaces, were an integral part of architecture before electric artificial illumination. A combination of controlled natural light and artificial light was generally considered the most desirable.[78]

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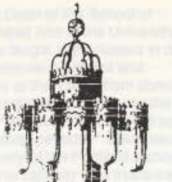
[76] C.L. Crouch and R.W. McKinley,"New Equipment for Planned Lighting," Architectural Record, December, 1947, p. 117

[77] Ibid.

[78] Hans Blumenfield, "The Integration of Natural and Artificial Light," Architectural Record, April, 1941, pp. 71-73



Chapter **5**

Frederick C. Baker: A Case Study

Introduction

Frederick C. Baker's sixty-eight year career, as Portland, Oregon's foremost designer and manufacturer of ornamental lighting fixtures, presents an unusual opportunity to examine the evolution of one designer's decorative lighting fixtures from the Early Illumination and Beaux-Art periods, through to the Art Deco and Modernist periods. The interactive forces driving this evolution included advances in material processing and illumination science and changing architectural design attitudes. The constant element in this progression was the successful integration of the decorative luminaires into their architectural settings; something only possible through the thoughtful collaboration of a talented lighting designer and the architect.

This chapter's greatest resource is the group of Building Case Studies highlighting existing Baker lighting installations in historic buildings, which are located in the appendix. These case studies are drawn from the progressive stages of Baker's fixture design - Early Illumination, Beaux-Art, Decorative Art-Deco, Planer Art Deco, and Modern.

The Making of a 'Lighting Man'

Frederick Charles Baker considered himself a student of ornament and a draftsman; a modesty that belies his creation of some of the finest crafted and imaginative luminaires in the country. His modesty may derive from his humble beginnings. He was born in Bay City, Michigan in 1887. "His father had visited Oregon as a cowboy employed by William Cody, and after marrying, the senior Baker brought his family to Oregon in 1892".[1] The Bakers, including five-year-old Fred, settled on a ranch in southern Oregon until the outbreak of the Spanish American war. The hostilities between the Spanish Empire and the United States, prompted by the sinking of the U.S. battleship Maine in the Havana harbor in 1898, created apprehensions of Spanish attack on the West Coast. "The Bakers returned east for the duration of the conflict, but later returned to southern Oregon, ultimately settling in Portland".[2]

Baker was fortunate enough to get his early drafting training under Ellis F. Lawrence, a graduate of the Beaux-Art style architectural program at the Massachusetts Institute of Technology (MIT), a man with a passion and gift for education, and an architect with a thorough understanding of ornamentation's role in architecture. Before

Figure 154. Frederick C. Baker in his younger years

[1] Charles Deemer, "The Draftsman as an Artist", Northwest Magazine, Sunday November 19, 1978.

[2] Stephen B. Schuber, "Frederick C. Baker: making art of light", Architectural Lighting, January, 1987, p. 46.

becoming the first Dean of the School of Architecture and Allied Arts at the University of Oregon, Lawrence taught night classes in drawing and drafting architectural ornament and architectural history at the YMCA from about 1908 to 1910.[3] Baker said that he enrolled in the first class offered and "studied all kinds of old books about the architectural periods".[4] Baker became acquainted with many of the Portland architects during this time in his capacity as a freelance draftsman and a moonlighting luminaire designer. He responded to an add, by a Buffalo, New York, decorating firm, for an architect to do drawings and floor plans of prospective Portland residential interiors. As he told an interviewer in 1978: "I thought I was an architect, of course I was not; they hired me. I would go to these houses, make sketches of the interiors, and a rough floor plan and send it to a company in Buffalo, New York - decorating outfit. I would receive 50 cents for a sketch of an interior and 50 cents for a plan of a small house that I would generally make right on the job. That job would pay me more than anyone else I knew, because that job could pay me between 2 1/2 and 3 dollars a day. After this ended, I made drawings for architects, and then there seemed to be a call for fixtures. After the Pittock job picked up, I could make more money doing fixtures".[5]

Baker's first major lighting commission was the Henry Pittock mansion; a commission that established his reputation among architects as the area's premier lighting fixture designer and

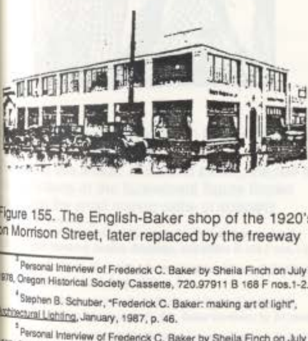


Figure 155. The English-Baker shop of the 1920's on Morrison Street, later replaced by the freeway

Figure 156. F.C. Baker drawing of the exterior lantern of the Temple Beth Israel

manufacturer. The winning of the commission wasthe result of a beautifully rendered set of drawingsand a bit of unabashed marketing on Baker's part. Baker asked Pittock, directly, if he could do some drawings of the light fixtures for the architect. As Baker later explained: "I didn't know anything about lighting, but I knew something of architectural design. I did some drawings and went up to the old Pittock place and showed them to Pittock, who sat in a chair flanked by his two daughters. I sat on the floor. He asked his daughter if they liked them and they said 'yes, their pretty'. I had worked out a price for him, didn't think he'd be interested enough to ask, but he did. So he said 'Well go ahead young man, put them in, let's do it.'"[6]

About 1912 Baker opened a small shop at Second and Mill streets,[7] in connection with J.C. English and company, for whom he served as a freelance draftsman. English came to Portland in 1909 and traveled around to the wealthy homes selling for the Oxley Ennus decorating and furnishing company. A wealthy Portlander was so impressed wi.h his services that he set him up in business. Baker merged with English in 1929; the

[3] Personal Interview of Frederick C. Baker by Sheila Finch on July 5, 1978, Oregon Historical Society Cassette, 720.97911 B 168 F nos.1-2.

[4] Stephen B. Schuber, "Frederick C. Baker: making art of light", Architectural Lighting, January, 1987, p. 46.

[5] Personal Interview of Frederick C. Baker by Sheila Finch on July 5, 1978, Oregon Historical Society Cassette, 720.97911 B 168 F nos.1-2.

[6] Ibid.

[7] Charles Deemer, "The Draftsman as an Artist", Northwest Magazine, Sunday, November 19, 1978.

... the first Dean of the School of ... and Allied Arts at the University of ... Lawrence taught night classes in drawing ... architectural ornament and ... history at the YMCA from about 1908 ... Baker said that he enrolled in the first ... and "studied all those all kinds of architectural periods." Baker became ... with many of the Portland architects ... in his capacity as a freelance ... and a moonlighting lighting fixture designer. ... by a Buffalo, New York, ... the architect to do drawings and ... of prospective Portland residential ... he told an interviewer in 1976: "I ... I was an architect; of course I was not; they ... I would go to these houses, make ... of the interiors, and a rough floor plan and ... to a company in Buffalo, New York - ... I would receive 50 cents for a ... of an interior and 50 cents for a plan of a ... that I would generally make right on the ... the job would pay the 25 cents also. I ... because that job could pay the freelance 2 ... a day. After this ended, I made ... for architects, and then there seemed to ... fixtures. After the Pittock job, picked up, ... making lighting fixtures."[1]

Baker's first major lighting commission was ... Temple Beth Israel, a commission that ... his reputation among architects as the ... lighting fixture designer and

Figure 14b. F.C. Baker drawing of the exterior lantern of the Temple Beth Israel.

manufacturer. The winning of the commission was the result of a beautifully rendered set of drawings and a bit of unabashed marketing on Baker's part. Baker asked Pittock, directly, if he could do some drawings of the light fixtures for the architect. As Baker later explained: "I didn't know anything about lighting, but I knew something of architectural design. I did those drawings and went up to the old Pittock store and showed them to Pittock, who sat in a chair flanked by his two daughters [illegible] on the floor. He asked his daughters if they liked them and they said 'yes, they're pretty.' I had worked out a price for them, didn't think he'd be interested enough to ask, but he did. So he said 'Well go ahead young man, put them in, let's do it.'"

About 1912 Baker opened a small shop at Second and Ash streets,[1] in partnership with J.C. English and [illegible], for whom he worked as a freelance draftsman. English came to Portland in 1909 and [illegible] to the wealthy homes [illegible] for the [illegible] Bros [illegible] and [illegible] company. A wealthy Portlander was so impressed with his services that he set him up in business. Baker merged with English in 1920; the

Figure 15. The English-Baker shop at the [illegible] Street, later replaced by the [illegible]

[1] Ibid.

[1] [illegible], "The Craftsman as an Artist," [illegible] Studio, [illegible]

[illegible] F.C. Baker [illegible]

two men casting lots to see who would become the president and second name in 'English Baker' and visa versa. It became the English Baker company, which lasted for about two or three years until Baker bought out English and changed the name to the Fred C. Baker Company. Prior to this, for a period of about one year in the early twenties, Baker had another partner by the name of Harkness who managed a shade shop on the second floor of his Morrison Street facility (Figure 155.)[8]. This was in connection with a branch of Baker's business that manufactured wooden and metal standing lamps.[9] During the thirties Baker became associated with a Tacoma firm developing the fluorescent lamp. Baker appended the patent name of this lamp to his firm's name to become the Baker-Barkon Corporation.[10] Baker's shop swelled to about 40 employees during the war when he built nearly all the lighting equipment for the shipyards at St. John's and Swan Island and related worker housing.[11]

Figure 157. Frederick C. Baker in his senior years

During the late forties, fifties and sixties, the rise to predominance of the fluorescent fixture forced Baker into the small market niche of specialty church lighting. The competition with foreign-made lighting fixtures after World War II forced mostlighting fixture dealers, such as Baker, into doing 90 percent of their business in foreign-made fixtures, mostly from Spain, Italy, Germany and later, the Orient. Baker could buy a foreign-made fixture for a quarter of the price it would cost him to make it. When Baker started in the lighting fixture business, the industry made 95 percent of everything it sold.[12] This general decay of the production sector, in his own industry as well as the country at large, profoundly disturbed Baker: "This is a sad situation. America became strong because we could produce more than we consumed. This is not true any more, my wife went shopping the other day for a pair of American-made shoes and couldn't find any. People aren't told this. They aren't aware of what's been happening to American business, but I lived through it. I was caught in the middle of it. It's very sad".[13]

Figure 158. F.C. Baker lantern design drawing

8 Personal Interview of Fred C. Baker by Sheila Finch on July 5, 1978, Oregon Historical Society Cassette, 720.97911 B 168 F nos.1-2.

9 "Fred C. Baker, King of Ornamental Lighting Fixtures", Business Success, Portland, Oregon, May, 1979. p. 6.

10 personal conversation with B. Garber of Garber Lighting Co., Portland (former Sales Manager for the F.C. Baker Company for 20 years)

11 "Fred C. Baker, King of Ornamental Lighting Fixtures", Business Success, Portland, Oregon, May, 1979. p. 7.

12 Charles Deemer, "The Draftsman as an Artist", Northwest Magazine, Sunday, November 19, 1978.

13 Ibid.

Response to Architecture, Material Processes and Illumination Science

F.C. Baker's lighting fixtures evolved during his career in response to changing architectural attitudes to the role of ornament and the luminaire and artificial light in general in architecture, and to advances in material processing and illumination science. This section will expand on Baker's progression from the ornamental cast bronze and wrought metal

Figure 159. F.C. Baker lantern design drawing

historicist direct lighting fixtures of his early years to the complex non-historicist ornamental cast and wrought metal direct and semi-indirect fixtures of the late twenties and early thirties, and finally to the spun metal luminaires of a sophisticated illumination science character of the later thirties through to the fifties. The three factors most influencing this evolution of Baker lighting fixture design were: changing architectural attitudes and styles, advances in material processing, and developments in illumination science.

1. Changing Architectural Attitudes and Styles

Ornament was an integral part of the historicist stylistic revival architecture of the Beaux-Arts Period. Baker, a skilled draftsman and delineator of ornament, designed cast bronze and wrought metal fixtures to harmonize with the architecture. A trend toward the flattened abstract conventionalization of this classical, floral and geometric ornamental vocabulary continued from the late twenties through the mid to late thirties. Concurrent with this ornamental evolution was an architectural movement to spaces defined by planes and articulated by lines, a condition which tended to become the dominant mode during the mid to late thirties. This latter architecture, typified by the interiors of the State Library or the University of Oregon Medical School Library, reduced interior architectural ornament to lines articulating recessing planes, corners, or wainscots. Baker's lighting fixture design response to this was to spin his fixtures from sheet metal stock on a spinning lathe. The decorative potential of the spinning lathe for creating horizontal layered offsets and perimeter tooling lines was harnessed to it's full capacity to effectively harmonize with this new architecture of planes and lines.

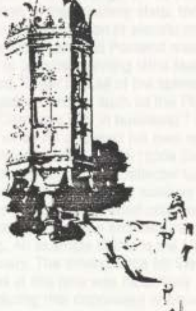


Figure 160. F.C. Baker lantern design drawing

2. Advances in Material Processing

Baker had to go to San Francisco to get most of his early casting done, such as those used at the Pittock Mansion, as he was unable to procure the castings in Portland. It was not long however before Portland foundrys, such as Oregon Brass Company, developed the expertise to do Baker's castings. As a skillful draftsmen, Baker would make a drawing of a prospective fixture design. In the Beaux-Arts years, this was usually a worms-eye perspective similar to the lantern designs on this and other pages. Baker drew on his developed talents as a delineator to generate a fairly precise drawing showing the three dimensional character of the ornament. He would either hand this to his blacksmiths to fabricate in wrought metal or sheetmetal, or if it was a cast item, mold the various pieces himself out of clay. A plaster cast would be made from the clay model, which would be used to make a lead cast. A lead model can be tooled to a considerably finer level of detail than a plaster cast. The lead cast would then be used to cast a bronze cast as a master mold for the finished product.[14] Baker would get the castings back from the foundry in a rough shape and would personally finish them. This would involve chiseling, filing and rifling the casting and then applying the desired finish. During the Second World War Baker was asked to melt down some of his priceless lead casting in support of the war effort, which he did.[15] One of the last cast fixture jobs were the fixtures for the Trinity Episcopal Church in Portland for Sutton and Whitney, Architects, in 1947.

In the early years Baker also had to get his spinning done in San Francisco and assemble the parts back in Portland. This would have been the case for the hollow stacked vase shapes that composed the baluster stem of the brass branched chandeliers of the early club buildings, such as the Waverly Country Club House and the University Club in Portland. During the Beaux-Art years spinnings were usually a less desirable substitute for castings, often used for internal housings or for the ceiling plates of less expensive fixtures. By the early thirties, spinnings were playing a more substantial construction role in Baker's luminaires. The U.S. Courthouse courtroom luminaires are an example of this, with the spun metal curved side of

Figure 161. F.C. Baker lantern design drawing

the reflector bowls and the spun metal pan- shaped bottom of this same assembled bowl reflectors, both of which are sheathed in bronze castings.

As noted in chapter four, the large manufacturers of commercial luminaires were making extensive use of spun metal reflectors in the 1920s. This was a specialized machining process, which forced Baker to go to San Francisco to procure his early spinnings. It was the mechanization of the machine shop, through advances in the application of electric motor technology, which allowed Portland machining companies to acquire spinning lathe facilities. After this occurred, Baker had all of the spinning done by Portland machine shops, such as the Plath Machining Company (still in business)[16] until later in the 1950's when he acquired his own spinning lathe.[17] During the early to mid-1930s Baker was designing plainer spun metal reflector luminaires for use in classrooms, offices, and auxiliary spaces but was still designing highly crafted cast and wrought metal fixtures for the prime architectural spaces of the building. An example of this is the University of Oregon Library. The driving force for the use of spun fixtures at this time was most likely a need for economy, during this depressed economic period,

[14] Personal Interview of Fred C. Baker by Sheila Finch on July 5, 1978, Oregon Historical Society Cassette, 720.97911 B 168 F nos.1-2.

[15] Ibid.

[16] personal conversation with B. Garber of Garber Lighting Co., Portland (former Sales Manager for the F.C. Baker Company for 20 years)

[17] Personal interview of Fred C. Baker by Sheila Finch on July 5, 1978, Oregon Historical Society Cassette, 720.97911 B 168 F nos.1-2.

Figure 181. F.C. Baker lantern design drawing

the reflector bowls and the spun metal pan-shaped bottom of this same assembled bowl reflectors, both of which are sheathed in bronze castings.

As noted in chapter four, the large manufacturers of commercial luminaires were making extensive use of spun metal reflectors in the 1920s. This was a specialized machining process, which forced Baker to go to San Francisco to procure his early spinnings. It was the mechanization of the machine shop, through advances in the application of electric motor technology, which allowed Portland machining companies to acquire spinning lathe facilities. After this occurred, Baker had all of the spinning done by Portland machine shops, such as the Flash Machining Company (still in business)[17] until later in the 1930's when he acquired his own spinning lathe.[18] During the early to mid-1930s Baker was designing plainer spun metal reflector luminaires for use in classrooms, offices, and auxiliary spaces but was still designing highly crafted cast and wrought metal fixtures for the prime architectural spaces of the building. An example of this is the University of Oregon Library. The driving force for the use of spun fixtures at this time was most likely a need for economy, during the depressed economic period.

[17] Personal conversation with R. Button of Button Lighting Co. Button (former Sales Manager for the F.C. Baker Company) ...

[18] Personal interview of Fred C. Baker by ... 1976. Oregon Historical Society ...

...Baker had to go to San Francisco to get ...of his early casting done, such as those used ...Pacific Mutual, as he was unable to procure ...castings in Portland. It was not long however ...Portland foundrys, such as Oregon Brass ...ompany, developed the expertise to do these c... As a skilled draftsman, Baker would make ...rawing of a prospective fixture design. In the ...earlier years, this was usually a worms-eye ...ew similar to the lantern designs on this ...and next pages. Baker drew on his developed ...skills as a draftsman to generate a fairly precise ...awing showing the three dimensional character of ...the fixtures. He would either hand this to his ...craftsmen to fabricate in wrought metal or ...castings, or if it were a cast form, mold the various ...pieces out of clay. A plaster cast would be ...made from the clay model, which would be used ...to make a lead cast. A lead model can be tooled to a ...finer detail than would a plaster cast. ...The lead cast would then be used to cast a bronze ...or a master mold for the finished product.[19] ...Baker would get the castings back from the foundry ...in rough shape and would personally finish them. ...He would involve chasing, filing and fitting the ...castings and then applying the desired finish. During ...the Second World War Baker was asked to melt ...down some of his precious lead casting in support ...of the war effort, which he did.[19] One of the last cast ...fixtures he made were the fixtures for the Trinity ...Episcopal Church in Portland, for Sutton and ...Whitney, Architects, in 1947.

In the early years Baker also had to get his ...spinning done in San Francisco and assemble the ...fixtures back in Portland. This would have been the ...case in the reflector bowl shapes that ...formed the bowl and lower stem of the brass branched ...fixtures of the early club buildings, such as the ...Waverly Country Club House and the University ...Club in Portland. During the Baker-Art years ...there were usually a less desirable substitute ...for castings, often used for interior locations or for ...secondary places of less expensive fixtures. By the ...1930s, spinnings were playing a more ...significant compositional role in Baker's luminaires. ...The U.S. Courthouse courtroom luminaires are an ...example of this, with the spun metal curved side of

[19] Personal interview of Fred C. Baker by Marie ... Oregon Historical Society ...

and a need for opaque reflectors for indirect lighting schemes which eliminated any possibility of glare from the stronger lamps being used. Baker became considerably more adept at spun metal designs in the mid to later thirties, adapting their profiles and perimeter tooled grooves to harmonize with the linear and planar character of these late Art Deco Interiors. The State Library and the University of Oregon Medical School Library are excellent examples of this.

Through most of his career, Baker was an excellent luminaire designer and an assembler of parts that he had made out of house. He had a standard metal shop with brakes, shears, bar benders, and metal lathes for finishing castings and doing small turned pieces. He operated out of his shop on the corner of 16 th Street and Couch. In the early twenties, as part of the lamp shop, the J.C. English Company, for whom Baker worked, ran wood and metal lathes off of belts connected to an overhead motorized power shaft.

3. Developments in Illumination Science

When Baker entered the lighting fixture business, the only electric incandescent lamp available was the 16 candle power carbon lamp. Because of the low level of intensity available from these lamps, gas fixtures, with their multiplicity of open flames, continued as the dominant fixture design for electrical lighting as well. GE's introduction of the tungsten lamp in 1907 allowed for the reduction in the number of lamps on a fixture but also demanded auxiliary equipment to diffuse and direct the brighter light source. Stronger tungsten lamps provided the catalyst for the development of entirely new lighting approaches, such as indirect and semi-indirect lighting schemes. Baker's work during his Early Illumination period reflects this transition from a reliance on the historical forms of the open-flame lighting tradition, to the new lighting forms better adapted to the brighter light sources. The Pittock Mansion, with it's beautifully crafted collection of traditional chandelier, wall bracket, and lantern forms in contrast to the translucent bowl semi-indirect fixtures, is a fine example of this. The Central library in Portland, designed by Doyle and Patterson and built in 1913, was another building which employed traditional lantern forms on the exterior and indirect reflecting bowl on the interior.

An examination of Baker's fixture designs

Figure 162. F.C. Baker lantern design drawing

through the Beaux-Art period seem to indicate a preference for the ornamental and design possibilities of direct lighting fixtures. Quite often a particular lighting company's translucent glass shade might be the focal element around which the fixture is designed as in Figure and , or it may be a repeating element which relates different fixture designs in a room or building to achieve a unified whole. Fine examples of the latter are the translucent glass cylinders of the two types of luminaires in the Public Lobby of the U.S. Courthouse and the domed shades and cylinders used throughout Temple Beth Israel.

This interest in an interplay between the shade and the metallic frame or housing is eclipsed in the thirties by a more controlled manipulation of light. A case in point is the use in the U.S. Courthouse courtroom fixtures of a silvered mirror glass reflectors for a strong indirect lighting source in conjunction with smaller incandescent lamps set lower in the bowl as a secondary light source to be carefully reflected on the cast ornamental relief on the side and bottom of the bowl. The spun brass luminaires in the Governor's suite and in the lobby alcoves of the State Capitol Building exhibit an equally sophisticated treatment of light in their edge lighting of decorative glass discs and panels. It was also during this period that Baker quit using the commercial suspended flattened opal glass shade fixtures in the less public areas (classrooms,

Figure 163. Portland Central Library entrance lantern

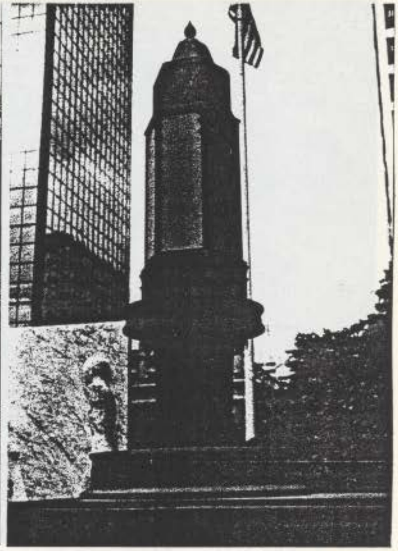


Figure 164. Entrance lantern of the U.S. Courthouse, Portland

offices, corridors) in favor of the opaque spun metal indirect luminaires, such as in the library classroom at the University of Oregon Library.

After the Second World War, the elimination of ornamental detail from architecture and an evolving architectural preference for higher light intensities and for inconspicuous concealed or recessed commercial fluorescent fixtures, forced Baker into the specialized market of custom designed church luminaires. This was one of the few remaining building types where the lower light intensity levels associated with incandescent lighting were still tolerable and where the exposed luminaire was still accepted as part of the architectural ensemble.

Baker was nearly an entrant, himself, in the race to commercially develop the fluorescent tube. Baker was associated with Dr. B.Fuller's small firm in Tacoma, Washington, that was developing the lamp, but this firm could not compete with General Electric's entry into the market place. The latter part of the firm name that Baker used during the thirties after he had bought out English, the Baker-Barkon Corporation, was actually the patent name of this jointly developed fluorescent tube. The intriguing fluorescent fixture that he designed for the vestibule of the University of Oregon Medical School Library illustrates his understanding of the artistic potential of this new light source.

There are other trends in the evolution of Baker's lighting fixture design which do not fit nearly so neatly into the argument developed above. One of these is the progression from the historicist-based entrance lantern (a light source surmounting a standard) toward the luminous pylon. The use of luminous pylons as beacons in the landscape to demarcate paths or spaces proved very successful at the early International expositions of the 1930s. The use of the luminous pylons, in the form of Baker designed lanterns, to

Figure 165. University of Oregon Library lantern

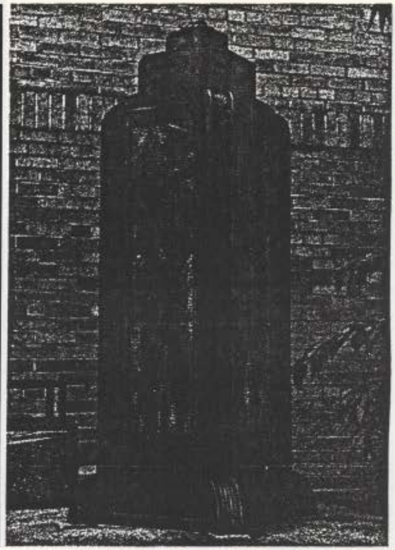


Figure 166. University of Oregon Medical School entrance lantern

define a prime entrance was an alluring concept for a number of Portland architects.

The clear evolutionary track can be followed: the cast bronze column-candelabrum entrance lantern of the Portland Central Library (Figure 163.), to the cast bronze entrance lanterns set atop an integral column-like podium at the U.S. Courthouse (Figure 164.), to the bronze lanterns mounted on the cast stone and brick podium at the University of Oregon Library (Figure 165.), and finally to the more vertically proportioned lanterns flanking the entrance to the University of Oregon Medical School Library (Figure 166.).

Collaboration with Architects

When Frederick Baker started in the lighting fixture business in connection with J.C. English, his only marketing contact was with architects, since most of his work as a freelance draftsmen was with architects. Baker's superb drafting skills proved to be a valuable marketing skill in his line of work. In his words: "I could draw and nobody else could, so I think the architects took me under their wing and gave me a lot of work."[18] "No one else in the lighting fixture business could draw pictures of their things."[19] "I didn't advertise, I didn't have a product to advertise. I dealt instead with the architect, who was the only one who really knew a good fixture from a bad one. Later when I began to manufacture fixtures, I did do some newspaper advertising, almost all of it in the Oregonian."[20] Baker's understanding of architecture and ornament, which he studied under Ellis F.

[18] Ibid.

[19] John Guernsey, "Light fixture designer, 94, leaves mark", Oregonian , September 27, 1981.

[20] "Fred C. Baker, King of Ornamental Lighting Fixtures", Business Success, Portland, Oregon, May, 1979.

Figure 165. University of Oregon Library lantern

[illegible] a grille and also was an abiding concern for [illegible] of Portland architects.

The [illegible] evolutionary [illegible] can be [illegible] the cast bronze column candelabrum [illegible] at the Portland Central Library [illegible] 162), to the cast bronze entrance lanterns [illegible] to an elegant column-like pattern at the U.S. [illegible] (Figure 164), to the interior lanterns [illegible] on the cast stone and brick podium at the [illegible] of Oregon Library (Figure 165), and [illegible] to the more vertically proportioned lanterns [illegible] the entrance to the University of Oregon [illegible] School Library (Figure 166).

[illegible]llaboration with Architects

When Frederick Baker started in the [illegible] business in connection with J.C. [illegible] his only marketing contact was with

Figure 168. University of Oregon Medical School entrance lantern

architect, since most of his work as a metalwork craftsman was with architects. Baker's superb drafting skills proved to be a valuable marketing aid in this line of work. In his words: "I could draw and nobody else could, so I think the architects took me under their wing and gave me a lot of work." [illegible] "No one else in the lighting fixture business could draw pictures of their things." [illegible] "I didn't advertise. I didn't have a product to advertise; I dealt more or less with the architect, who was the only one who really knew a good fixture from a bad one. Later when I began to manufacture fixtures, I did do some newspaper advertising, almost all of it in the Oregonian." [illegible] Baker's understanding of architecture and ornament, which he studied under Ellis F. [illegible]

[illegible]

[illegible]

[illegible]

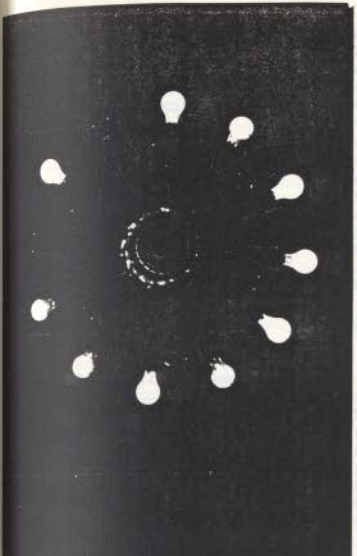


Figure 167. Portland Masonic Temple
banquet room fixture

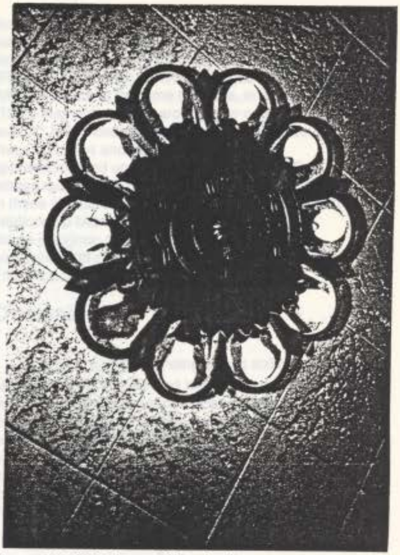


Figure 168. Neighbors of Woodcraft
banquet room fixture

Lawrence, as well as his understanding of the complex industry of ornamental lighting fixture design and manufacture, made him a particularly valuable ally to architects concerned with the integration of decorative art into architecture. According to Baker, "Prior to World War II, there weren't many people who would design, plan and engineer lighting schemes to fit the architecture of a building."[21]

Most of Baker's drawings during the twenties, and many afterward, were an experiential three dimensional rendered drawing that would leave no doubt in the craftsmen's mind as to the design character and ornamentation of the fixture. These worm's eye perspectives, being rendered to show shade and shadow, would be a visually accurate communication of the fixture design as seen by an observer on the ground. This drawing would also be submitted to the architect for approval.

Baker preferred the designation of architectural draftsman, despite the discovery that the 9000 drawings he bequeathed to the Oregon Historical Society were exquisitely detailed . Many of the drawings were tinted with pastels and watercolors and occasionally color applied to the back to give the effect of muted light shining through ornament. Many of the lantern drawings in this chapter have a background ink wash applied to set off the fixture.

Baker's list of collaborative architects reads as a Who's Who of historical Portland architects, starting with the venerable firm of Whidden and Lewis and the Multnomah County Courthouse. A draftsman in this firm, Whitney, would prove to be one of Baker's strongest allies as a later principal of Sutton and Whitney, Architects. After the First World War, Baker reopened his small shop in

[21] Stephen B. Schuber, "Frederick C. Baker: making art of light", Architectural Lighting, January, 1987, p. 46-50.

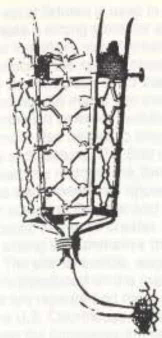


Figure 169. F. C. Baker lantern design drawing

association with J.C. English, and did a number of jobs with the prominent firm of Doyle and Patterson, two of which include the Multnomah County Library and the U.S. National Bank (which retains many of its original handsome fixtures). Baker's early collaboration with Morris Whitehouse at the Waverly Country Club House in 1912/13 was repeated at the University Club (1913), Temple Beth Israel (1928), Sixth Church of Christ Scientist (1931),U.S. Courthouse (1933), State Capitol Building (1937) and the State Library (1938). Ellis F. Lawrence was also a faithful Baker patron, particularly with the University of Oregon campus buildings, most of which he designed. Oddly, the unusual wrought iron wall bracket lights which added to the dramatic Gothic imagery of Lawrence's Elsinore Theater, in Salem, were not Baker's.[22]

The influence of the architect's design aesthetic can be detected in looking at some of these long term collaborations. Whitehouse's extensive use of Baker's brass baluster stem branched chandeliers at the Waverly Country Club, the University Club and the Arlington Club is matched by his use of Baker fixtures composed of clustered cylinders at the Sixth Church of Christ Scientist, the U.S. Courthouse, and Temple Beth Israel. Another striking example of the architect's influence/collaboration are the suspended banquet room ceiling fixtures employing exposed bulbs in the Portland Masonic Temple and the Neighbors of Woodcraft Building, which Baker designed for Freddy Fritch of Sutton and Whitney (Figure167. and 168.). Baker did all of Sutton and Whitney's work at that time because, in his words, "There was no one else around who could do the work."[23] Fritch designed the architectural detail for these buildings and obviously had a deep appreciation and understanding of lighting. The related quality and inventiveness of the luminaires in these two buildings underscores a close working relationship between architect and the lighting fixture designer; a fact supported by the warm accolades and commending remarks Baker had for Fritch in a personal interview.[24]

Ornament

Baker's understanding of and ability to draw ornament not only informed his luminaire design but allowed him to enhance a room's identity and unity through a lighting scheme with repeated ornamental detail. His extensive practice of assembling fixtures out of ornamental cast metal parts encouraged this 'reuse' of cast parts from one fixture to another. As at the Pittock Mansion, Temple Beth israel, and the U.S. Courthouse, cast

Figure 170. Temple Beth Israel luminaire

[22] Shellenbarger, Michael, Ellis F. Lawrence Survey, (Eugene, Oregon: University of Oregon Press, 1989)

[23] Personal interview of Fred C. Baker by Sheila Finch on July 5, 1978, Oregon Historical Society Cassette, 720.97911 B 168 F nos.1-2

[24] Ibid.

parts from one set of fixtures is used in a related set of fixtures to create a strong sense of spatial unity.

Another important use of ornament by Baker was to reinforce the special character of the architecture by the incorporation of the building's 'customized' ornamental motifs into the luminaires. This strong correlation between building and luminaire ornament also helped to integrate the fixtures into the architecture. The Star of David motif incorporated into many of the Temple Beth Israel luminaires also prominently appears in the carved wooden screen of the altar and other parts of the interior decor. The motif creates a strong sense of unity among the luminaires themselves (Figures and). The star-in-a-circle, eagle feathers, and acorn motifs introduced on the main exterior door mouldings are repeated on most of the luminaires in the U.S. Courthouse, creating similar relations between the luminaires themselves as well as the architecture. The pine cone and needle motif shared by the lobby friezes and many of the luminaires in the State Library can be taken as a final example of this.

Baker lamented the passing of ornament in architecture, incisively and correctly assessing the blame to the architecture schools in their "lack of emphasis on teaching the history of architecture and the finer points of ornamental design to students in the field."[25] He felt that "architects have forgotten the classical forms without improving on them."[26] and that he had "lived through a different era. We were fond of beautiful things or ornamentation. Today the emphasis is to be different, even if you end up with nothing but a pile of concrete."[27] The excising of ornament from the modernist architectural manifesto had an equally devastating effect on the allied decorative arts. In 1981, Fred Baker told an interviewer: "You just can't find a blacksmith today who can do the required ornamental design work."[28]

The Legacy

By Baker's own admission, he " was never a big volume manufacturer of fixtures. Instead I was concerned with making a top quality product for a top quality market."[29] Apart from their rare beauty, the remaining Baker lighting installations are a valuable tool to a generation of graduate architects and designers who have been left ignorant of the potential role ornamental lighting fixtures can play in aiding architectural expression.

Figure 171. F.C. Baker lantern design drawing

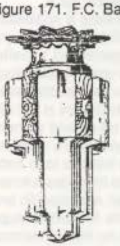


Figure 172. F. C. Baker ceiling fixture design drawing

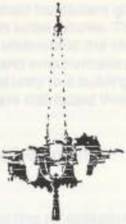
[25] Stephen B. Schuber, "Frederick C. Baker: making art of light", Architectural Lighting, January, 1987, p. 46-50.

[26] Ibid.

[27] Ibid.

[28] Ibid.

[29] "Fred C. Baker, King of Ornamental Lighting Fixtures," Business Success, May, 1979



Chapter **6**

Lighting Rehabilitation Strategies

Introduction

The previous chapters have established an understanding of historic lighting's role in architecture through a study of luminaire historic precedent, developments in twentieth century material processing as applied to luminaire fabrication, developments in Twentieth Century illumination science, and a case study of Portland lighting fixture designer Fred C. Baker. This final chapter will draw on the above explorations, as well as examples of lighting rehabilitations included at the end of this chapter, to establish some general guidelines for lighting rehabilitation.

Lighting Rehabilitation Guidelines

1. Gather Documentation on Original Lighting Scheme

Original drawings of the fixtures and period photographs of the spaces showing the lighting fixtures are the strongest form of background documentation that can be expected and is quite often obtainable. Frequently, parts of a luminaire will have been removed as an effort to increase light intensity levels, and historic photographs and plans of the fixture are the only clue as to the it's original appearance. Such evidence can also lend valuable insight as to what the architect's original design intentions were. For large public-funded projects during the 1930s, at least in Oregon, a set of detailed construction drawings, including sections, mechanical specifications, and fixture schedules, would have been included in the bid document. These can provide the information to accurately reproduce or sensitively rehabilitate the historic luminaire. Prior to the 1930s, if F.C. Baker can be taken as representative, the most that can be reasonably be expected is a well rendered perspective drawing, most probably in the archives of the lighting fixture fabricator, for which it served as an in-house construction design. Period photographs and building/luminaire drawings might be located in the collection of local or state historical societies.

2. Develop an Understanding of the Designer's Original Lighting Intentions

A full understanding of the original lighting installation is essential as a basis for establishing any lighting rehabilitation strategy. As silvered mirror reflector technology, allowing indirect lighting applications nearly as bright as modern expectations, was well established as early as 1913, it is important to recognize that a low light intensity level in an historic interior was most probably a carefully conceived design strategy. A good deal of effort was expended to eliminate the harmful aspect of contrast, glare, through directing and diffusing the new brighter light sources. An equal amount of effort went into accentuating the contrast of light on interior architectural elements; more precisely the play of shade and shadow on the projections and recesses of plaster ceiling ornamentation, projecting interior cornices and mouldings, pilasters and recessing wall planes. The light intensity level, projection of light sources, color control through diffusing glass and room surface color, and location of luminaires played a key role in establishing the intended ambience of many of these interiors.

Sometimes the light diffusing element, which could be modified to increase light intensity levels, is a central theme of lighting scheme

unification, as with the domed translucent glass shades of the Temple Beth Israel fixtures. This underscores the need to understand the shared luminaire design themes and ornamentation which can lend a sense of spatial unity to a building when these related luminaires are distributed throughout the building.

3. Establish the Objectives of the Rehabilitation

The goal of the lighting rehabilitation should be to successfully respond to the new set of performance and technical demands put on the building's lighting system, while maintaining the integrity and character of the original lighting scheme. One of the general goals of historic preservation also needs consideration: the preservation of the cultural built environment for the enjoyment and education of future generations. The ambiance created by an original light scheme is a vital part of our understanding of an historic architectural interior and needs to be preserved.

The objectives of the lighting scheme need to be clearly defined in order to satisfy the conflicting goals of historic preservation and higher performance criterion. Quite often a higher light intensity in a space is the prime objective of an historic rehabilitation, such as in the lobby of the Colorado State Office Building. The basis of this objective was to better exhibit the ornamental plasterwork of the vaulted ceiling by washing the ceiling with powerful quartz lamps concealed near the top of the luminaire (Figure 176.).[1] The original luminaires, incorporating less powerful uplighting lamps, would have illuminated the ceiling with a level of light that would have created shades and shadows in ornamental plasterwork and allowed the wall lanterns to accentuate the recessed wall panels between the pilasters. The unfortunate result of the rehabilitation is an over-lighting of the bays in which the luminaires are hung, completely washing out the play of shade and shadow in the ornamental plasterwork as well as the shadows cast by the wall lanterns. By over-lighting the two bays in the the lobby it creates an unbalanced lighting scheme which also greatly diminishes the effectiveness of the skylight as the central focus of the vaulted ceiling. In this case, the objective of highlighting the relief of the ornamental plasterwork would have been better served by retaining the original lighting scheme. Although all the fixtures in the lobby and adjacent spaces have been refurbished to their original condition, the drastic alteration of the original lighting scheme has denied present building users the opportunity to experience the original ambiance with it's subtle use of light to highlight surface texture. This example emphasizes the importance of understanding the architect/lighting designer's original design intentions as an informant to drafting a well conceived lighting rehabilitation objective.

In many cases this urge to increase the lighting levels of historic interiors is simply the 'knee- jerk' reaction of a generation raised on fluorescent lighting schemes. The 5 to 10 foot-candle illumination level of typical historic interiors seems dim compared to the 80 foot-candle illumination level of a fluorescent lighting scheme. In drafting the rehabilitation objectives, the designer should over-ride this conditioned response to dimly illuminated historic interiors, and draw on more objective reasoning. If this situation prevailed, many historic spaces not specifically requiring a higher working level of illumination would retain their original lighting schemes, with perhaps some improvements such as lighting controls and higher efficacy lamps.

4. Determine Lighting Rehabilitation Strategies

The three most common objectives of an historic lighting rehabilitation are:

- to restore the fixtures to their original splendor
- to replace the existing lamps with higher efficiency lamps
- to increase the light intensity level

a) Luminaire restoration or reproduction

Restoration should be guided by the existing fixtures or original documentation toward a faithful representation of the original design and materials.

If possible the original opal, ground or stenciled glass auxiliaries should be ordered from the old stock of Lighting Companies (Phillips Lighting Co., for example) or custom made by a

[1] Charles Linn, "The best of both worlds: Historic luminaires and modern illumination," Architectural Lighting, March, 1987, p. 24.

[illegible]ation, as with the ornate translucent glass [illegible] of the Temple Dutch lower flowers. This [illegible] the need to understand the shared [illegible] design themes and ornamentation which [illegible] and a sense of spatial unity to a building when [illegible] related elements are distributed throughout the building.

[illegible] Establish the Objectives of the [illegible]abilitation

The goal of the lighting rehabilitation [illegible] is to successfully respond to the new and [illegible] performance and technical demands put on the [illegible] lighting system, while maintaining the [illegible] and character of the original lighting [illegible]. One of the general goals of historic [illegible] also needs consideration: the [illegible] of the cultural built environment for [illegible] enjoyment and education of future [illegible]. The ambiance created by an original [illegible] scheme is a vital part of our understanding of [illegible] historic architectural interior and needs to be [illegible].

The objectives of the lighting scheme [illegible] to be clearly defined in order to satisfy the [illegible] goals of historic preservation and higher [illegible] objectives. Quite often a higher light [illegible] is a threat to the other objectives of an [illegible] rehabilitation, such as in the lobby of the [illegible] State Office Building. The basis of this [illegible] was to clearly exhibit the ornamental [illegible] of the vaulted ceiling by washing the [illegible] with powerful quartz lamps concealed near [illegible] of the luminaires (Figure 17h).[7] The original [illegible], incorporating less powerful uplighting [illegible], would have illuminated the ceiling with a [illegible] of light that would have created shadows and [illegible] to ornamental plasterwork and allowed the [illegible] to accentuate the recessed wall panels [illegible] the pilasters. The unfortunate result of [illegible] is an over-lighting of the base in [illegible] the luminaires are hung, completely washing [illegible] the play of shade and shadow in the ornamental [illegible] as well as the shadows cast by the wall [illegible]. By over-lighting the test bays in the the [illegible] creates an unbalanced lighting scheme [illegible] and greatly diminishes the effectiveness of [illegible] as the central focus of the vaulted [illegible]. In this case, the objective of highlighting

[7] [illegible]. The [illegible] of [illegible] historic [illegible] and [illegible] Lighting, March, 1987, p. 50.

the relief of the ornamental plasterwork would have been better served by retaining the original lighting scheme. Although all the fixtures in the lobby and adjacent spaces have been refurbished to their original condition, the drastic alteration of the original lighting scheme has denied present building users the opportunity to experience the original ambiance with its subtle use of light to highlight surface texture. This example emphasizes the importance of understanding the architect/lighting designer's original design intentions as an important to drafting a well conceived lighting rehabilitation objective.

In many cases the urge to increase the lighting levels of historic interiors is simply the 'knee-jerk' reaction of a generation raised on fluorescent lighting schemes. The 5 to 10 foot-candle illumination level of typical historic interiors seems dim compared to the 60 foot-candle illumination level of a fluorescent lighting scheme. In drafting the rehabilitation objectives, the designer should over-ride this conditioned response to dimly illuminated historic interiors, and draw on more objective reasoning. If this reasoning prevailed, many historic spaces not specifically requiring a higher working level of illumination would retain their original lighting schemes, with perhaps some improvements such as lighting controls and higher efficacy lamps.

4. Determine Lighting Rehabilitation Strategies

The three most common objectives of an historic lighting rehabilitation are:

- to restore the fixtures to their original operation
- to replace the existing lamps with higher efficacy lamps
- to increase the light intensity level

a) Luminaire restoration or reproduction

Restoration should be guided by the existing fixtures or original documentation known a faithful representation of the original design and materials.

If possible the original opal, ground or stenciled glass auxiliaries should be ordered from the old stock of Lighting Companies (Historic Lighting Co... for example) or custom made by a glass manufacturer. If a substitute of plastic is used it should be carefully matched for the same light diffusing and light color modifying characteristics as the original. If panels or formed sections of opalescent glass need repair or replacement, a stained glass restoration artist should be consulted. These professionals have a full compliment of manufacturers samples and are highly skilled in finding a good match of historic to contemporary stained glass.

A detailed procedural description of the metal finishing and restoration should be prepared for the firms specializing in this type of work. Although the contrast of an intentionally patinaed bronze and applied gilt cast detail was a characteristic of nineteenth century gas fixtures, bronze was generally valued for it's natural appearance in the twentieth century (again, taking F.C. Baker as representative). It was often given a protective lacquered coating to avoid oxidation. This coating would eventually wear off with exposure to the environment or due to maintenance activities, resulting in some unintended oxidation of the bronze. An unfortunate current trend in bronze restoration is to respond to this 'weathered state' with an over-zealous application of oxidizing chemicals to bring out the green patina.Two examples of this can be drawn from the lighting rehabilitation examples at the end of this chapter. The entrance torcheres at the Colorado State Office Building in Denver were removed, sent to a firm in New York, thoroughly cleaned and indiscriminately treated with an oxidizing chemical to give them an unnatural all-over green patina. The cast and wrought bronze rehabilitated luminaires at the Portland Theatre were, in many cases, given a similar all-over treatment of oxidizer, this time resulting in an even more unnatural blue-green condition. This popular but deceitful practice of faking an antique bronze finish generally runs counter to the designer's original intention and should be avoided. In some cases, where a part of a luminaire has been replaced or repaired, a slight patina to make the part fit with the rest of the luminaire, is in order.

Cast parts should never be replaced with spun or stamped parts, if possible. If casting is prohibitively expensive, a moldable composite material would be a closer approximation of the casting than a spinning.

b) Replacing existing lamp types

A common secondary objective is to replace the existing incandescent lamps with more efficient lamps of a longer life span in order to reduce maintenance costs and to reduce the danger of damage to the luminaire which most often occurs during relamping.

High Intensity Discharge (HID) lamps are often chosen as replacement lamps, but the color of light they emit needs special consideration when dealing with historic lighting schemes. For instance, a mercury vapor lamp with it's color temperature at the low end, in the range of 3000 degrees Kelvin, should be selected as a replacement of an incandescent lamp, which would have a comparable color temperature. A mercury vapor lamp can have a life span of 24,000 hours, as opposed to an incandescent lamp of a 1200 hours.

Low voltage compact reflector lamps are finding greater application in lighting rehabilitation work. These lamps generally consist of a miniature halogen bud lamp mounted in a " sophisticated, computer-designed reflector of faceted glass. Dichroic reflector coatings on the glass allow a beam that is cooler and has less UV content than beams from metal or aluminized glass reflectors."[2] This arrangement provides an intense highly controlled light source in a compact package. The 20 Watt MR16 lamps in this category have the most application to lighting rehabilitation and also have the extremely long life of 3500 hours. Their small size allows for their inconspicuous installation in luminaires or room surfaces. As they are an intense light source, their application should be used with discretion to avoid over-lighting.

c) Increased Light Intensity Levels

There are two general strategies to an objective of increasing the light intensity level, both of which in the optimal situation, take advantage of multiple lighting circuits or dimmer control.

i) Rehabilitated luminaire

The objective is to provide higher intensity light levels when needed, but to never relinquish the capacity to revert to the light intensity level of the original lighting scheme. This can be done by discretely concealing low voltage compact reflector lamps on the luminaire as required, either on a

[2] James R. Benya, "The Lighting Design Professional," Architectural Lighting, January, 1988, P. 42.

A common secondary objective is to replace the existing incandescent lamps with more efficient lamps of a longer life span in order to reduce maintenance costs and to reduce the danger of damage to the luminaire which most often occurs during relamping.

High Intensity Discharge (HID) lamps are often chosen as replacement lamps, but the color of light they emit needs special consideration when dealing with historic lighting schemes. For instance, a mercury vapor lamp with it's color temperature at the low end, in the range of 3000 degrees Kelvin, should be selected as a replacement of an incandescent lamp, which would have a comparable color temperature. A mercury vapor lamp can have a life span of 24,000 hours, as opposed to an incandescent lamp of a 1000 hours.

Low voltage compact reflector lamps are finding greater application in lighting rehabilitation work. These lamps primarily consist of a miniature halogen bulb lamp mounted in a " scientifically engineered dichroic reflector of faceted glass. Dichroic reflector coatings on the glass allow a beam that is cooler and has less UV content than beams from metal or aluminized glass reflectors." This arrangement provides an intense highly controlled light source in a compact package. The 35 Watt MR16 lamps in this category have the most application in lighting rehabilitation and also have the extremely long life of 3500 hours. Their small size allows for their inconspicuous installation in luminaires or niche surfaces. As they are an intense light source, their application should be used with discretion to avoid over-lighting.

d) Increased Light Intensity Levels

There are two general strategies to the problems of increasing the light intensity level, both of which to the optimal situation, (the advantage of multiple lighting circuits or dimmer control).

i) Refurbished luminaire

The objective is to provide higher intensity light levels when needed, but to never relinquish the capacity to revert to the light intensity level of the original lighting scheme. This can be done by discreetly incorporating low voltage compact reflector lamps on the luminaire as required, when such a

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Lamps in Review, "Of the Lighting Design Professional," Architectural Lighting, Jan. 1988, V. 40.

reproduction. If a selection of plastic is used
... carefully matched for the same light
... and light color modifying characteristics as
... glass. If panels or formed sections of
... glass need repair or replacement, a
... glass restoration artist should be consulted.
... professionals have a full complement of
... glass samples and are highly skilled in
... a good match of fabrics to contemporary
... of glass.

A detailed pictorial description of the
... ing and restoration should be prepared
... assist in this type of work.
... be exposed to an intentionally polished
... and applied gilt coat there was a
... of nineteenth century gas fixtures
... was generally valued for it's natural
... in the twentieth century, objects, being
... such as chandeliers, it was often given a
... baked lacquered coating to avoid tarnishing.
... coating would eventually wear off with
... to the environment or due to
... cleaning practices, resulting in some
... and tarnishing of the fixtures. An
... current trend in bronze restoration is as
... to the "traditional" state, with an over-
... tendency of polishing chemicals to bring
... to original state, then examples of this can be
... that the lighting rehabilitation examples at
... of this chapter. The bronze luminaires at
... Dexter Horton Building in Seattle were
... sent to a firm in New York, thoroughly
... and radioactive ... treated with an
... coating to give them an appearance of
... great patina. The cast and wrought bronze
... installed luminaires of the Portland Theater
... a heavy patina, given a similar oil-wax
... of treating the area resulting in an even
... patina.

The possible
... practice of having an antique bronze
... carefully done subject to the designer's
... intent and should be avoided. In some
... where a part of a luminaire has been
... or replaced, a slight patina to make the part
... the rest of the luminaire, is in order.

Old parts should never be replaced with
... standard parts, if possible. If casting is
... a replicate composite
... would be a closer approximation of the
... than a substitute.

... existing lamp types

separate dimmable circuit from the original lamps, or on the same dimmable circuit, but staged to come on after the original lamps have attained full intensity. Either approach preserves the original ambiance, when appropriate, and allows higher lighting levels, when required. This approach would have avoided the unfortunate, irreversible lighting rehabilitation at the Temple Beth Israel.

ii) Separate Auxiliary Lighting System

Perhaps the most prudent approach is to leave the original luminaires unaltered, and discretely install a entirely separate lighting system to augment the original light intensity level when required. This not only preserves the original ambiance of the space but preserves the original appearance and function of the luminaires, even at maximum intensity. The low voltage compact reflector lamps can also be inconspicuously located throughout the space in order to retain the original character of the space with it's luminaires. The lighting control systems suggested above could also be used in this approach. This approach was followed most of the way in the lighting rehabilitation of Trinity Episcopal Church in Portland. A separate system of flood lights supplements the Baker-designed luminaires (Figure 184.) and on the same dimmable circuit. Unfortunately the flood lights come on before the luminaires achieve full capacity, so an experience of the church illuminated by the luminaires alone is not possible.

Lighting Rehabilitation Projects

Colorado State Office Building, Denver

The renovation of the 1920 Colorado State Office Building included a restoration and rehabilitation of the historic lighting fixtures. The luminaires were designed and fabricated by the Sechrist Manufacturing Company. This was a local decorative lighting fixture manufacturer who dominated the Denver market in this area in much the same way that Baker dominated the Portland market. The rehabilitation was featured in a glowing article by Charles Linn in the March, 1987 issue of Architectural Lighting. The author was able to pay a site visit subsequent to reading the article and draw some considerably different conclusions about the success of the rehabilitation.

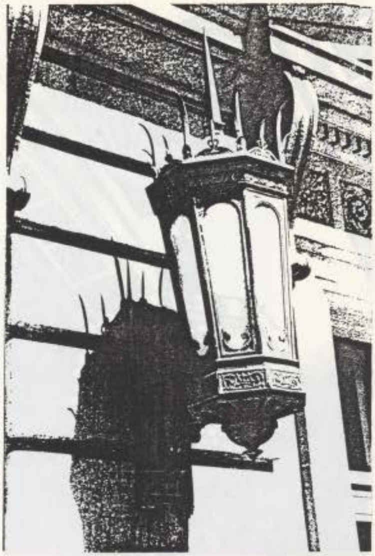

Figure 173. Exterior lantern

The exterior wall brackets (Figure 173.) were removed and cleaned, broken translucent glass panels matched and replaced, and the incandescent lamp replaced with a metal halide lamp. This replacement lamp emits a color of light in the blue-green range of the color spectrum, as opposed to the yellow of the incandescent, but in this exterior application, it seems acceptable.

A pair of cast bronze torcheres, originally fitted with elliptical globes of alabaster glass are located at either side of the entrance doors. This glass would have had a yellow to rich soft brown tone "which, when lighted, produces a light that is uncommonly mellow and agreeable."[3]

[3] Harry Pickardt, "The New Lighting," The Architectural Record", February, 1913, p. 154.

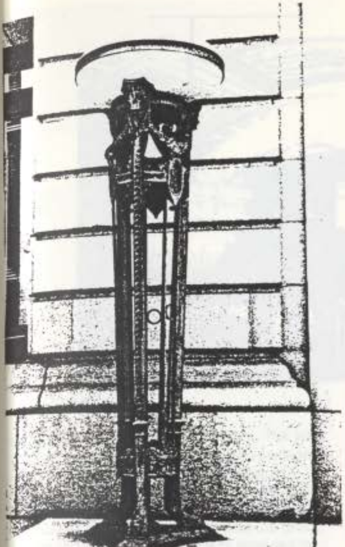

Figure 174. Exterior torchere

Figure 175. Rehabilitated lobby luminaire

The intended color scheme of the fixture was, then, bronze and yellow/soft brown (the globe). The luminaires were removed, sent to a firm in New York where they were cleaned and were then, in Linn's words, "restored to a light patina."[4] This is the unnatural all-over green color treatment mentioned earlier. Because the original globes were missing, new globes of polished, vandal-resistant white acrylic were formed to match the original. The globe halves were joined by a hand-tooled bronze band as the original had been. This effort of reproduction should be commended.

[4] Charles Linn, "The best of both worlds: Historic luminaires and modern illumination," Architectural Lighting, March, 1987, p. 23.

The incandescent lamps were replaced with metal halide lamps, which emit a blue-green to white light. The final luminaire color scheme, then, was green and white, with the globe emitting a bright white light, as compared to the uncommonly mellow and agreeable emission of the original.

The two story lobby has a decorative arched plaster ceiling with a central stained glass skylight. Two large rehabilitated luminaires light this space (Figure 175.). The fixtures were removed and sent to New York where many of the cut translucent stained glass pieces of the lower bowl were matched and replaced because of breakage or absence. Because this lower glass has a greenish-yellowish tint to it, the bowl would have emitted a mo e yellowish glow from the

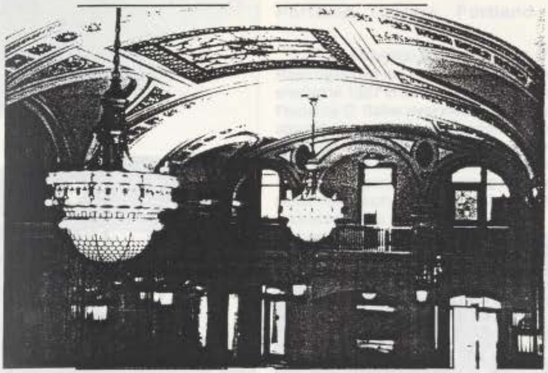

Figure 176. Lobby

incandescent lamps housed in the bowl. The color scheme of the luminaire, then, would have been bronze and yellow. The lighting rehabilitator replaced the incandescent lamps with a 250 Watt mercury vapor lamp, which emits a greenish-blue light, because he wanted to emphasize the green tint of the glass in the bowl. This was intended to create a contrast against the bronze in order to "bring out the bronze." [5] The intended design strove for color unity while the rehabilitation strove for color contrast; the result is a greenish bowl emitting the greenish light of it's lamp. A more successful approach was taken in restoring the exposed studded lighting of the luminaires. The A-type lamps around the perimeter were replaced with 11 Watt pear-shaped clear sign lamps, which are historically accurate, highlight the cast bronze and help compensate for the greenish bowl. The unfortunate effect of the four 300 Watt indirect quartz lamps concealed in the top of each luminaire has already been discussed. It's effect of diminishing the impact of the central skylight from over-lighting is even more disturbing considering the effort expended to backlight the stained glass skylight. The skylight was originally lighted by daylight from a central light well through the building but had to be closed off for fire code reasons. A light box with a four foot ceiling was constructed of metal studs and gypsum board overtop of the skylight. Eight 500 Watt quartz incandescent lamps reflect off of the light box surfaces, painted white, to backlight the skylight. A photocell, mounted on the building exterior, drives a dimming system connected to the light-box lamps so that they will echo outdoor brightness conditions. When a cloud moves in front of the sun, the light box dims.[6] It is a pity that such an interesting feature of the ceiling is dull next to the over-lighted ceiling bays where the rehabilitated luminaires hang.

One of the lobby alcove fixtures (Figure 177.) was missing and an original of the same type was sent to New York and used as model to cast all the parts for a replacement. The corridor lighting was required to be on 24 hours a day for egress reasons. This presented a maintenance problem which was solved by retrofitting the existing globe fixtures with twin 9-watt compact fluorescent lamps. The ballast hardware is quite small for these and was able to fit into the spun brass ceiling plate. The fluorescent lamps are low enough in surface brightness not to create a glare condition or be seen through the opal glass globe. The main benefit is the 12,000 hours of expected service from the lamps.[7]

[5] Ibid.

[6] Ibid. p. 24

[7] Ibid., p. 25

Figure 177. Lobby alcove luminaire

Figure 178. Corridor globe fixture

Portland Theatre, Portland

The Chicago architectural firm of Rapp and Rapp designed the Portland Theatre, which was erected in 1927 in the Italian Renaissance style. Frederick C. Baker designed the lighting fixtures at about the time he became a partner in the English-Baker Company. The lighting fixtures were rehabilitated in 1981 as part of a major rehabilitation. Although, in general, the lighting fixtures fared better than much of the historic fabric (the rubbed-in polychromatic treatment of the ornate plasterwork was simply painted over in white), the

Figure 179. Stair lobby luminaire

appearance and light intensity levels were altered in several significant ways:

•Color Harmonization

Baker had originally employed small glass disks set into the cast and wrought framework of

the stair lobby and auditorium luminaires in a rainbow of alternately varying colors. It was a carnival effect and it was the strongest relation between the two quite different sets of fixtures in the two areas. This effect was emphasized on the auditorium fixtures where bunches of multi-colored colored glass grapes were suspended from the frame. BORA Architects employed a color consultant from California, Tina Beeby, who advised that a color coordination of the glass disks was essential. Disks of the same color grouping were set to specific fixtures - all the red/orange disks were installed on the stair lobby luminaires and all the blue/purple disks were installed on the auditorium fixtures. The multi-colored grape clusters were apparently found to 'clash' with this new ordered harmony and were removed from a number of the auditorium fixtures, including the esconse of Figure 181. [#]

•Bronze Antiquing

A quite unnatural blue-green patina was applied in an all-over fashion, apparently in an effort to create a color contrast with applied gilt detail. The original luminaire color scheme was bronze with gilt detailing and yellow to amber diffusing glass. This is the same type of glass that was used and remains in the stair lobby fixtures. The rehabilitated color scheme is blue-green with gilt detailing and white diffusing glass.

•Increased Light Intensity Levels

As alluded to above, the light intensity level, particularly in the auditorium was increased by replacing pale yellow opalescent diffusing glass with white.

The few alterations that were done adversely affected the very details and elements that Baker was using to create relationships between fixtures in the lobby and auditorium.

figure 180 Stair Lobby fixture

[#] Personal interview with Judith Rees, original preservation consultant

Figure 181. Auditorium esconse

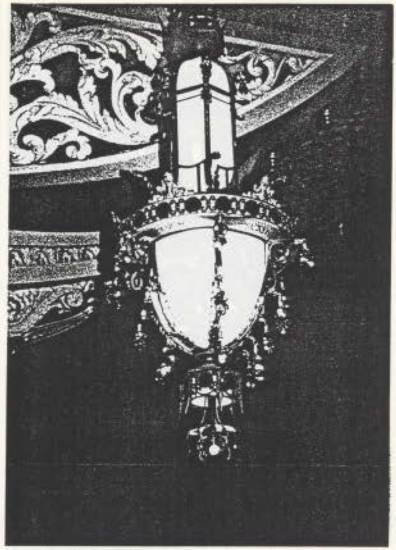

Figure 182. Auditorium fixture with hanging clusters of multi-colored glass grapes

The relationships were developed to created spatial unity through a sharing of details and elements in the two different spaces. Again, this underscores the need to understand the architect/lighting designer's original intentions before launching ahead on a lighting rehabilitation.

Figure 183. Detail of glass disk

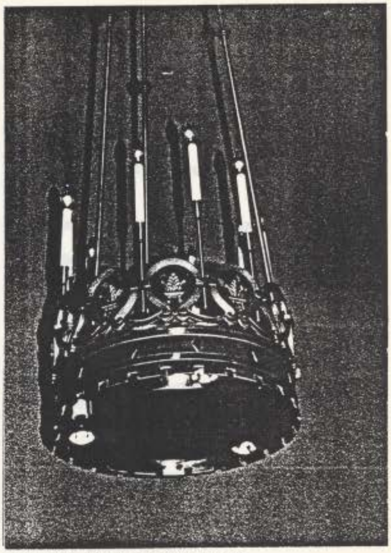

Figure 184. Trinity Church luminaire

Trinity Episcopal Church, Portland

The fixtures in Trinity Episcopal Church were designed by Baker for the firm of Sutton and Whitney in 1947. They are of spun and cast brass with copper detailing. The spun brass reflector bowl is equipped with lamps for indirect lighting and three lamps are located between the bottom of the bowl and the inside of the exterior decorative rim to provide down-lighting. Compact reflector lamps have replaced the incandescent lamps originally installed for down-lighting.

As explained earlier, this system of luminaires, which are suspended from the hammer-beam trusses of the church, are supplemented by a separate flood light system on the same circuit and controlled by a dimmer. The flood lights come on just before the luminaires attain full intensity.

Summary

The background chapters on luminaire historic precedent, material processing, illumination science and F.C. Baker's luminaire design evolution in response to these have explored the issues involved in a deeper understanding of historic lighting. These background chapters provided a valuable base of understanding of historic lighting strategies and luminaire design, which made it easier to ascertain the original lighting design intentions of the architect or lighting designer. Understanding original design intentions is a critical element in determining lighting rehabilitation strategies.

The chapter on F. C. Baker explores how one talented lighting fixture designer's luminaires evolved in response to changing architectural

styles and attitudes, advances in illumination science and lamp technology and his eventual move to machining processes from casting and forging processes. There is a clear evolution of Baker fixture designs:

• from the rich high relief cast and wrought historicist luminaires of the earlier years;

• to cast and wrought luminaires composed in a more abstract flattened ornamental vocabulary;

• to the spun metal luminaires of the late thirties, often employing sophisticated lighting techniques to harness the full potential of brighter lamps for higher light intensity levels and also for special effects to highlight the luminaire itself.

Of particular interest to the project, was the means by which Baker achieved the high level of luminaire integration, and thus, spatial unity, on so many of his lighting installations. This was most often accomplished through a shared building/luminaire ornamental vocabulary and a repetition of cast and wrought parts on identical and related luminaires throughout a building or room. The spun luminaires of the later thirties, with their emphasis on simple layered forms and linear ornament, integrated with the planar architecture of this period. The repetition of cast parts and the simple forms and linear ornament of the spun luminaires were a natural outgrowth of their associated material processes.

The background chapters provided an understanding of historic lighting. Based on this framework of understanding, the following set of lighting rehabilitation guidelines were established:

•**gather documents on the original lighting scheme** (luminaire drawings, historic photographs showing original luminaires);

•**develop an understanding of the designer's original lighting design intentions;**

•**establish the objectives of the rehabilitation.** (The objectives of the lighting scheme need to be clearly defined in order to satisfy the conflicting goals of historic preservation and higher performance criteria. For example, is a higher light intensity level really needed in a certain space, or is our contemporary conditioned preference for higher light intensity levels making that decision for us. In some cases, documentation and study may indicate that a lower light intensity level was intended in order to create plays of shade and shadow on interior surfaces or to create a certain color of reflected light.);

•**determine lighting rehabilitation strategies.**

Two general approaches were suggested:

1) rehabilitate the luminaire with concealed compact reflector lamps with dimmable lighting controls to increase the light intensity level from the original level to some higher level;

2) install a separate auxiliary lighting system, discretely located for minimal visual impact, to supplement the original luminaires. Dimmable lighting controls would not bring on the auxiliary system until the original luminaires were at full capacity.

Both of these approaches would preserve the original lighting ambiance of the space.

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Figure 169. - Oregon Historical Society photographic album #797 - (photographs of F. C. Baker lighting fixture design drawings)

Figure 170. - Oregon Historical Society photographic album #797 - (photographs of F. C. Baker lighting fixture design drawings)

Figure 171. - Oregon Historical Society photographic album #797 - (photographs of F. C. Baker lighting fixture design drawings)

Figure 172. - Oregon Historical Society photographic album #797 - (photographs of F. C. Baker lighting fixture design drawings)

Chapter Six - Lighting Rehabilitation Strategies

Title illustration - Oregon Historical Society photographic album #797 - (photographs of F. C. Baker lighting fixture design drawings)

Figure 173. - photograph (collection of the author)

Figure 174. - photograph (collection of the author)

Figure 175. - photograph (collection of the author)

Figure 176. - photograph (collection of the author)

Figure 177. - photograph (collection of the author)

Figure 178. - photograph (collection of the author)

Figure 179. - photograph (collection of the author)

Figure 180. - photograph (collection of the author)

Figure 181. - photograph (collection of the author)

Figure 182. - photograph (collection of the author)

Figure 183. - photograph (collection of the author)

Figure 184. - photograph (collection of the author)

Appendix - Case Studies of F. C. Baker Lighting Installations

Early Illumination Period (1910 - 1914)
Beaux-Art Period (1918 - 1929)
Decorative Art Deco Period (1929 - 1935)
Planar Art Deco Period (1935 - 1940)
Modernist Period (1946 - 1965)

A-1 Pittock Mansion, Portland

A-2 Elks Temple, Portland

A-3 Temple Beth Israel, Portland

A-4 University of Oregon Museum of Art, Eugene

A-5 United States Courthouse, Portland

A-6 Sixth Church of Christ Scientist, Portland

A-7 University of Oregon Library, Eugene

A-8 State Capitol Building, Salem

A-9 University of Oregon Medical School Library, Portland

A-10 State Library, Salem

A-11 First Congregational Church, Eugene

The Pittock Mansion

Although the building of lighting fixtures was merely a sideline interest of Frederick Baker's, his main occupation being a freelance draftsman to architects and decorators, the winning of the important Pittock Mansion commission in 1913 established his life-long career in ornamental lighting fixture design and manufacture. His talents in understanding and drawing architectural ornamentation, nurtured by Oregon's first Dean of Architecture, Ellis Lawrence, in some early Portland night classes, allowed him to prepare (by his own admission) a fine set of drawings for Henry Pittock's perusal. Pittock, and his daughters, liked the illustrated fixtures and Baker got the job.[1]

A study of these fixtures will illustrate how Baker was able to aid architectural expression by designing fixtures in harmony with the architect's design intention.

The predominant manufacturing process, bronze metal casting, also contributed to the high level of interior architectural unification within many of the rooms. The bronze castings were quite expensive, as Baker had to have them cast in San Francisco from his own plaster models because no one in Portland could do the work.[2] To ease the expense of this, the larger suspended ceiling fixtures were composed of a few smaller cast members, which were then repeated radially about the center. This collection of identical cast members were assembled into the fixture by Baker back in Portland. To make the most of his expensive castings, Baker borrowed from the ceiling fixture's kit of cast parts to compose the room's several complimenting wall brackets, which were an essential architectural lighting element in well-appointed formal suites at this time. This distribution of repeated cast elements assisted in spatially unifying a room.

A thoughtful application of indirect, semi-indirect and direct lighting strategies is well represented at the Pittock mansion.

Perhaps the best way to experience the lighting fixtures is to take a tour of the house (the Figure numbers of this case study are keyed to the attached floor plans).

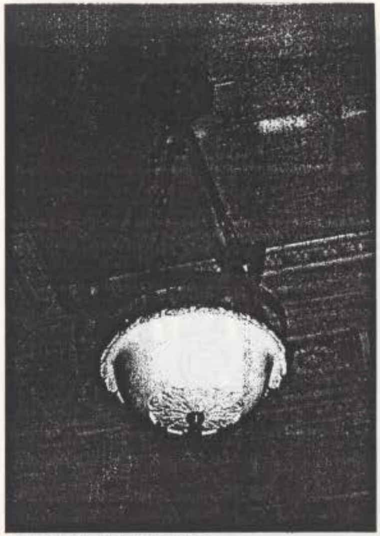

Figure 1. Lobby lighting fixture frame.

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[1] Personal interview of Baker conducted by Sheila Finch-Tepper, July 5, 1978, Oregon Historical Society cassette, 720.97911, B168F1978, nos. 1-2.

[2] Ibid.

A-5 Drawing 1.

A-5 Drawing 1.

Lobby

The small lobby is graced by an attractive semi-indirect luminous bowl fixture, composed of a beautifully crafted opal glass bowl suspended from a cast bronze ring. The bowl would have been pressed or cast in its rough form and then carved by an artisan with a hand-held sandblasting tool to achieve the softly rounded foliated rim and bottom detail. The bowl is suspended from the horizontal bar extending across the rim by an attached vertical threaded rod, with its decorative cast nut evident at the center of the bowl. The wrought bronze scroll chain supports that are attached to the rim, have applied cast bronze acanthus leaf detail which conceal the wires which run down over the scrolls and also serves as a nut to support the lamp socket bracket assembly. A live and neutral wire were threaded down each chain to supply each lamp socket, with a third ground wire being grounded

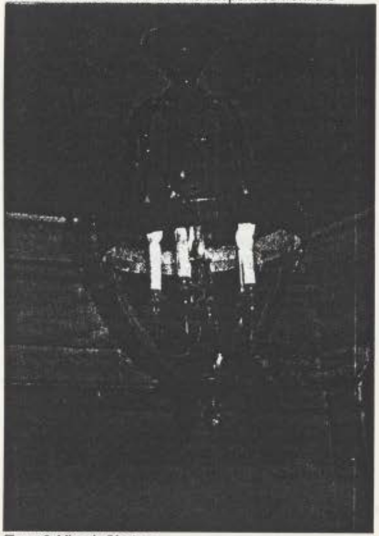


Figure 2. Minor hall lantern

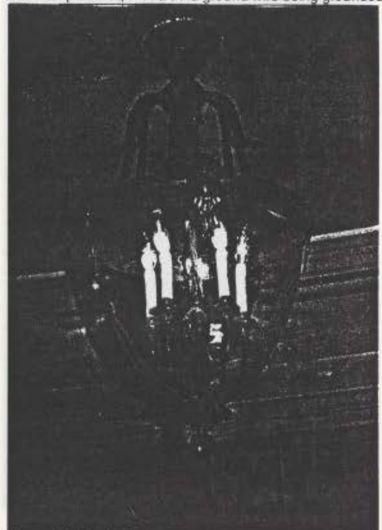


Figure 3. Major hall lantern

A-5 Drawing 1.

A-5 Drawing 1.

to the outlet box in the ceiling. The cast ceiling mount has integral hooks from which the support chains are hung. The fine cast detail, such as the bead and reel molding on the ceiling support, the acanthus leaf detail, and the minute beaded edge on the rim would have been roughly cast and then chiseled, rifled and filed by Baker, as part of the finishing he did on each fixture.[3] Integration of cast metal and glass parts is achieved through foliated detail.

Stair Hallway

A subtle variation of size and detail between the minor and major hall lanterns, (Figures 2. and 3.), reinforces the axis set up by the symmetrically split staircase and the elevator. An economy of means is again evident in achieving this, as the two types of lanterns are identical, except that a larger glass bowl and an additional pair of decorative rim cartouches, on axis with the stairway, are used in the major hall lantern. Baker gave many of the fixtures a polychromatic treatment to bring out the sculptural relief of the bronze castings; the stairhall lanterns are a nice example of this. The color palette for all of the polychromed fixtures is turquoise and red and is usually applied as 'rubbed out' detail, with much of the bronze showing through. This is done by applying a second coat of paint (in most cases, turquoise) over a dry undercoat (usually red) and rubbing the turquoise out, down to the red with a solvent-charged cloth before it is entirely dry. This highlights the relief by rubbing the ridges down to the original color and leaving the recesses in the second coat.

Corridors

Exquisite torch-brackets (Figure 4.) are mounted on the wall at the corridor entry, just below the rather high carved stone wainscot molding. The low relief of this molding is accentuated by the cast shadows resulting from this light source. Velvet cord has been carefully wrapped around the threaded standard and screwed into the ribbed junction from which emanates a cast bronze foliated shroud for a particularly rich effect.

The barrel-vaulted corridors are indirectly lighted by lamps mounted in the plaster cornice cove (Figure 5.). The light colored ceilings are quite effective in reflecting the light back into the space. A more even distribution of

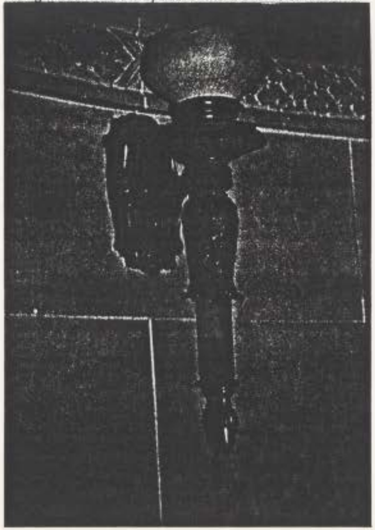


Figure 4. Corridor wall bracket

[3] Ibid.

A-5 Drawings I.

A-5 Drawings I.

light, rather than the 'spots of light' achieved with just exposed bulbs, could have been possible with the use of a continuous reflector trough in the cove or with silver-backed reflectors; both strategies were in common use during this period.[4] A suspended minor hall lantern also punctuates this space.

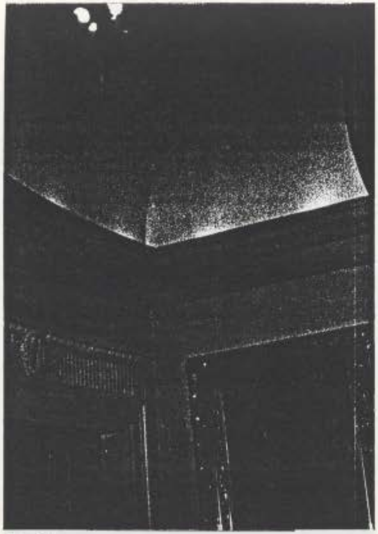


Figure 5.

[4] Bassett Jones Jr.,"Indirect Lighting," The American Architect, December, 1909, p. 247.

A-5 Drawing 1.

Library

The library is indirectly lighted from a cove situated in the plaster cornice that is finished in a good imitation of the room's wood paneling, a precaution prompted by the owner's fear of the indirect lighting being a fire hazard.[5] As the paneled wall surfaces reflect little light, the cove lighting merely highlights the ceiling plasterwork and contributes to the dark rich ambiance. Cove reflector

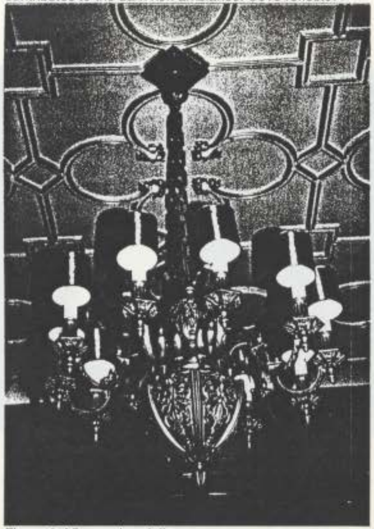


Figure 6. Library chandelier

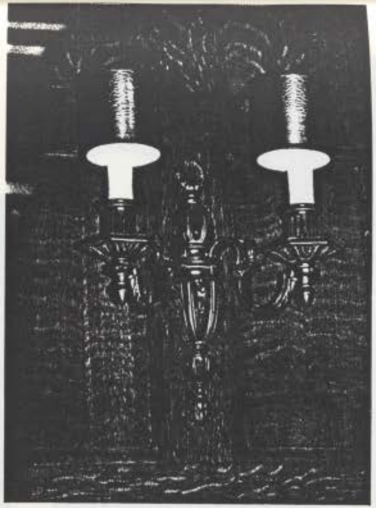


Figure 7. Library wall brackets

troughs or silvered reflectors would also have benefited this lighting installation.

The clear-cut silhouette and the apparent mass of the reserved Neo-Baroque chandelier, and its related four wall brackets, are well suited to this somber interior. A close correlation between the suspended fixture and wall bracket is achieved by using the same scrolled branches,

[5] Pittock Mansion tour notes

bobeches and shades. The wall bracket also uses the same vocabulary of stacked vase shapes as the chandelier.

Entrance Vestibule

The stone-lined drum and dome of the entrance vestibule, with its plaster domed oculus, provide a perfect foil for the large luminous opal glass bowl semi-indirect luminaire. The cast bronze frame features a small balustrade containing a foliated

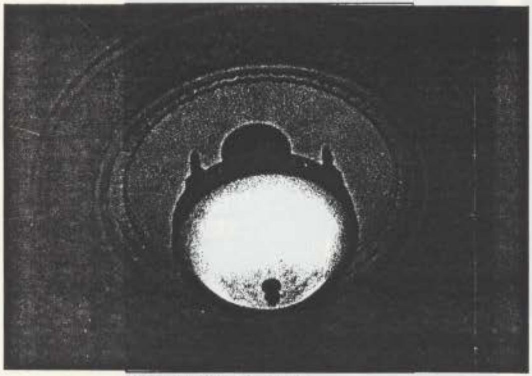


Figure 8. Entrance vestibule

rinceau motif and is punctuated by blocks topped with classical urns. This fixture's predominant direct lighting component accentuates the horizontal architectural lines of the room by casting shadows from the prominent projecting wainscot molding, while the indirect component echoes the prime architectural theme of the room, a dome.

Figure 9. Entrance vestibule

A-5 Drawing 1.

A-5 Drawing 1.

Living Room

This room's three major window apertures and the generally light-colored decorative treatment, provide the light airy backdrop for Baker's two crystal chandeliers. The crystal beads and pendants, which are 24 percent lead content Czechoslovakian crystal[6], are draped between the structural armature. The lower part of this armature, including the main horizontal hoop, and the radial

Figure 10.Living room crystal chandeliers

Figure 11. Living room crystal chandelier

members connecting to the decorative base, are cast bronze, while the upper radial members connecting to the decorative cast bronze crown, are wrought brass bars with applied bronze ornament. Besides the candle lamps, the interior of the bowl is illuminated by six light sockets supported on brackets connected to the inside of the hoop; three sockets projecting below the hoop into the bowl and three sockets projecting above the

[6] Ibid.

hoop toward the upper sweep of draped crystal. The rubbed-out polychromy is very subdued to provide maximum reflection off of the metal.

The four wall brackets are of the same character as the chandeliers, utilizing the same bobeches and also draped in crystal. These brackets feature very rich cast bronze sculptural relief and a beveled glass mirror.

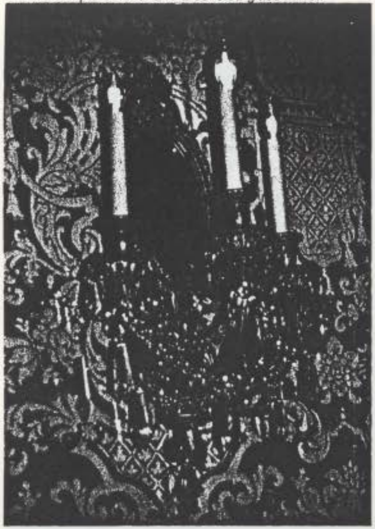


figure 12. Living room wall brackets

Smoking Room

The exotic character of this room's fixture is well suited to the rest of the decor, which features exquisite polychromed plasterwork in the 'Turkish manner'. Rubbed-out finishing has been used here to give the main body a streaked appearance and to leave a colored paint residue in the crevices for a mysterious 'antiqued' look. The half-moon motif of the finial has long been associated with

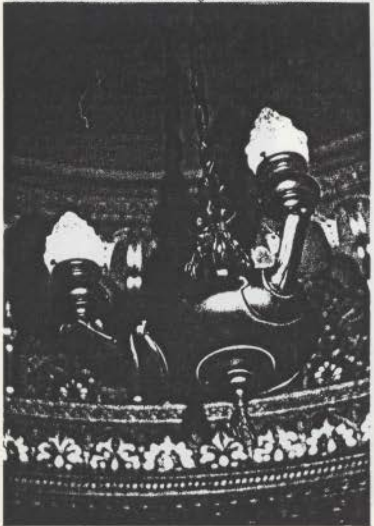


Figure 13. Smoking room lamp

Near-Eastern mysticism and is quite appropriate here. The three identical 'wick spouts' would have been cast from the same Baker plaster model and then brazed to the cast body.

Dining Room

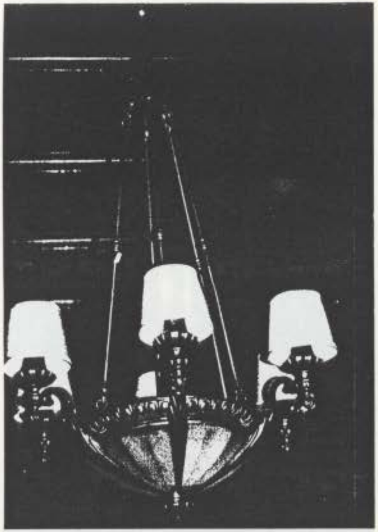


Figure 14. Dining Room suspended lighting fixture

Although the dining room fixture has an open bowl in the character of a semi-indirect fixture, the dark light-absorbing ceiling of mahogany beams and dark plaster suggests that the luminous opal glass bowl served primarily as a direct lighting source. An integration of cast metal and glass components is achieved through a repetition of a scalloped gadrooned motif.

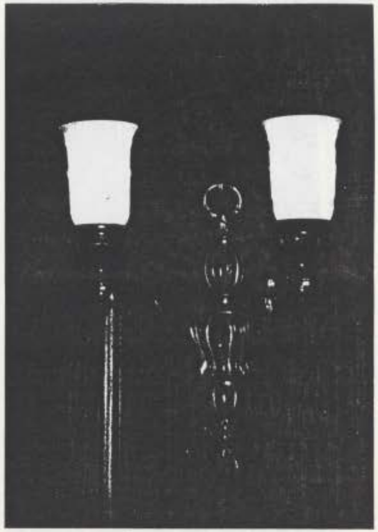


Figure 15. Dining Room wall bracket

A-5 Drawings 1.

The close correlation between the suspended fixture and the wall brackets, all sharing the same scalloped bobeches and deep rubbed-out color palette, helps to unify the interior decor.

Breakfast Room

The light transparent character of this lantern suits the breakfast room, which is flooded with daylight from a bank of windows along one full side. The horizontal frame

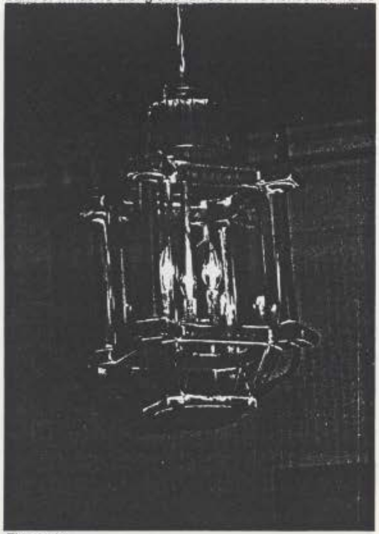


Figure 16.

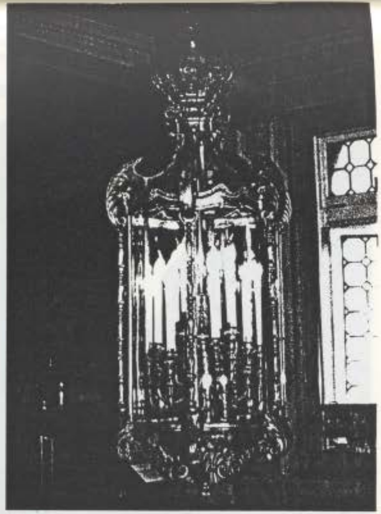


Figure 17. Stair landing hall lantern

Stair Landing

The sweeping split grand staircase is matched by an equally magnificent hall lantern. It is modeled after the grand French Baroque hall lanterns (Figure 37. in text), complete with the internal cluster of cast candle holders. The specially made convex plate glass panes have a beveled edge. The brazed connections between the cast bronze members are difficult to detect; a result of patient

finishing with files, riflers, and chisels by Baker himself.

Writing Room

This room is adequately illuminated by an attractive semi-indirect luminous bowl fixture. The pressed glass bowl is articulated by low relief sculptural detail, including decorative swags near the rim, which have been highlighted with a rubbed-out blue and yellow polychromatic treatment. The ceiling plate is of spun copper with repousse detailing. The copper chain connections which wedge on the bowl's upper rim, is an interesting detail.

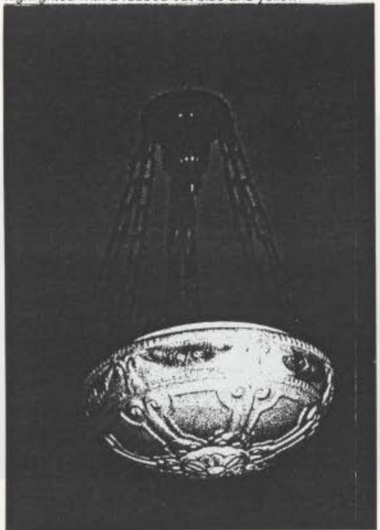


Figure 18. Writing Room fixture

Bathroom fixture

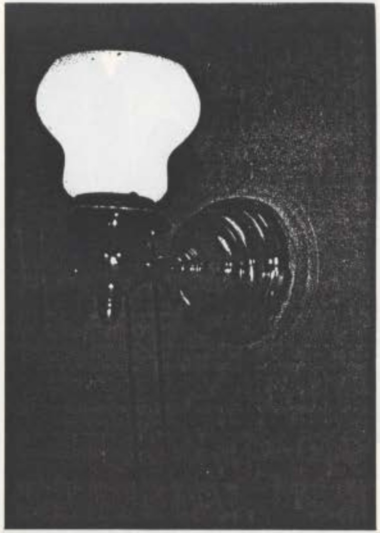


Figure 19. Bathroom wall bracket fixture

A-5 Drawings 1.

A-5 Drawings 1.

The nickel-plated wall bracket, near the shower in the bathroom, solved the corrosion and hygiene problem. The electroplated nickel surface resists corrosion and the fixture's smooth surfaces facilitates cleaning.

Bedrooms

The bedrooms are all graced by ceiling fixtures which feature a cast brass ceiling plate, a spun brass drum concealing the wiring and the threaded rod and housing which supports the scalloped opal glass shade similar to the dining room fixture. A decorative cast brass finial nut screws on to the support rod. The scalloped detail of the shade is reflected on the outer edge of the ceiling plate, while the motif of the decorative foliated band on the inside edge of the ceiling plate is repeated on the finial.

Figure 20. Bedroom ceiling fixture

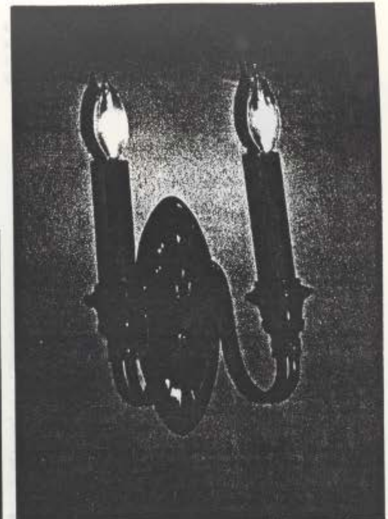


Figure 21. bedroom wall bracket

The cast brass wall plates of these fixtures also reflect the scalloped detailing present in the ceiling fixture. The extruded tubular brass branches are a considerably less expensive route than cast bronze, and could have

influenced the decision to use brass instead of bronze in these more utilitarian areas.

figure 22. Dressing closet and entry ceiling fixture

The decorative foliate band of the bedroom ceiling fixture is repeated again on the simple closet fixture.

Original exterior bracket fixture

This original bracket was damaged in the Columbus Day Storm and removed to a display window in the house museum's basement. With its abundant classical detail and deep weathered patina, it is indeed an attractive fixture.

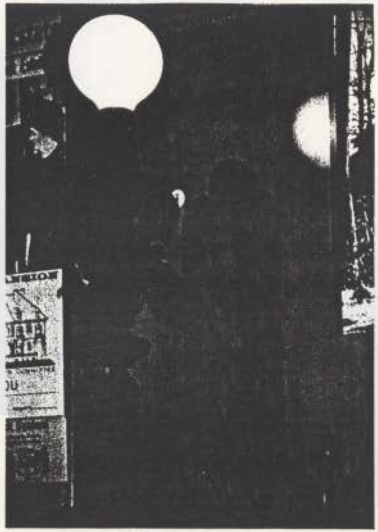


Figure 23. Original exterior bracket

A-5 Drawing 1.

Basement stair landing fixture

This unusual fixture was designed for dimmer low wattage 'A' type exposed lamps which would have presented a less bulbous appearance than the modern lamps; the voluptuously detailed cast bronze shade was only meant to conceal the hardware and not as an indirect shade. Baker reused this fixture in the utilitarian areas of A.E. Doyle's U.S. National Bank three years later in 1916.[7]

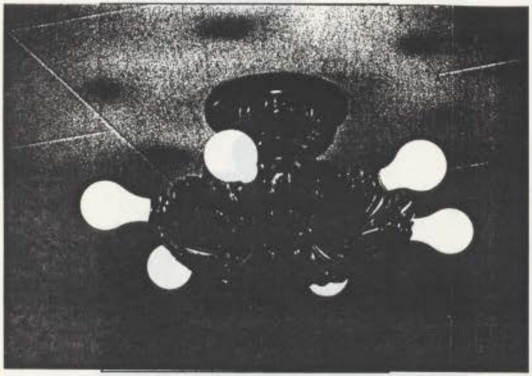


Figure 24[8]. Basement stair landing ceiling fixture

Basement Stairhall

A bronze lantern made from the same cast parts as the lantern of Figure 3, was fitte for four 100 watt tungsten bulbs and an decoratively etched bowl to control the glare. The entire bowl has been lightly sandblasted, with deeper sandblasting for the pattern.

Figure 25. Basement stairhall

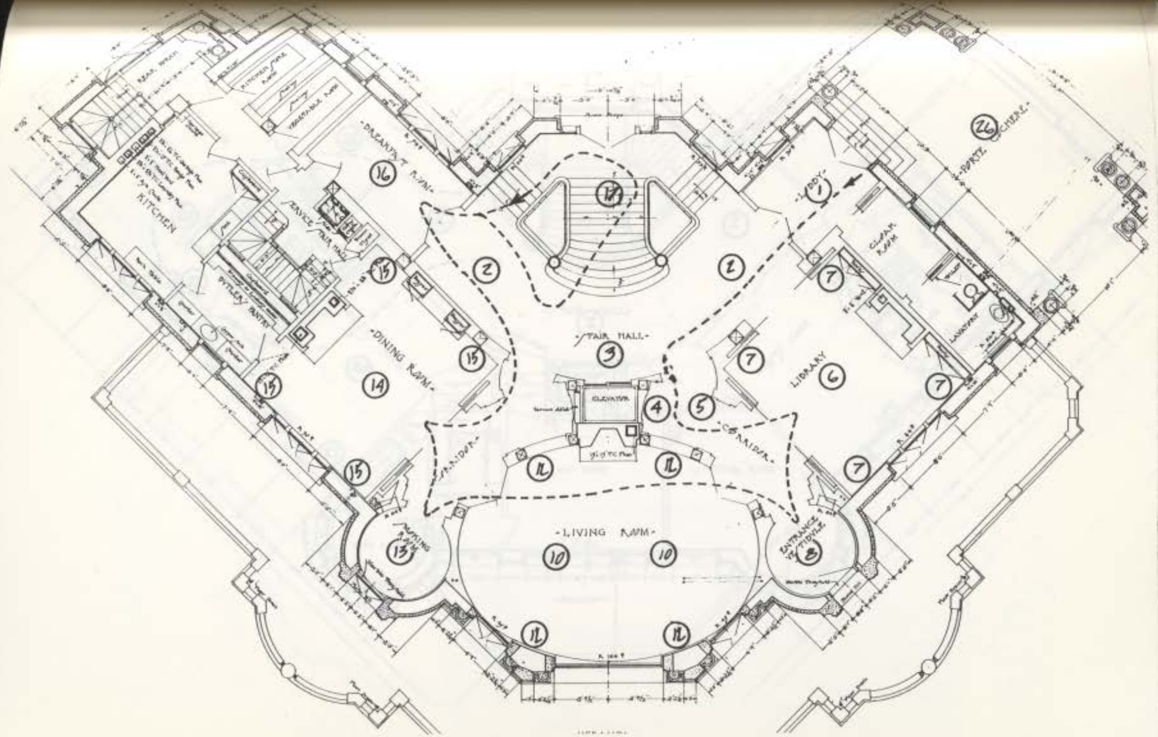
[7] Site visit, June 21,1990

[8] All the figures in this case study are part of the austhor's collection, the house plans are reprinted from the architect's original blue prints

Port Cochiere lantern

The port cochiere lantern was assembled of cast bronze parts and fitted with bevelled glass panels. Although this is one of the less imaginative and decorative lighting fixtures in the Pittock Mansion's collection, it was the start of a venerable Baker lineage. In the years that followed, Baker would push the lantern form, in its cast, wrought and sheet metal manifestations, to its veritable limits.

Figure 26. Porte Cochiere lantern

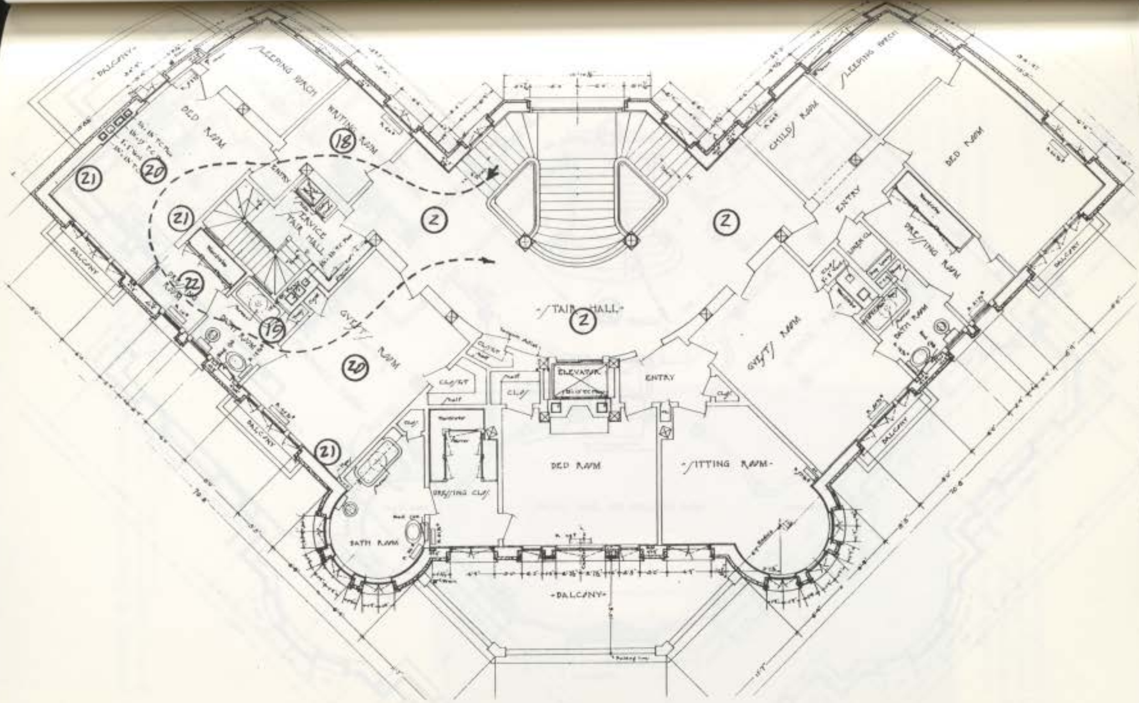


FIRST FLOOR PLAN

A-1 Drawings 1.

A-5 Drawings 1.

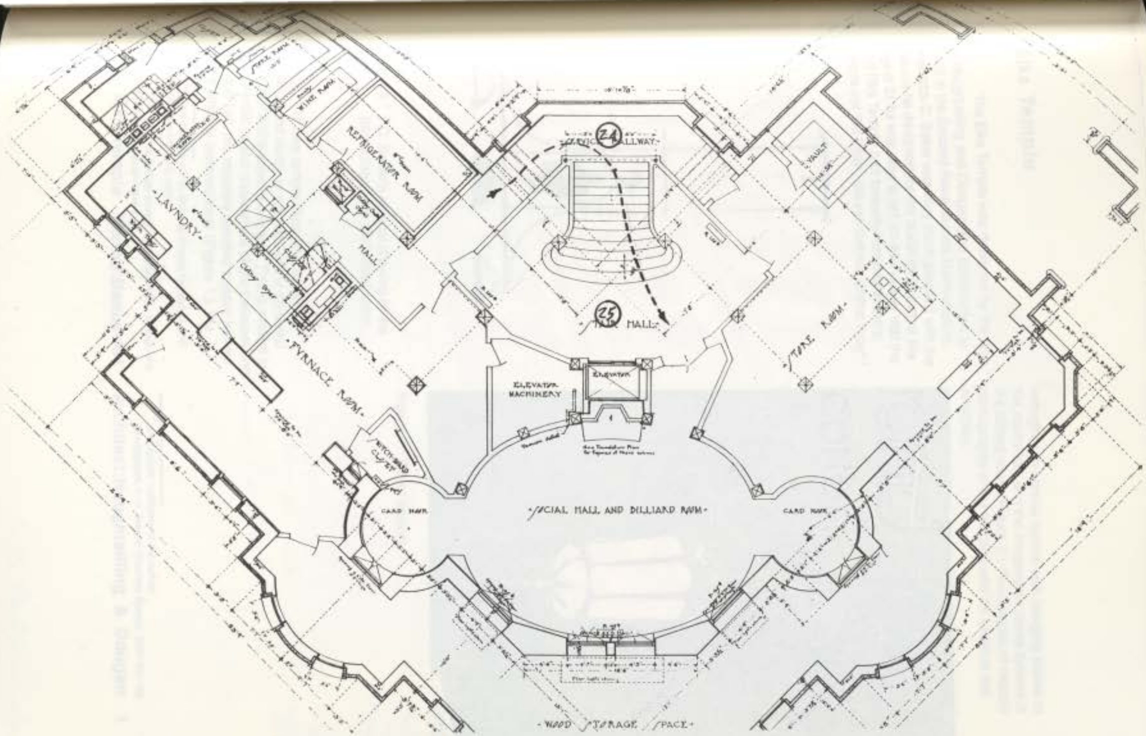
A-6 Drawings 1.



SECOND FLOOR PLAN

A-1 Drawing 2.

A-5 Drawing 1.



BASEMENT PLAN

A-1 Drawing 3.

Elks Temple

The Elks Temple was designed by the firm of Houghtailling and Dougan and constructed in 1922 in the Second Renaissance Revival Style. Frederick C. Baker was very much pleased with the fixtures he designed for the building, in fact at the age of 91 he was able to tell an interviewer that the "old Elks Temple had beautiful fixtures in there, people still like them, still sell fixtures of that type".[1]

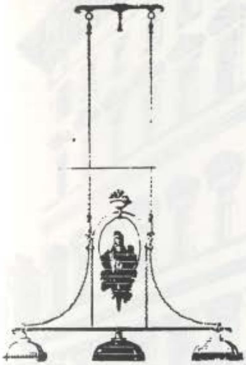


Figure 2.[2] F.C. Baker's original drawing of the parrot fixtures in the billiard room

The Elks temple illustrates Baker's versatility and ability to respond to the intended architectural character of a space. This is evident in the splendid crystal chandeliers of the ballroom and banquet hall, the minutely detailed copper lantern of the ornately coffered foyer (Figure 1.), the wrought iron corona replete with hanging stakes in the men's bar, and the imaginative parrot fixtures in the billiard room (Figure 2.) Photocopies of historic photographs of the building and it's interiors are attached.

Figure 1.[3] Foyer lantern

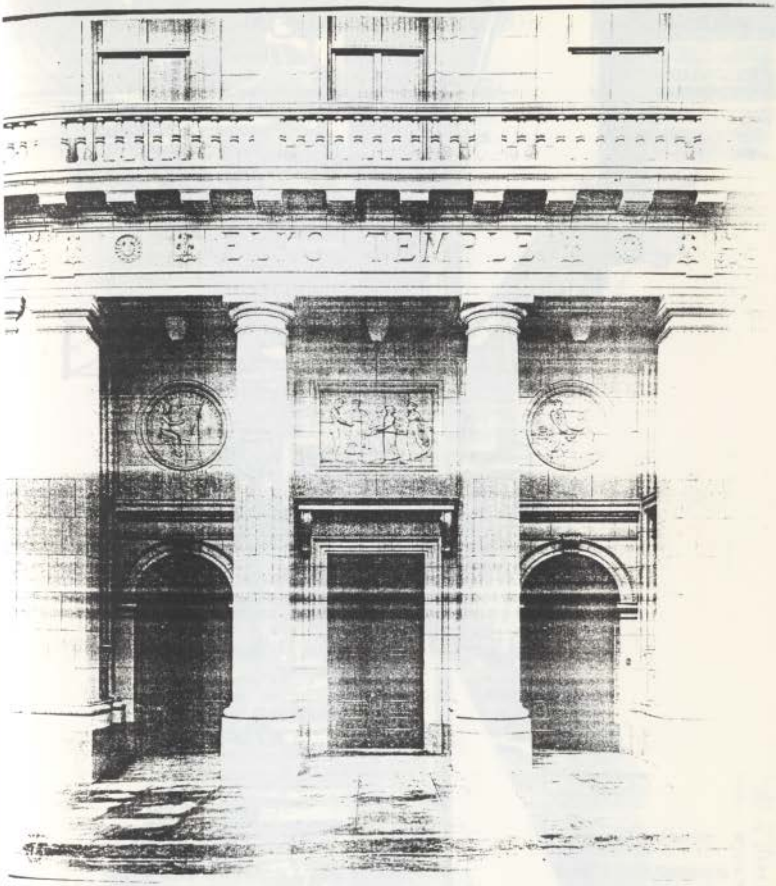
[1] Personal interview of F.C. Baker by Charles Digregoria, OHS Cassette 720.97911 B168 D 1977

[2] Oregon Historical Society photographic album 797 - photographs of F. C. Baker luminaire design drawings

[3] photograph - collection of the author)
photographs 1-10. Oregon Historical Society 0431-Y-(1-10)

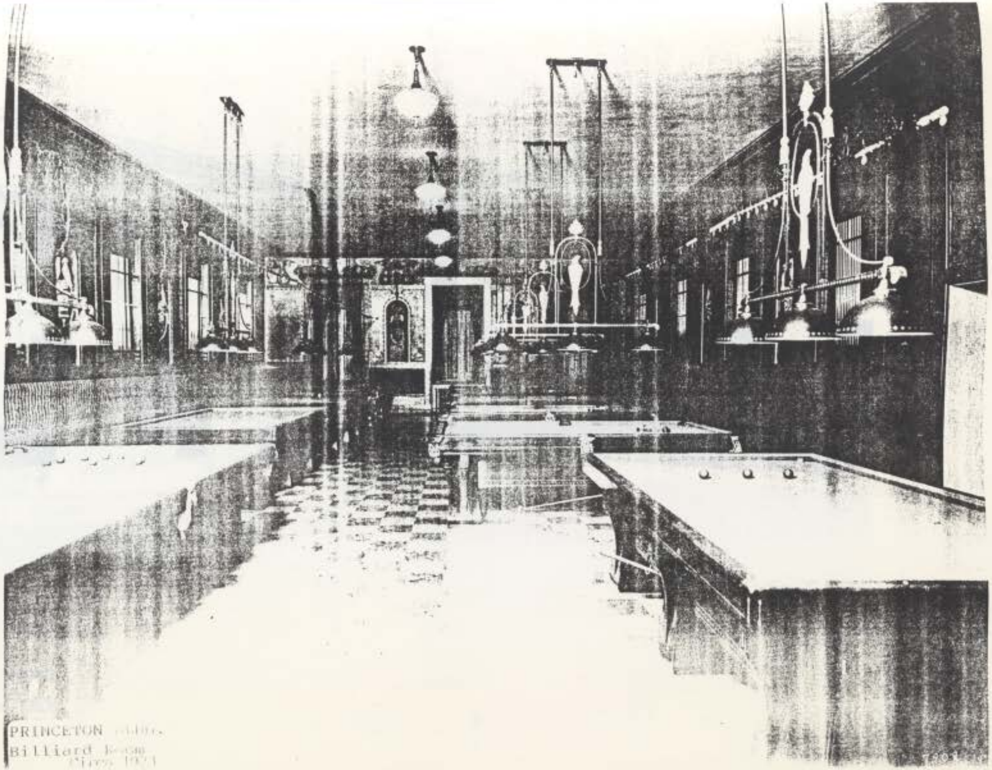
PRINCETON BLDG.
Exterior

A-2 Photograph 1.



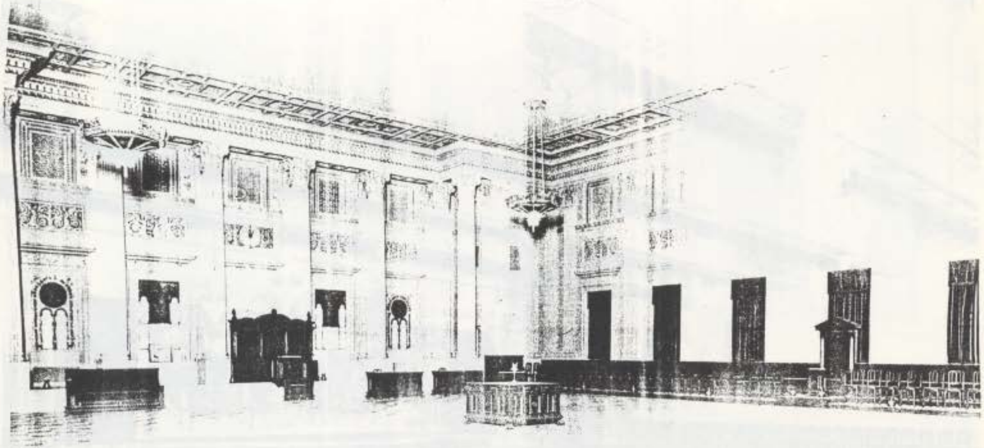
PRINCETON BLDG.
Exterior
Circa 1923

A-Z Photograph 2.



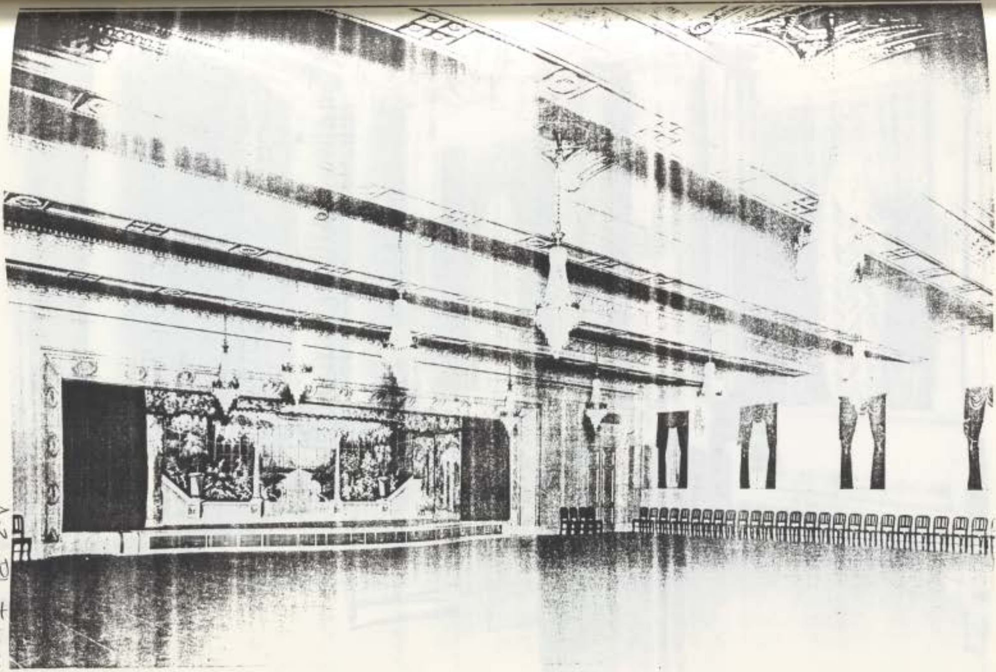
PRINCETON [illegible]
Billiard Room
[illegible]

A-2 Photograph 3



PRINCETON BLDG.
Suite 400
Circa 1923

A-2 Photograph 4



PRINCETON BLDG.
Ball Room
Circa 1923

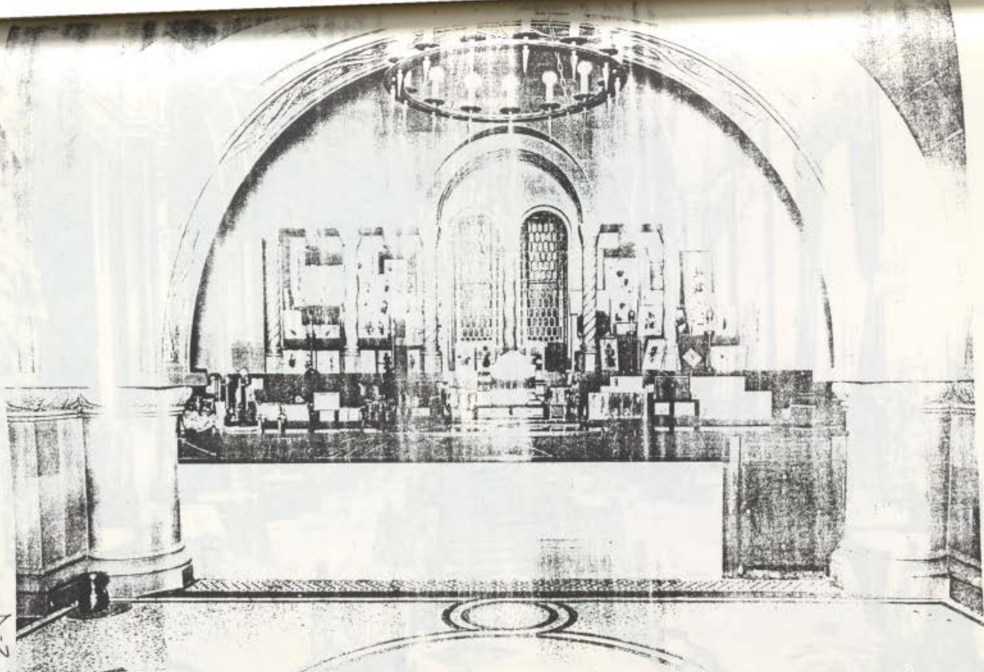
A-2 Photocrest 5.

A-2 Photograph 6.

PRINCETON BLDG
Ladies Lounge

A-5 Drawings 1.

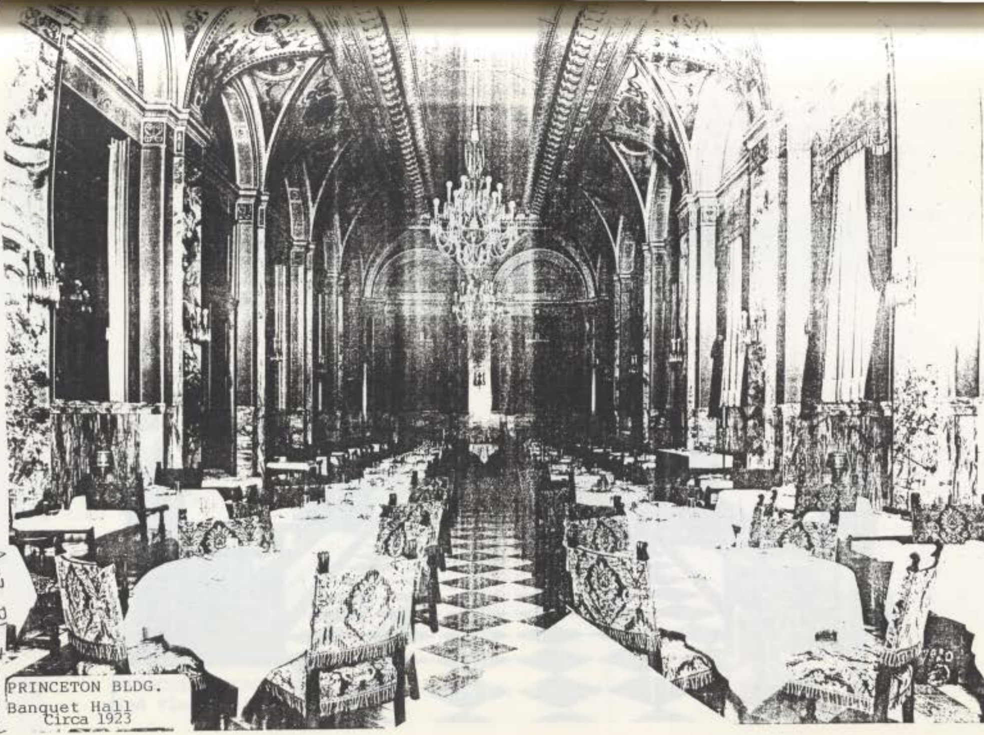
A-6 Drawing 1.



PRINCETON BLDG.
Men's Bar
Circa 1923

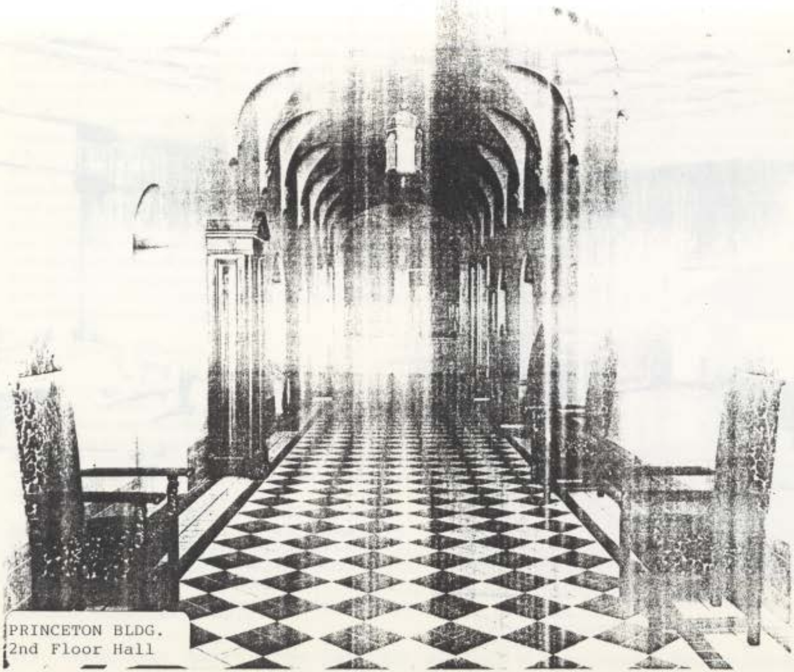
A-2 Photograph 7.

A-5 Drawings 1.
A-8 Drawings 1.



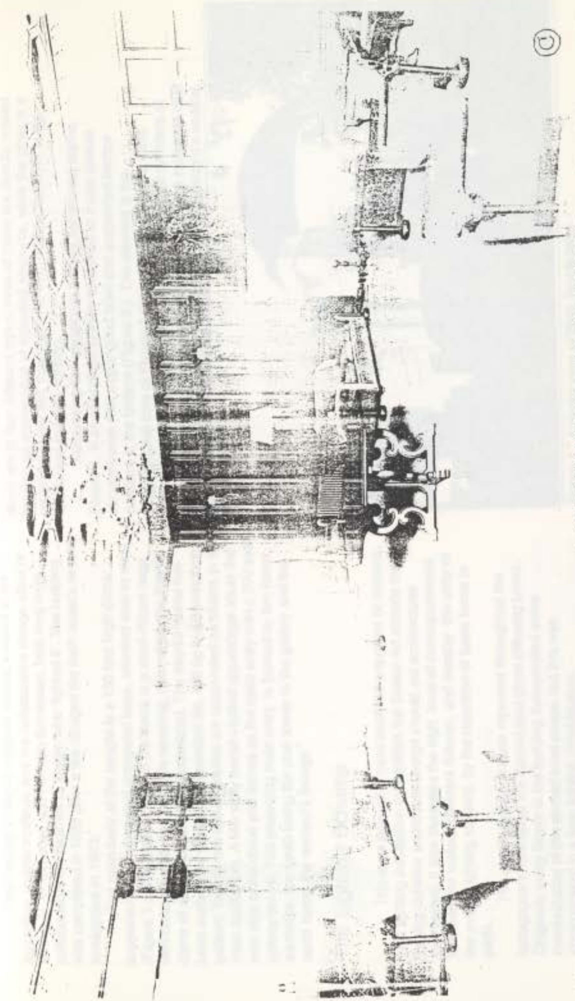
PRINCETON BLDG.
Banquet Hall
Circa 1923

A-2 Photograph 8.



PRINCETON BLDG.
2nd Floor Hall

A-2 Photograph 9.



A-2 Photograph 10.

A-5 Drawings 1.

A-6 Drawings 1.

Temple Beth Israel

This notable Portland religious edifice, erected in the Byzantine stylistic tradition, was the collaborative design effort of Morris H. Whitehouse and Herman Brookman, both long term collaborators of Frederick C. Baker, who 'lighted it'. The building was completed in 1928 after a fire ravaged the Beth Israel's second synagogue in 1923.[1]

The main body of the temple is a 100 foot high dome supported on an elongated octagonal base, oriented east to west (Figure 1.). The exterior shell of the dome is a steel-ribbed cage with concrete and terra cotta tile covering, from which the interior dome of steel and plaster is suspended. The interior dome has been surfaced in Gustafino acoustical tile, laid up in a herringbone pattern. Twenty-two Baker fixtures are suspended on chains in this main auditorium. A two story barrel-vaulted appendage abuts the east side of the dome and serves as the main entry with a 200 seat gallery above. This projecting main entry is flanked by two tower elements; the south being the stair tower to the gallery and the north being the women's lounge.[2]

The Lighting Scheme

This is an instructive case study for a number of reasons. This lighting installation exemplifies the Beaux-Art attitude that the lighting scheme and fixture design should aid architectural expression. It also illustrates the high level of correspondence between the various different fixtures, and thereby the unity of the overall lighting scheme, by the repetition of basic forms or parts.

The salient design feature repeated throughout the synagogue's luminaires are domed opal glass diffusing bowls. Originally every fixture in the building incorporated some manifestation of this domed bowl shape, but this was compromised in a later lighting rehabilitation.

[1] Jon Horn and Reed Elwyn, "Temple Beth Israel," National Register of Historic Places, (Washington D.C. :National Park Service, 1978), p. 8-3

[2] Ibid. p. 7-1

Original Luminaires

The twenty-two luminaires suspended from the auditorium dome are of four different types; three of these are directly related through an aggregation of repeated elements, while the other is a repetition of the two foyer fixtures, thus relating the foyer to the auditorium through lighting.

Addressing the aggregate fixtures mentioned above, Fixture 1, is an opal glass cylinder contained in a cast bronze circular frame with a opal glass bowl and suspended bronze pendant at the bottom (Figure 2.). This element is the compositional core of Fixture 2 (Figure 3.), which has a more elaborate framework to support elongated opal glass cylinders at the four cardinal points. These outrigger tubes have elaborate cast bronze upper and lower finials which help to emphasize it's vertical

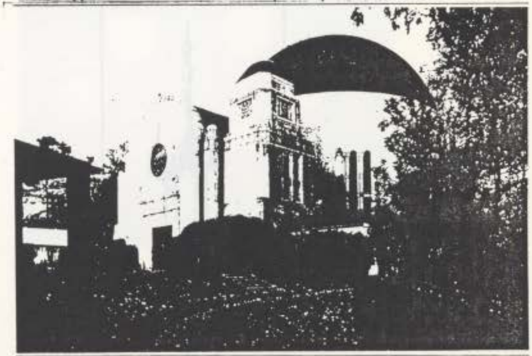


Figure 1.[3] Exterior view of Beth Temple Israel

[3] James B. Norman, Oregon's Architectural Heritage (Salem, Oregon: The Solo Press, 1986), p. 145.

A-5 Drawing 1.
A-8 Drawing 1.

Figure 2.[4] Fixture 1. (Baker drawing)

proportions, and thus it's presence in the vast cavity of the auditorium dome. Fixture 3 (Figure 4.) uses Fixture 2 as it's central compositional element within a wrought bronze enclosure. The principle decorative element of this enclosure is a horizontal band which supports twelve inverted cylindrical domed opal glass shades. These shades are similar to the cluster of six shades surrounding the central large inverted-domed opal glass diffusing shade of Fixture 4 (same as Figure 5., the foyer fixture).

The luminaires are hung from the dome in three concentric circles, each at it's own level. The inner-most level is comprised of Fixture 4 and occupies the middle level of the three. With it's open cylindrical central opal shade, a portion of the light was meant to

Figure 3. Fixture 2. (Baker drawing)

[4] Figures 2-4, 11, and13. - Oregon Historical Society photographic album #797

A-5 Drawings 1.

A-8 Drawings 1.

Figure 4. Fixture 3. (Baker drawing)

I reflect off of the dome as indirect light. Fixture 3 occupies the next and lowest concentric circle, most of it's light being direct. Fixtures 1 and 2 alternate within the outer concentric circle. The extensive vertical surface area of these luminaires facilitated indirect illumination off of the side walls. With the variety of luminaire size, brightness and location within the volume, an appropriate lighting i nstallation metaphor might be

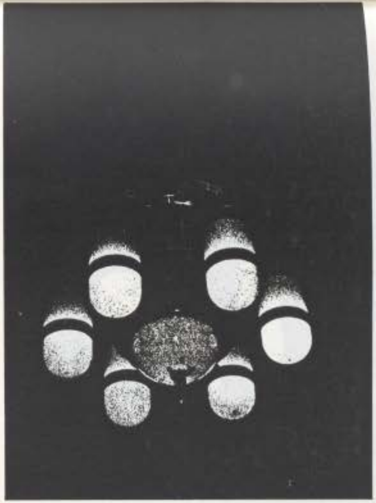


Figure 5.[5] Fixture 4.

the stars within the domed hemisphere of the heavens (Figure 6.).

The foyer, which is a shallow barrel-vaulted space on transverse axis to the entry, is illuminated by two suspended luminaires (Figure 5.). The space between the foyer and the

[5] photograph (collection of the author)

A-5 Drawing 1.

A-6 Drawing 1.

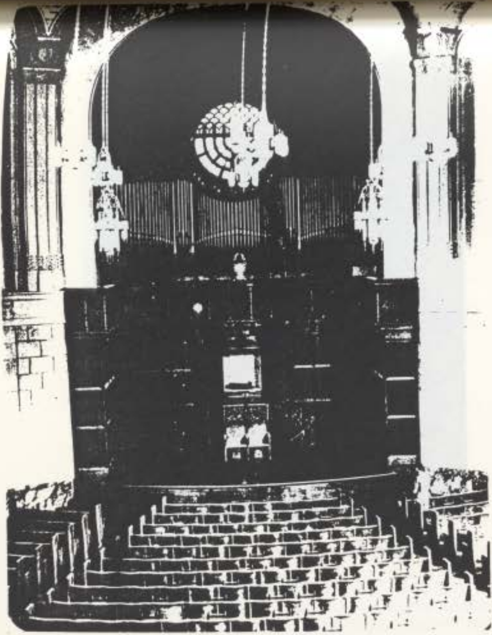


Figure 6.[6] 1928 view of original lighting fixtures

Figure 7.[7] Inter-foyer space fixture

auditorium is illuminated by a cast bronze ceiling light (Figure 7.); unfortunately, its central shade missing (most probably a cylindricadomed shade similar to the others in use in the building). The cylindrical domed-light theme is also taken to the auxiliary areas, such as the women's lounge sub-foyer (Figure 8.) and the

[6] Oregon Historical Society - negative # CN 007407 0029p174.

[7] Figures 7-10, 12,14-21. - photographs (collection of the author)

A-5 Drawings 1.

A-8 Drawings 1.

Figure 8. Women's lounge sub-foyer ceiling fixture

Figure 9. Vestibule exit foyer wall lights

exit vestibule wall lights (Figure 9.).

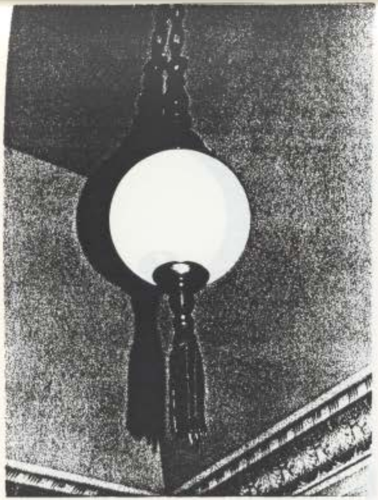


Figure 10. Women's lounge luminaire

Figure 11. Baker drawing of Women's lounge luminaire

Theluminaires in the women's lounge and the four suspended globe luminaires in the gallery are a subtle variation on a theme, as evident in Baker's design for both (Figures 11. and 13.) The more squat proportions of the lounge fixture are better suited to the lower ceiling of the lounge. Both fixtures have well crafted textile tassels suspended from the tip of the cast bronze pendant. The fact that women normally occupy both spaces may explain the close correlation between the two luminaires.

A-5 Drawing 1.
A-8 Drawing 1.

Figure 13. Bakers drawing of the Gallery luminaire

Figure 12. Gallery luminaire

A larger globe than that of the lounge is used on this fixture for increased illumination and presence in this larger space. A beautifully crafted pierced brass plate Star of David terminates the tassel.

The three-flight open-well stair tower has carved wooden brackets and timber ceiling, ornate hand-finished plaster work, and a stained glass window framed in decorative terra cotta tiles. A lantern hangs down into the center of this room (Figure 14.). The inspiration for this lantern, as well as a rather similarly designed lantern suspended over the altar area and visible in Figure 6., is a brass lantern that survived from the burned second temple (Figure

Figure 14. Stair tower lantern

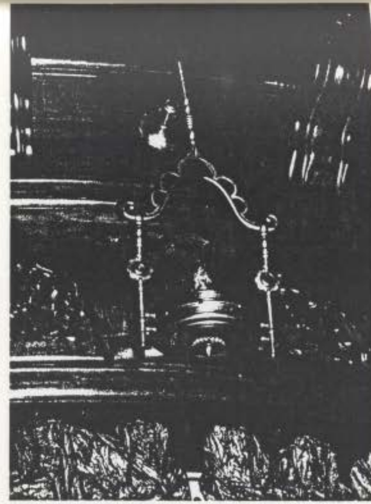


Figure 15. Brass lantern surviving from the second temple

15.).[8] The horizontal pan of the candleholder seems to correspond to the horizontal band of the stair tower lantern. In fact this horizontal band may have been the creative germ of Baker's design process, as it is a recurring design motif in almost all of the building's luminaires.

8 Ibid. p. 7-3.

The lantern is a combination of materials and material processing. Most of the lantern is of wrought and cast bronze, including hand forged diamond linked chain, upper frame and scrolled housing bracket, and the cast bronze shade retainer ring. The Star of David has been cut from a plate of brass, stock brass balls have been used in the upper frame, extruded brass tubing frame the decorative horizontal band and the lower globe retainer plate and finial nut are respectively spun and cast brass. The wide decorative band is a hand-tooled sheet of pewter.

Figure 16. Detail of Stair Hall Lantern

Figure 17. Loggia lantern

The loggia extending from the south tower to the semi-circular drive houses two suspended brass lanterns. Two sides at a time were cut from a sheet of brass and then bent to the desired angle in the brake and carefully brazed together along their seems. The lanterns flanking the main entrance (photograph 1.[9]) are

[9] Oregon Historical Society - organized lot 116, oversized folder 1-5.

A-5 Drawings 1.
A-8 Drawings 1.

mounted on cast bronze brackets with an interesting chiseled edge, the top bracket mounted on perforated bronze panel backed by a cavity in the stone block wall for an intriguing play of depth. The body is of sheet brass and the domed top is the same shaped brass form used in the loggia lantern.

Figure 18. Fixture 1 as rehabilitated

Ornament

The ornamental vocabulary is overtly non-classical. Shade retainer rings and finials show no affinity to classical vase shapes or moldings. Surfaces incorporating sculptural relief are avoided in favor of two-dimensional perforated and scribed detail.

The principal design motifs are a simple scribed zig-zag framing small circles which occurs on horizontal bands, scribed elongated hexagons joined by lines which occur on vertical bands and the Star of David, used as an accent on many of the fixtures.

The Lighting Rehabilitation

In about 1963 Baker rehabilitated the auditorium lighting fixtures of Temple Beth Israel. His commission was to increase the

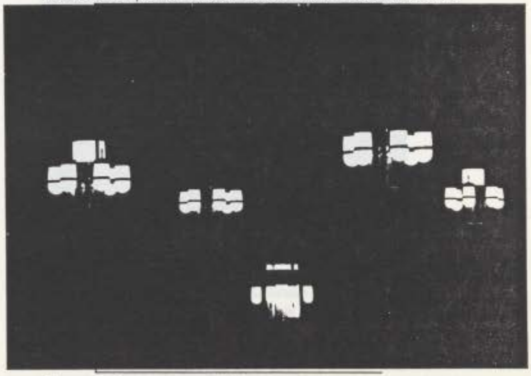


Figure 19. Fixture 4. as rehabilitated

A-5 Drawing 1.
A-8 Drawing 1.

light 300 percent. So, in places with 5 footcandles, they wanted 20 footcandles. In Baker's words, he "changed the old fixtures very little.

Baker's major modification was to replace the large central lower domed opal shades from all of the luminaires and install a flood lamp and a concentric ringed louver in the plane of the lower frame element (Figures 18. to 21.). This modification sacrificed the

Figure 20. Fixture 2 as rehabilitated

Figure 21. Fixture 3 as rehabilitated

principle unifying element of the lighting scheme, the central domed opal glass shade of each luminaire. This element related the auditorium fixtures to the lobby, stair tower and altar area and it's removal has compromised the high level of unification which originally characterized the lighting scheme.

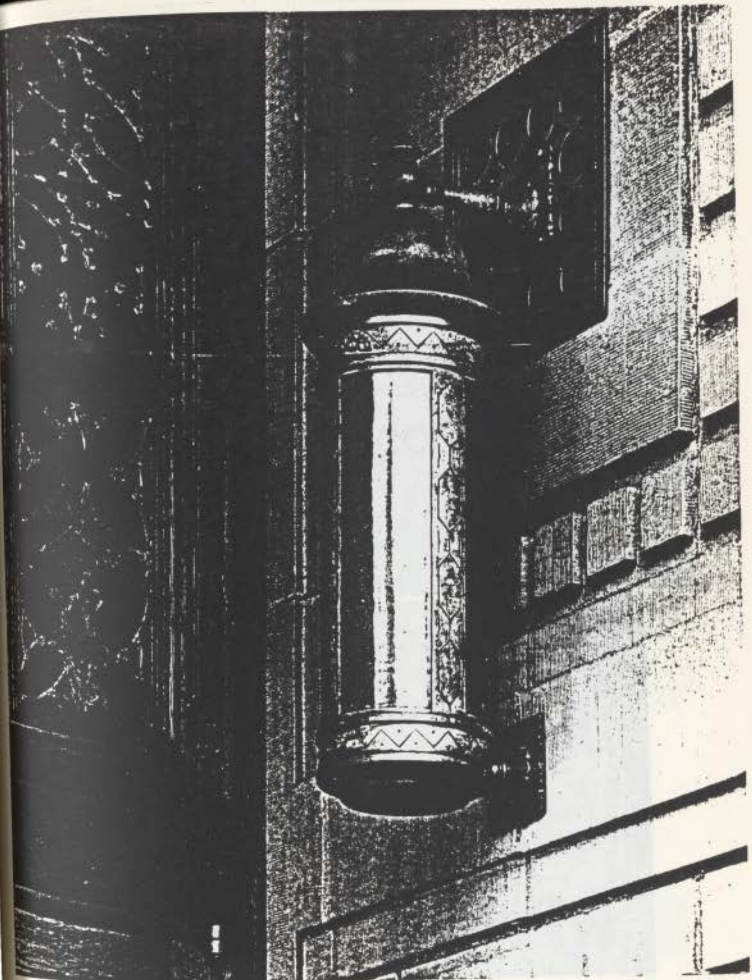
A preferable approach would have been to set up a separate set of projecting lights attached to the structure and on a

separate dimmable circuit. This would have preserved the original lighting intentions of the architect and lighting designer as well as allowed for the potential of higher light intensities that are also occasionally required by the congregation.

A-3 Temple Beth Israel Period: Beaux-Art Architect: M.Whitehouse & Herman Brookman 12

A-5 Drawing 1.

A-8 Drawing 1.



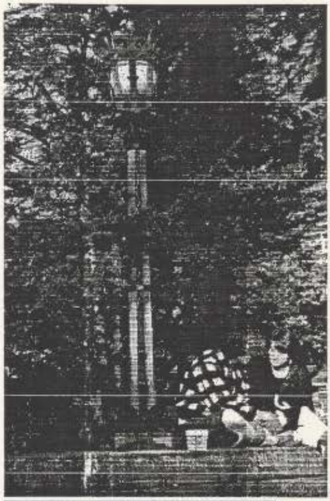
Morris H. Whitehouse. — Herman Brookman
~ Architects ~

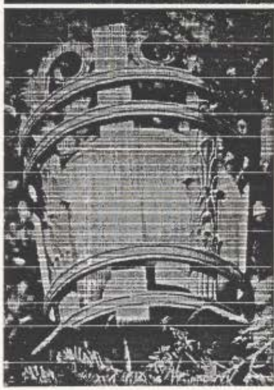
Exterior Main Entrance lantern   A-3 Photograph 1.

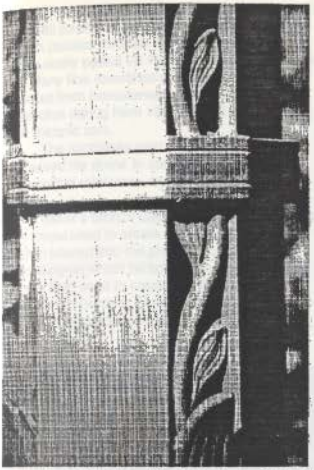
A-5 Drawings 1.
A-6 Drawings 1.

University of Oregon Museum of Art

The Museum of Art was designed by Ellis Lawrence and erected in 1930 in an exotic style most accurately described as Lombardian Romanesque. The entrance lanterns are based on the seventeenth century pole lantern (below), although the lantern itself is based on the Northern Italian (an area encompassing the state of Lombardy) open-work lantern (known as a cresset) of the same period. The lantern encloses an opal glass globe which houses the lamp.

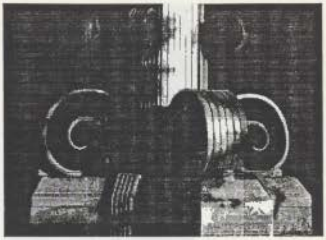




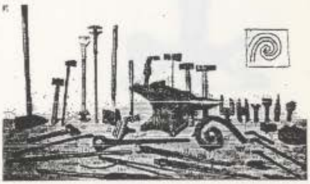


The material used for the lanterns is Monel Metal. It is a trade-name for a nickel-copper alloy manufactured by the International Nickel Company. It is generally composed of 68% nickel, 27% copper and the remaining five parts of iron, manganese, silicon and carbon.[1] It is one of the 'white metals' that became popular in the twenties and thirties as the modern architectural metal for the 'modern architect'.

It combines the highly desirable attributes of being able to be cast, like bronze, and being able to be forged, like wrought iron. It can be welded and soldered and is very corrosion resistant, acquiring a silver-grey patina that halts further corrosion.[2] The floral verticals on the lantern were cast, while the stem rising up the standard was wrought (right).



The scrolled volutes at the base have been forged by the blacksmith. Traditionally, the scroll was formed by heating the strip of metal and driving it around the inside of the heavy scroll tool, shown to the right of the anvil (the process is illustrated in the small box above the tool collection). The scroll was started in the tool shown inserted into the left side of the anvil.[3] A table-top scroll devise was later developed which allowed the forming of scrolls without forging (heating).



[1] Gerald K. Geerlings, Metal Crafts in Architecture, (New York:Bonanza Books, 1927), p. 185.

[2] Ibid.

[3] Gerald K. Geerlings, Wrought Iron in Architecture, (New York: Dover Publications, 1929), p. 15.

The torchiere fixtures in the four corners of the domed pavilion of the cloister at the rear of the museum (access through the front doors) are conspicuously based on Roman torchieres (bottom right). Many fine examples of these fixtures were excavated from Herculaneum and Pompeii, two Roman citys dating from 100 BC, that were buried under volcanic ash.

The torchieres cast their light up on the gold-backed tile dome to create a very unusual ambiance that reinforces the space's role as a memorial.

Baker's bronze casting process started with a clay model used to create a plaster mold. Lead was then poured into the plaster mold to create a lead casting on which he could sharpen his details. This was then used to create the final plaster mold for the molten bronze. The final bronze would then be chiseled and filed for crisp detailing.

United States Court House, Portland

Morris H. Whitehouse and Associates designed this building in 1931, with construction complete in 1933.[1] The doughnut-shaped stone-clad Neo-Renaissance structure adheres to the classical arrangement of a rusticated base, applied colossal pilaster trunk and an articulated attic story with a pronounced projecting cornice. The flattened facade ornament and the oversized blank corners of the trunk of the building are manifestations of the Art Deco movement. This application of Art Deco detailing to a basic Beaux-Art composition is as true for the interior architecture as it is the lighting fixtures, which were designed by Frederick C. Baker.

Lighting Scheme

Exterior Lighting

The main north facade is composed of nine bays, the center bays corresponding to the three centrally located doorways. Most of the facade ornamentation is limited to the attic story. "The frieze is terra cotta with alternating triglphs and metopes with an incised stylized floral pattern. A modified egg and dart ovolo moulding beneath a moulded cornice and a solid parapet with a cheneaux finish the facade".[2] The only ornamentation of the rusticated base are the ornamental mouldings surrounding the three main entrances on the main north facade (photograph 1.[3]). "A stone star-in-a-circle pattern is repeated at roughly 2 foot intervals on the surrounds with a garland pattern added across the lintel. A Decoesque stone eagle with wings outspread and clutching three arrows surmounts the center door."[4] These last two ornamental motifs, as well as classical, floral and geometric motifs, constitute F.C. Baker's ornamental vocabulary for the lighting fixtures.

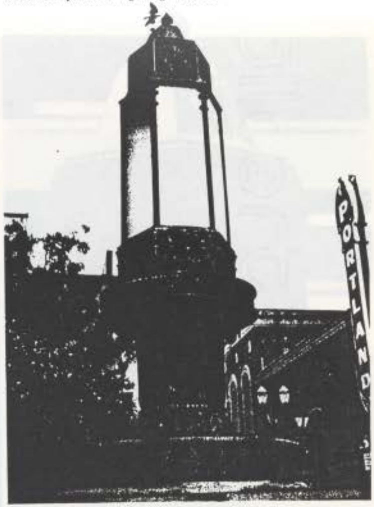


Figure 1.[5] Main Street entrance lanterns

Two 8 1/2 foot high bronze lanterns flank the main entrance on masonry cheekblocks (Figure 1. and photograph 2.). This lantern marks a steady progression from Baker's more historically correct lanterns on standards to the luminous pylon lantern type marking entrances, such as those found at the

[1] Kristine Bak, "United States Courthouse National Register of Historic Places", National Register of Historic Places, (Washington D.C.: National Park Service), p. 8-6.

[2] Ibid., p. 7-1

[3] Ibid., photograph 2. (Photographs 2 and 3. of this case study are the same source)

[4] Ibid.

[5] All figures, except Figure 19., are photographs (collection of the author)

A-5 Drawings 1.
A-8 Drawings 1.

University of Oregon Library. The abundance of classical and stylized foliate cast bronze detail, set these lanterns off, like a piece of jewelry, against the plain austere facade.

As noted in Drawing 1., the lantern is entirely assembled of cast pieces; some of it ornamented structure, and some of it applied ornament. A number of the members have been cast and then turned on a metal lathe to obtain a smooth polished appearance to contrast with the sculptural relief of a more elaborate juxtaposed cast element. An example of this is in the flat cylindrical 'column capital' that supports the lantern (Figure 2.), where the top and bottom plate are cast as large washers and turned on a lathe for polishing and to tool the projecting ridges to receive the ornate cast spacer band. The larger cylindrical base is constructed in the same way. The ornate foliated 'column base' and lantern base are cast as separate parts, while each overhanging leaf of the column shaft was cast separately and applied to a cast core. Inside strips of sheet metal were used to secure the glass to the ornate vertical cast corner frames. Drawing 1.[6] indicates that the decorative perforated lantern top was cast as one piece and notched into the lower canted casting. An inside ledge was allowed on the perforated casting for the installation of the stained translucent glass panels, which were held in place from behind by soldered strips. The cast bell cap (Figure 3.) rabbeted on to the top of the

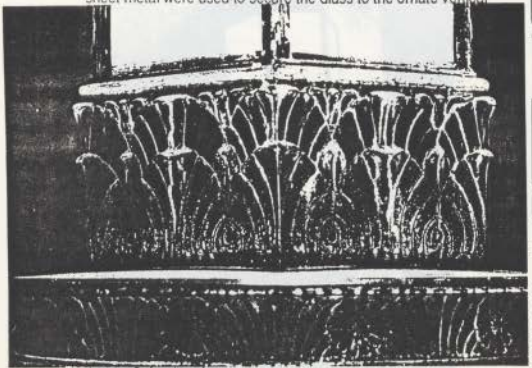


Figure 2. Lantern base

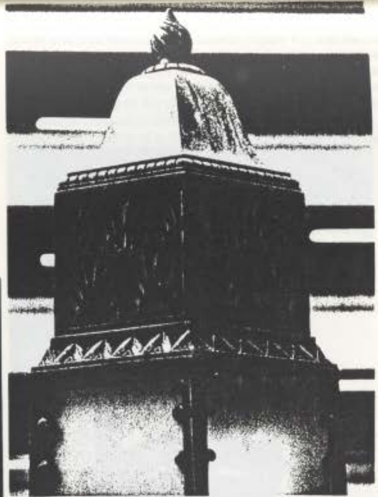


Figure 3. Lantern top

[6] Oregon Historical Society collection of F.C. Baker drawings

A-5 Drawing 1.
A-8 Drawing 1.

perforated casting and was attached to the crowning finial, which was cast as three separate members, the center one being turned for a contrasting effect with other two. As noted above, a complicated but coherent set of concealed rabbets facilitated ease of assembly and provided internal ledges for supporting glass.

The ornament is a mixture of stylized floral motifs, some of which are based on classical models such as the acanthus leaf of the lantern base (Figure 2.) and the anthemion of the perforated grille of Figure 3., as well as classical and geometric mouldings.

There is an interesting design compositional correspondence, albeit at a reduced scale, between the Broadway Street entrance flanking wall lanterns (Figure 4.), and the main street pedestal lanterns (Figure 1.). A high relief overhanging leaf base supports a strongly framed decorative band; the same elements that occur in the pedestal lantern, but at a reduced scale. The same casting as the pedestal lantern is then used as a base for the lantern. Instead of the larger perforated casting on top, a smaller solid casting of a similar abstract foliate design is used. The

Figure 4. Broadway Street entrance lanterns

Figure 5. Lantern over Northeast entrance

A-5 Drawings 1.
A-8 Drawings 1.

same bell cap and cast finial is used in both lanterns. This not only saves money through using the same expensive casting molds, but provides a direct correspondence between the two fixtures which helps unify the lighting scheme (Drawing 2.).

The half-lantern of Figure 5. (Drawing 3.), is located overtop of a ground level entrance on the northeast corner of the building's east facade that leads directly into the basement and to a stairway and elevator up. The pierced base provides some downlighting for this descent. The fixture was actually constructed differently than shown in Drawing 3.; the lower portion with the open leaf arrangement was actually cast as one piece, including the bottom frame of the glass panes. The drawing indicates a separate piece for the bottom frame. The upper part of the glass frame may well be as complicated as indicated in the drawing. The cast bronze star-in-a-circle ornament on the diagonals of the upper frame (the center ones are now missing) echo similar cut stone motifs in the Main Street entrance door mouldings, as well as on many of the luminaries used throughout the building. As on the other lanterns, internal sheet metal strips are screwed to the outer vertical cast members to secure the glass panes. The glass was specified to be a translucent light diffusing glass with a textured exterior and surface colored as selected. Provision of a threaded nipple and surface thumb nut was made to easily lift off the top for relamping.

The Madison Street entrance on the south facade was illuminated by two of the large cast bronze ceiling fixtures shown on Drawing 4. The vertical members of the frame and the removable bottom hub are reeded and provide a pleasing contrast with the rectilinear moulded frame and base. This contrast is accentuated by turning the cast base element. The stepped radial framing members were cast as one piece and notched on the inside to fit like a glove over the horizontal framing members. Two different sizes of translucent glass cylinders were used for the two vertical glass surfaces, while the two levels of horizontal glass sections were set on ledges formed on the inside of the horizontal framing members. These fixtures housed six porcelain sockets and were about two feet in diameter. As the Madison Street entrance was primarily a service entrance, the size of these fixtures suggests that they were possibly installed within the three-bay wide recessed mailing platform on the south Madison Street facade of the building. The author did not have access to this area and can not confirm this.

Figure 6. Main Street foyer lantern

Foyer lighting

The bronze Main Street entrance doors lead from the landing through to the foyer, which is 18 ' 5" tall, 42' wide and 20'

A-5 Drawing 1.

A-8 Drawing 1.

deep. Daylight is emitted through the bronze framed entrance doors and overlights and transmitted to the lobby through the bronze and brass framed south glass wall of the foyer, which also has three bronze-framed doors matching the entrance doors. This daylight, plus the light-colored plaster ceiling and cornice, make this quite a light room. The lobby is lighted by two attractive cast bronze lanterns (Figure 6., Drawing 5.) These lanterns support a translucent glass cylinder in a framework of cast bronze parts. The cast and turned horizontal bands are notched to fit around the outside of the vertical members; the lower ones providing an inside ledge for the support of the glass cylinder. The partially open bottom is composed of cast stylized feather groups and brazed to the same cast and turned rim to which the vertical bars are attached. A threaded 1/4 inch nipple screws into a bridge across this rim to support the removable (for relamping) bottom ornament. The outside framework is attached near the top to an internal cast horizontal spider section. This member resembles a spoked hub with an intermediate rim and provides the rigidity to the upper framework and also rabbeted ledges for the support of translucent glass panels to diffuse the uplight.

Figure 7. Base of the Main Street foyer lantern

Apart from the reeded and geometric motifs, this fixture imaginatively incorporates the building's customized ornamental motifs announced by the main entrance's ornamental moulding: the star in a circle, the eagle and the acorn (the Oregonian factor). Cast bronze stars are applied to the cast and turned section half way up the stem. A cast acorn is embraced by a splayed surround of cast feathers (an eagle's, no doubt) on the bottom ornament. As mentioned, cast feather shields are incorporated into the base of the lantern.

The cast bronze frame of the Broadway Street foyer lantern was assembled in much the same way as the Main Street foyer lantern, including a ledge to support a translucent glass cylinder and a cast spider on the inside of the upper frame. This spider was also ledged to support glass panels. A threaded nipple connected the cast bottom ornament to a metal strap (web) that spanned across the bottom. This suspended ornament, which was open all around, consisted of the same acorn-in-feather motif pendant used on the Main Street foyer lantern, but set in a star and stylized feather plate (Drawing 6.). A feather and acorn motif was also worked into the upper rim ornamental band. The attractive canopy (ceiling plate) was of a star character. As seen in Figure 8., the bottom ornament, together with it's supporting web have been removed, supposedly to minimize the inconvenience of relamping. Fortunately, this is a rare incident of slothful maintenance in this building.

The attractive semi-indirect ceiling fixture of Figure 9. (Drawing 7.)was installed in the northeast entrance basement foyer as well as in the 6th floor corridor connecting the District Court lobbies and in the District Court lobbies. Light reflected from the

A-5 Drawing 1.
A-8 Drawing 1.

inside of the cast bronze bowl and then off of the spun brass interior reflector to spill on the base and ceiling. The aperture of the cast bowl was notched to receive a domed glass shade for direct lighting. As seen in the figure, the glass shade has been removed to accommodate a larger lamp; the effect of which is a blinding glare and obliteration of any detail on the fixture. Except for the four ribbed 'feet', the ornament is of an expertly crafted classical nature; a vine rinceau and beaded edge on the cast bronze bowl and an acanthus leaf molding on the rim of the base casting.

Figure 8. Broadway Street foyer lantern

Figure 9. Ceiling fixture

Another simple but elegant ceiling fixture which graced the east vestibule on the first floor (bottom left of Drawing 4.) utilized the same acorn in feather pendant as the other foyer luminaires.

A-5 Drawing 1.

A-8 Drawing 1.

The main lobby space is about 125 ' wide by 25 ' deep with three 14' X 11' alcoves, corresponding to the coffered ceiling, alternately extending off of the lobby to the south. The south wall and alcoves contain bronze lockboxes and postal service windows. The axis of the lobby is east-west, with the bronze-framed glass wall/main entry being situated centrally, the Broadway Street foyer at the west end and a vestibule leading to stairs down to the Sixth Avenue northeast entrance at the east end of the lobby. Four elaborate cast bronze writing desks are arranged along this axis, with bronze wall clocks mounted high up on the east and west walls.[7]

The ceiling is 18' 9" high[8] and articulated by decorative plaster beams whose spacing along the axis reflects the external bays of the facade, and also corresponds to the dimensions and location of the alcove spaces and the three bronze- framed bays of the main foyer glass wall. The most spectacular luminaries in the building are suspended from alternate bays along the length of the public lobby; a total of five (Figures 10. to 13., Drawing 8.).

A 1/2 " pipe connects the lowest of the cast rings supporting the fixture with a central heavy cast and turned disk at the level of the cylinder bands, by threaded connections. Another pipe suspends a thinner cast and turned disk at a level corresponding to the bottom of the cylinders. The radiating elongated fan shaped castings (Figures 11. and 12.) are screwed to the underside of this disk and tangentially brazed to the cylinder bases, for their prime structural support. The open foliated castings on the base play a deceptive role by occupying the most likely location for a structural support but appearing too light to support the cylinders; they are purely ornamental. The vertical cast members between the cylinders are supported by the structural fan shaped casting and notched to support the cast and turned cylinder bands. A 3/8 " solid rod connects the vertical member to the heavy central disk for rigidity. This upper disk is rabbeted to receive the cast flaring feather ornamental casing, which were cast as separate feathers and soldered to the internal cast ring. An internal pipe sandwiches all the lower ornament between the bottom cast finial and the base of the lowest disk which it screws into. One of these pieces of ornament is the decorative cast plate

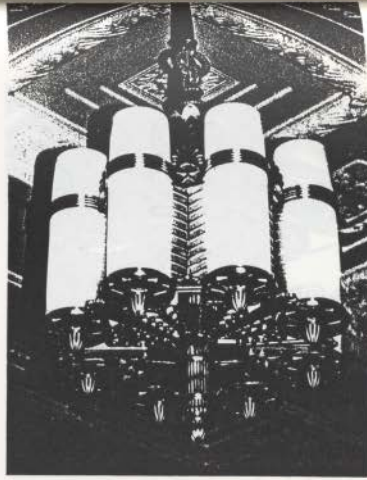


Figure 10. Public lobby luminaire

seen in Figure 13., which conceals the screwed connections on the underside of the lower disk.

The star-in-a-circle motif is prominently emblazoned on the vertical cast members separating each of the eight cylinders at the level of the cylinder bands. The lower part of these vertical bands may in fact represent the shaft of a feather, since from many sight lines from the floor of the lobby the flaring feather ornament on the

[7] Ibid., p. 7-2

[8] Ibid.

A-5 Drawing 1.
A-8 Drawing 1.

stem could be taken as an extension of the lower "feather shaft".

Each cylinder accommodated two lamps, as indicated in Drawing 8. The cylinders were also equipped with removable tops to facilitate relamping. These cast and turned tops provided an attractive terminus to these elaborate fixtures. The removal of these cast bronze tops has diminished the aesthetic impact of these attractive fixtures as well as adversely effected the intended lighting scheme. As indicated by the original fixture arrangement, uplighting was never the design intention here. The conversion of

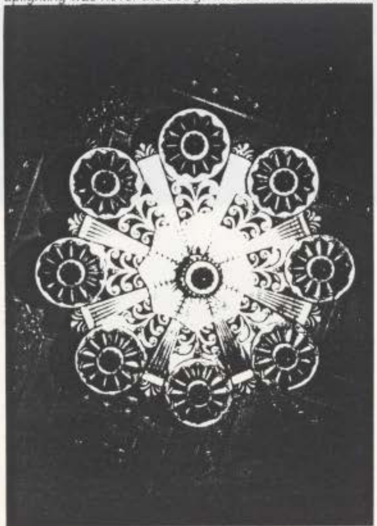


Figure 11. Base of the Public Lobby luminaire

Figure 12. Detail of thé Public Lobby luminaire

these fixtures for ceiling reflected light has resulted in an imbalanced light distribution in the lobby by overlighting the alternate bays where the fixtures hang. It also washes out the subtle shades and shadows of the low relief plaster coffers.

The Public Lobby alcove luminaries (Figures 14. and 15., Drawing 9.) is very closely related the larger lobby luminaries through repetition of parts and similarity of design and

A-5 Drawing 1.

A-8 Drawing 1.

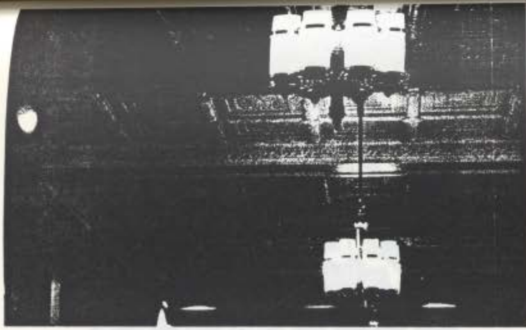


Figure 13. Public Lobby

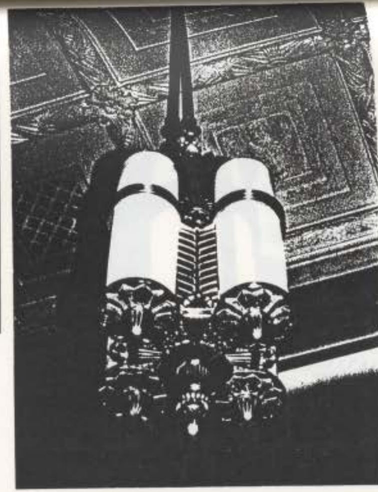


Figure 14. Public Lobby alcove luminaries

construction. These fixtures seem perfectly scaled for their alcove spaces and provide a strong connection between the alcoves and the lobby. These fixtures have also been robbed of their tops with a subsequent overlighting of their spaces.

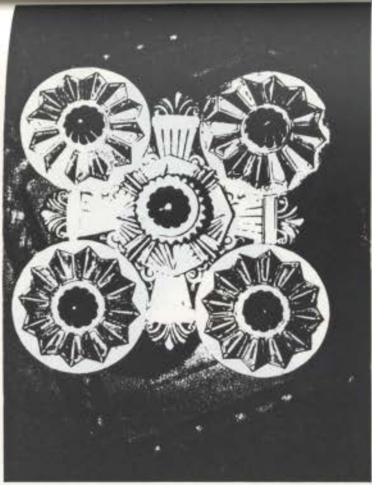


Figure 15. Base of Public Lobby luminaire

Figure 16. Stair lobby luminaire

The two stair lobbies at either end of Public Lobby were lighted by the lanterns shown in Figures 16. and 17. and Drawing 10. Their construction is similar to the other lanterns, including a feathered stem shroud (Figure 17.) which was cast as one piece. This fixture has suffered another effort to increase lighting levels, as the ornamental hinged cast bottom has been removed.

Figure 17. Detail of stair lobby luminaire

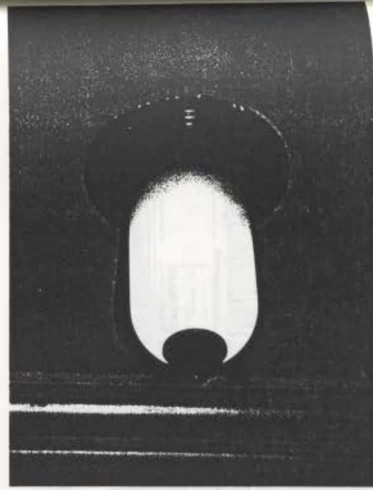


Figure 18. Second floor stair landing ceiling light

The top landing of these stairs are illuminated by the attractive ceiling fixture depicted in Figure 18. and Drawing 10. The reeded ornament at the bottom of the translucent shade is purely ornamental as the shade is secured to the cast and spun base by thumb screws at it's indented rim.

A-5 Drawing 1.
A-8 Drawing 1.

The Court of Appeals lobby and corridor on the Seventh floor also feature fine lanterns (photograph 3., Drawings 11. and 12. respectively).

The two sixth floor District Courtrooms have a 24' 4" high ornamental coffered ceiling, while the seventh floor Court of Appeals has a 15' 6" high plaster coffered ceiling.[9] The semi-indirect fixtures employed in these rooms as well as the Judge's Chambers were designed primarily for indirect lighting but employed a system of apertures and reflecting surfaces to illuminate the exterior of the cast bronze luminaire.

The luminaries in the Court of Appeals courtroom (Figures 19. - 21., Drawing 13.), are typical of these three room's fixtures. A central cast housing supports eight sockets with silver mirrored reflectors and 150 Watt incandescent lamps for indirect lighting. Three 50 Watt lamps are supported on the lower part of this housing to provide a source of light that will be reflected out of the two apertures to illuminate the side of the cast bronze bowl and the fairly plain underside of the bowl; the latter effect was to provide a halo of spilled light around the outside of the elaborately cast lower plate.

The building's customized ornament of a star-in-a-circle, the eagle (feathers adequately qualifying), and acorns become dominant ornamental elements on these fixtures. The lower ornamental plate features a five pointed star on a bed of feathers, while cast feathers have been applied individually to the internal spinning for the bowl.

Figure 19.[10] View of the Court of Appeals courtroom

[9] Ibid.

[10] Oregon Historical Society Negative # CN 015552 03212010

A-5 Drawings 1.

A-8 Drawings 1.

Figure 20. Court of Appeals luminaire

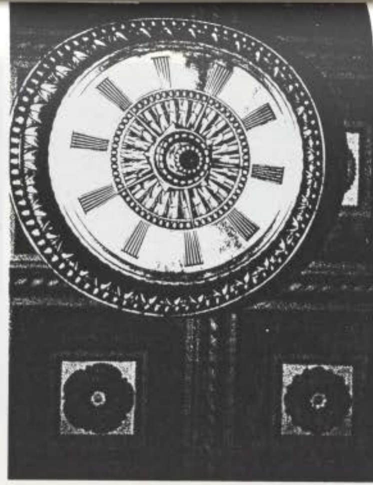


Figure 21. Court of Appeals luminaire

A-5 Drawing 1.

A-8 Drawing 1.

This courtroom has undergone a fairly sensitive lighting rehabilitation, with downlights inconspicuously set into alternating coffer rosettes. This sensitive compromise to historic interior architecture may well have preserved the integrity of this historic lighting rehabilitation.

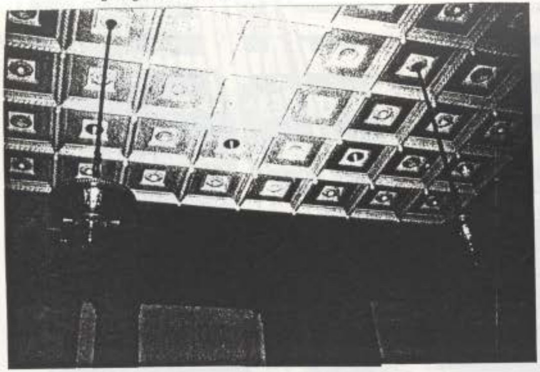
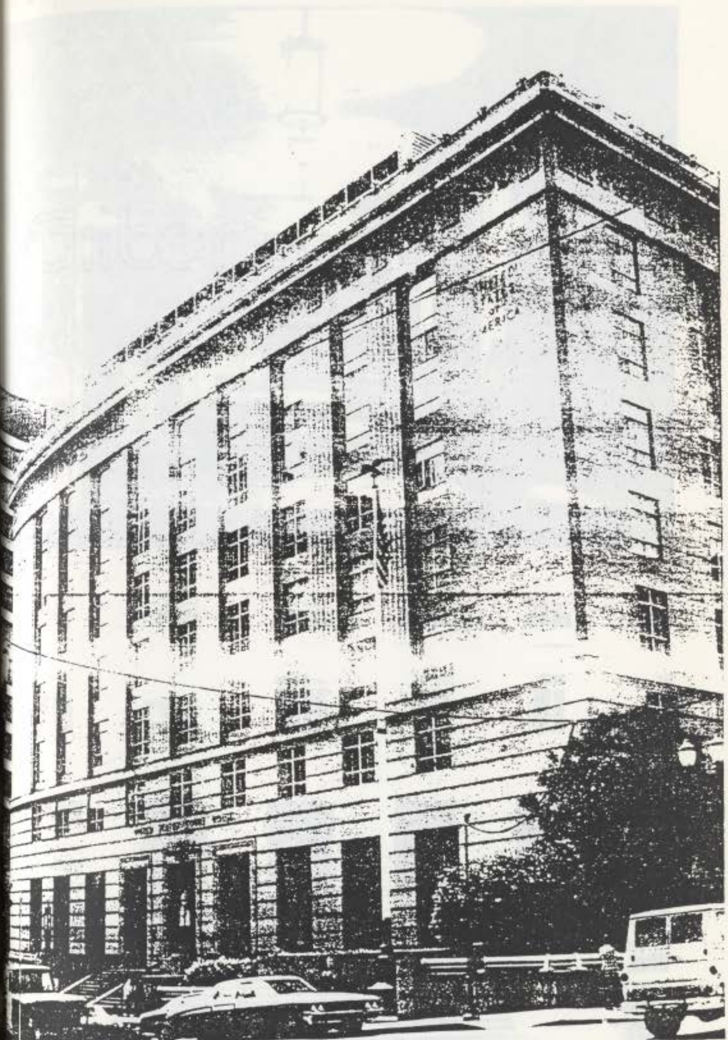


Figure 22. Court of Appeals lighting rehabilitation

Figure 23. Detail of the downlight installation

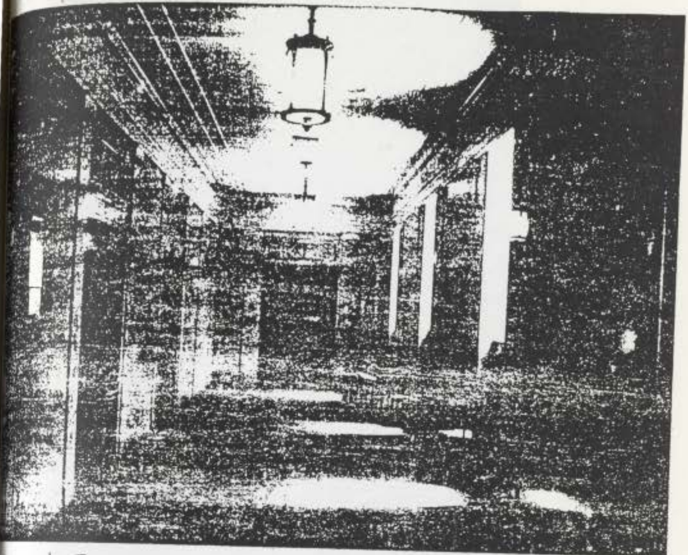
A-5 Drawings 1.

A-8 Drawings 1.

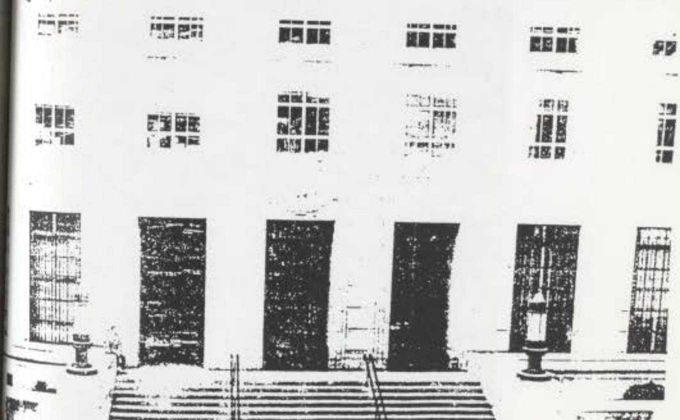


A-5 photograph 1.

A-5 photograph 3.



…ograph 2.

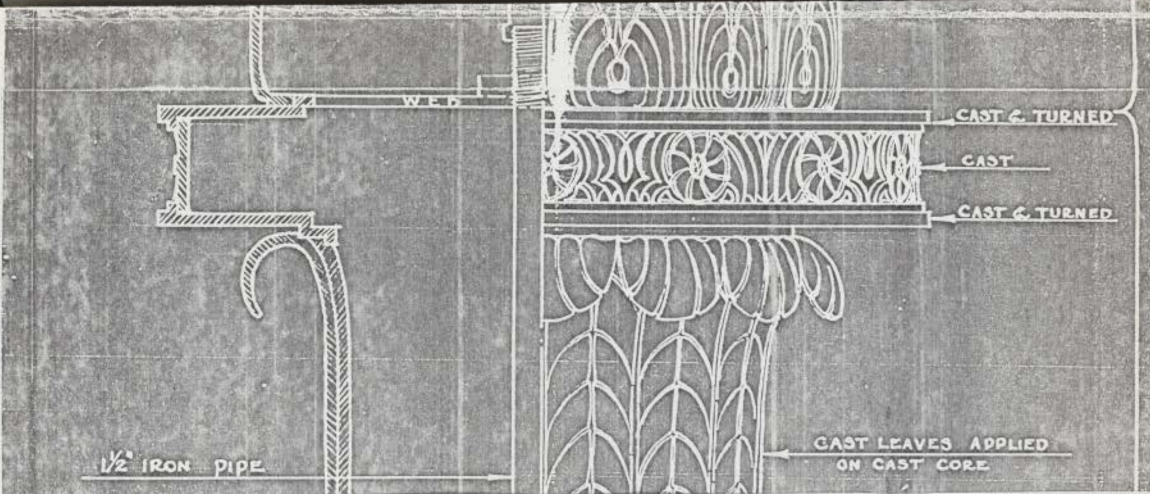


A-5 photograph 3.

A-5 photograph 2.

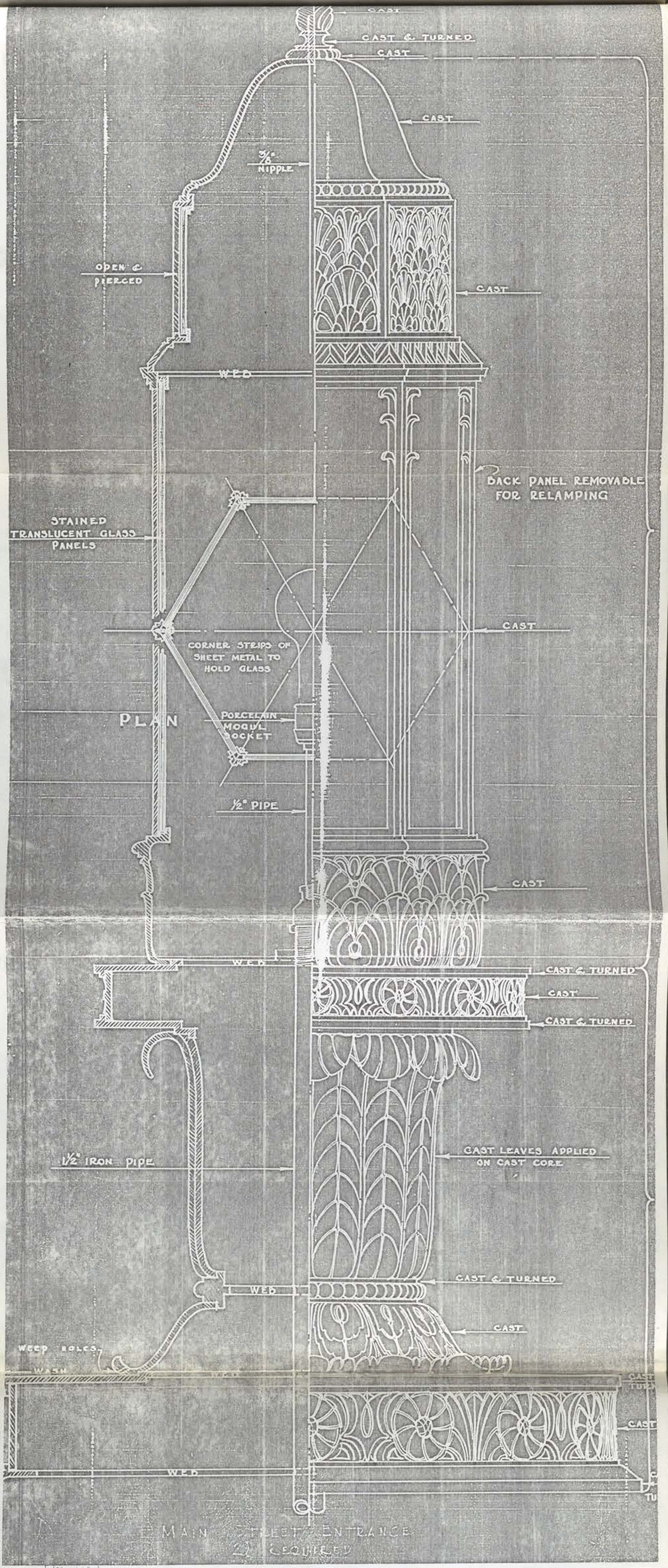
A-5 Drawings 1.

A-8 Drawings 1.



A-5 Drawing 1.

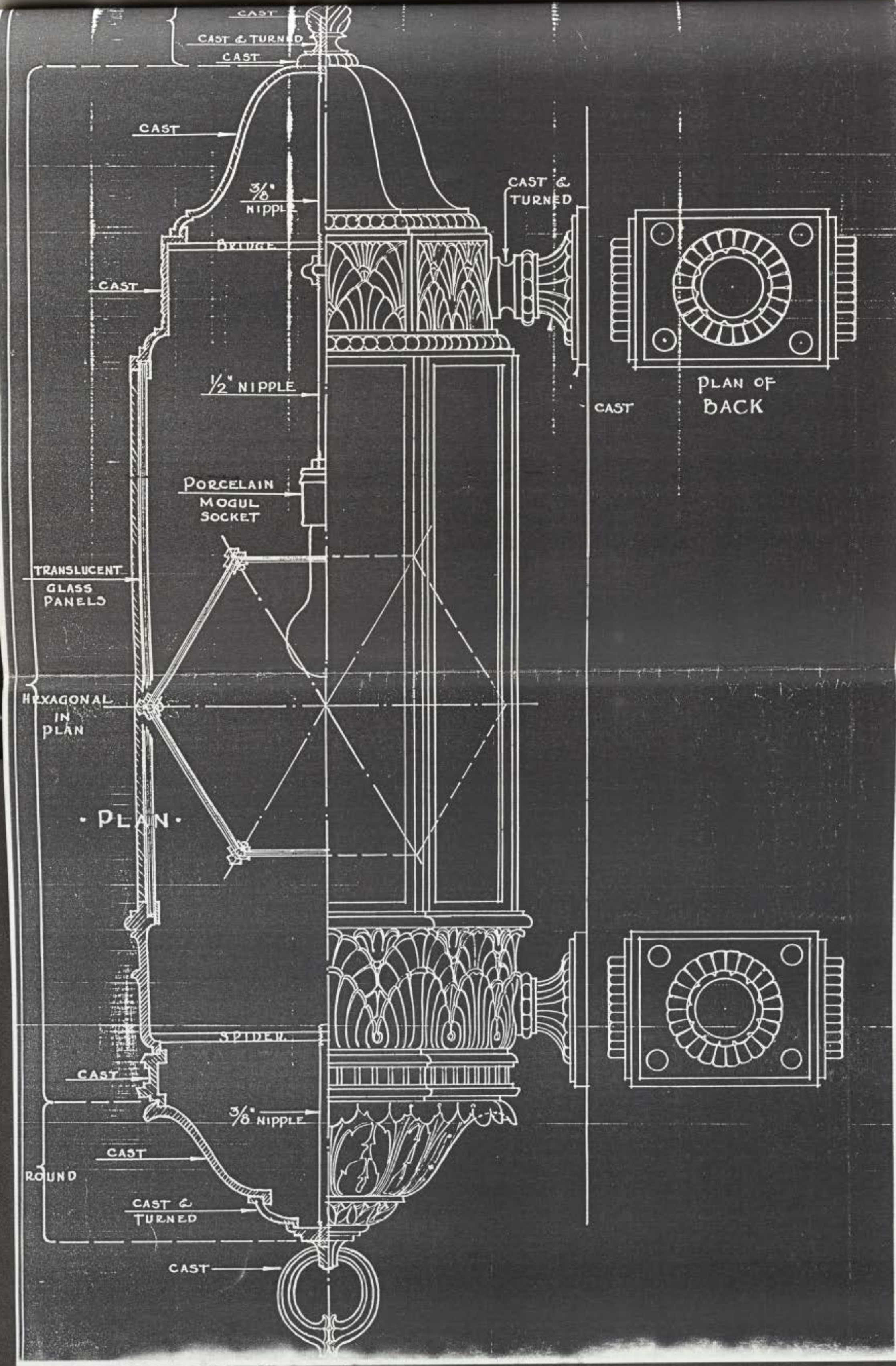
A-8 Drawing 1.


CAST
CAST & TURNED
CAST
CAST
3/8" NIPPLE
OPEN & PIERCED
CAST
W.E.D.
BACK PANEL REMOVABLE FOR RELAMPING
STAINED TRANSLUCENT GLASS PANELS
CAST
CORNER STRIPS OF SHEET METAL TO HOLD GLASS
PLAN
PORCELAIN MOGUL SOCKET
1/2" PIPE
CAST
W.E.D.
CAST & TURNED
CAST
CAST & TURNED
CAST LEAVES APPLIED ON CAST CORE
1 1/2" IRON PIPE
CAST & TURNED
W.E.D.
CAST
WEEP HOLES
WASH
CAST
W.E.D.
MAIN STREET ENTRANCE

A-5 Drawing 1.

A-5 Drawing 2.

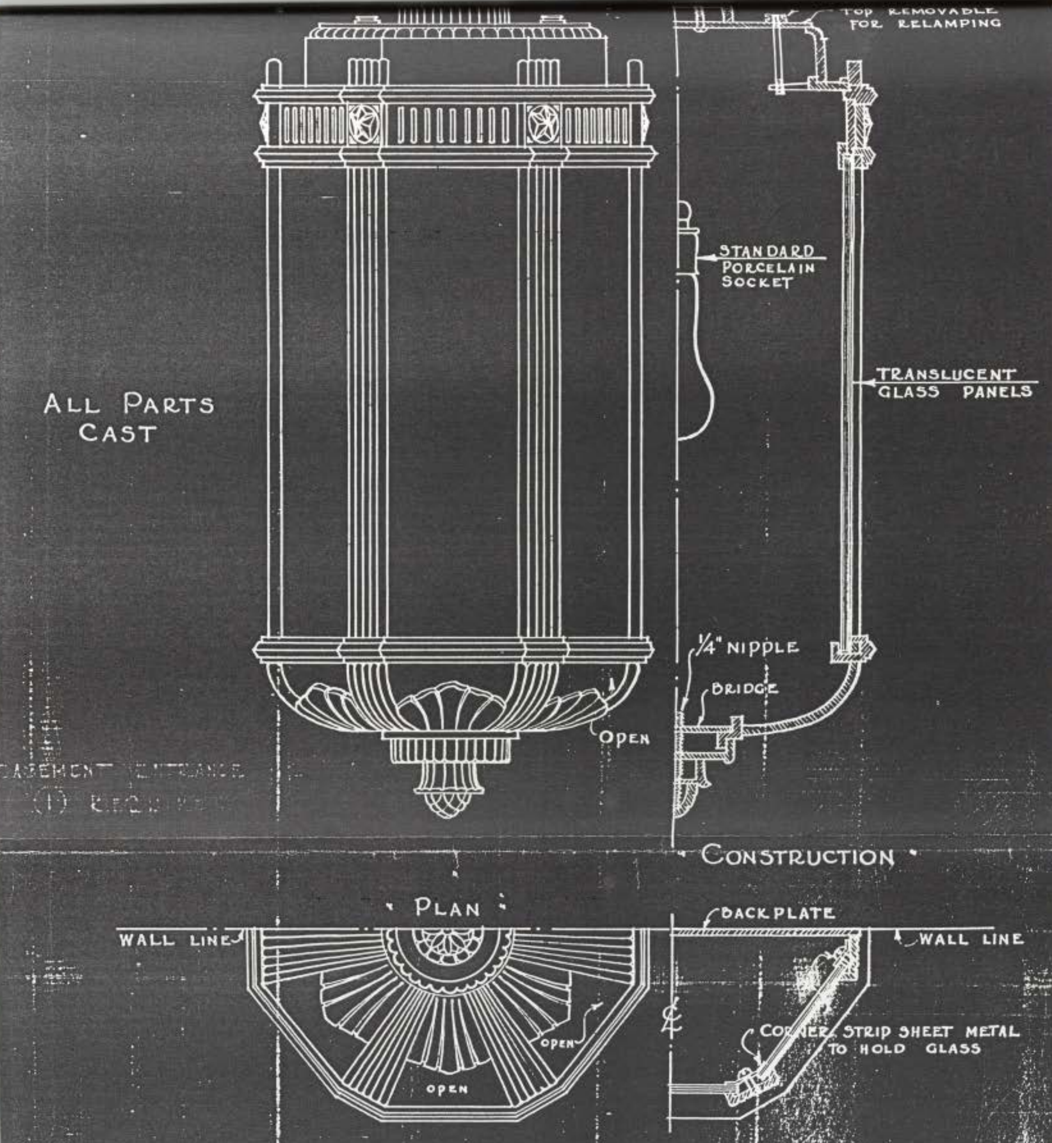
A-8 Drawing 1.


CAST
CAST & TURNED
CAST
CAST
3/8" NIPPLE
BRIDGE
CAST
CAST & TURNED
PLAN OF BACK
CAST
1/2" NIPPLE
PORCELAIN MOGUL SOCKET
TRANSLUCENT GLASS PANELS
HEXAGONAL IN PLAN
· PLAN ·
SPIDER
CAST
3/8" NIPPLE
CAST
ROUND
CAST & TURNED
CAST

A-5 Drawings 2.

A-5 Drawing 3.

A-6 Drawing 1.



GENERAL NOTES

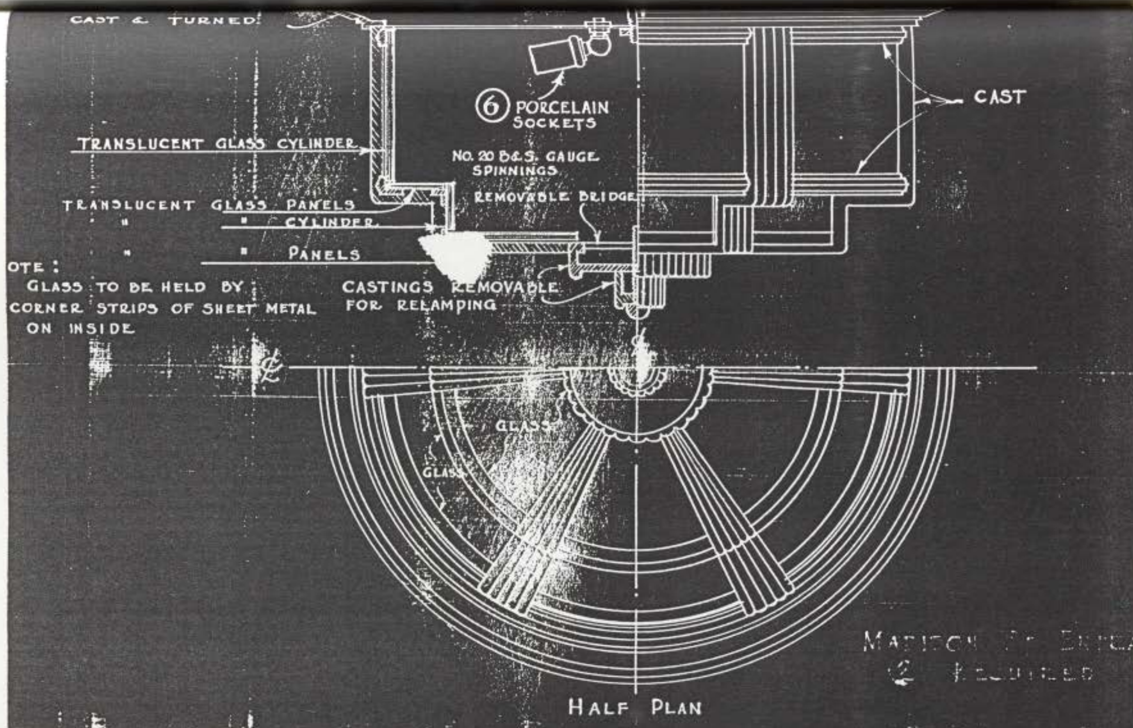
ALL FIXTURES ON THIS SHEET ARE OF BRONZE AND ARE TO BE CAST FROM CHASED MASTER METAL
TERNS.
ALL CASINGS - SPUN CANOPIES & SHELLS - UNLESS OTHERWISE NOTED, TO BE NO. 20 B.&S. GAUGE
ASS. ALL SURFACES SHOWN PLAIN ON CASTINGS TO BE TURNED WHERE REQUIRED TO
DUCE SMOOTH FINISH & POLISHED TO CORRESPOND TO FINISH OF CASINGS & SPUN PARTS.
ALL DETAILS OF CAST ORNAMENTATION TO BE PLAINLY BROUGHT OUT BY HAND FINISHING
ALL PARTS TO BE THOROUGHLY CUT DOWN ON GREASE WHEEL BEFORE BUFFING
TER WHICH THEY ARE TO BE BUFFED BRUSHED & SHADED TO BRING-OUT THE DETAIL
GHLIGHTS TO BE RENEWED & LEFT IN NATURAL BRONZE COLOR.

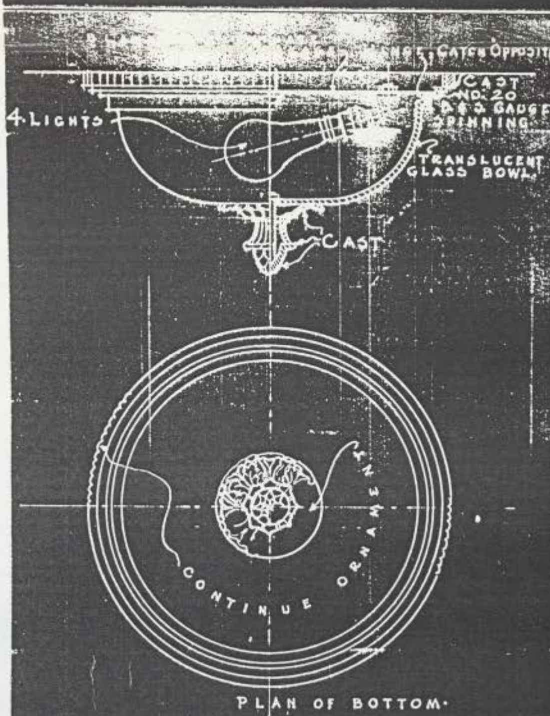
SCALE 3" = 1'-0" (1/4 SIZE)

ALL GLASS TO BE TRANSLUCENT LIGHT DIFFUSING GLASS WITH TEXTURED EXTER
RFACE - COLORED AS SELECTED. SUBMIT SAMPLE FOR APPROVAL.

A-5 Drawings B.

A-5 Drawing 4.





PLAN OF BOTTOM·

P-2

EAST VESTIBULE 1st FLOOR

GENERAL NOTES

SCALE 3" = 1'-0"

ALL FIXTURES ON THIS SHEET ARE OF BRONZE AND ARE TO BE CAST FROM CHASED MASTER METAL PATTERNS.

ALL CASINGS, SPUN CANOPIES & SHELLS, UNLESS OTHERWISE NOTED TO BE NO. 20 B&S GAUGE BRASS.

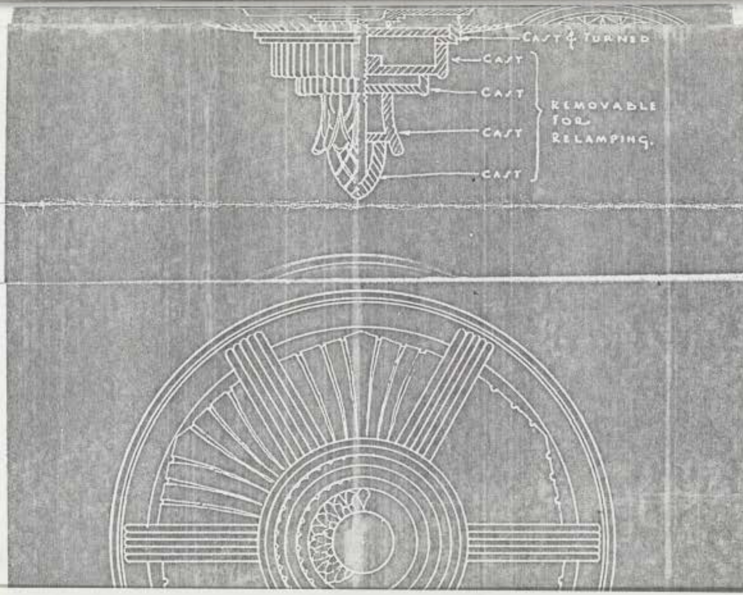
ALL SURFACES SHOWN PLAIN ON CASTINGS TO BE TURNED ~~WHERE~~ REQUIRED TO PRODUCE SMOOTH FINISH & POLISHED TO CORRESPOND TO FINISH OF CASING & SPUN PARTS.

ALL DETAILS OF CAST ORNAMENTATION TO BE PLAINLY BROUGHT OUT BY HAND FINISHING.

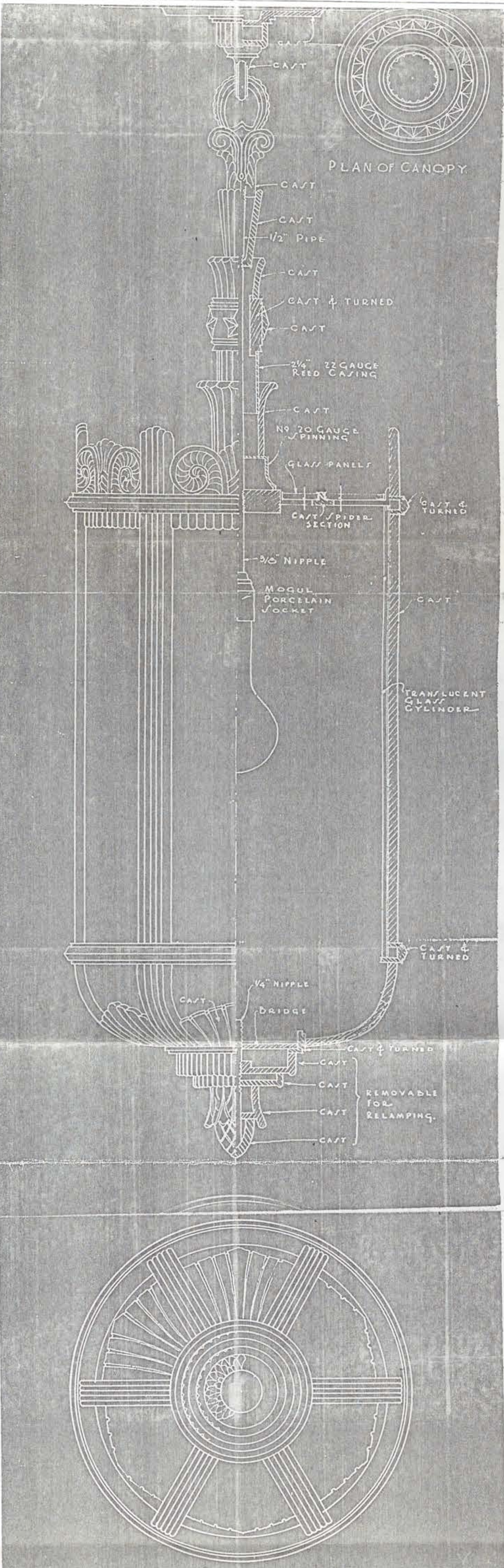
FINISH - ALL PARTS TO BE THOROUGHLY CUT DOWN ON GREASE WHEEL BEFORE BUFFING AFTER WHICH THEY ARE TO BE BUFFED, BRUSHED AND SHADED TO BRING OUT THE DETAIL, HIGHLIGHTS TO BE RELIEVED AND LEFT IN NATURAL BRONZE COLOR.

ALL GLASS TO BE TRANSLUCENT LIGHT DIFFUSING GLASS WITH TEXTURED EXTERIOR SURFACE, AND COLORED AS SELECTED. SAMPLES OF ALL GLASS TO BE SUBMITTED TO THE ~~SUPERVISING~~ ARCHITECT FOR APPROVAL.

A-5 Drawings 4.



A-5 Drawing 5
A-5 Drawing 7
A-8 Drawing 1.



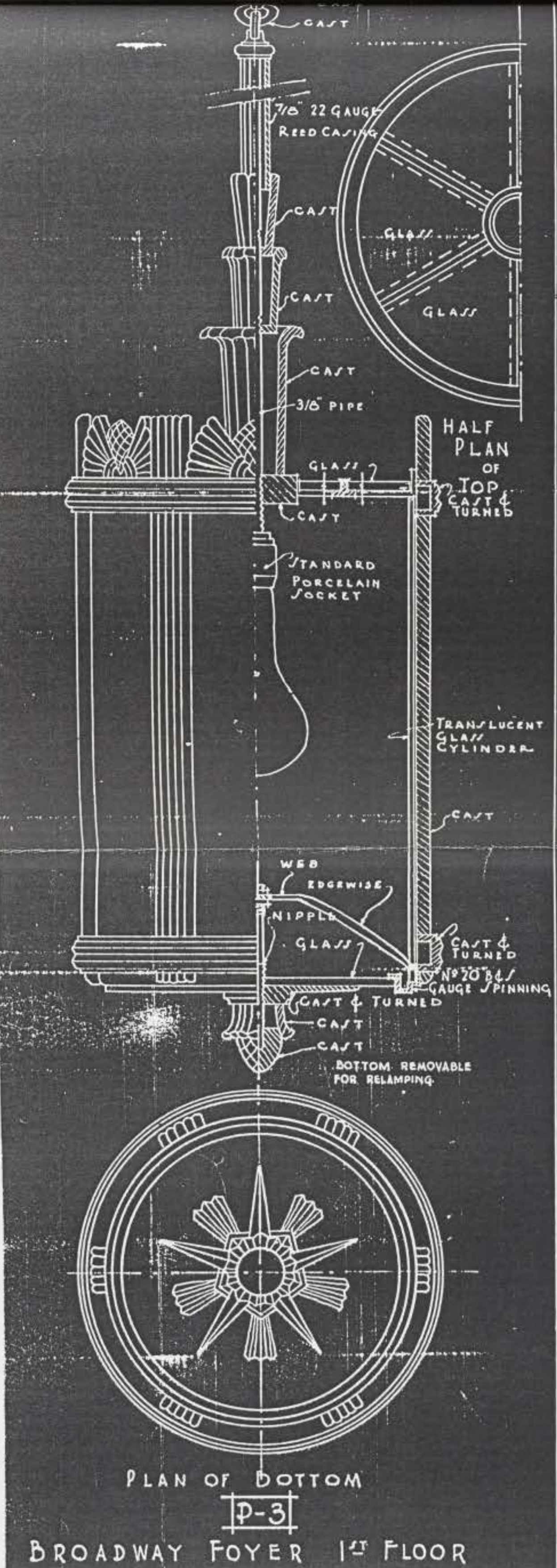
P-4

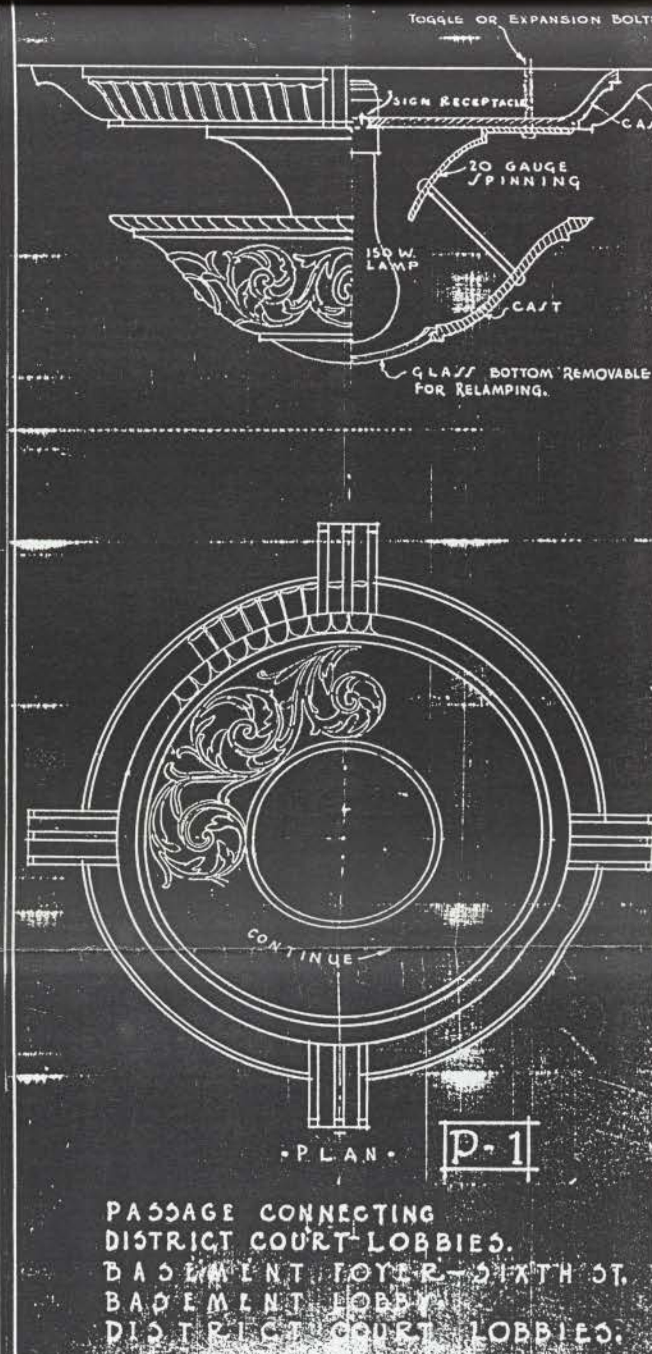
MAIN STREET FOYER 1st FLOOR

Drawing 6.

A-5 Drawing 7.

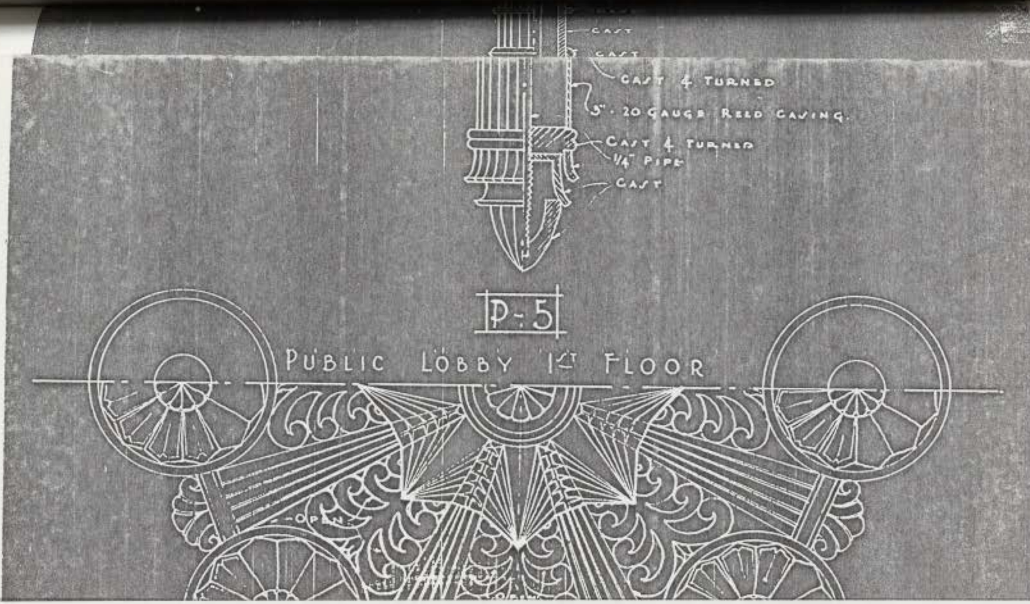
A-8 Drawing 1.


CAST
7/8" 22 GAUGE
REED CASING
CAST
CAST
CAST
3/8" PIPE
GLASS
GLASS
GLASS
HALF
PLAN
OF
TOP
CAST &
TURNED
CAST
STANDARD
PORCELAIN
SOCKET
TRANSLUCENT
GLASS
CYLINDER
CAST
WEB
EDGEWISE
NIPPLE
GLASS
CAST &
TURNED
No 20 B&S
GAUGE SPINNING
CAST & TURNED
CAST
CAST
BOTTOM REMOVABLE
FOR RELAMPING
PLAN OF BOTTOM
P-3
BROADWAY FOYER 1ST FLOOR


TOGGLE OR EXPANSION BOLTS.
SIGN RECEPTACLE
CAST
20 GAUGE
SPINNING
150 W.
LAMP
CAST
GLASS BOTTOM REMOVABLE
FOR RELAMPING.
CONTINUE
· PLAN ·
P-1
PASSAGE CONNECTING
DISTRICT COURT LOBBIES.
BASEMENT FOYER—SIXTH ST.
BASEMENT LOBBY.
DISTRICT COURT LOBBIES.

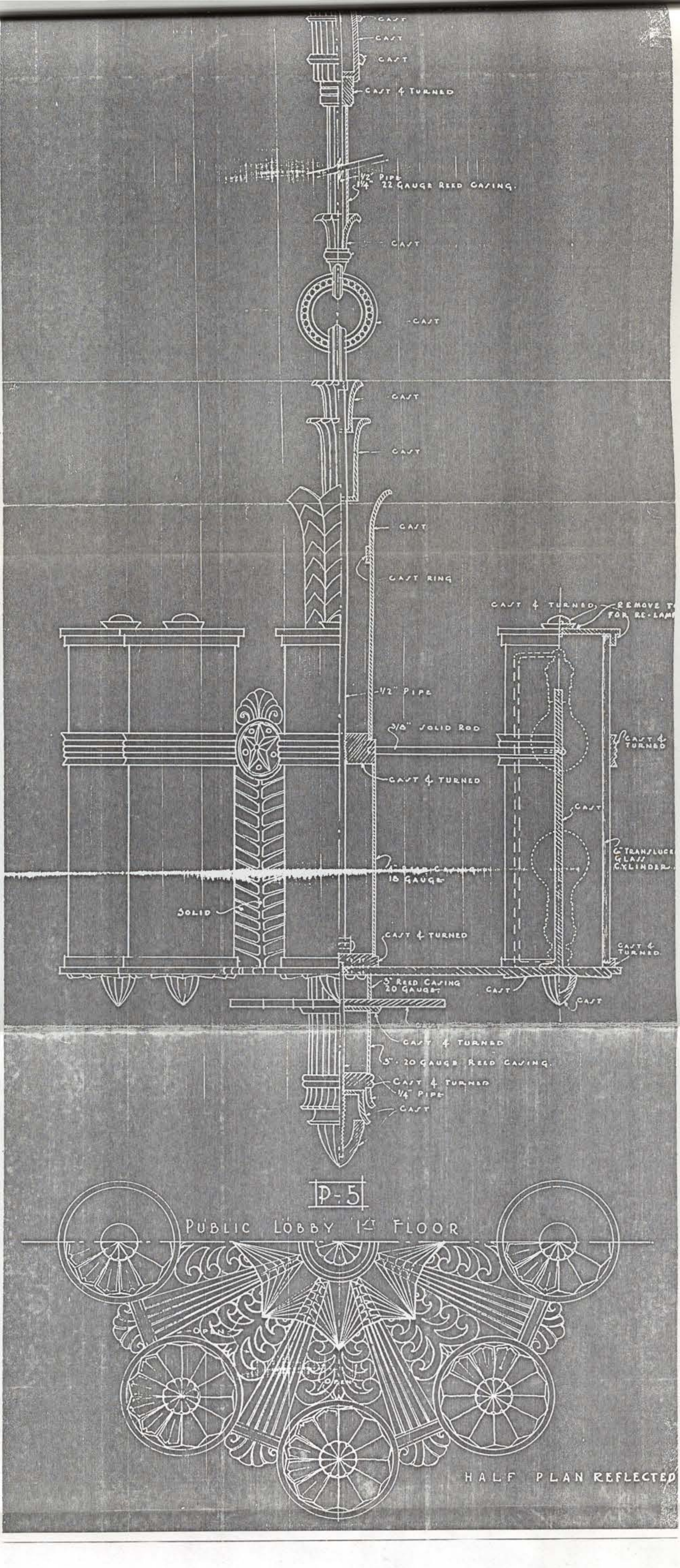
Drawing 6.

A-5 Drawing 7.



A-5 Drawing 8.

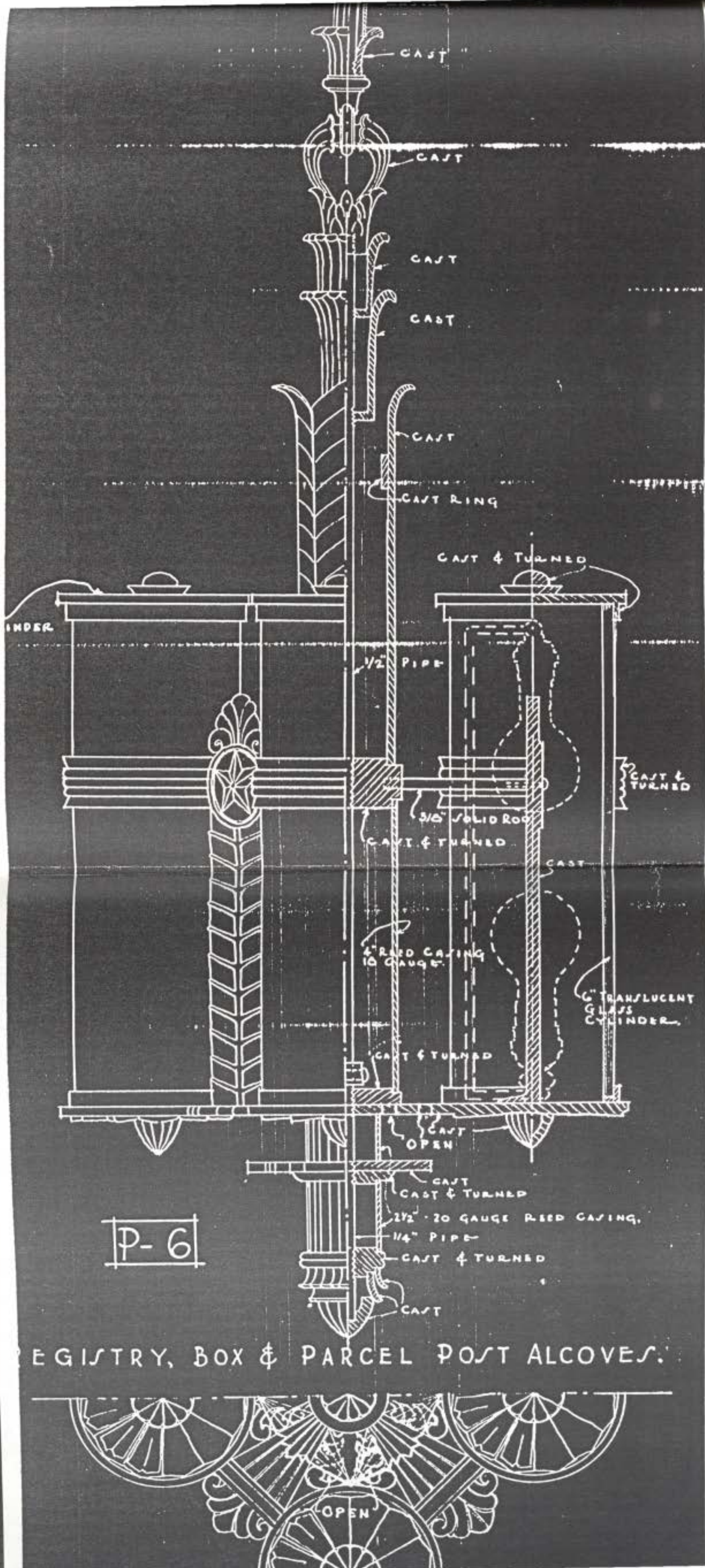
A-8 Drawing 1.



CAST
CAST
CAST
CAST & TURNED
1/2" PIPE
1 1/4" 22 GAUGE REED CASING.
CAST
CAST
CAST
CAST
CAST
CAST RING
CAST & TURNED
REMOVE FOR RE-LAMP
1/2" PIPE
3/8" SOLID ROD
CAST & TURNED
CAST & TURNED
CAST
6" TRANSLUCENT GLASS CYLINDER
18 GAUGE
SOLID
CAST & TURNED
CAST & TURNED
3" REED CASING 20 GAUGE
CAST
CAST
CAST & TURNED
5" 20 GAUGE REED CASING.
CAST & TURNED
1/4" PIPE
CAST
P-5
PUBLIC LOBBY 1st FLOOR
OPEN
OPEN
HALF PLAN REFLECTED

A-5 - Drawings 9

A-6 Drawings 1.

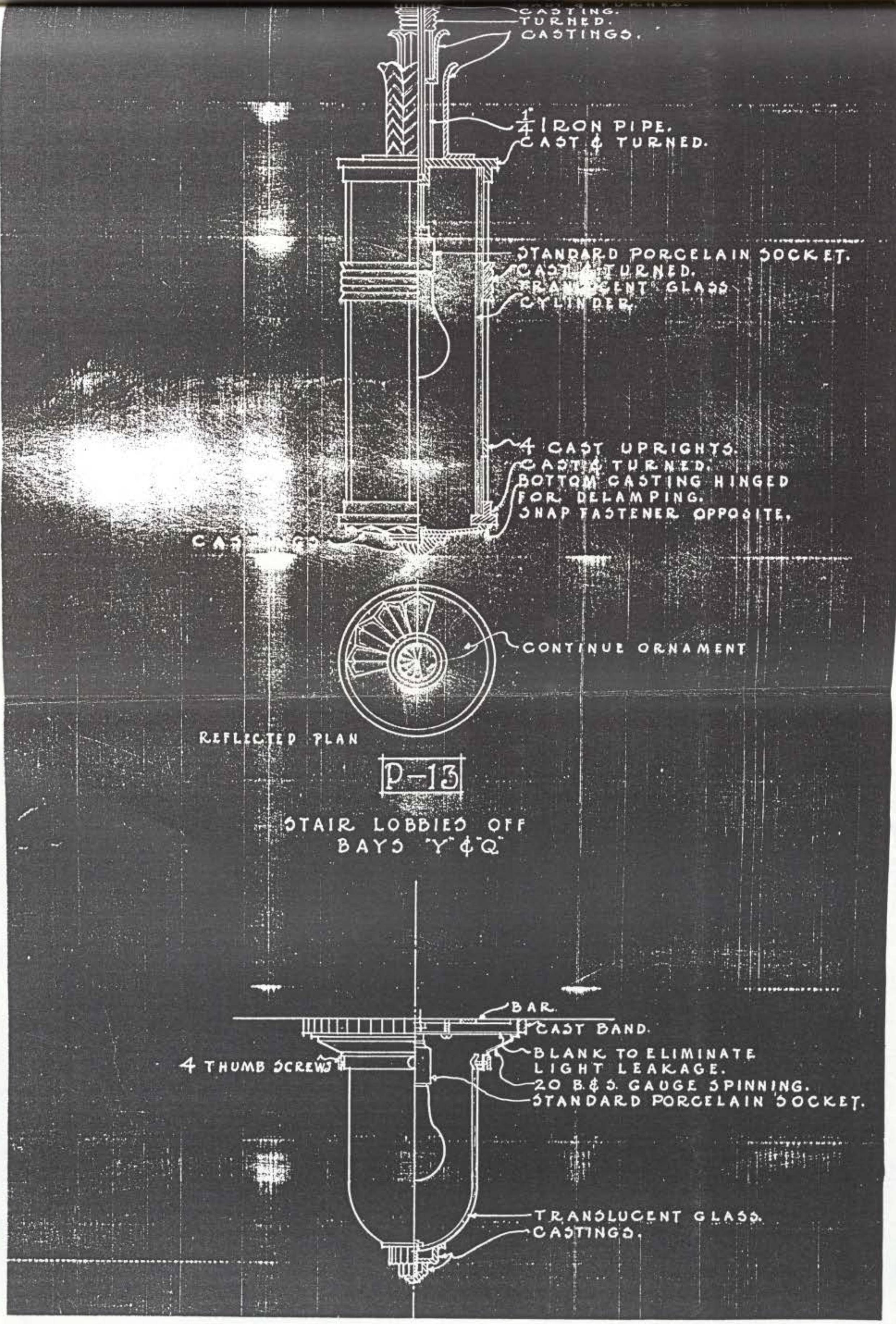


CAST
CAST
CAST
CAST
CAST
CAST RING
CAST & TURNED
INDER
1/2" PIPE
CAST & TURNED
5/16" SOLID ROD
CAST & TURNED
CAST
4" REED CASING 10 GAUGE
6" TRANSLUCENT GLASS CYLINDER
CAST & TURNED
CAST
OPEN
CAST
CAST & TURNED
2 1/2" 20 GAUGE REED CASING.
1/4" PIPE
CAST & TURNED
CAST
P- 6
REGISTRY, BOX & PARCEL POST ALCOVES.
OPEN

A-5-Drawings ?

A-5 Drawing 10.

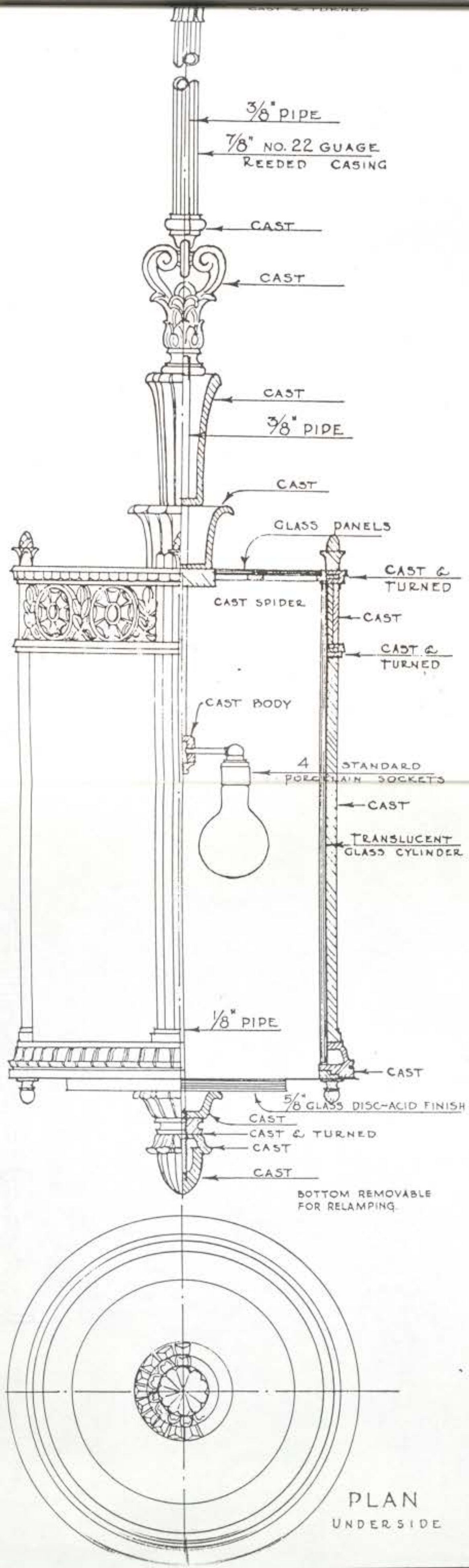
A-8 Drawing 1.



CASTING.
TURNED.
CASTINGS.
1/4" IRON PIPE.
CAST & TURNED.
STANDARD PORCELAIN SOCKET.
CAST & TURNED.
TRANSLUCENT GLASS CYLINDER.
4 CAST UPRIGHTS.
CAST & TURNED.
BOTTOM CASTING HINGED FOR DELAMPING.
SNAP FASTENER OPPOSITE.
CONTINUE ORNAMENT
REFLECTED PLAN
P-13
STAIR LOBBIES OFF BAYS "Y" & "Q"
BAR.
CAST BAND.
4 THUMB SCREWS
BLANK TO ELIMINATE LIGHT LEAKAGE.
20 B.& S. GAUGE SPINNING.
STANDARD PORCELAIN SOCKET.
TRANSLUCENT GLASS.
CASTINGS.

A-5 Drawings 10.

A·5 Drawings II.
A·6 Drawings I.

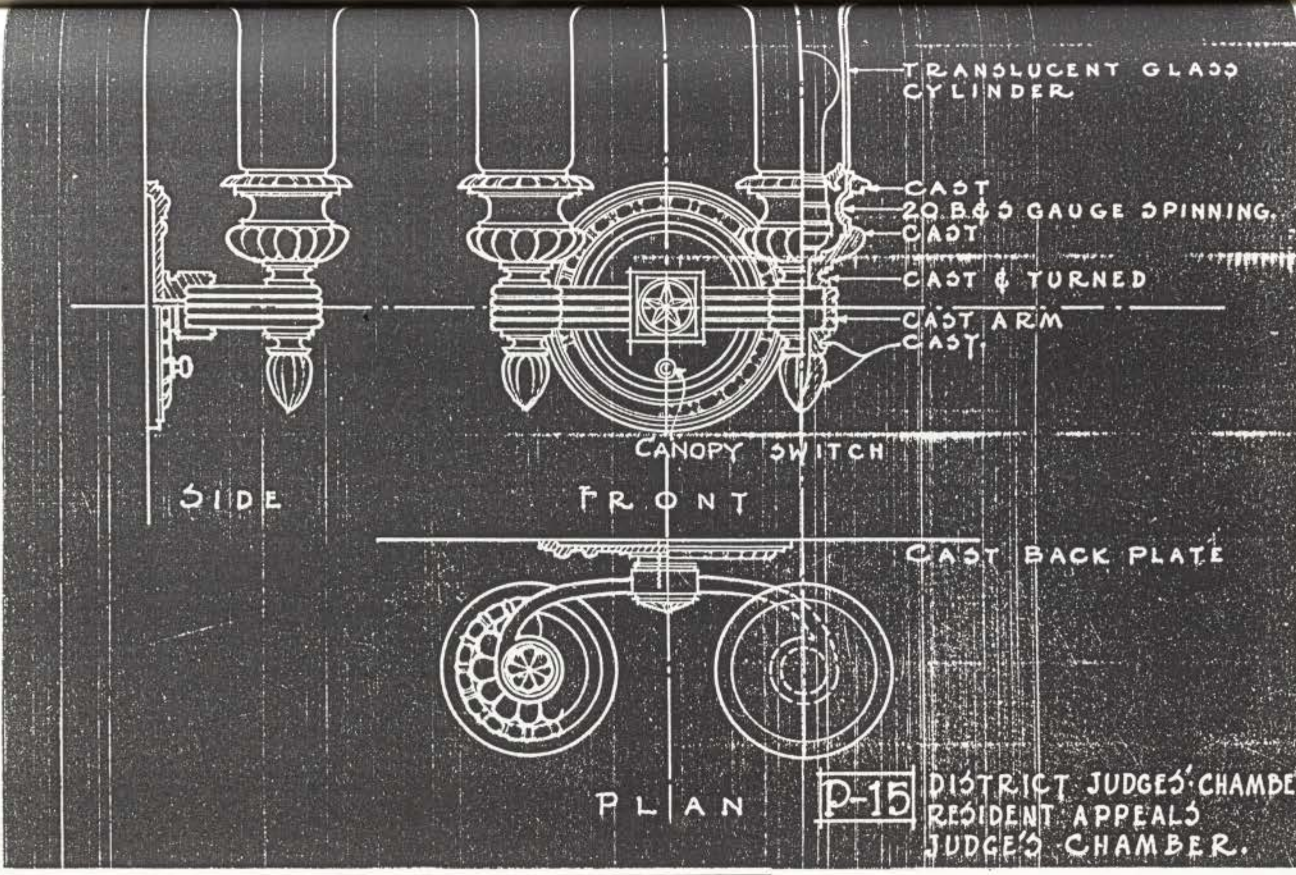

3/8" PIPE
7/8" NO. 22 GUAGE
REEDED CASING
CAST
CAST
CAST
3/8" PIPE
CAST
GLASS PANELS
CAST & TURNED
CAST SPIDER
CAST
CAST & TURNED
CAST BODY
4 STANDARD PORCELAIN SOCKETS
CAST
TRANSLUCENT GLASS CYLINDER
1/8" PIPE
CAST
5/8" GLASS DISC-ACID FINISH
CAST
CAST & TURNED
CAST
CAST
BOTTOM REMOVABLE FOR RELAMPING
PLAN
UNDERSIDE

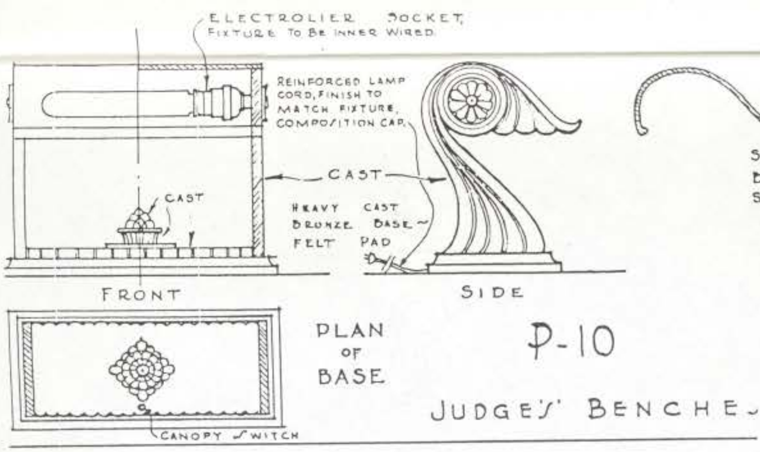
11

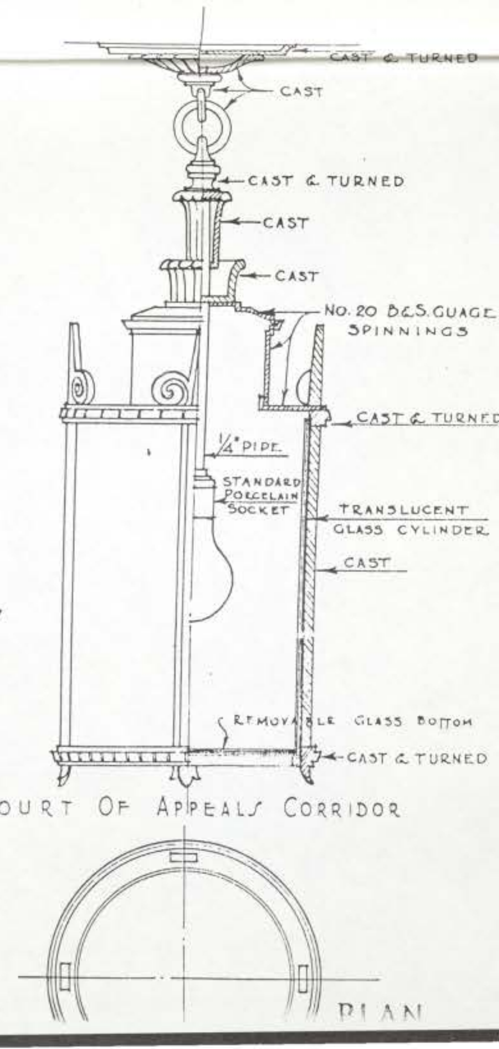
A.5 Drawings 11.

A-5 Drawing 12.

A-6 Drawing 1.


TRANSLUCENT GLASS CYLINDER
CAST
20 B&S GAUGE SPINNING.
CAST
CAST & TURNED
CAST ARM
CAST
CANOPY SWITCH
SIDE
FRONT
CAST BACK PLATE
PLAN
P-15 DISTRICT JUDGES' CHAMBE
RESIDENT APPEALS
JUDGE'S CHAMBER.


ELECTROLIER SOCKET, FIXTURE TO BE INNER WIRED.
REINFORCED LAMP CORD, FINISH TO MATCH FIXTURE, COMPOSITION CAP.
CAST
CAST
HEAVY CAST BRONZE BASE ~ FELT PAD
FRONT
SIDE
PLAN OF BASE
P-10
JUDGE'S' BENCHES
CANOPY SWITCH

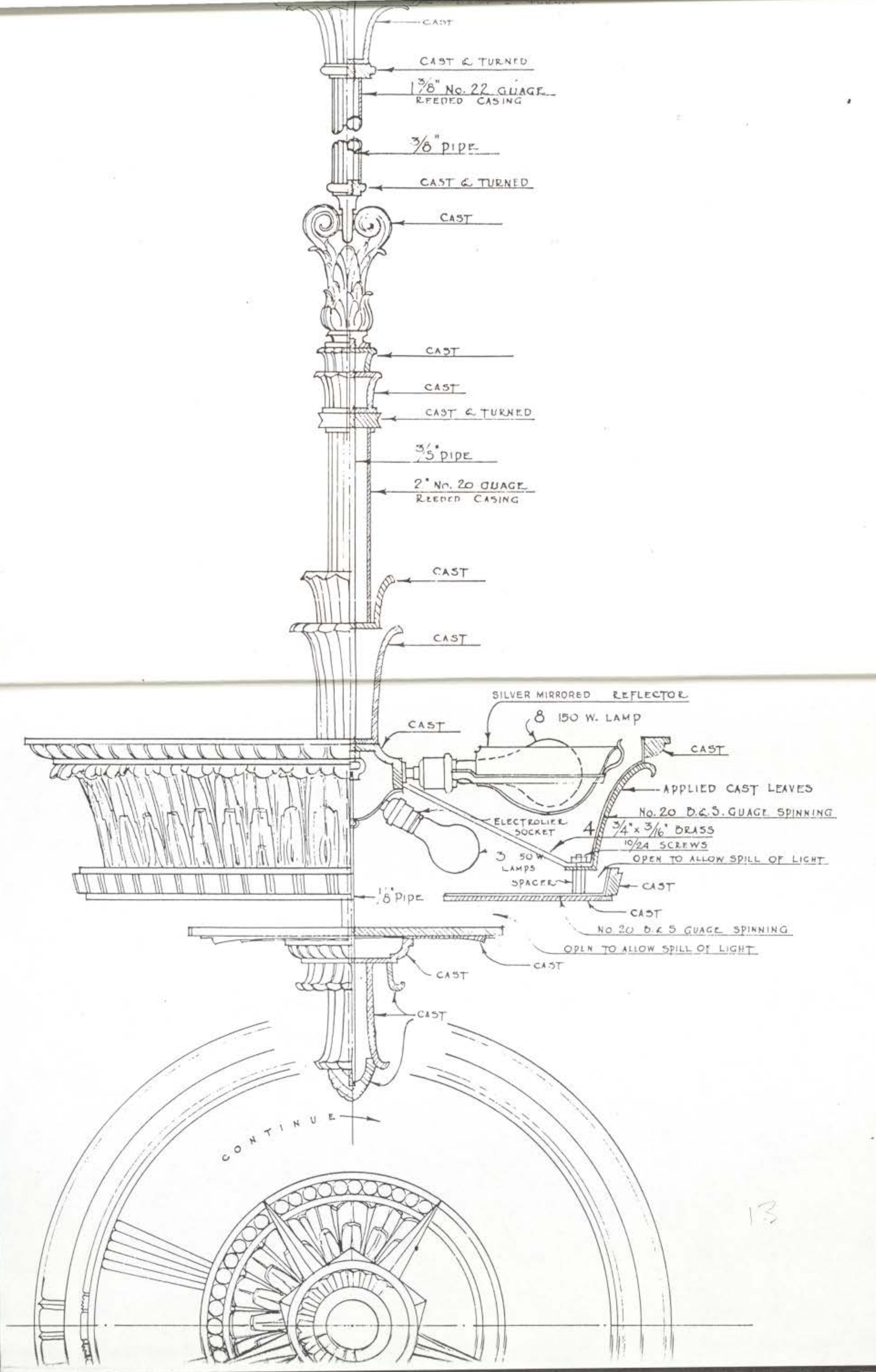

CAST & TURNED
CAST
CAST & TURNED
CAST
CAST
NO. 20 B&S. GUAGE SPINNINGS
CAST & TURNED
1/4" PIPE
STANDARD PORCELAIN SOCKET
TRANSLUCENT GLASS CYLINDER
CAST
REMOVABLE GLASS BOTTOM
CAST & TURNED
COURT OF APPEALS CORRIDOR
PLAN

7

A-5 Drawings 12.

A·5 Drawing 13.

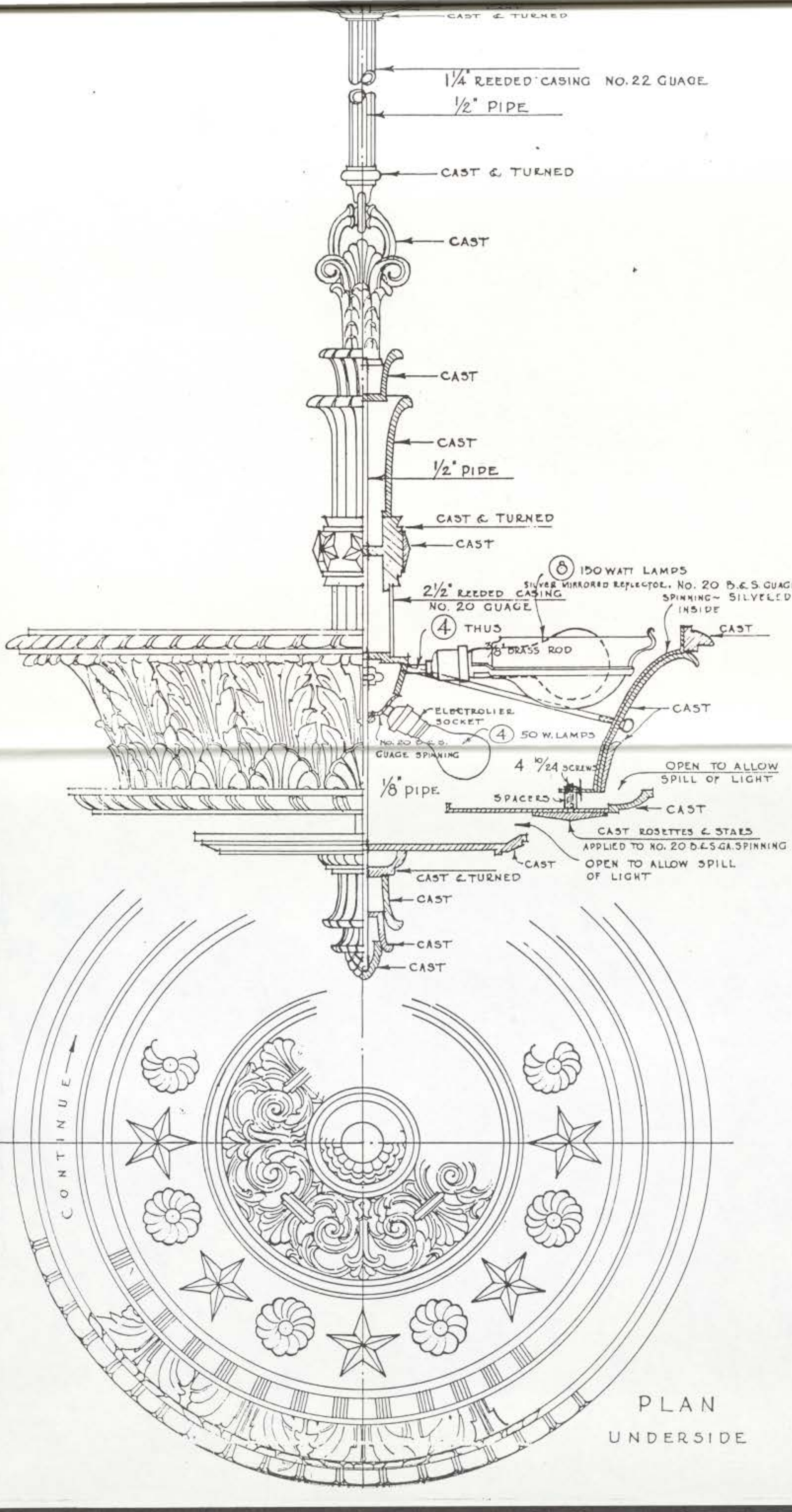
A-8 Drawing 1.



CAST
CAST & TURNED
1 3/8" No. 22 GUAGE REEDED CASING
3/8" PIPE
CAST & TURNED
CAST
CAST
CAST
CAST & TURNED
3/8" PIPE
2" No. 20 GUAGE REEDED CASING
CAST
CAST
SILVER MIRRORED REFLECTOR
8 150 W. LAMP
CAST
CAST
APPLIED CAST LEAVES
No. 20 B.& S. GUAGE SPINNING
ELECTROLIER SOCKET
4
3/4" x 3/16" BRASS
10/24 SCREWS
OPEN TO ALLOW SPILL OF LIGHT
3 50 W. LAMPS
SPACER
CAST
1/8" PIPE
CAST
No. 20 B. & S GUAGE SPINNING
OPEN TO ALLOW SPILL OF LIGHT
CAST
CAST
CAST
CONTINUE
13

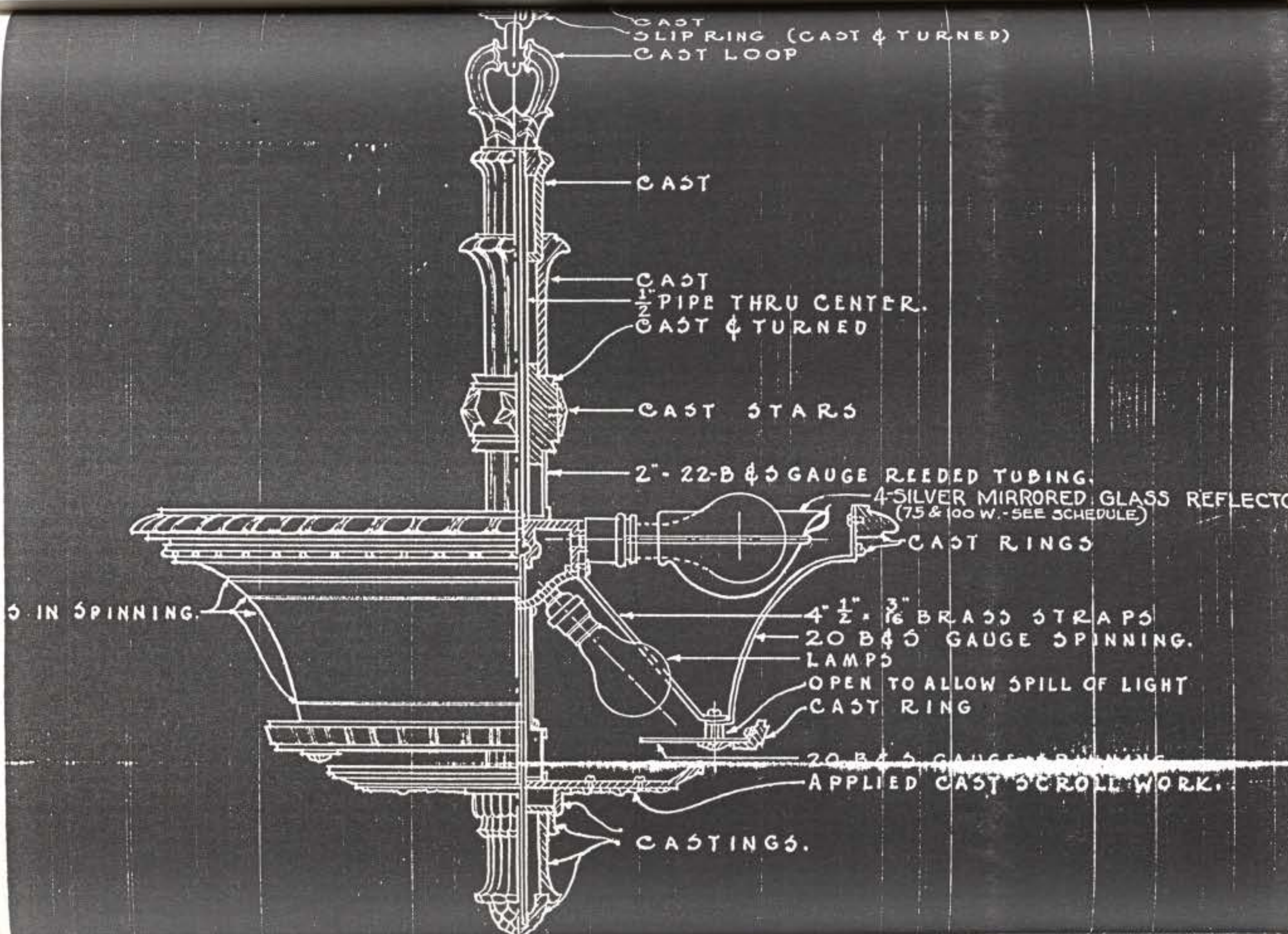
A.5 Drawing 13.

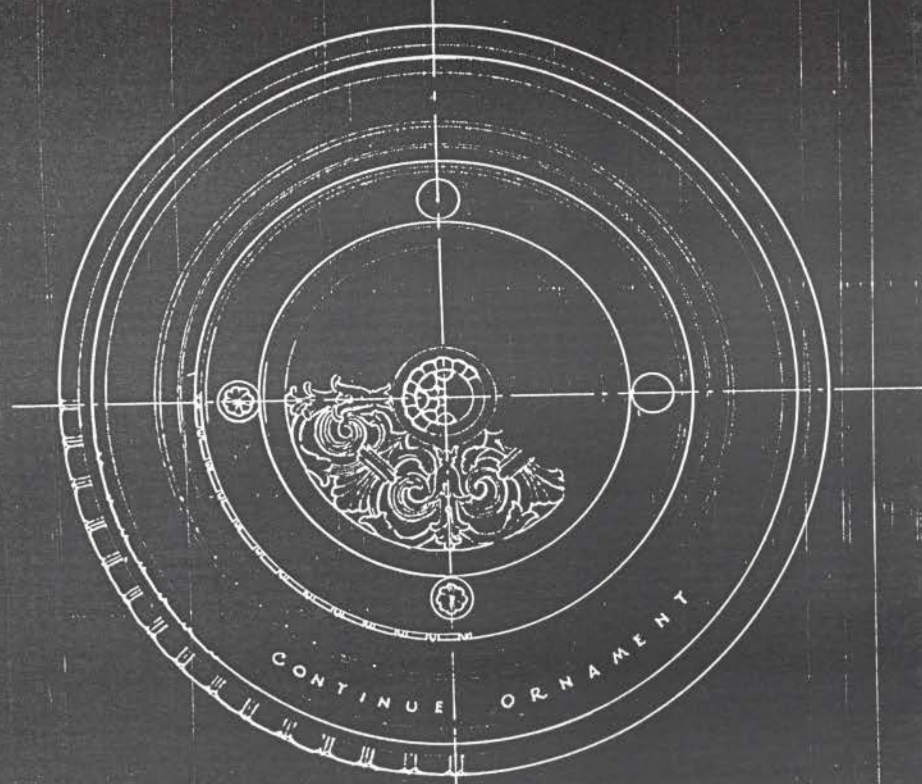
A-5 Drawing 14.


CAST & TURNED
1¼" REEDED CASING NO. 22 GUAGE
½" PIPE
CAST & TURNED
CAST
CAST
CAST
½" PIPE
CAST & TURNED
CAST
(8) 150 WATT LAMPS
SILVER MIRRORED REFLECTOR. NO. 20 B.& S. GUAGE SPINNING~ SILVERED INSIDE
2½" REEDED CASING NO. 20 GUAGE
(4) THUS
⅜" BRASS ROD
CAST
CAST
ELECTROLIER SOCKET
(4) 50 W. LAMPS
NO. 20 B.& S. GUAGE SPINNING
4 10/24 SCREWS
OPEN TO ALLOW SPILL OF LIGHT
⅛" PIPE
SPACERS
CAST
CAST ROSETTES & STARS APPLIED TO NO. 20 B.& S. GA. SPINNING
OPEN TO ALLOW SPILL OF LIGHT
CAST
CAST & TURNED
CAST
CAST
CAST
CONTINUE
PLAN
UNDERSIDE

A-5 Drawing 14.

A-5 Drawing 15





· REFLECTED PLAN ·

A.5 Drawings 15.

Sixth Church of Christ Scientist

Morris H. Whitehouse and Associates were responsible for the design of the Sixth Church of Christ Scientist in Portland, Oregon, built in 1931. Built in a modernistic Byzantine stylistic tradition, the main auditorium space is a large ornate plaster dome carried on four large arches. The detailing in the church is based on a stylized classicism in conjunction with a non-historisist geometry which was typical of the Art Deco period.

Suspended from the center of this dome is a large luminaire consisting of a cluster of twelve radially-disposed and ornately framed segmented cylindrical diffusing shades. Suspended from the center of the coffered arches which support the dome are twin cylinder fixtures with a decorative band of cast low relief conventionalized floral motifs (photographs 1 - 7.[1]).

The central fixture design may well have been inspired by the massive fifteenth century corona de lux (Figure 1.) that were installed in several French cathedrals. These fixtures incorporated twelve lanterns in a large ornate circular rim and were meant to symbolize the twelve gates of Jerusalem. The complex suspension systems sometimes incorporated rods and solid connectors.

The central fixture in the auditorium is of cast or wrought bronze and also has twelve lanterns; perhaps some symbolism intended. Six wrought bronze rods connect the alternate inside intersections at the base of the lanterns to a hoop consisting of six cast bronze panels and wrought bronze connector bands. The rods connecting the hoop to an ornate supporting crown are accented by wrought bronze decorative connectors. The lamps were originally installed at the top of the segmented tubes to light the ground glass panels in the sides and bottom, and to provide some measure of uplighting. There is an interesting similarity of design between this fixture and the U.S. Court House lobby fixtures Baker designed for the same architect, Whitehouse, almost at the same time, 1931.

Ornamentation

There is an interesting juxtaposition of geometric-based and conventionalized curvilinear floral motifs in the lighting fixtures. The same character of low relief conventionalized floral motifs present in the vertical separator band and cylinder crest of the arch lanterns occurs on the bottom frame and cylinder crest of the central fixture. The ornamentation on the bottom framework of this fixture is tightly contained between the rigid geometric lines of the frame. An anthemion motif terminates the floral ornament of the radiating arms of the bottom frame while the cylinder finial nuts are composed of a palm leaf motif. The vertical bands connecting the cylinders of the central luminaire are composed of a delicate cast bronze grape vine rinceau motif, which is repeated in miniature in the serrated hub of the bottom frame. The vine rinceau has a long tradition in Christian ornament. The medallion and eight-sided star motif of the linked hoop is a prominent motif repeated in the ornamental plaster vault, as seen in Figure 1. The ornamental rod connectors above the hoop incorporate a cross, as does the supporting crown.

The exterior lanterns (photograph 7.) are of a similar character to the interior fixtures.

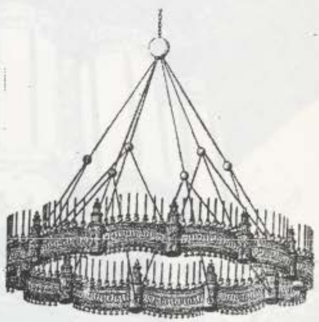


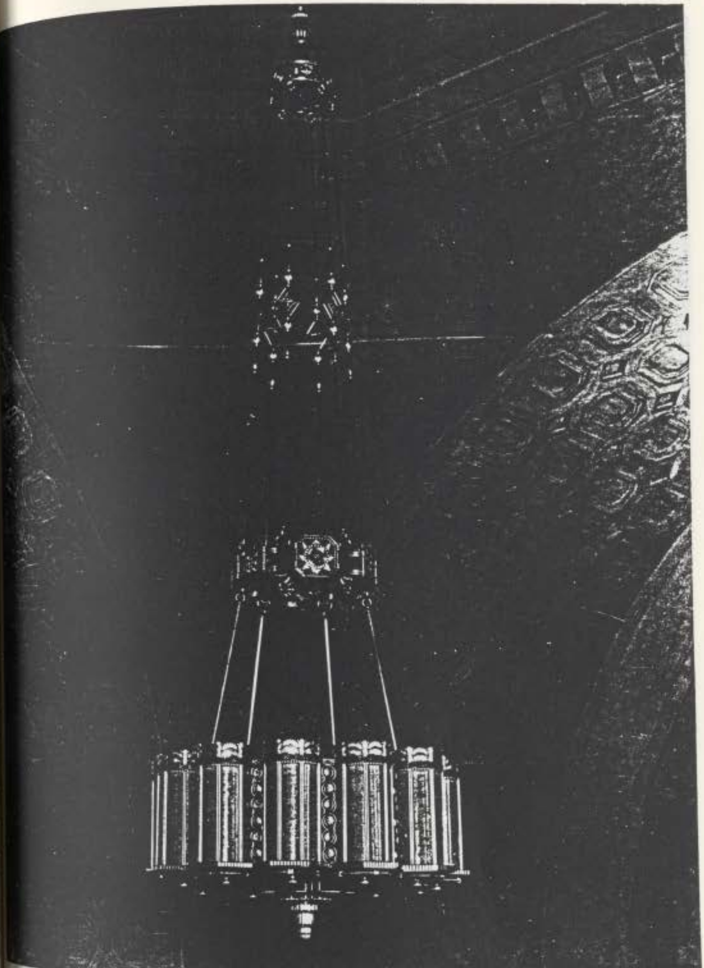
Figure 1. 15 th century corona de lux, Reims Cathedral, France

1 Oregon Historical Society - Organized lot 116, oversized folders 1-

[illegible] Church . [illegible]
[illegible] Consulting Architect.

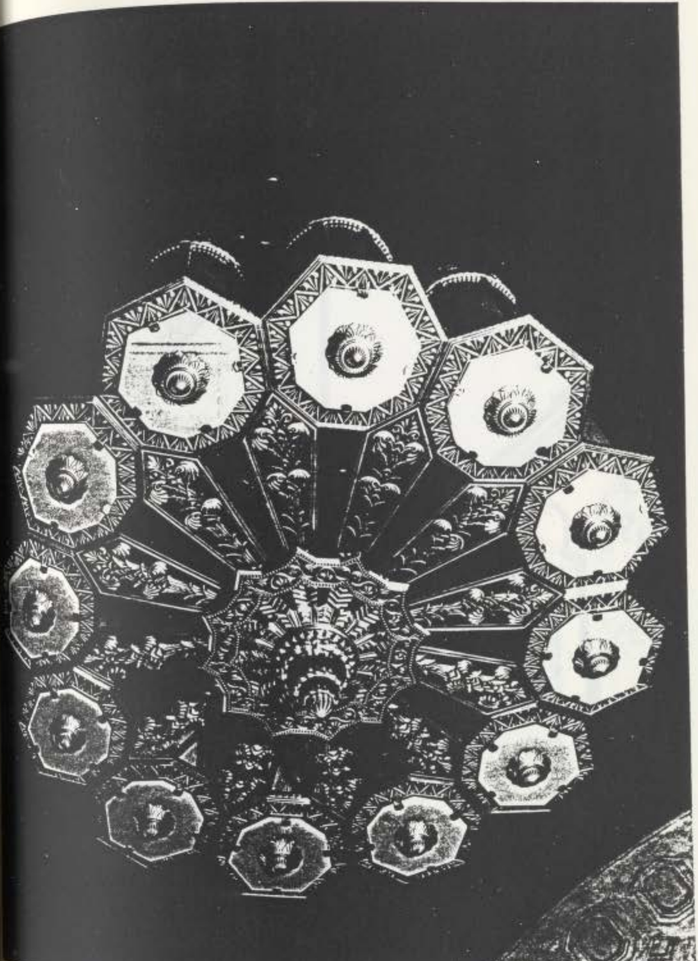
A-6 photograph 1.

A-8 Drawings 1.



…house Stanton & Church · Architects.
C.H. Walwork · Consulting Architect.

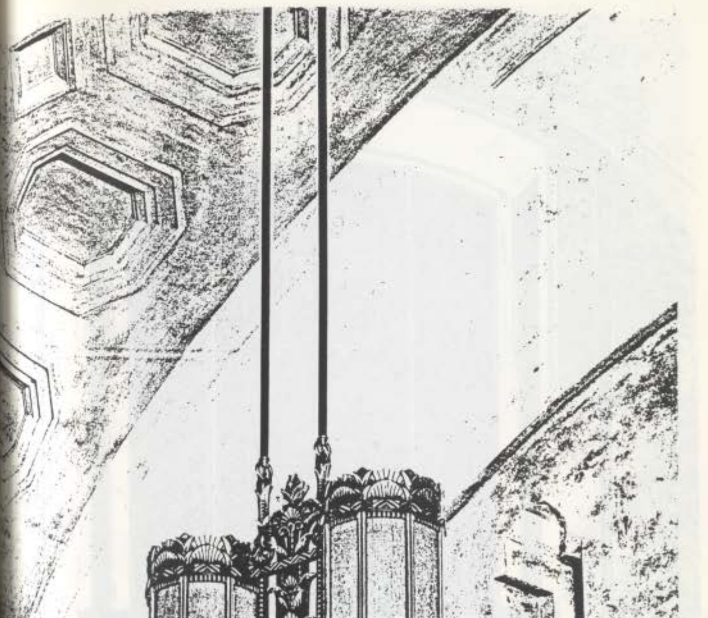
A-6 photograph 2.



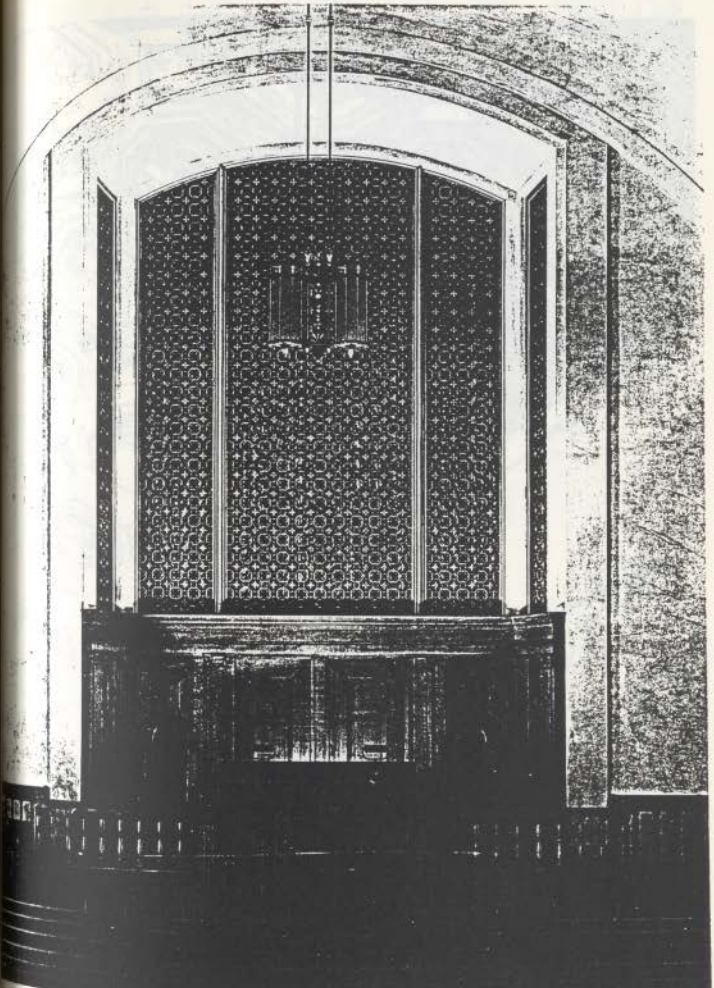
...house Stanton & Church. Architects.
C.H. Walwork Consulting Architect.

A-6 photograph 3.

A-8 Drawing 1.



A-6 photograph 4.



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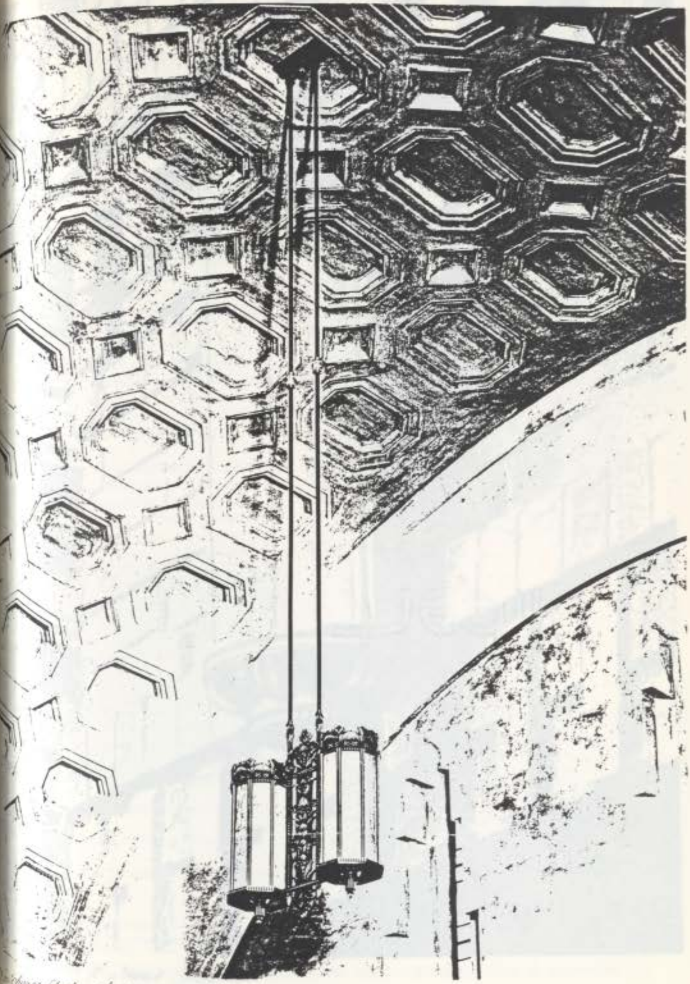
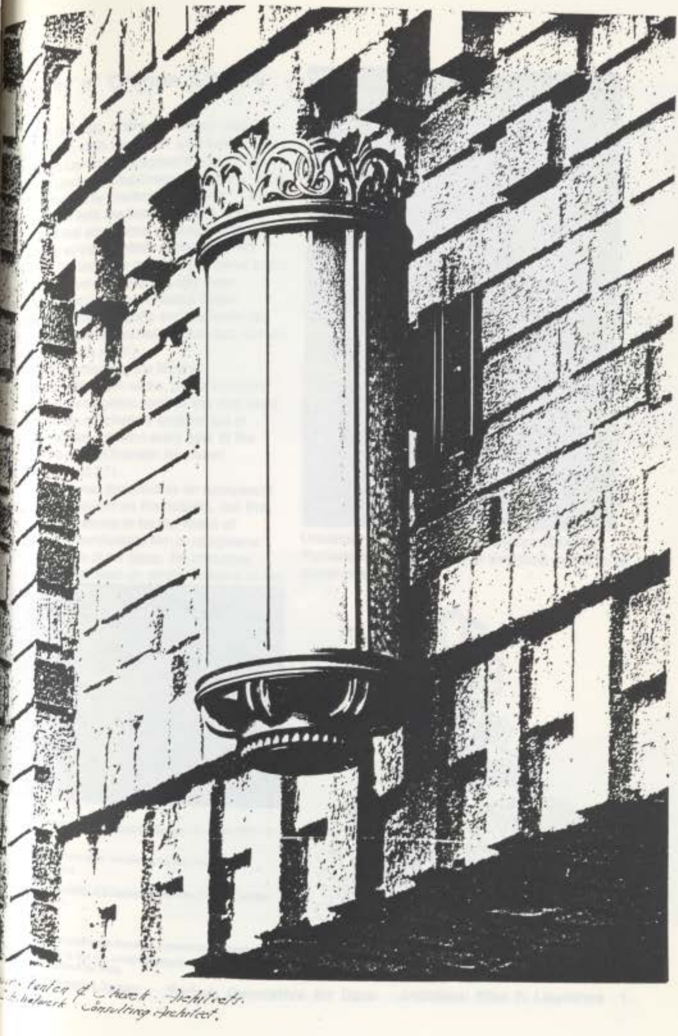
A-6 photograph 5.

A-8 Drawings I.



...chouse Stoller & Church . Architects.
...H. Nalwork . Consulting . Architect.

A-6 photograph 6.



...fenton & Church Architects.
C.H. helwerk Consulting Architect.

A-6 photograph 7.

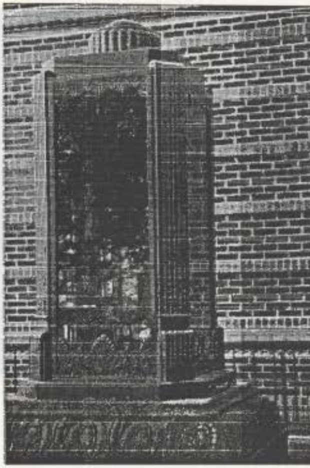
A-8 Drawings 1.

University of Oregon Library

The University of Oregon Library was erected between 1935 and 1937 with funding by the PWA. Ellis Lawrence designed the building in a modernized Lombardy and Greco-Byzantine' style with lighting fixtures by Frederick C. Baker.[1] The luminaires which flank the two entrances to the library[2] exhibit that abstraction of design and ornamentation so characteristic of the early Art Deco period. The large fan motifs in the lower band of cast bronze ornament have actually been abstracted by Baker from the classical Greek anthemion motif (middle right[3]) and the lower fan motifs have been abstracted from a classical Roman acanthus motif (lower right[4]).

By strongly framing the library quadrangles's north-south walks, these lanterns reinforce Lawrence's cloister parti for the mall itself. These lanterns are matched by another set of lanterns atop the wrought iron entry gate at the north end of the mall on Franklin Boulivard (Photographs 1. and 2.[5]).

The glass was specified as an opalescent glass etched and stained on the outside, but the toning of the glass seems to be the result of applying a dark brown/orange film of celophane material to the inside of the glass. An attractive opalescent glass was used on similar lanterns at the



University of Oregon Medical School Library in Portland, so the originality of this glass seems to be questionable.

[1] Michael Shellenbarger, Ellis Lawrence Survey, (Eugene OR:U of O Press, 1989)

[2] All figures in this case study are photographsin the author's collection, except as noted

[3] A.D.F. Hamlin, A History of Ornament, (New York: Cooper Square Publishers, 1973), p.119.

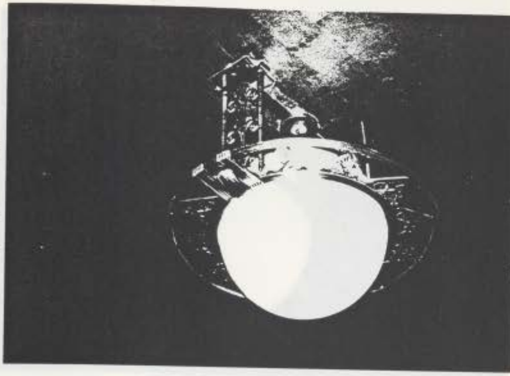
[4] Ibid., p. 151.

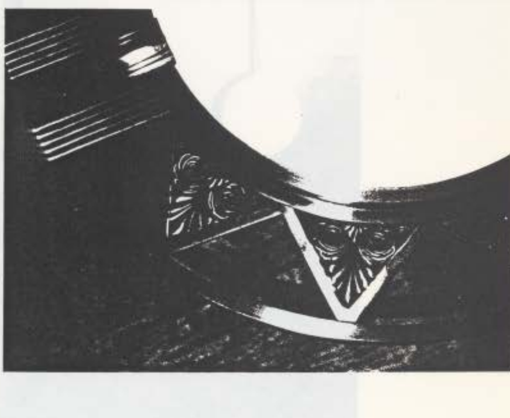
[5] All attached photographs and drawings - University of Oregon Archives, collection 12310, box 12., except photograph 4., which is U O Special Collection negative # CN 1090.

The strong north-south axis set
e parallel walks of the campus
nd reinforced by the twin lanterns
g the identical east and west
es of the library's main north
are given a dramatic terminus in
ical east and west vestibules.
suspended vestibule luminaire
plays a critical role in achieving this
nt sense of place.

The cast and wrought bronze
centrally placed in this
y proportioned vestibule. As it
architect's intent to set up a
space capable of terminating the
m generated by the mall axis,
e of an intensely centralized
such as a compass star, was
ate, if not brilliant.

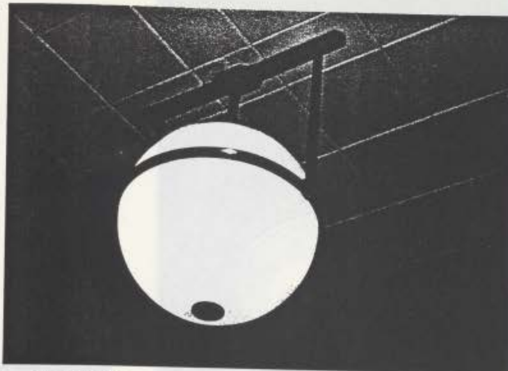
Reflection off of the gold leaf
would have provided
bly more illumination prior to
al of much of the gold leaf by
zealous cleaning staff.
of light from the luminous
through the thin gold layer to the
ndercoat and subsequent
would have resulted in a rich
en tint of reflected light. The
y polished marble-clad walls
ave augmented the reflection of
the space.



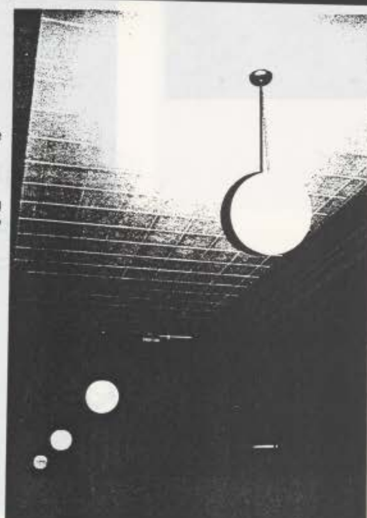


The anthemion motif of the
and support members was a
ornamental motif of the lantern
. The repetition of cast bronze
al parts is again apparent here,
numerous cast bronze floral
in the wrought bronze frame
erior ring.

The vestibule luminaires were ...nt to momentarily stop the ...entum of the mall; the luminaires in ...allway adjacent to the vestibule are ...t to shift the axis ninety degrees in ...ment with the building's east-west ... This cast bronze luminaire's strong ...ment with the building's east-west ...effectively makes this transition.



The suspended globe ...aires down this hallway set up a ...ing linear rhythm between the ...aces and also serve as a plain foil ...more decorative fixtures in the ...pal rooms. These luminaires ...ear to be 1950s replacement for the ...al ones, which had spun brass ...hemispheres and would have ...nized nicely with the other spun ...indirect luminaires in the browsing ...to the left and the delivery room to ...ght of photograph 3.



More decorative globe fixtures
reeded cast bronze nuts securing
opal glass globes accent the main
ical circulation space and sub-lobby
ces (right and lower right of Drawing
Three decorative metal bands ring
center of the globe.

Smaller decorative globes (right upper right in Drawing 4.) were also ...ed in ancillary public circulation ...ces.

Along with the lobby spaces, ...principal rooms of the library were ...ed with attractive decorative indirect ...em-indirect luminaires (Drawings 2. ...4.) These drawings were prepared ...C. Baker for Ellis Lawrence as part ...e bid document specifications.

The ones installed in the Upper ...on Reading room were the most ...rative and sophisticated in their ...ment of light (lower right of Drawing ...nd Photograph 4.). The ...fications indicate that the main ...opy was cast bronze, which would ...e been turned on a lathe to get it ...oth and polished. The specifications ...ate an opening in the bottom of this ...sing, so the housing would have ...n cast as a shallow cylinder with a ...ral opening in the bottom. A ...ered rabbet cut into the bottom outer ...e of the cylinder and tooled ...centric grooved rings on the bottom ...are two ornamental possibilities of ...metal lathe applied here. Baker also ...wed a casting and turning ...cedure on various portions of the ...rior standing lanterns at the U.S. ...rthouse in Portland of 1931. The ...bronze ornamental band around the ...body of the fixture incorporates a ...zag and anthemion ornamental ...der on the upper and lower edges.

The translucent glass disc on ...bottom face is suspended slightly ...w and projects slightly beyond the ...ing so that no direct light could be ...e and also to provide a reflected ...of light' on the polished underside ...e bronze housing. Baker achieved a ...r effect with the courtroom fixtures ...e U.S. Courthouse in Portland in ... The bronze ring on top of the ...ucent glass plate, and also ...ended from the opening with it, is ...back from the edge of the glass ...to allow for edge lighting. The cast ...mental disc below the glass is sufficiently perforated with a star design to pass light.

A direct correspondence between this fixture and the ones in the vestibule is achieved through this ornamental cast bronze star motif, as it is the base design of the vestibule luminaires. The use of a reeded ornamental motif on the stem (which was just a casing over an internal 1/2 inch pipe), cast holder (upper part of socket apparatus) and the bottom cast nut supporting the housing is repeated on many of the other luminaires as well as the building ornamentation; note the reeded door jambs in photograph 4.

An internal housing supported five sockets within commercial silvered mirror reflectors, which were equipped with 200 Watt incandescent lamps.[6] It is also most likely that this internal housing also supported, beneath the silvered reflectors, several sockets for low wattage (50 Watt) incandescent lamps as a direct lighting source. The lamps mounted in the silvered mirror reflectors would have provided no downlighting. This arrangement of lamps was used in the similarly conceived luminaires of the courtrooms in the U.S. Courthouse Building in Portland.

The low relief of the ceiling panels and the high relief of interior cornice would have provided for a generous play of shade and shadow. This aspect of the lighting scheme is not discernible in photograph 4., as it has been shot with a remote flash. Fourteen fixtures were originally installed in this room, a pair per window bay.

The delivery room, where books retrieved from the stacks were delivered to waiting borrowers (Photograph 5.), were lighted by spun brass indirect bowl fixtures, as depicted in the lower left of drawing 1. The fixture consisted of a one inch diameter stem and a cast bronze 'break' capping and connecting the larger reeded socket to the stem. A large cast bronze reeded ornament supported the bowl. The bowl was equipped with one 750 Watt lamp and a porcelain or glass reflector to reflect light to the ceiling. The spun bowl was given a bronze finish.[7]

Fixture F., in the lower right of Drawing 4. was specified to go into the first floor Browsing Room, flanked by fixture E., lower left of Drawing 2., in the Homer Collection and Choice Books areas. Instead fixture G., the same as in the Delivery Room, was installed, albeit with a different cast bronze finial at the base of the bowl (Photograph 6.). Fixture F. was not specified for any other room and was apparently not used.[8]

Fixture E., lower left of Drawing 2., was installed in the Lower Division Reading Room, the adjoining study, and the Periodical Reference Reading Room (Photograph 7.) on the first floor and the Map Room and Special Collections Room on the second floor. The fixture was basically a spun brass indirect bowl with a cast bronze ornamental rim, base plate and ornamental finial. The reeded stem and cast bronze break are in character with the more ornamental fixtures in the building.[9]

The luminaire specified for the third floor library class room was a "Pittsburgh Reflector Company's luminaire No. B-51 or a Curtis Lighting Inc. luminaire No. 5070.". As seen in Photograph 8., the fixture actually installed is quite different from the specified fixture depicted in the upper right of Drawing 3. It is, in fact, the standard English-Baker luminaire shown in the upper right of **A-8** Drawing 7., and used in various locations of the State Capitol Building. Since the Capitol Building was finished a year after this building, it is quite possible Baker developed this simple inexpensive luminaire to compete with similar products marketed by the large national lighting fixture companies, and added it to his standard line of fixtures. This fixture was also used in the graduate reading room as well as various offices and workrooms throughout the building.

[6] Lawrence, Holford, Allyn, Architects, University of Oregon Library : Specifications to Bidders Package, University of Oregon Archives,Collection 12310, box 12,Section 85 to 109.

[7] Ibid.

[8] Ibid.

[9] Ibid.

B.), Fixture K. was not specified for any other space and was apparently not used.[1]

Fixture E., lower left of Drawing 2., was installed in the Lower Director [illegible] Room, the adjoining Study, and the Packaged [illegible] Reading Room (Photograph 7.) on the first floor and the other [illegible] and [illegible] Periodicals Room on the second floor. The [illegible] was basically a [illegible] [illegible] reflector [illegible] with a cast bronze [illegible] [illegible] [illegible]. The [illegible] and [illegible] [illegible] [illegible] one or the other with the [illegible] [illegible] [illegible] in the building.[1]

"The Lutheran specifications for [illegible] Main [illegible] Company's [illegible] [illegible] lighting fixture [illegible]. As seen in Photograph 8., the fixture [illegible] [illegible] different from the specified fixture [illegible] in the set of light on Drawing 2. [illegible] [illegible] [illegible] below [illegible] shown in [illegible] (Drawing 2.) and [illegible] [illegible] of the State Capitol Building. [illegible] the fixture [illegible] was finished a year after the building. It is [illegible] probable [illegible] [illegible] [illegible] [illegible] [illegible] by the large [illegible] lighting fixture [illegible] and added it to the [illegible]. This fixture [illegible] [illegible] [illegible] lighting [illegible] as well as [illegible] [illegible] and [illegible] throughout the building.

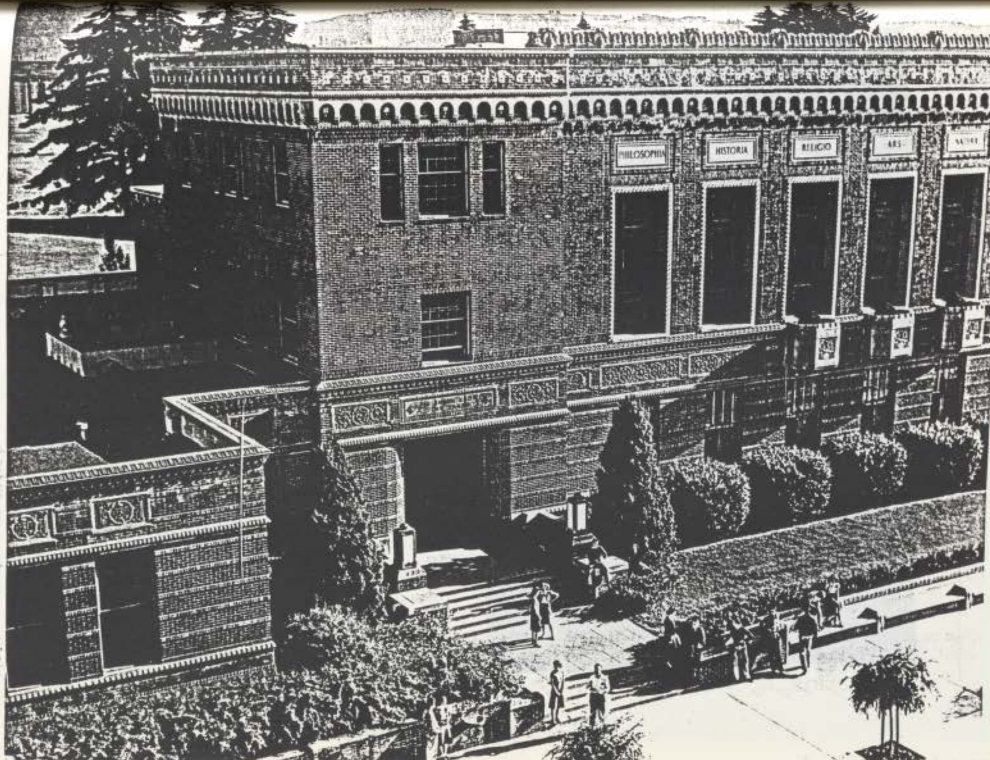
A direct correspondence between the [illegible] and the [illegible] in the vestibule is achieved [illegible] the [illegible] [illegible] [illegible] [illegible], as is the [illegible] design of the vestibule luminaires. The [illegible] of a [illegible] ornamental motif on the [illegible] [illegible] [illegible] a [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] and the [illegible] [illegible] [illegible] supporting the housing [illegible] [illegible] of the other luminaires as well as [illegible] [illegible] [illegible] with the [illegible] [illegible] in photograph 4.

An internal housing supported five sections [illegible] [illegible] [illegible] reflectors, which [illegible] equipped with 200 Watt incandescent [illegible]. It is also most likely that the internal [illegible] was supported, beneath the [illegible] [illegible], several sockets for low wattage (60 Watt) [illegible] [illegible] as a direct lighting source. The [illegible] [illegible] to the [illegible] mirror reflectors [illegible] have provided no downlighting. This [illegible] of lamps was used in the similarly [illegible] luminaires of the courtrooms in the U.S. Courthouse Building in Portland.

The low relief of the ceiling panels and the [illegible] [illegible] [illegible] would have provided [illegible] play of [illegible] and shadow. This [illegible] of the lighting scheme is not [illegible] in [illegible], as it has been shot with a [illegible] [illegible] fixtures were originally [illegible] [illegible], [illegible] per window bay.

The delivery room, where books [illegible] [illegible] were delivered to waiting [illegible] (Photograph 6.), [illegible] lighted by [illegible] [illegible] [illegible] fixtures, as depicted at the lower left of Drawing 1. The fixture consisted of a [illegible] [illegible] [illegible] and a cast bronze "tulip" capping and [illegible] the larger [illegible] socket to the [illegible]. A large cast bronze [illegible] ornament [illegible] the [illegible]. The bowl was equipped with [illegible] 300 Watt lamp and a [illegible] or glass reflector to reflect light to the ceiling. The [illegible] bowl was [illegible] bronze [illegible].[1]

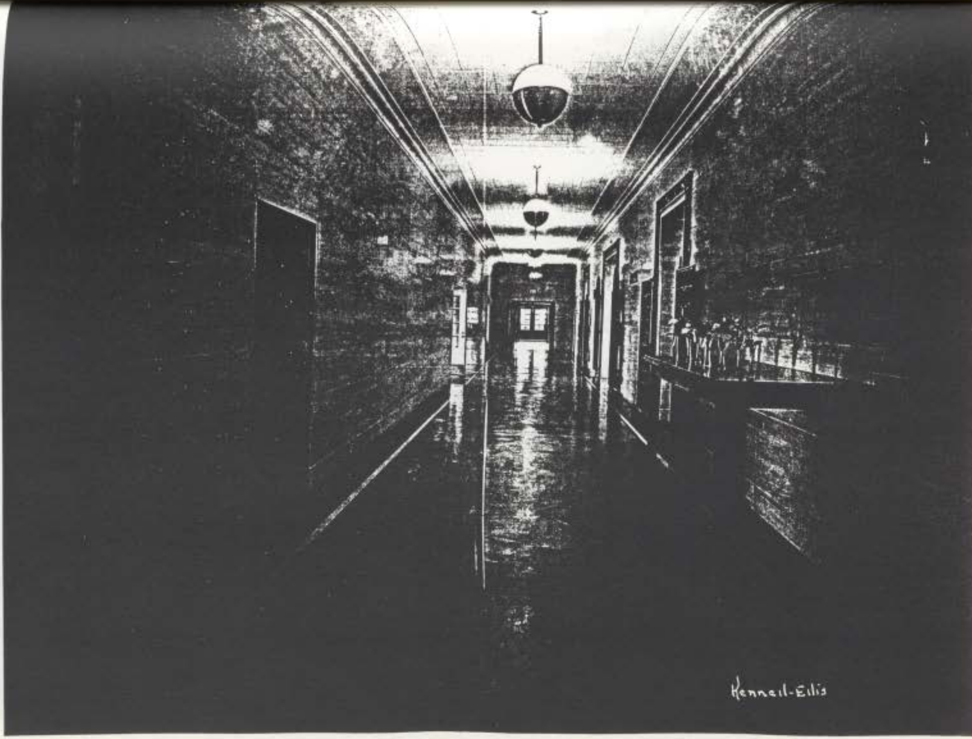
Fixture F., at the lower right of Drawing 4. [illegible] [illegible] [illegible] the first floor [illegible] Room, [illegible] [illegible] fixture [illegible] lower left of Drawing 3., [illegible] [illegible] Collection and [illegible] [illegible] [illegible] [illegible] fixture G., the same as in the Delivery Room, was installed, [illegible] with a [illegible] [illegible] [illegible] at the [illegible] of the bowl (Photograph



A-7 Photograph 1.

A-7 photograph 2

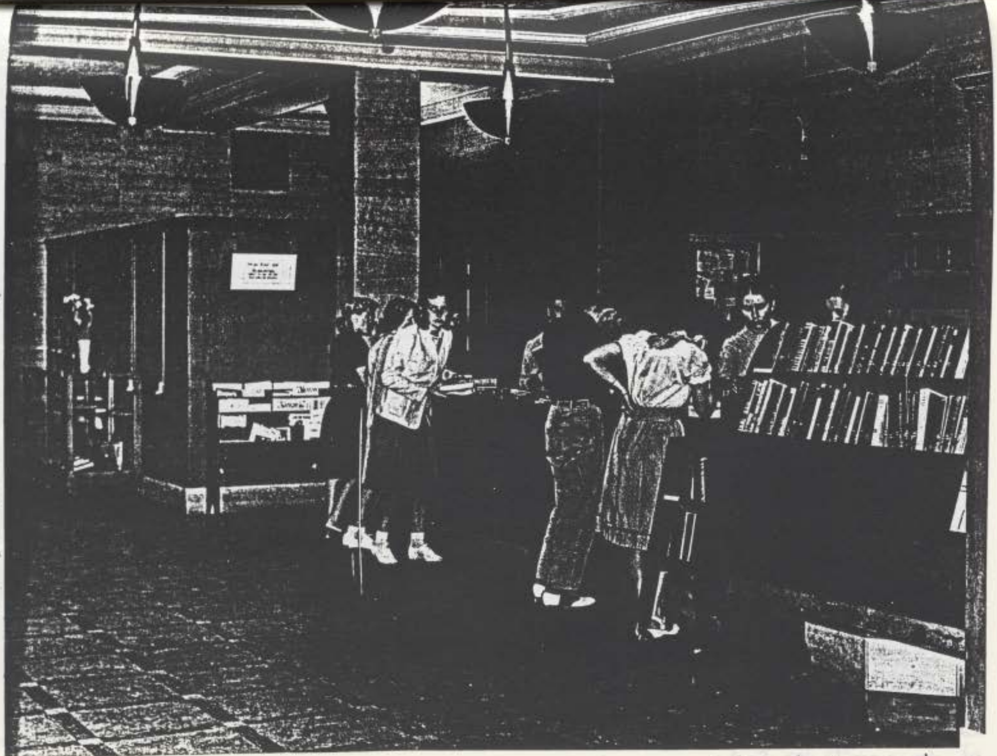
A-8 Drawing 1.



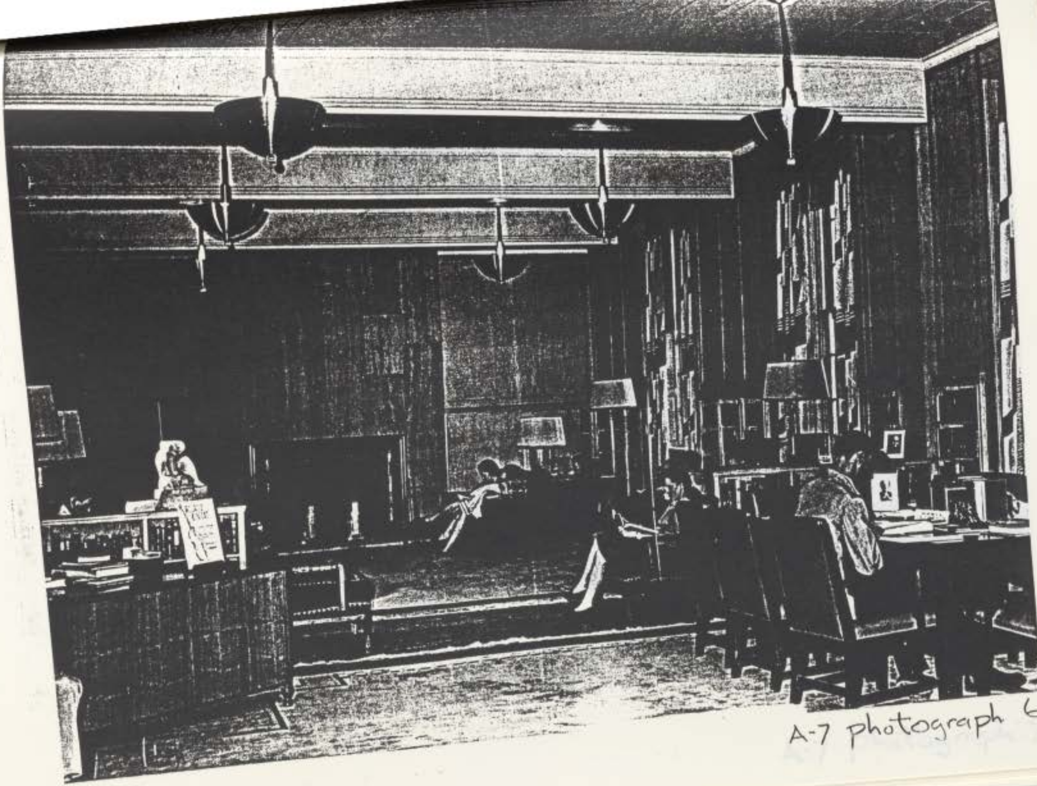
A-7 photograph

A-7 photograph 4.

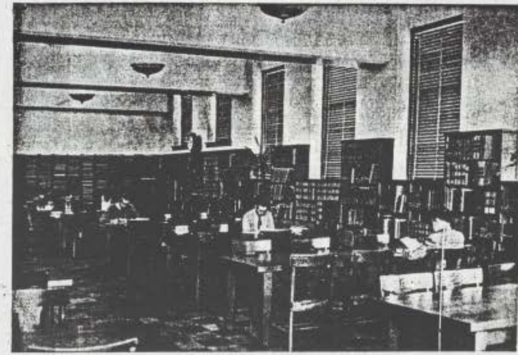
A-8 Drawings 1.



A·7 Photograph 5.



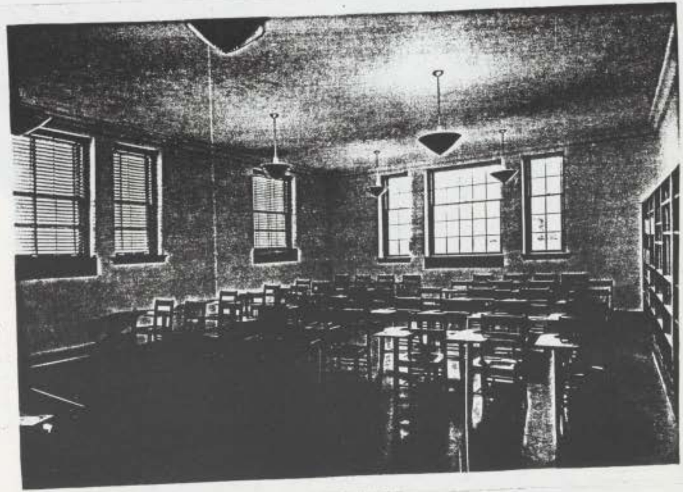
A-7 photograph 6.



The Reference and Periodical Room

A-7 Photograph 7.

A-8 Drawing 1.

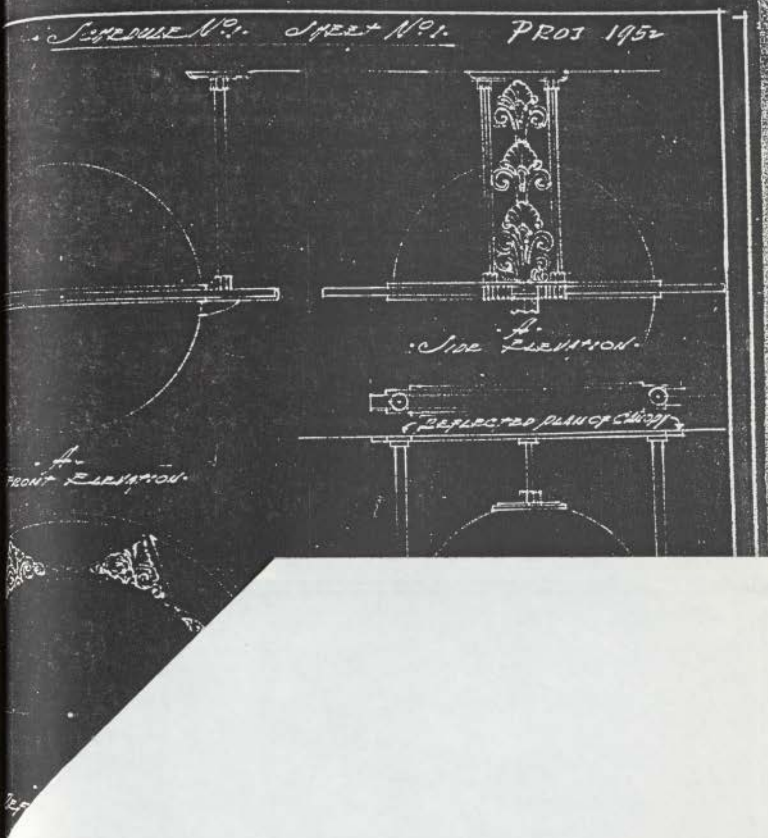


A-7 photograph 8

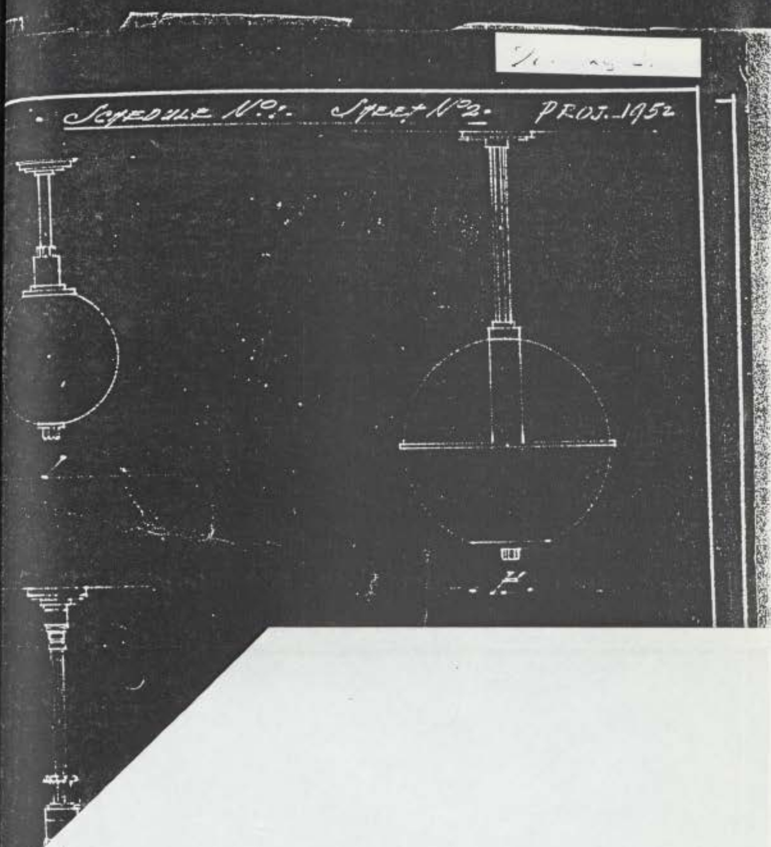
A-8 Drawings 1.

Drawing 1.

A-8 Drawing 1.



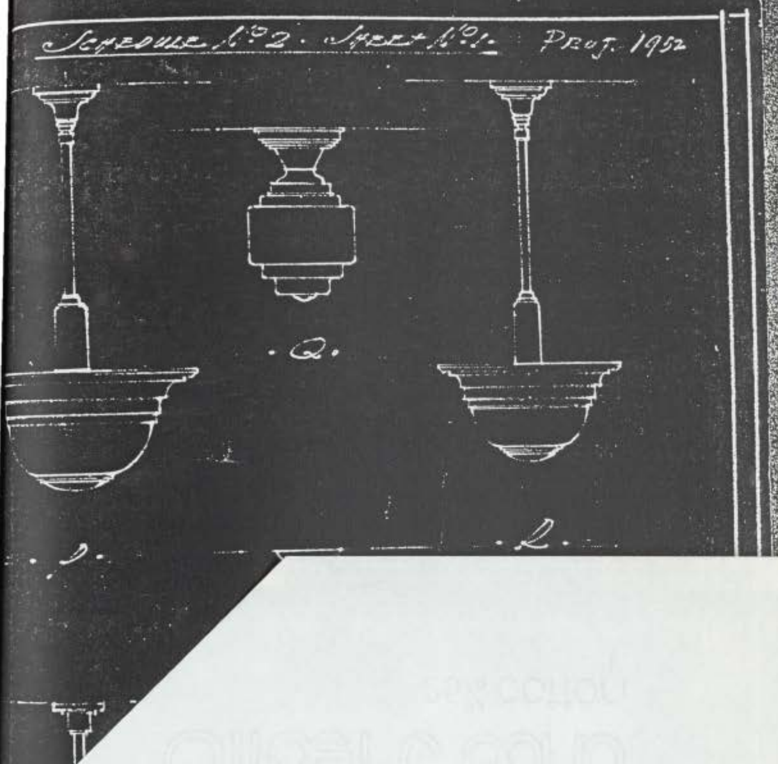
A-7 Drawing 1.



A-7 Drawing 2.

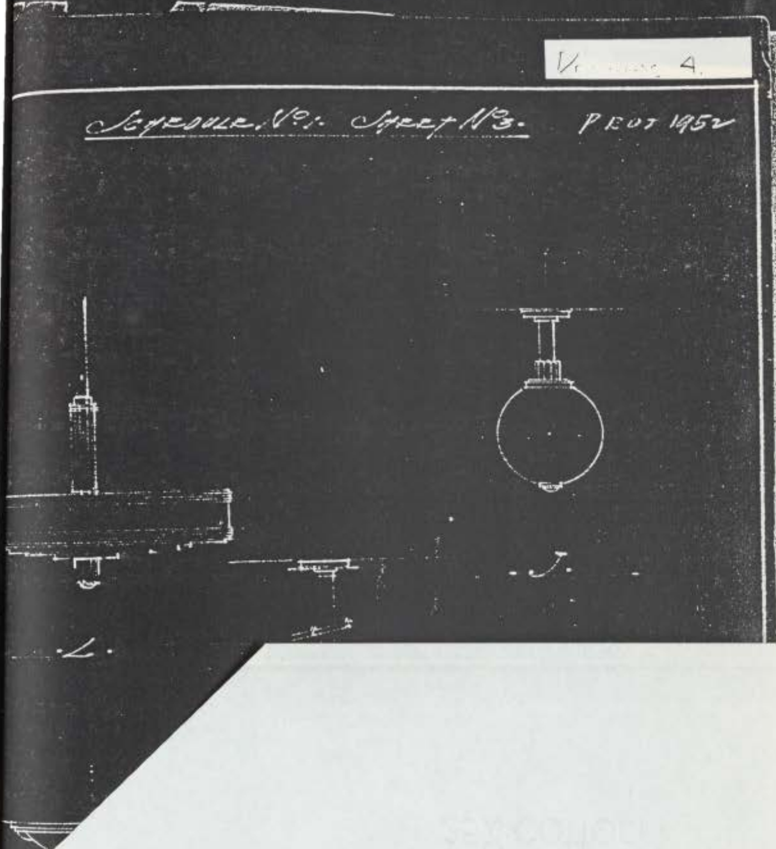
A-8 Drawing 1.

Drawing 3.



A-7 Drawing 3.

A-8 Drawings 1.

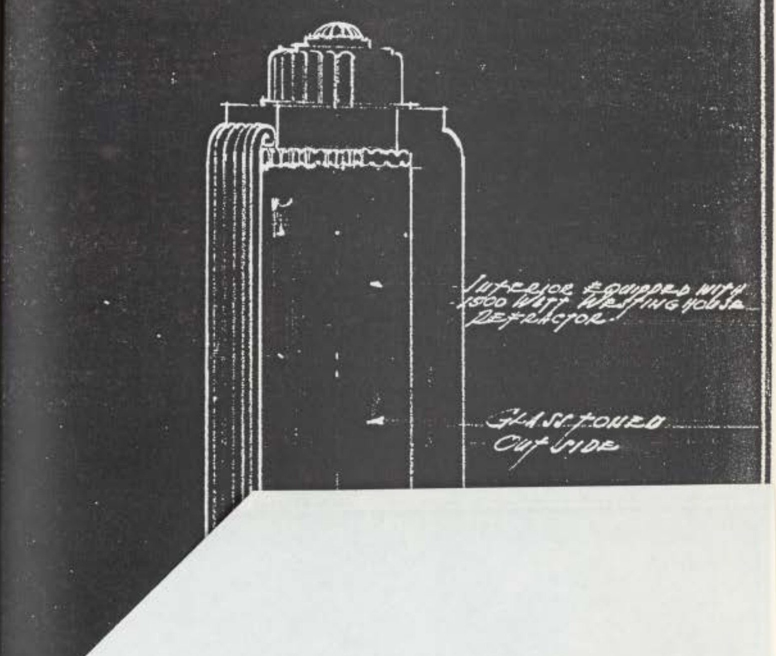


A-7 Drawings 4.

A-8 Drawings 1.

Drawing 5

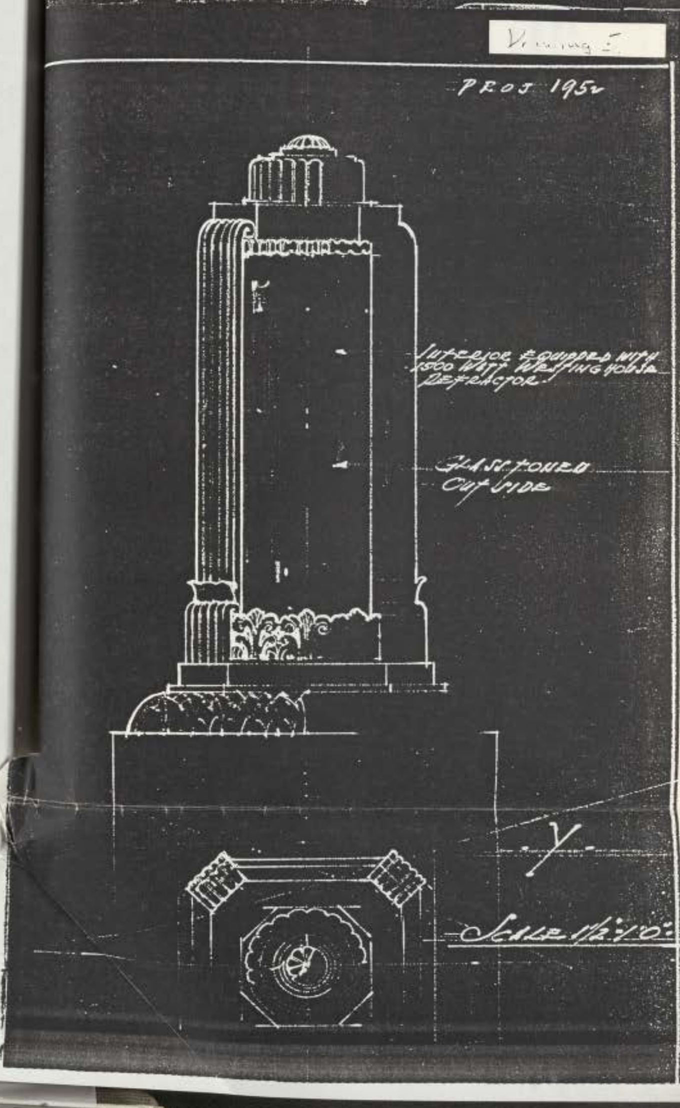
PROJ 1952



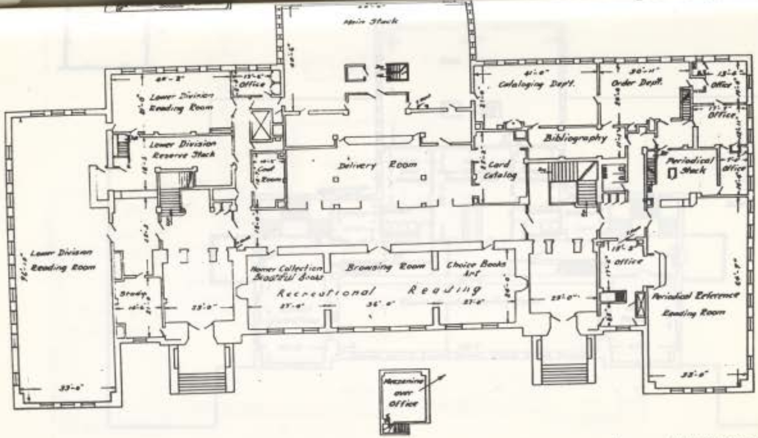
A-7 Drawings 5.

A-8 Drawings 1.

A-8 Drawings 1.



A-7 Drawing 5.



UNIVERSITY OF OREGON

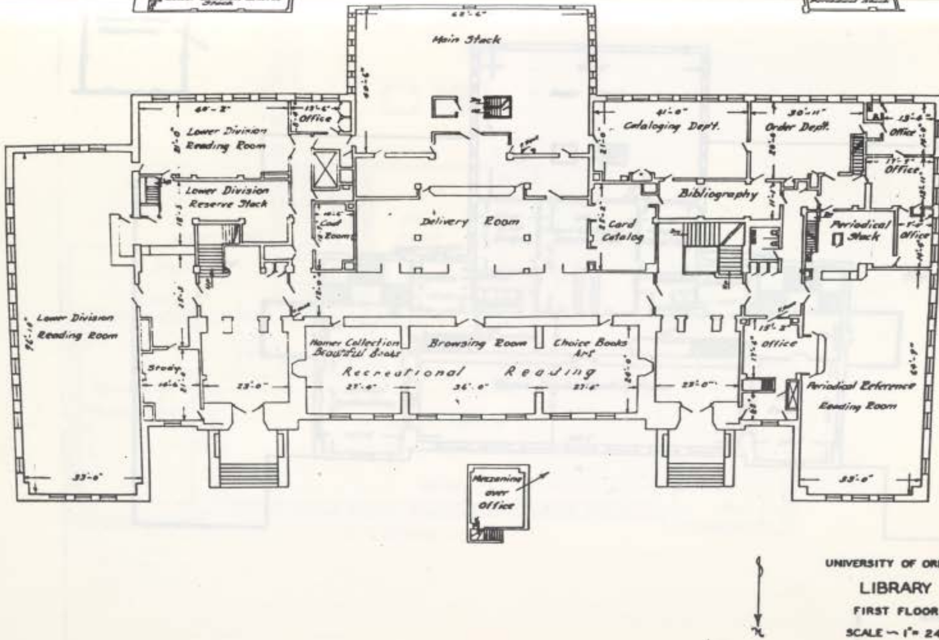
LIBRARY

FIRST FLOOR

SCALE — 1" = 24'

A-7 Drawing 6

A-8 Drawing 1.



UNIVERSITY OF OREGON

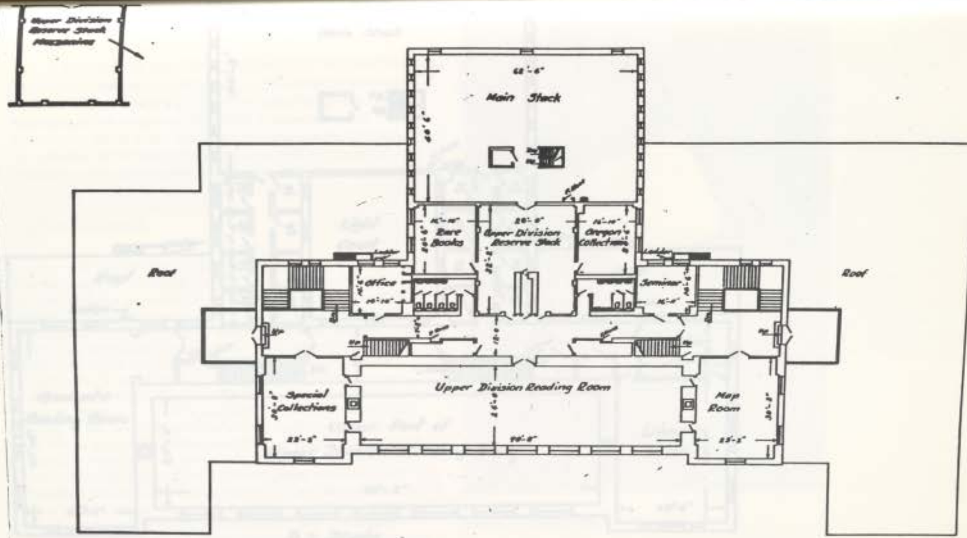
LIBRARY

FIRST FLOOR

SCALE ~ 1" = 24'

A-7 Drawing 6

A-8 Drawing 1.



UNIVERSITY OF OREGON

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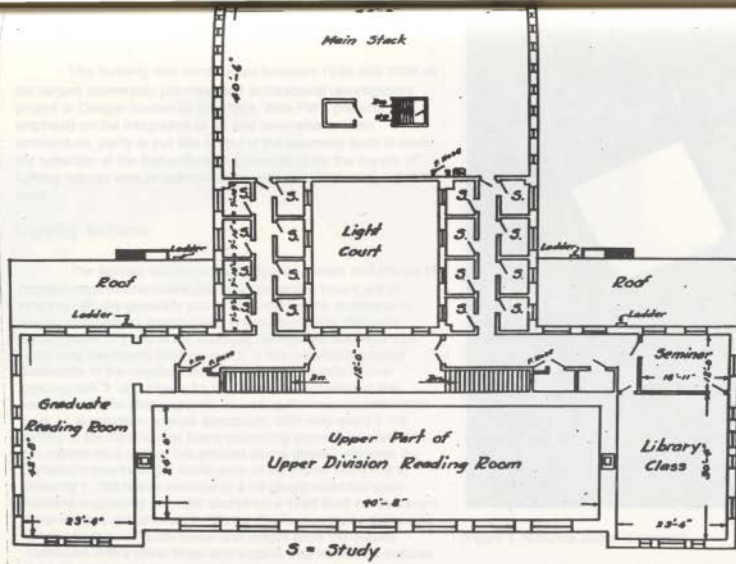
SECOND FLOOR

SCALE ~1" = 24'

A-7 Drawing 7.



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THIRD FLOOR

A-7 Drawing 8.

A-8 Drawing 1.

This building was constructed between 1935 and 1938 as the largest community planning and architectural development project in Oregon funded by the PWA. With PWA projects' emphasis on the integration of art and decorative art into architecture, partly to put this sector of the economy back to work, the selection of the Baker-Barkon Corporation for the supply of lighting fixtures was an acknowledgment of the firm's high artistic merit.[1]

Lighting Scheme

The lighting fixtures in the Rotunda, Senate and House of Representatives chambers and their respective foyers are in keeping with the generally planar character of the architecture. Inocuous recessed downlighting is provided in the Rotunda (photograph 1.[2]) and in the chamber ceilings and chamber end-walls over the murals (photograph 2.[3]) The gridded recessed luminaires in the vestibule and second floor rotunda alcove (photograph 3. and Figure 1.) are the most decorative of the luminaires in the above spaces, as well as the most sophisticated from an illumination science standpoint. With only about 2 1/2 inches of the cast bronze frame extending beyond the plane of the marble-clad ceiling, this gridded planar fixture reinforces the architect's intention: the dominance of the plane. Referring to Drawing 1., the fixture consists of a 20 gauge recessed spun housing supporting one light socket for a 1500 Watt incandescent lamp within a silvered mirror reflector. The interior frame of the cast bronze framework is set below and hinges off of the outside framework with a piano hinge and a catch. The framework secures 3/4 inch sections of 'carved and molded cast glass'; carving refers to a sandblasting technique using an applied rubber or plastic-based resistand cast glass is the pouring of molten glass into a prepared plaster or sand mold. The frame is arranged to allow exposure of the inside edge of the perimeter sections of glass to the light source resulting in an effect known as edge lighting. The light propagates through the section of glass toward the outside edge directly and by reflection off of the spun metal housing.

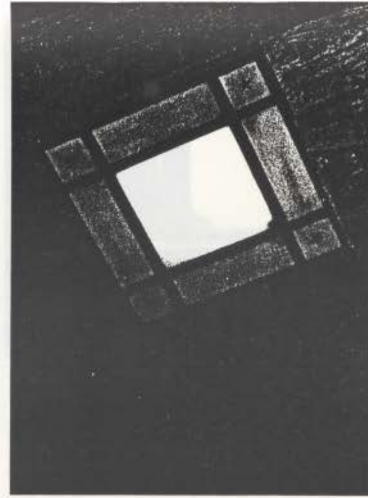


Figure 1. Rotunda alcove luminaires

[1] Elizabeth Walton Potter, "Oregon State Capitol," National Register of Historic Places (Washington DC: National Park Service, 1988) p. 7-1

[2] Photograph 1 and 4-7, are from the author's collection

[3] Photographs 2, 3 and8., and Drawings 10-16. - Elizabeth Walton Potter, "Oregon State Capitol," National Register of Historic Places (Washington DC: National Park Service, 1988).

A-8 Drawing 1.

Figure 2. Chamber foyer fixtures

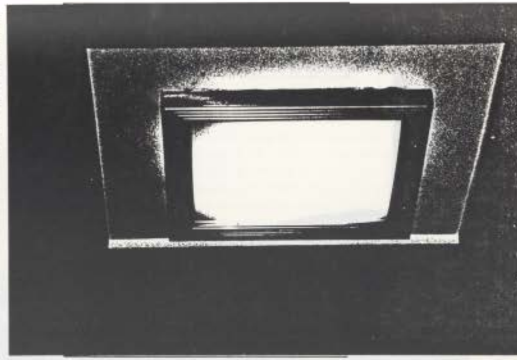


Figure 3. Senate and House of Representative chamber side aisle luminaire

The chamber foyer fixtures are shallow bronze-framed boxes suspended a short distance below the ceiling by four extruded bronze tubes. The rods connect to a central junction box supporting eight sockets. The diffusing plate of glass has a narrow carved glass border. Drawing 2 represents a luminaire projecting about the same illumination intensity as the fixtures installed and may have been an earlier version of this fixture.

The fixture in the upper left of Drawing 3 was installed in the side aisles (beneath the galleries) of the Senate and House of Representative chambers.

A-8 Drawing 1.

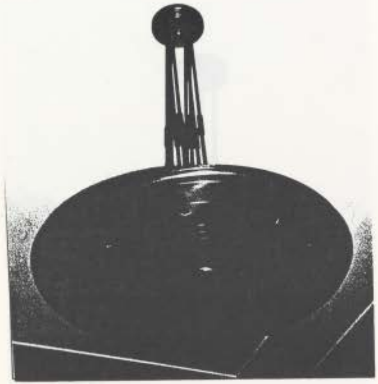


Figure 4. Luminaire in the Governor's reception room

The spun brass luminaires in the Governor's reception room (photograph 4., Figure 4. and Drawing 4.) illustrates an interesting use of light. A subtle edge lighting of the central glass lens is achieved by setting the lens into a metal housing which only reveals it's edges to the light source. Carved rings in the face of the lens are accentuated by the light propagating through the lens. Another special effect around the rim of the spun bowl results in back lighting of the brass tube which is held out from the edge of the rim by rod supports (Figure 5.). The upper coved rim is attached to the rear of the tube in the same manner. This leaves a slit around the entire perimeter that allows light to reflect off of the back of the tubing back on to the brass rim to backlight the tubing.

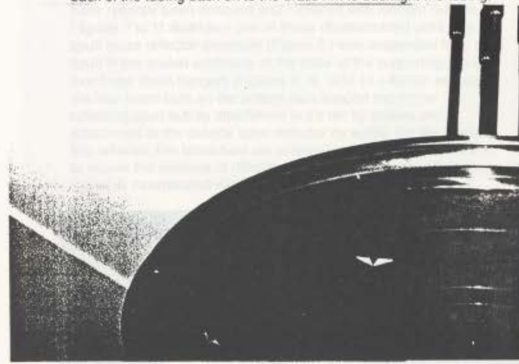


Figure 5. Backlighting of tube on fixture rim

A-8 Drawing 1.

The spun brass and white diffusing glass semi-indirect fixture featured in photograph 5 of the Office of the Governor's Secretary and photograph 6 of the Board of Control meeting room are the same ones installed in the cafeteria, except these have applied decorative cast brass stars. The fixtures in the cafeteria have recently been removed and replaced with modern fixtures. Figures 7 to 11 illustrates one of these disassembled units. The spun brass reflector assembly (Figure 7.) was suspended from the spun brass socket enclosure at the base of the supporting rod by four brass chain hangers (Figures 8., 9., and 10.) As can be seen, the four brass bars on the bottom face support the center reflecting spun hub by attachment to it's rim by screws and attachment to the outside spun reflector by welds. On the inside of the reflector, thin brass bars are screwed to the exposed brass bars to secure the sections of diffusing opal glass. A screwed leveling devise is incorporated into the chain supports

Figure 6. Governor's office luminaire

The fixture in the Governor's office is quite similar to those in the adjoining reception room except that the backlit tube arrangement is replaced with a cast brass ribbed ring punctuated with small cast spearhead ornaments (Figure 6., Drawing 5.) Although the drawing indicates a carved beaver surrounded by stars, only a few stars of a larger size were actually carved.

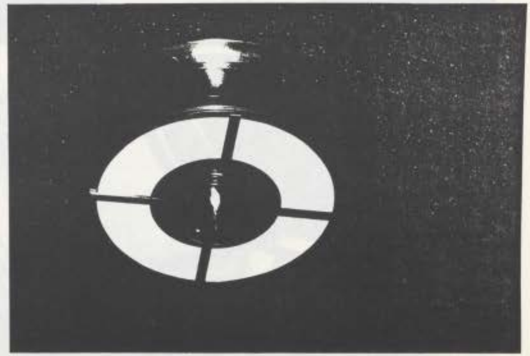
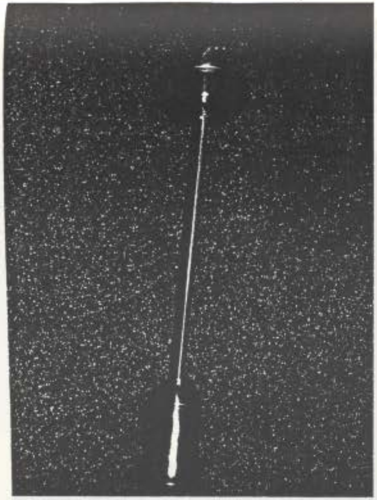
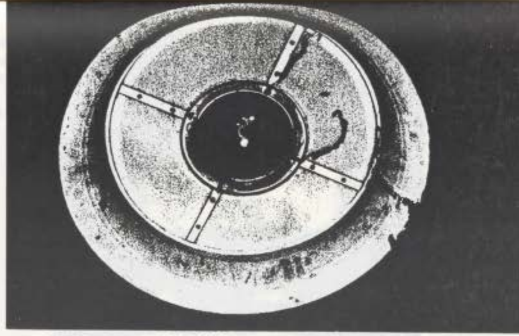


Figure 7. Cafeteria fixture (reflector portion)

A-8 Drawing 1.





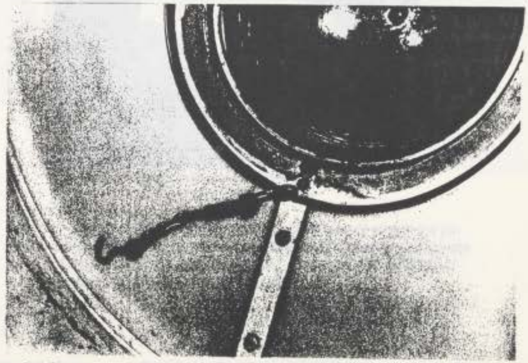


Figure 8. Cafeteria fixture (tube and socket portion)
Figure 9. (above right) Cafeteria fixture (inside of reflector)
Figure 10.(below right) Detail of above

to assist in leveling the shade after installation.

A-8 Drawing 1.

The fixture in the Governor's private office (photograph 7.) is an abstraction of earlier historicist brass chandeliers Baker designed for Whitehouse at the Waverly Country Club in Portland. These were baluster-type chandeliers of stacked spun brass vase shapes, using the same horizontal band for connecting the two spun halfs of shapes as well as attachment of the brass tube branches. The reduction of these complicated baluster stems to a simple sphere may reflect the architect's desire for simple unornamented surfaces.

Figure 11. Stairwell wall light

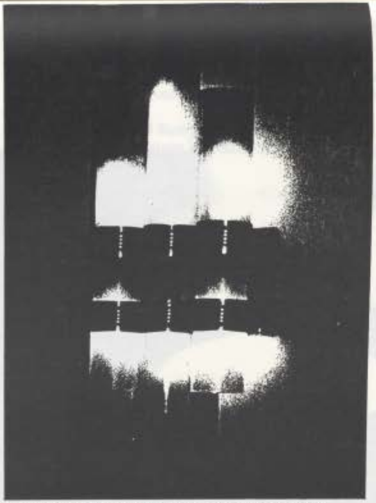


Figure 12. Wall light in the main floor vestibule of the Sixth Church of Christ Scientist

The Stairwell wall light pictured in Figure 11 and in the top left of Drawing 6 is a simplified version of Baker's earlier wall fixtures of this type, such as the ones found in the main floor vestibule of the Sixth Church of Christ Scientist (Figure 12.).

A-8 Drawing 1.

Even simple corridor ceiling lights had a simple elegance, such as the one seen in photograph 8, Figure 13 and center left of Drawing 6. This fixture features an exposed spun brass ceiling plate and a decorative cast brass nut securing the opal glass shade.

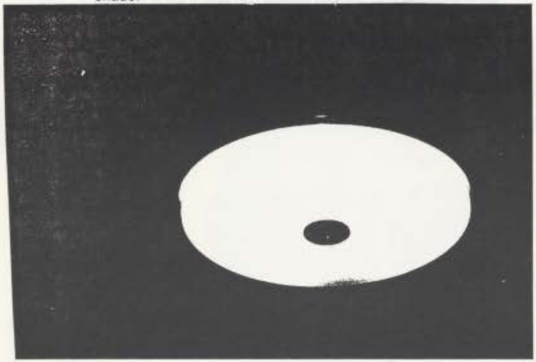


Figure 13. Ceiling fixture

When appropriate, Baker would draw from his own repertoire of luminaires that he had developed on other lighting jobs. This would allow him to draw from a standard stock of parts, such as the aligners and socket enclosures of the two English-Baker fixtures depicted at the top of Drawing 7. It would also allow him to reuse the wooden block forms used for spinning the metal shades. As noted, some of these standard fixtures used spun aluminum reflectors with a lighting company's standard globe shape.

Drawings 6 and 7 also illustrate the various approaches to building signage. These include sandblasted edges and figures with edge lighting from above, probably with a slim 'lumiline' incandescent lamp, cast glass letters mounted on metal, and an illuminated enclosure of ruby glass and perforated bronze sheeting.

Baker also used purely commercial fixtures in utilitarian areas, such as the washroom fixture of Figure 14 and bottom right of Drawing 6.

Drawings 7 to 9 illustrate various other fixtures and alternate designs for fixtures submitted by Baker for the building.

Figure 14. Washroom fixture

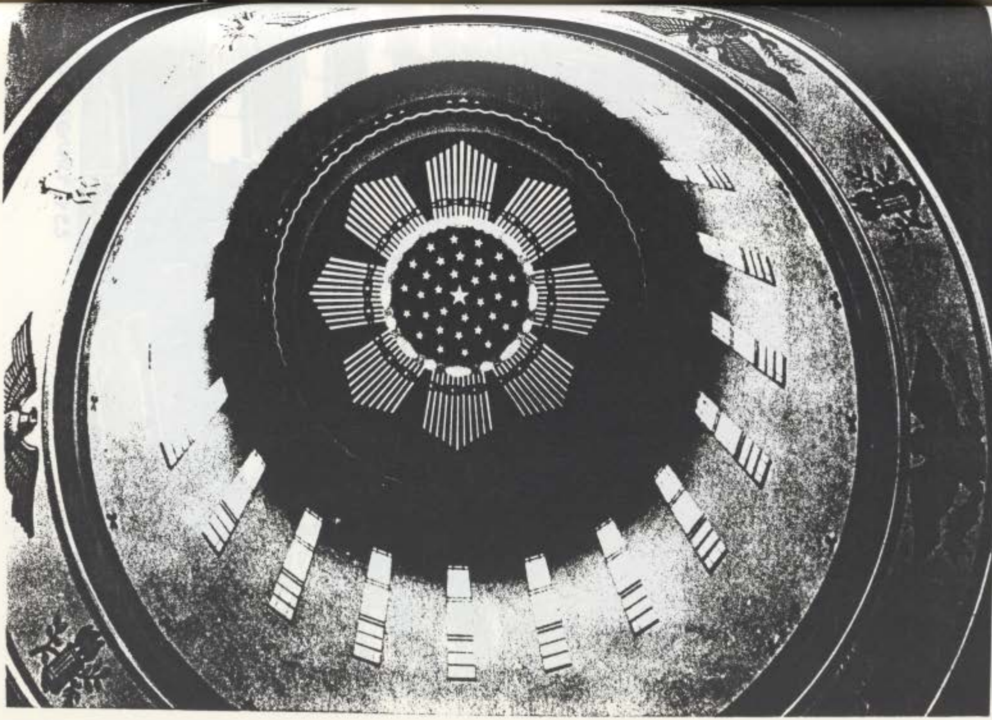
Ornament

Besides the concentric tooled rings on the spun reflectors and the linear grooves on cast elements, the principal metal ornamental motif is the star. The inspiration for this is the appearance of stars on the state flag, and is quite appropriate for the state capitol building. Other state decorative motifs, used as sandblasted decoration on luminaire glass panels, are beavers,

wheat sheaves, and sailing vessels, all representing early Oregon industries.

A subtle example of ornamental variation can be seen in the cast brass rod ornament in Figures 4. and 6.; reeded cast brass sections in the former and layered disk-like cast elements in the latter.

A-8 Drawing 1.



A-8 photograph 1.

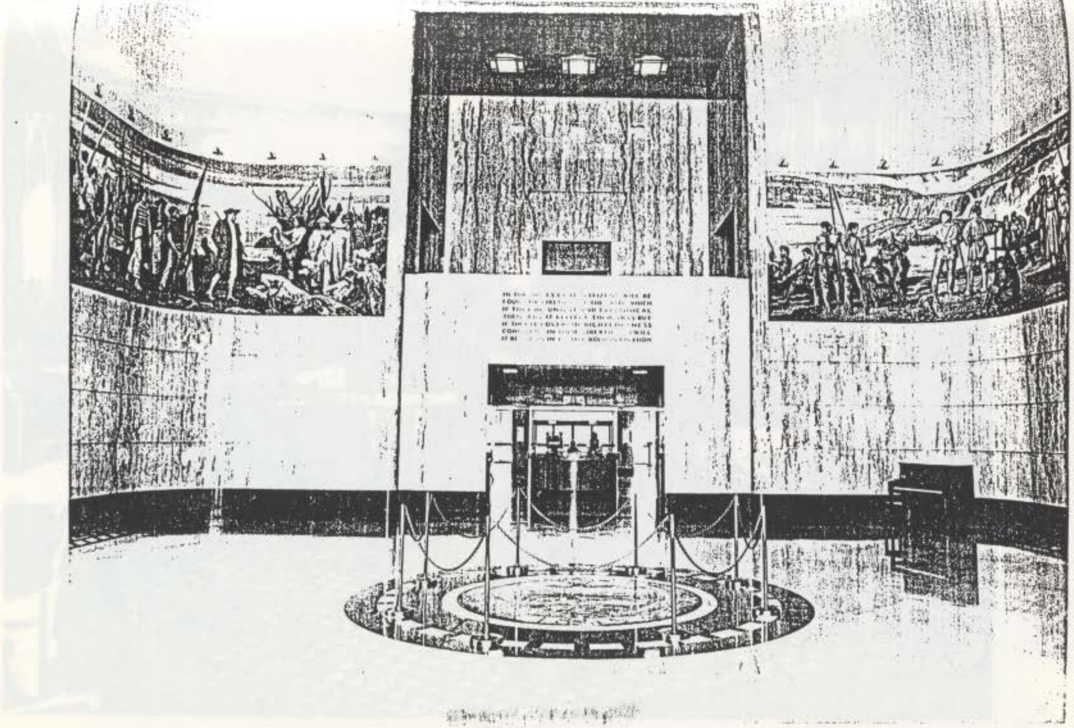
A-8 Drawing 1.

A-6 Photograph 1

se of Representatives 8484

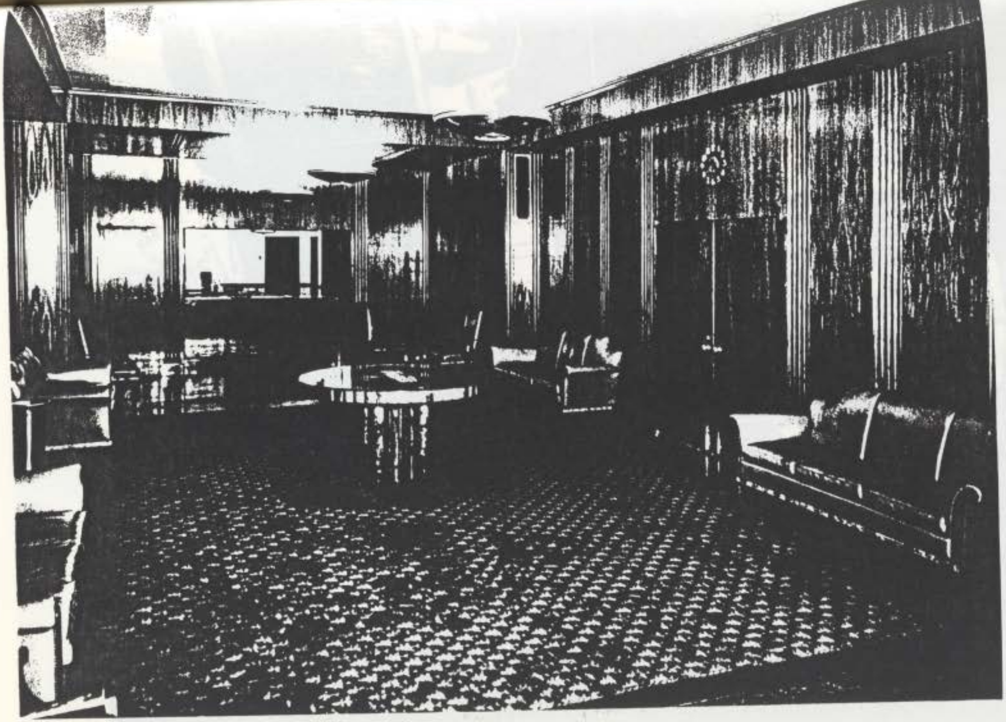
A-8 photograph 2.

A-8 Drawings 1.



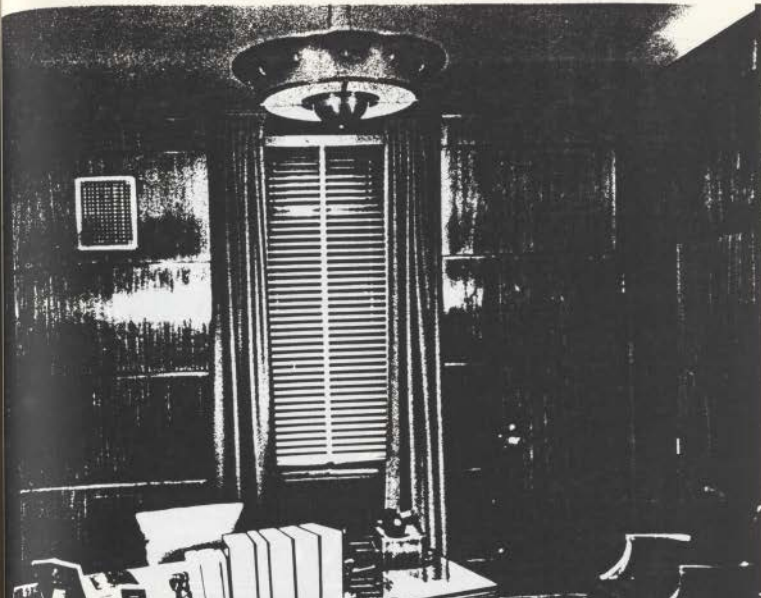
A-8 photograph 3.

A-8 Drawing 1.



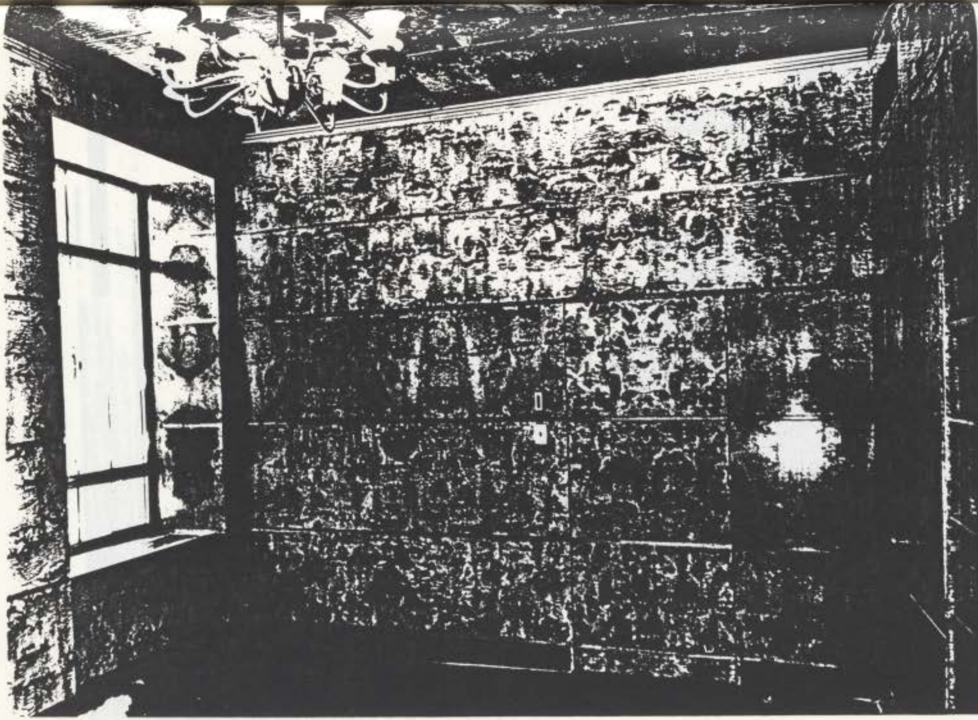
A-8 photograph 4

A-8 Drawing 1.

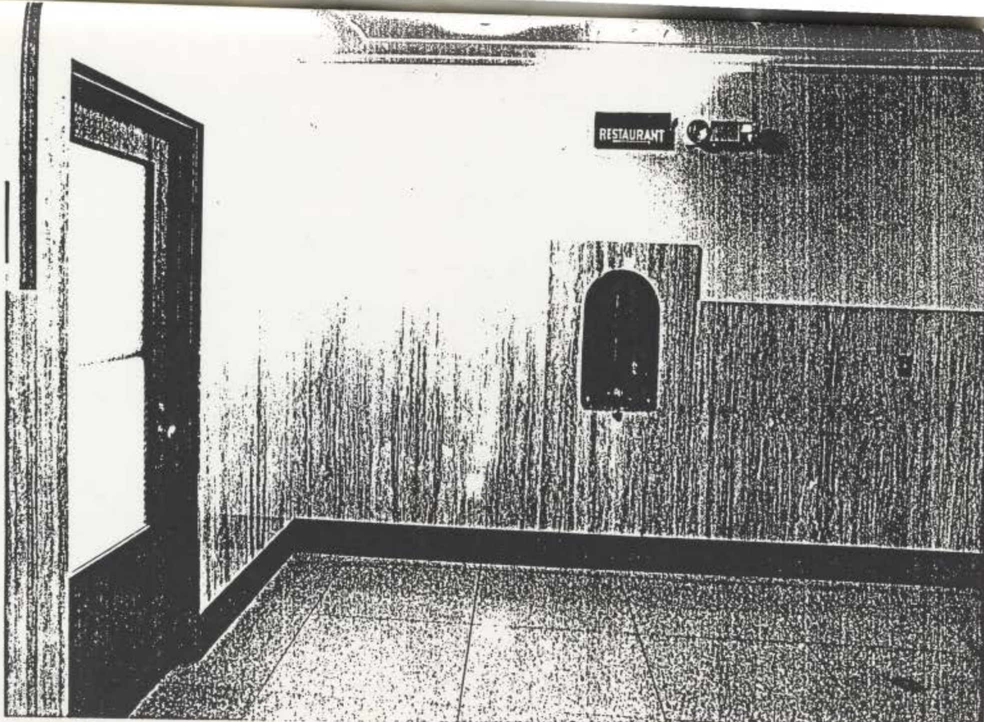


A-8 photograph 5.

A-8 photograph 6.



A-8 photograph 7.

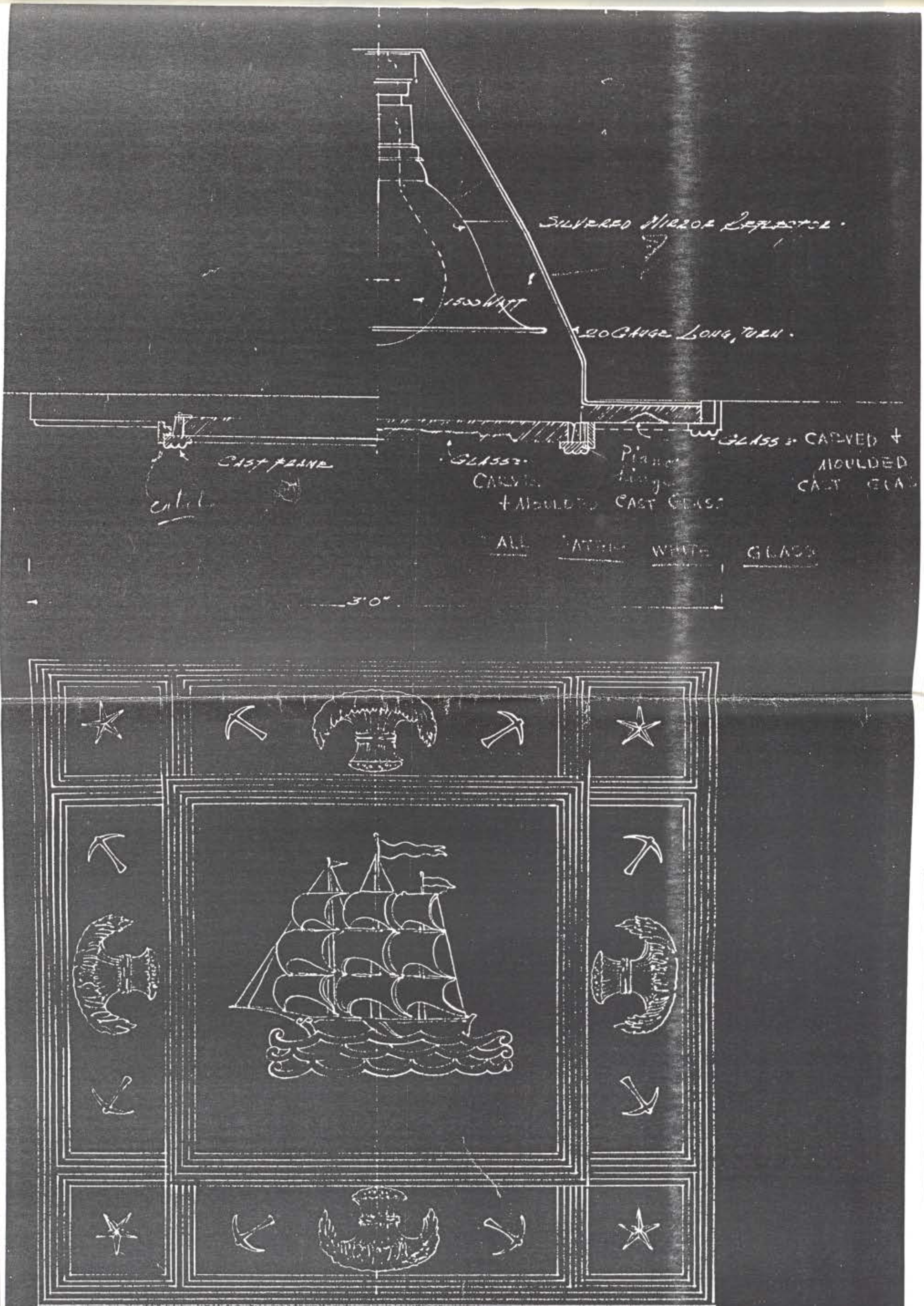


photograph 8

A-8 photograph 8.

A-8 Drawing 1.

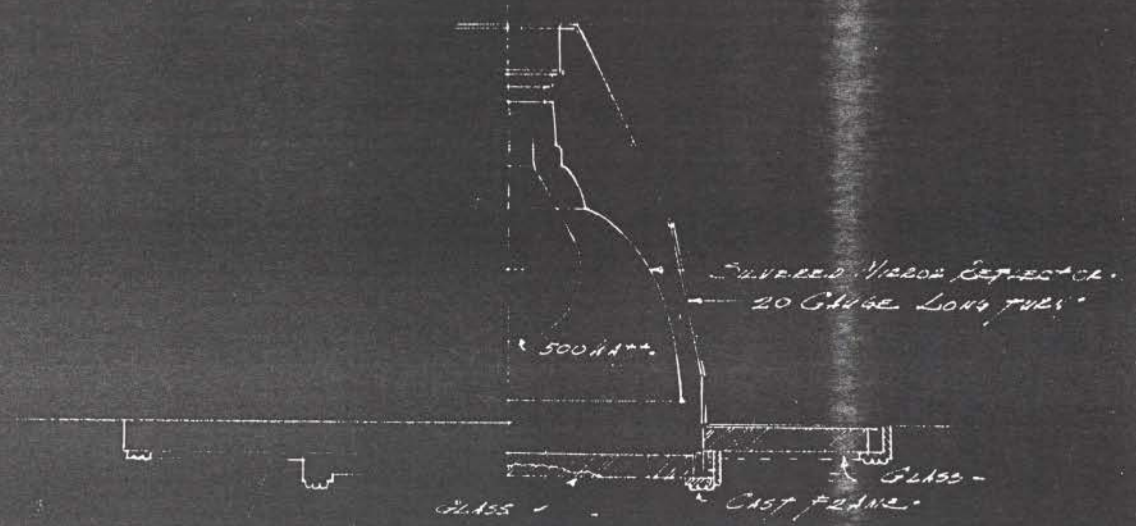
A-8 Drawing 1.

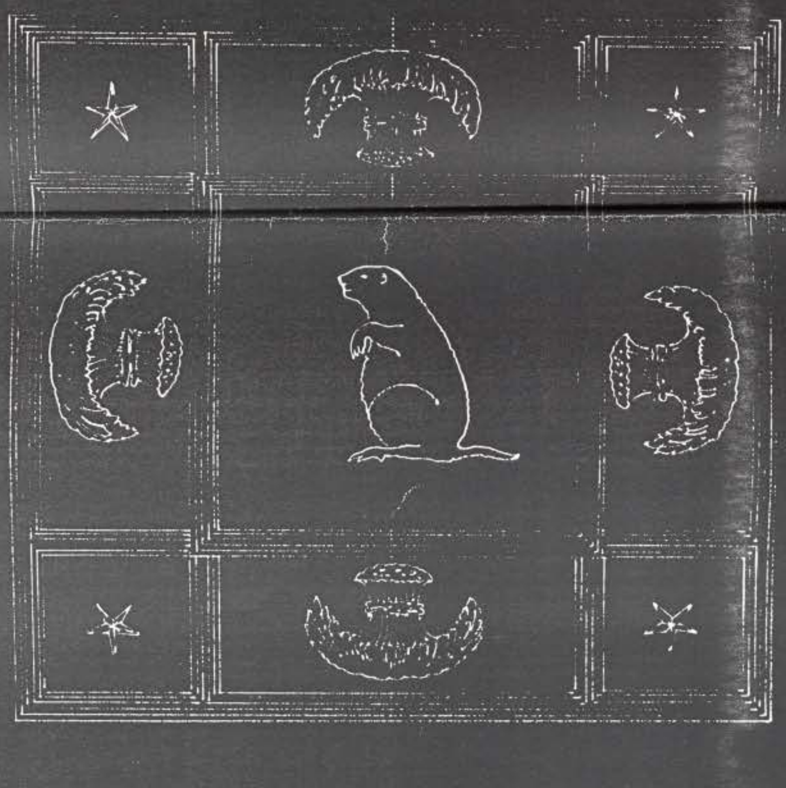

SILVERED MIRROR REFLECTOR.
1500 WATT
20 GAUGE LONG, TURN.
GLASS - CARVED +
MOULDED
CAST GLA
GLASS -
CARVED
+ MOULDED CAST GLASS
CAST FRAME
ALL WHITE GLASS
3'0"

rawing 1.

A-8 Drawins 1.

A-8 Drawing 2

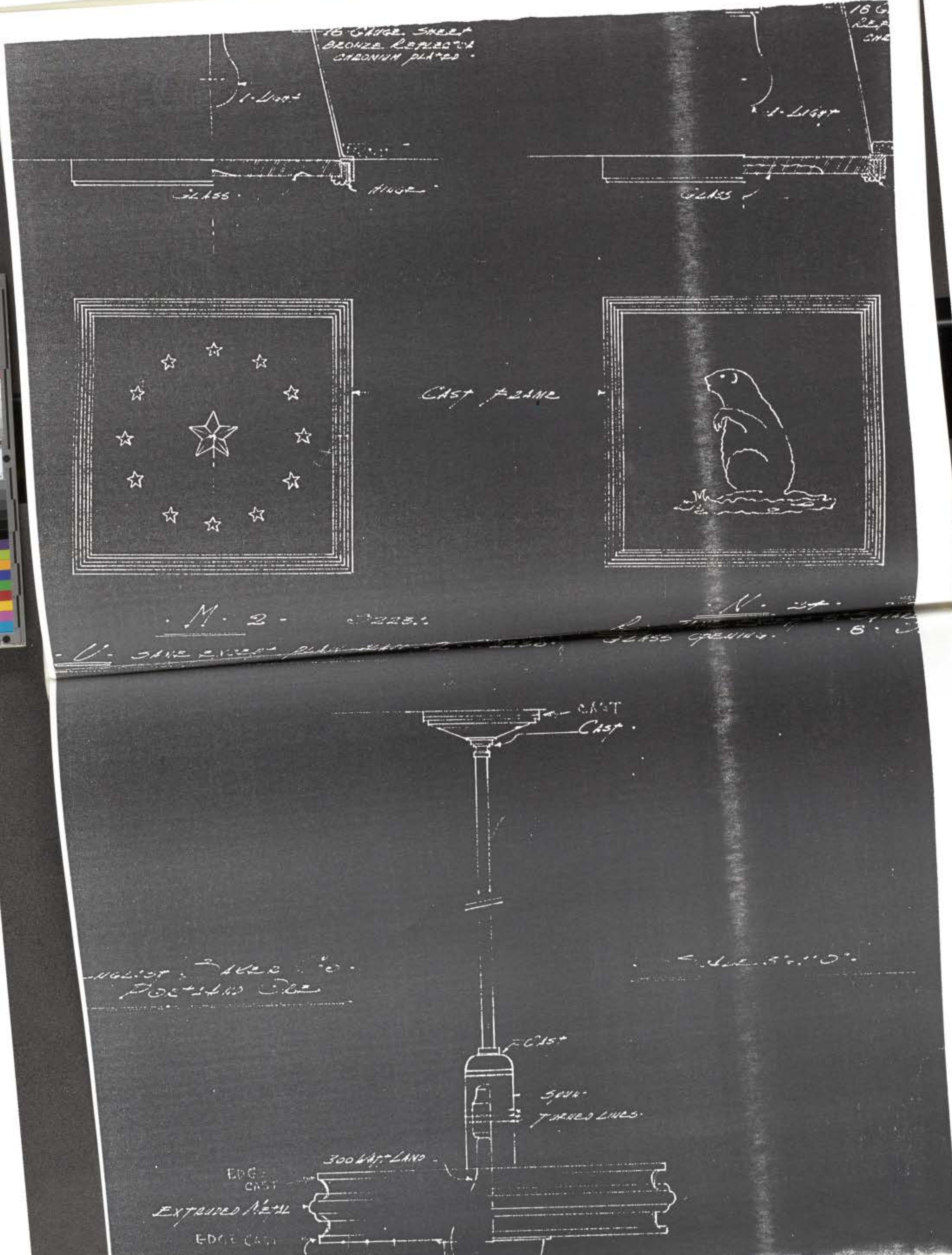

SILVERED MIRROR REFLECTOR.
20 GAUGE LONG TUBE.
500 MM.
GLASS -
CAST FRAME.
GLASS -



'rawing 2.

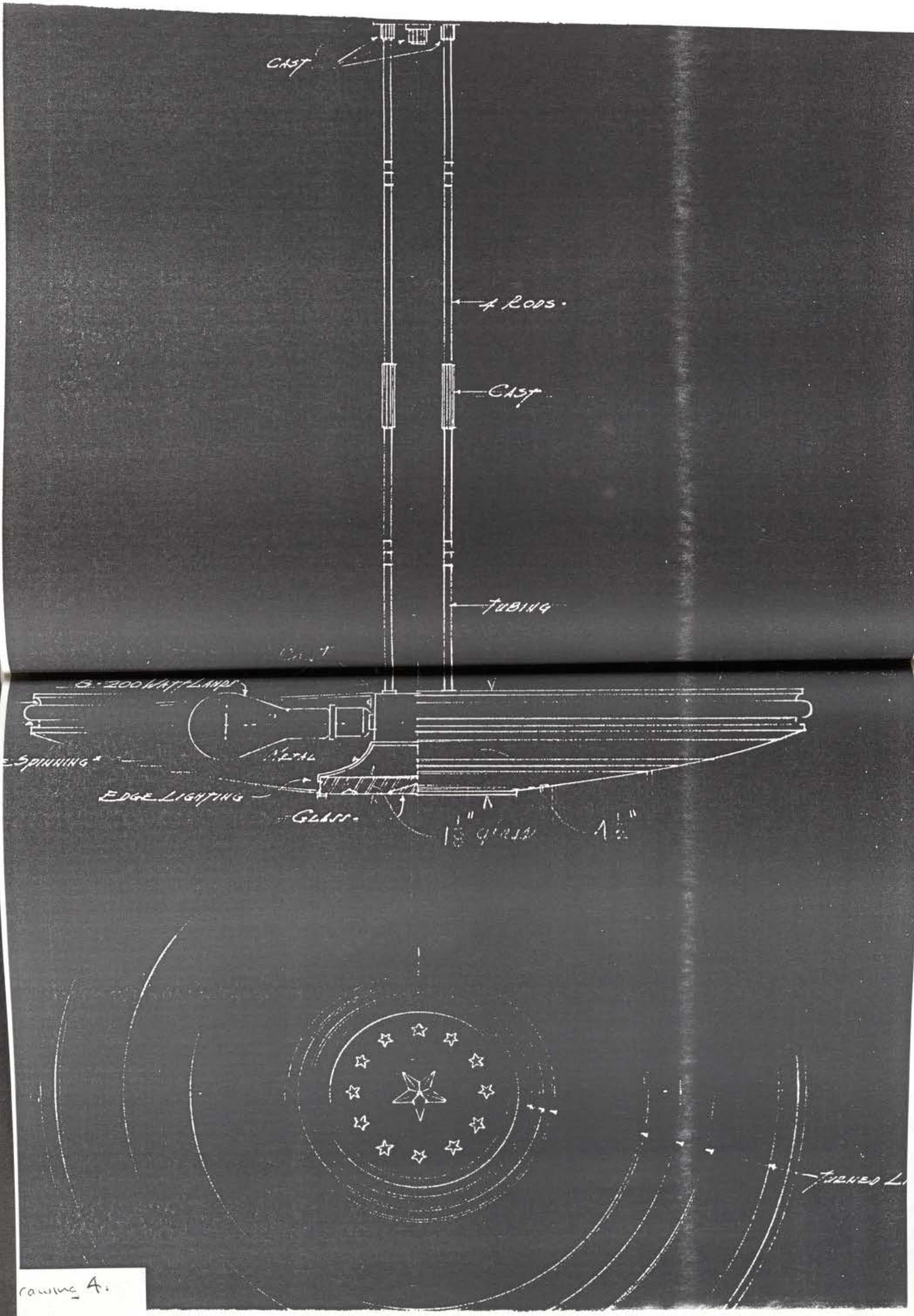
A-8 Drawing 2

A-8 Drawing 3.


16 GAUGE SHEET BRONZE REFLECTOR CHROMIUM PLATED.
1-LIGHT
GLASS.
HINGE
1-LIGHT
GLASS
CAST FRAME
M. 2.
GLASS OPENING.
CAST
CAST.
CAST
SPUN.
TURNED LINES.
300 WATT LAMP
EDGE CAST
EXTRUDED METAL
EDGE CAST
SPINNING
METAL SPIN.

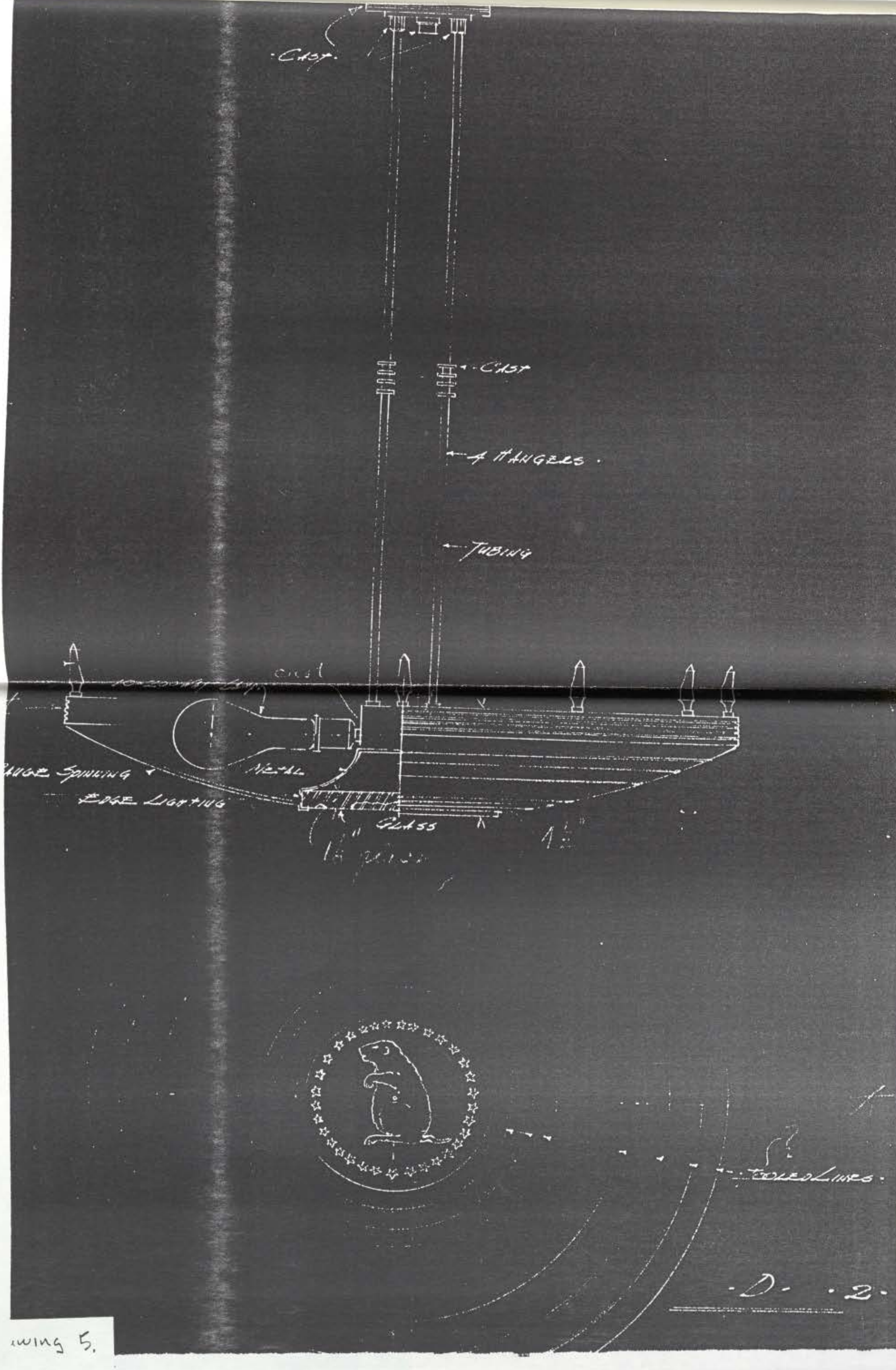
Drawing 3.

A-B Drawing 4.


CAST
4 RODS.
CAST
TUBING
6-200 WATT LAMPS
SPINNING
METAL
EDGE LIGHTING
GLASS.
1⅛"
1½"

rawing 4.

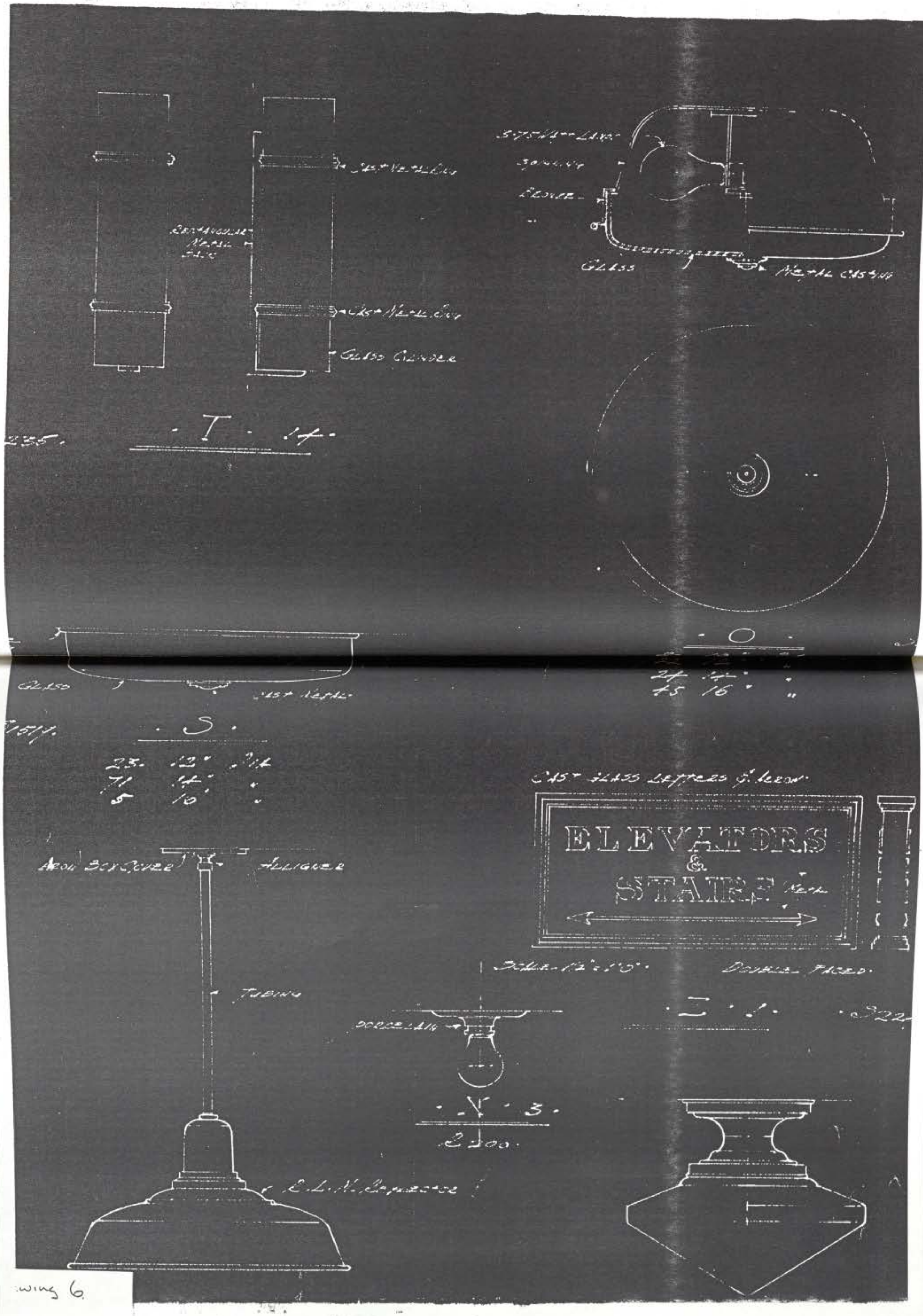
A-8 Drawing 5.


·CAST·
← CAST
← 4 HANGERS.
← TUBING
METAL
ANGE SPINNING
EDGE LIGHTING
GLASS
1½"
TOOLED LINES.
·D· ·2·

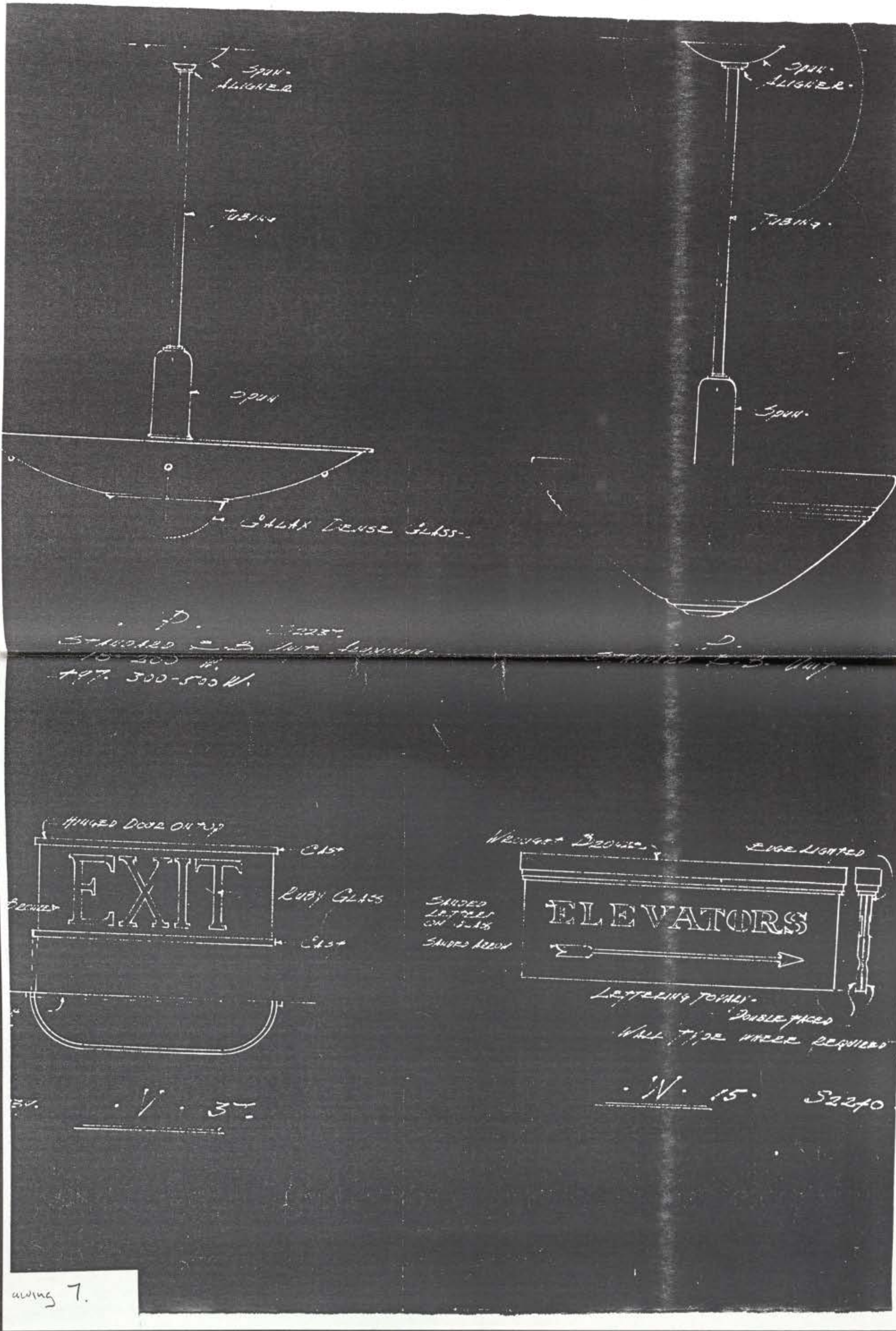
wing 5.

A-8 Drawing 5.

A-8 Drawings 6.

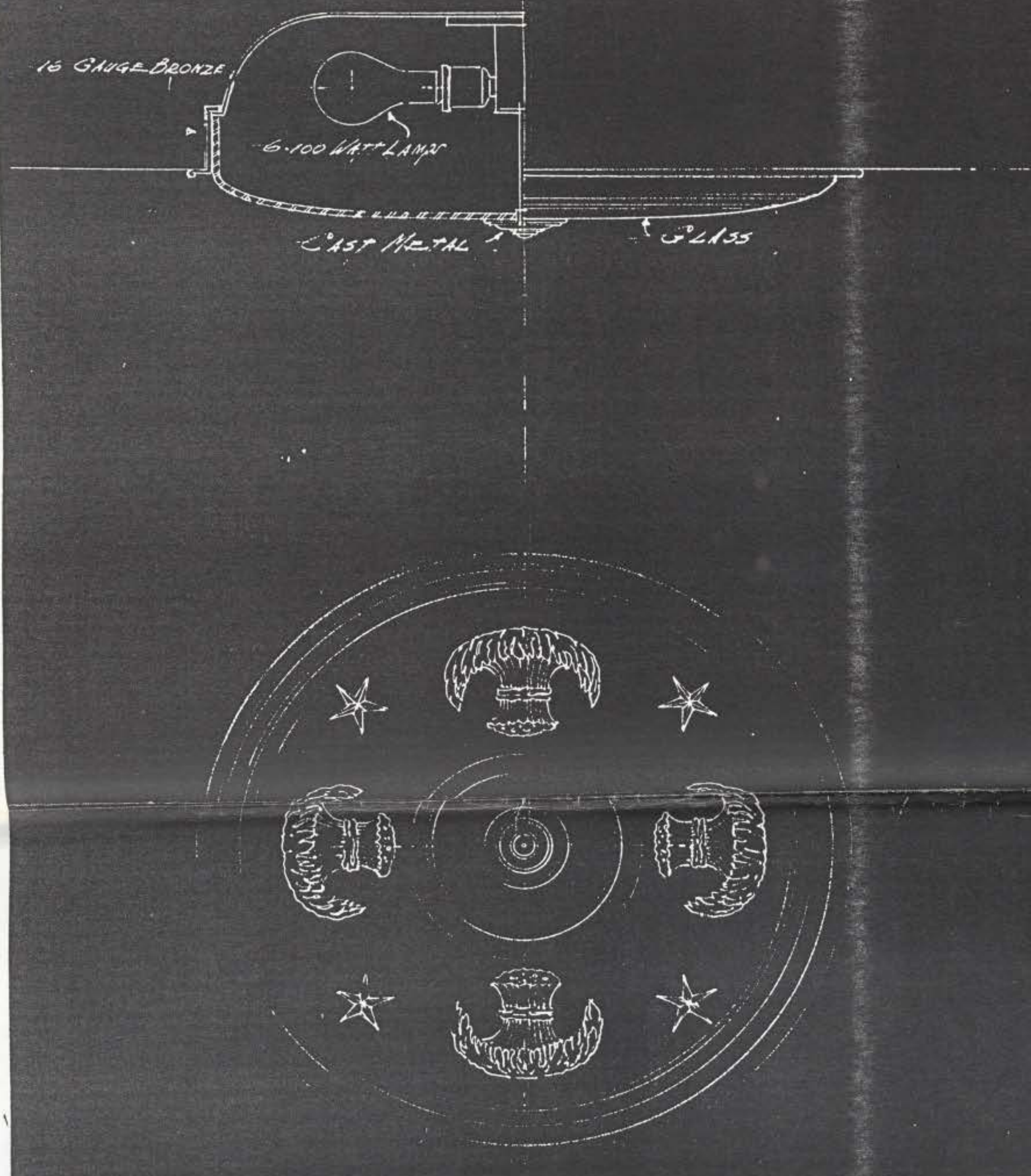

GLASS
METAL CASING
CAST METAL CAP
GLASS CYLINDER
· T · 14 ·
· O ·
· S ·
CAST GLASS LETTERS & FRAME
ELEVATORS
&
STAIRS
DOUBLE FACED
TUBING
PORCELAIN
· Y · 3 ·

A-8 Drawing 7.


SPUN ALIGNER
TUBING
SPUN
GALAX DENSE GLASS
SPUN ALIGNER
TUBING
SPUN
· P ·
STANDARD E.B. UNIT LUMINAIRE
300-500 W.
· D ·
STANDARD E.B. UNIT
HINGED DOOR ON TOP
CAST
RUBY GLASS
CAST
BRONZE
EXIT
· V · 3 ·
WROUGHT BRONZE
EDGE LIGHTED
SANDED LETTERS ON GLASS
SANDED ARROW
ELEVATORS
LETTERING TOTALLY
DOUBLE FACED
WALL TYPE WHERE REQUIRED
· N · 15 ·
S2240

wing 7.

A-B Drawing 8.



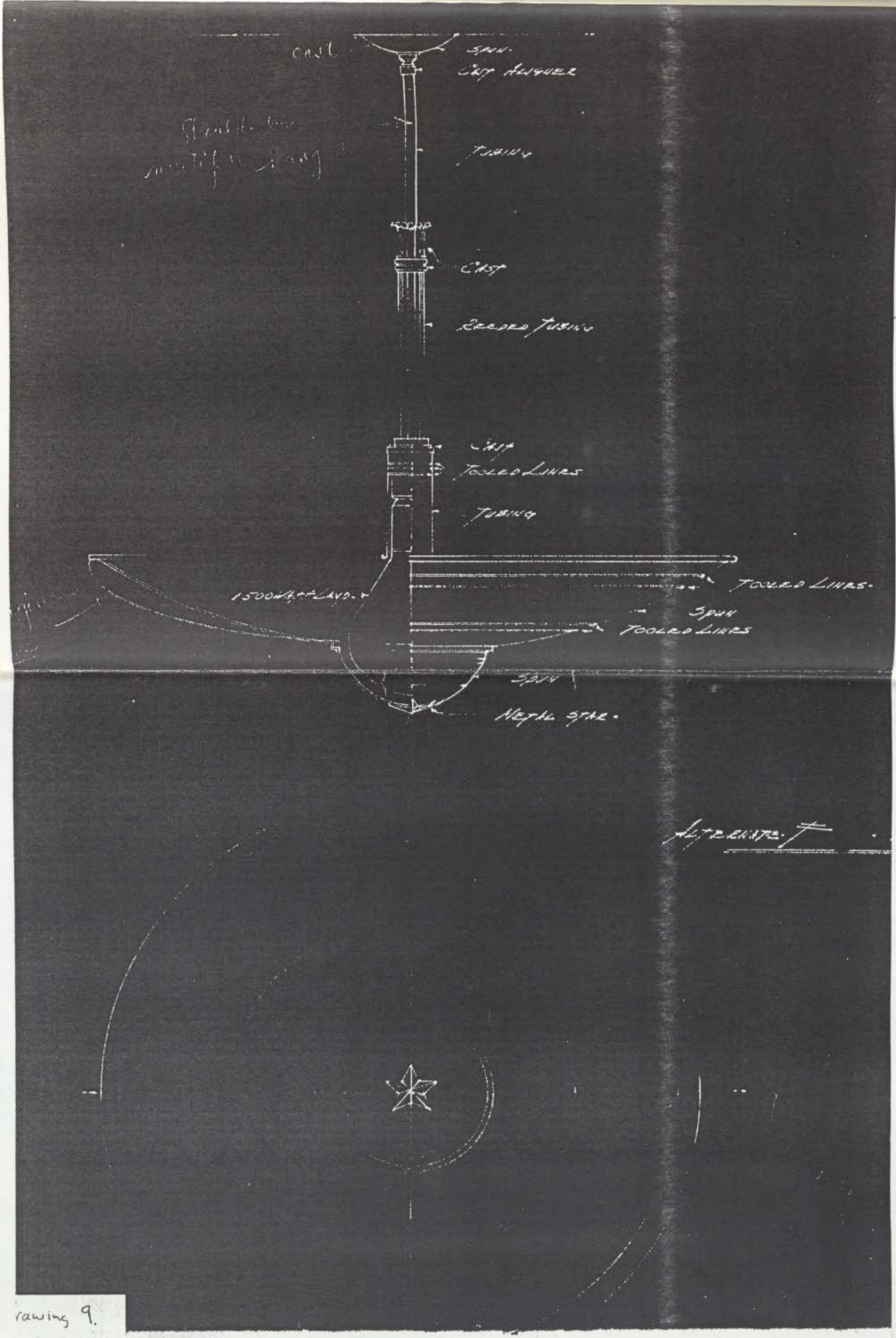
. B.

5- 20" Dia
5- 24" "

rawing 8.

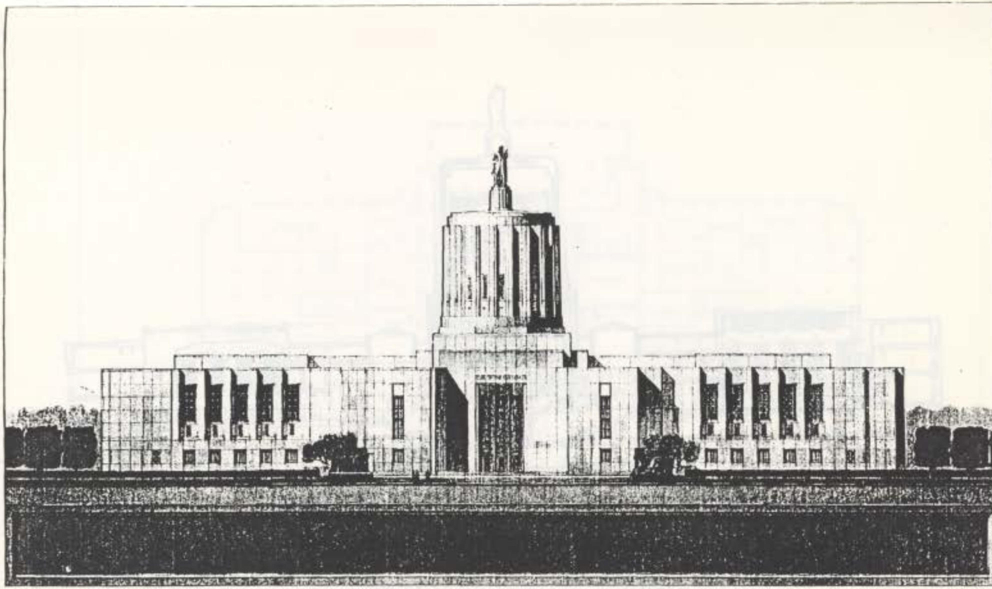
A-B Drawing 8.

A-8 Drawing 9.

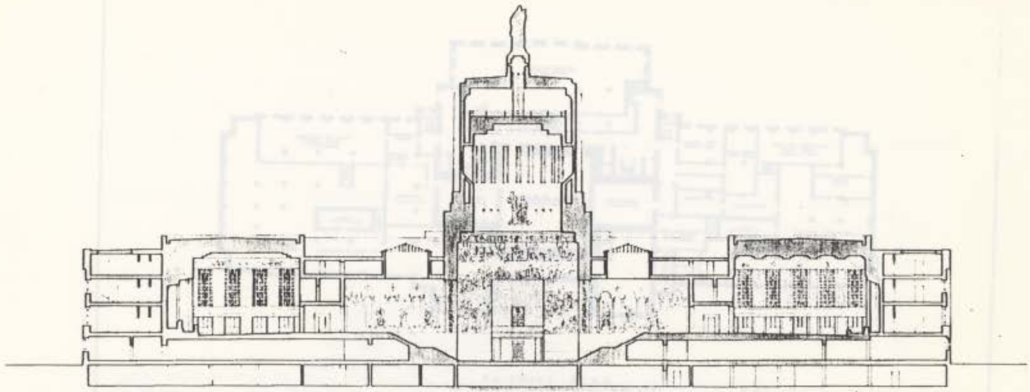

cast
SPUN.
CAST ALIGNER
TUBING
CAST
REEDED TUBING
CAST
TOOLED LINES
TUBING
1500WATT LAMP
TOOLED LINES.
SPUN
TOOLED LINES
SPUN
METAL STAR.
ALTERNATE

rawing 9.

A-8 Drawing 9.



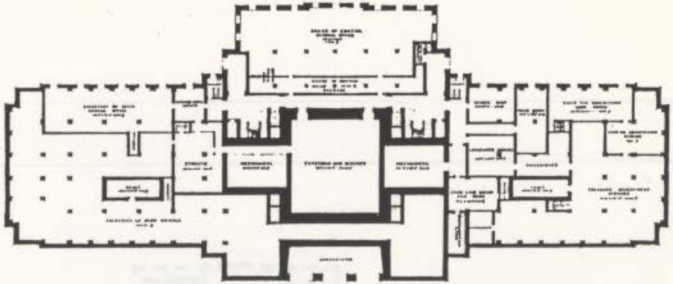
A-8 Drawing 10.



LONGITUDINAL SECTION
SCALE ONE SIXTEENTH INCH EQUALS ONE FOOT

OREGON STATE CAPITOL COMPETITION

A-8 Drawings II.



BASEMENT PLAN

SCALE ONE SIXTEENTH INCH EQUALS ONE FOOT

OREGON STATE CAPITOL COMPETITION

A-8 Drawing 12

FIRST FLOOR PLAN
SCALE ONE SIXTEENTH INCH EQUALS ONE FOOT

OREGON STATE CAPITOL COMPETITION

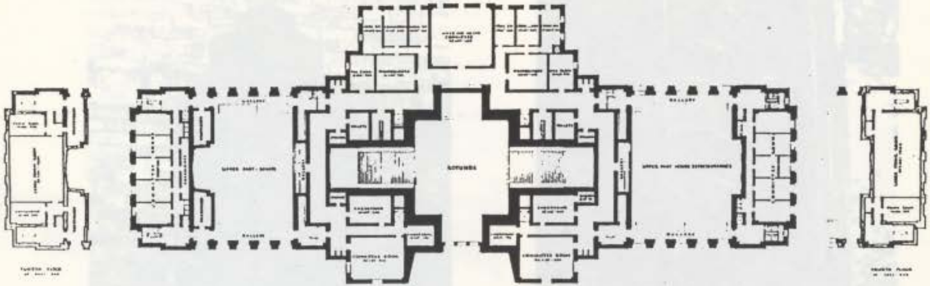
A-8 Drawings 13

SECOND FLOOR PLAN

SCALE ONE SIXTEENTH INCH EQUALS ONE FOOT

OREGON STATE CAPITOL COMPETITION

A-8 Drawing 14



THIRD FLOOR PLAN
SCALE ONE SIXTEENTH INCH EQUALS ONE FOOT

OREGON STATE CAPITOL COMPETITION

University of Oregon Medical School Library and Auditorium

The University of Oregon Medical School Library and Auditorium was designed by Ellis F. Lawrence and constructed from 1936 to 1938 as the second building on the campus.[1]

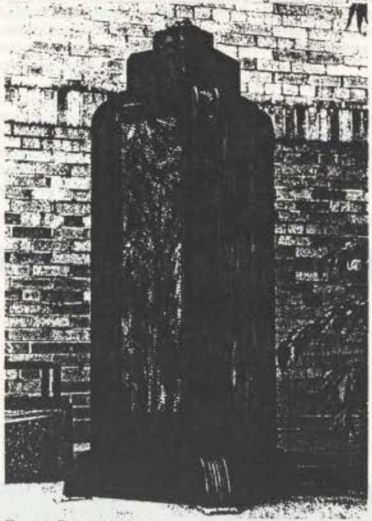


Figure 1. Entrance lantern

Figure 2.[2] Detail of cast bronze ornament on lantern

Apart from the cast bronze lanterns marking the entrance, most of the building's fixtures are typical of Baker's later Art Deco work and are characterized by a reduction of ornament on spun metal luminaire reflectors to simple horizontally layered shapes and linear tooling; the ornamental vocabulary of the spinning lathe.

[1] Michael Shellenbarger, Ellis Lawrence Survey, Eugene, (OR: University of Oregon Press 1989)

[2] All of the figures in this case study are from the author's collection.
The attached photocopied historic photographs were reproduced from originals in the Uninversity of Oregon Library's Special Collection Division, Ellis Lawrence Collection, AX 56.

Like the University of Oregon Library, this building's entrance is marked by flanking bronze lanterns (Figure 1. and 2., and photograph 1.). The proportions of the latter have been given a slight vertical accent to better harmonize with the towering entrance. Projecting diagonal corner fins framing a narrow vertical band of cast bronze conventionalized floral motifs augments this vertical design theme. The use of roughly textured multi-toned brown and white opalescent glass in these lanterns makes them attractive by day and night.

An intriguing luminaire featuring tube lamps is located in the vestibule (Figure 3. and Photograph 2.). The general shape of the fixture and the cast bronze grooved lamp socket mounts harmonize with the bronze linear air supply grille beneath it. Baker was associated with a Tacoma firm trying to develop the fluorescent lamp at this time, and may have been trying to explore the creative potential of a luminaire employing them.

Figure 3. Vestibule fixture

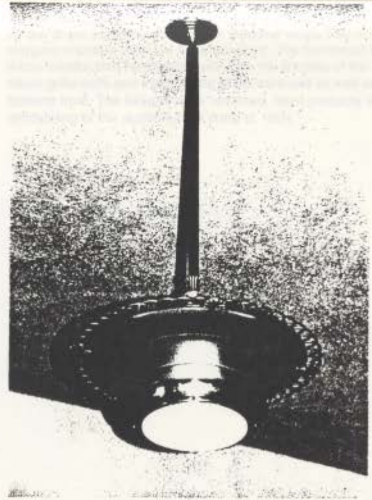


Figure 4. Lobby luminaire

The two luminaires in the lobby were the most decorative of the interior fixtures, incorporating a cast brass fringe extending out beyond the upper rim of the reflector (Figure 4.). The bottom lens and coved retainer ring are suspended below the bottom of the top reflector. This allows light from the lamps located within the spun brass reflector to reflect off of the inside convex surface of the lens retainer ring back onto the outside surface of the main

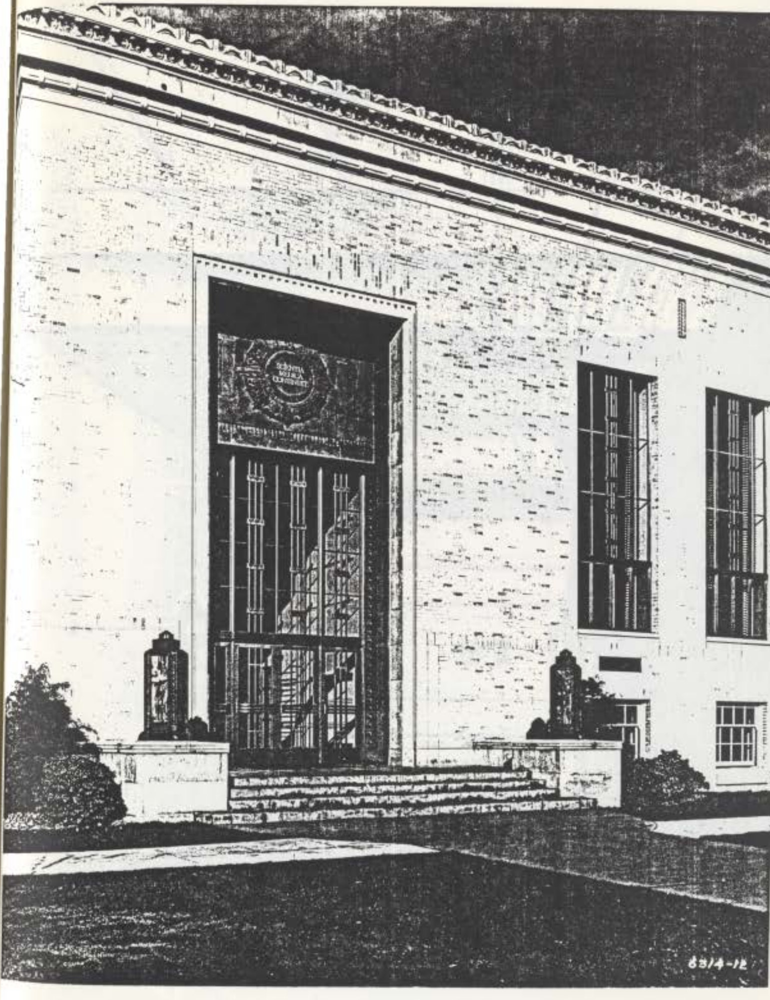
reflector bowl. The stepped rings in the reflector bowl and the projecting fringe of cast ornament are accentuated by this reflected light.

The spun aluminum semi-indirect fixtures installed in the original reading (photograph 3.) and reference rooms were Baker's standard fixtures; one is depicted in the upper left of Drawing 7., **A-8**, and was used at the State Capitol building as well. The reading room fixtures have since been replaced.

Figure 5. Reference room fixture

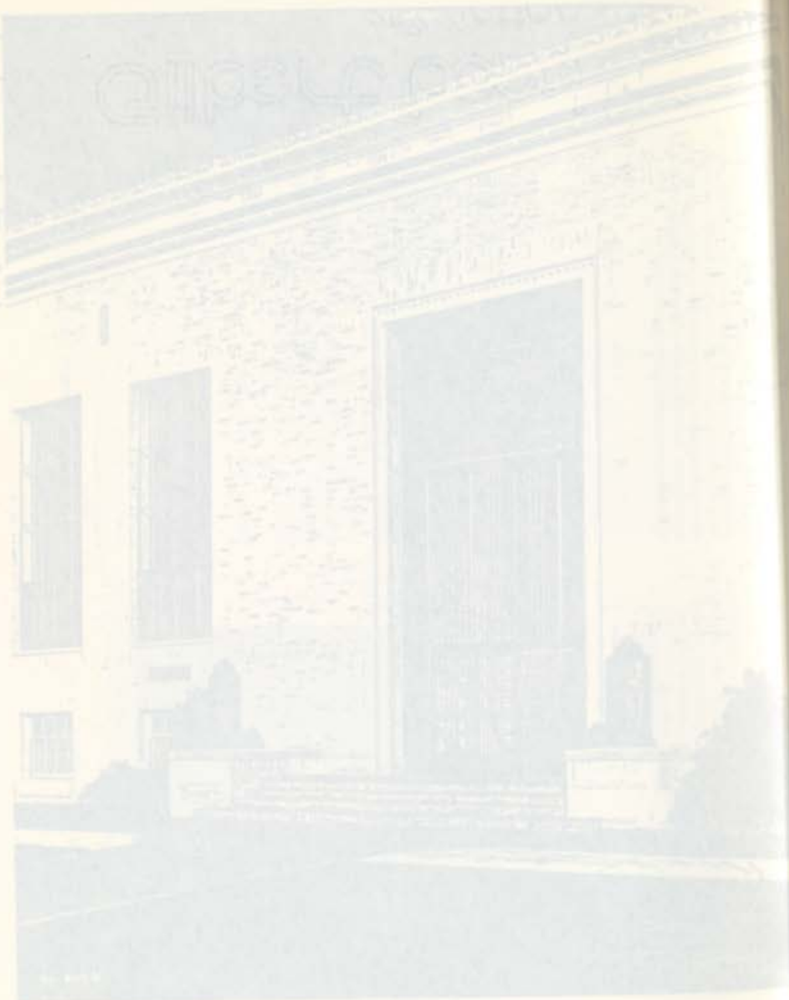
The spun metal indirect fixtures originally installed in Weeks Memorial Auditorium (photographs 4. and 5.) were notable for the direct correspondence their stepped shape had with the stepped acoustic ceiling of the room itself. The horizontal rings of these fixtures also harmonized well with the linearity of the air return grille-work and stage frame of the front wall as well as the balcony front. The fixtures were removed, most probably in the remodeling of the auditorium in June of 1984.[3]

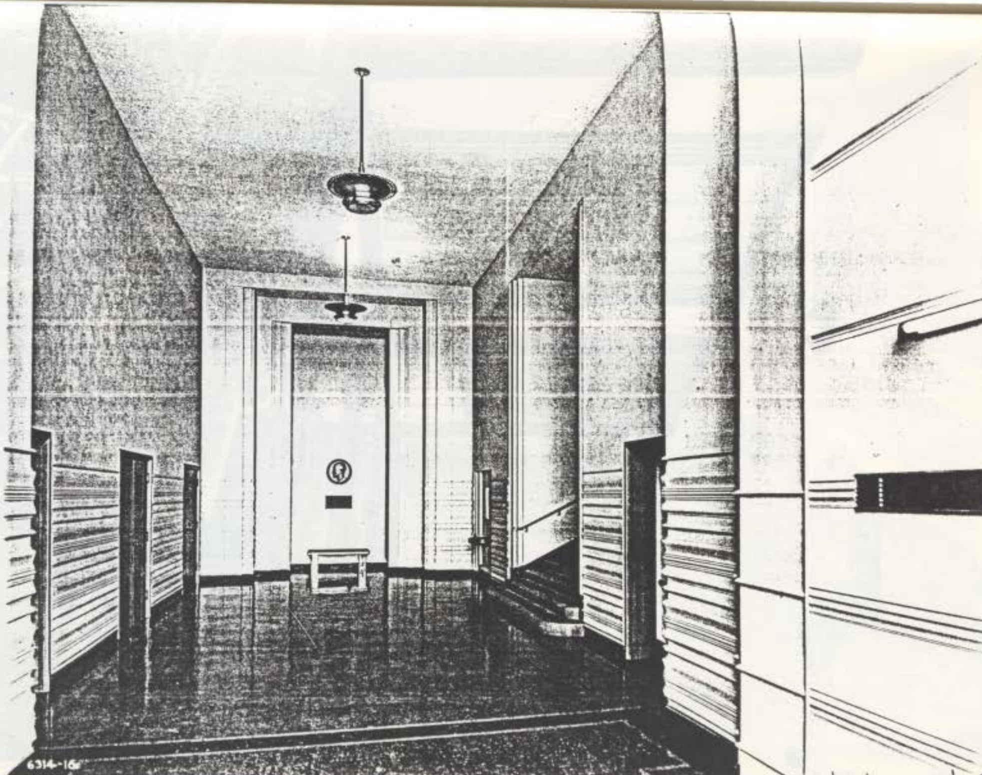
[3] Ibid.



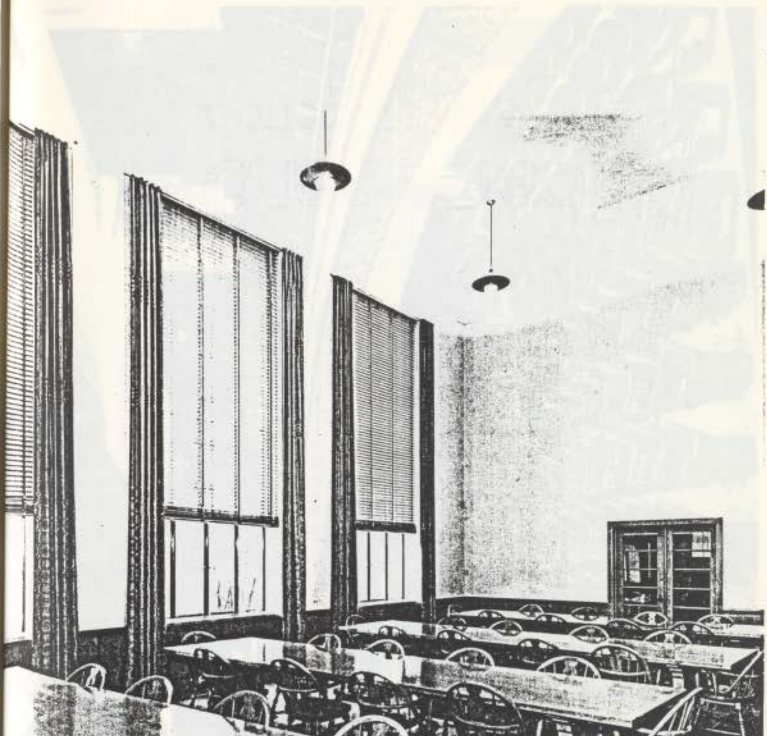
A-9 photograph 1.

A-9 Photograph 1.



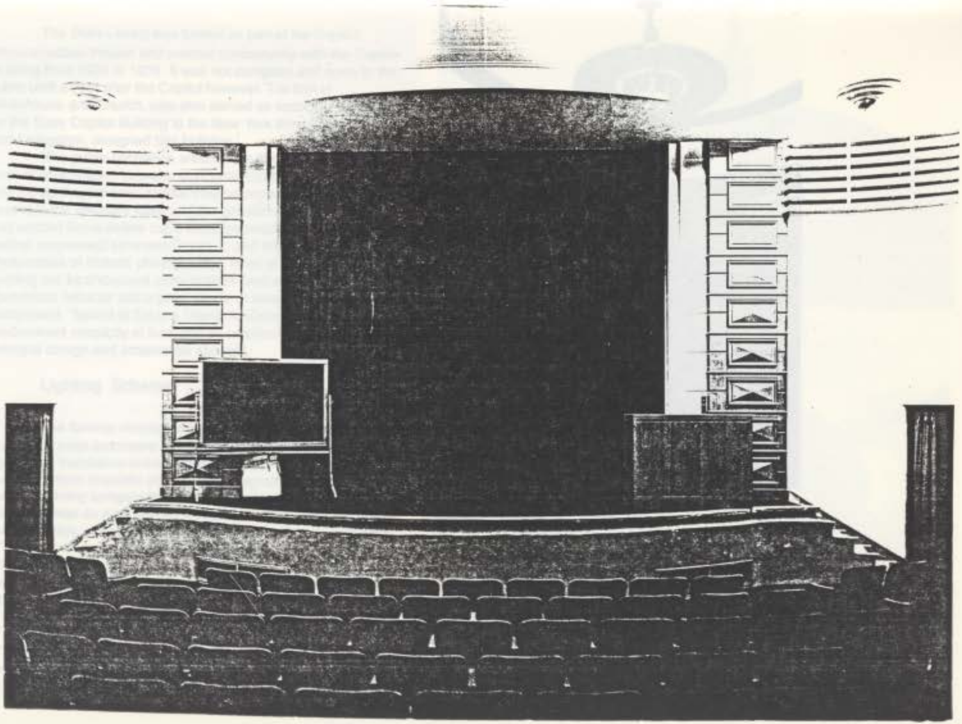


A-9 photograph 2.



A-9 photograph 3.

A-9 Photograph 4.



A-9 photograph 5.

The State Library was funded as part of the Capitol Reconstruction Project and erected concurrently with the Capitol Building from 1935 to 1939. It was not complete and open to the public until a year after the Capitol however. The firm of Whitehouse and Church, who also served as associate architects for the State Capitol Building to the New York firm of Trowbridge and Livingston, designed this building.[1]

The public circulation areas of the library exhibit a high level of coordination between structural expression in the space and the lighting scheme. Marble clad columns and shallow plaster beams in the entrance foyer and the circulation lobbys on the first and second floors define cubic modules which are highlighted by a central suspended luminaire(Figure 1. and the attached photocopies of historic photographs). Most of the fixtures in the building are incandescent semi-indirect luminaires incorporating a spun-brass reflector and a glass shade or lenses for a direct light component. Typical of Baker's Planar Art-Deco period, there is a predominant simplicity of form and an emphasis on line as the principal design and ornamental element.

Lighting Scheme

The fixtures developed for the first floor lobby are the building's most decorative and sophisticated in their treatment of light. Their installation in three shallow plaster saucer domes is the building's most dramatic architectural integration of lighting. The indirect lighting component of the fixture effectively uses the saucer domes as a secondary reflecting surface and accentuates the concentric vertical stepped rings, which reflect more brightly (Figure 2.). The decorative brass retainer ring securing the opal glass shade is an element repeated in the second floor lobby and reading room luminaires, thereby linking the three major public spaces.

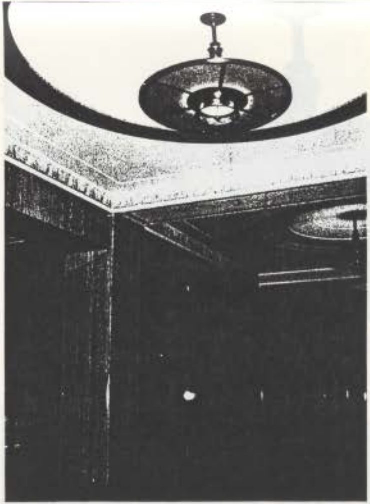
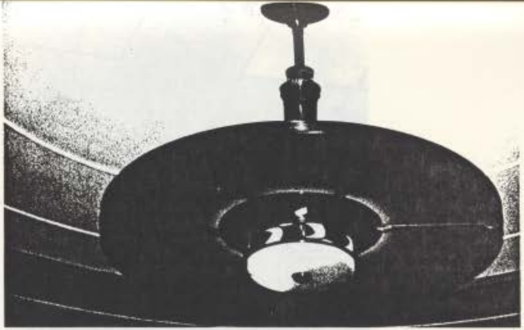
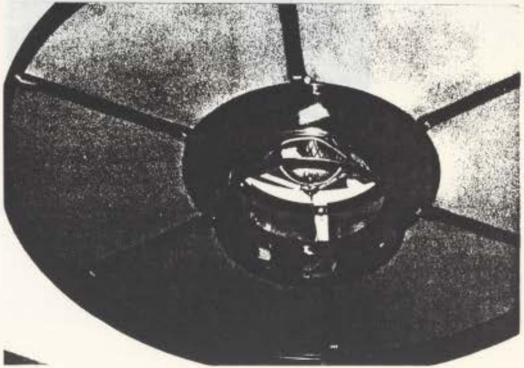


Figure 1.[2] First Floor Lobby

[1] Elizabeth Walton Potter, "Oregon State Capitol," National Register of Historic Places (Washington DC: National Park Service, 1988) p. 7-1.

[2] All the figures in this case study are photographs in the author's collection.
The attached photocopied historic photographs are from the Oregon Historical Society - lot number 0321 - C.





First floor lobby luminaire (Figure 1., above, Figure 3., above right, Figure 4., below right)

The subtle spill of light around the hub is made possible by an intentional gap left between the interior partial bowl ceiling reflector and the exposed spun brass retainer ring that is attached to the decorative perforated collar surrounding the shade. Light from the side of the lamp reflects off of the interior convex surface of the retainer ring and is reflected again off of the exterior convex surface of the reflector bowl on to the horizontal glass panels. Mild steel brackets connect the inner rim of the retainer ring to the base of the reflector bowl, which is also where the three suspension chains from the supporting shaft are connected. The one socket for the 300 to 500 Watt lamp is located at the base of this supporting shaft. A decorative tooled brass nut supports the opal glass shade by connection to a threaded shank which screws into the three armed bracket connected to the inside retainer ring rim. The small ribbed cast brass knobs on the radiating members serve as nuts; an inside metal strip sandwiches the edges of the opal .

glass sections to the exposed brass bar with screws fastened to the decorative knobs. A decorative brass sleeve with a flared top lends mass to the supporting shaft.

The second floor lobby fixtures match the shade and perforated collar of the lower lobby luminaires to a large spun brass reflecting bowl (Figures 5. and 6., historic photographs 1. to 3.). The collar perforations provide an interesting play of light on the bowl. Luminaires of this type were originally installed in the reading room (historic photographs 4. and 5.) and have since been replaced with fluorescent luminaires.

Figure 5. Second floor lobby luminaire

Figure 6. Second floor lobby luminaires

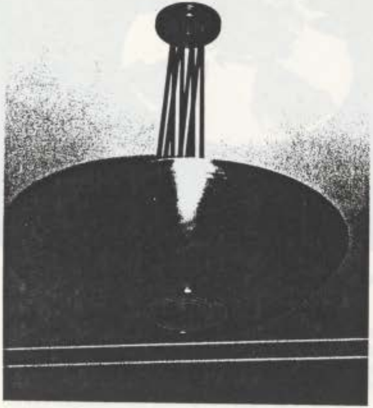


Figure 7. Entry foyer luminaire

Figure 8. Sub-foyer luminaire

The projecting shade of the second floor lobby luminaire is replaced with a flat ringed lens in the entry foyer fixture (Figure 7.). A smaller variation of this spun brass fixture, but with a steeper contoured bowl, is used in the flanking sub-foyers on both the first and second floors (Figure 8.).

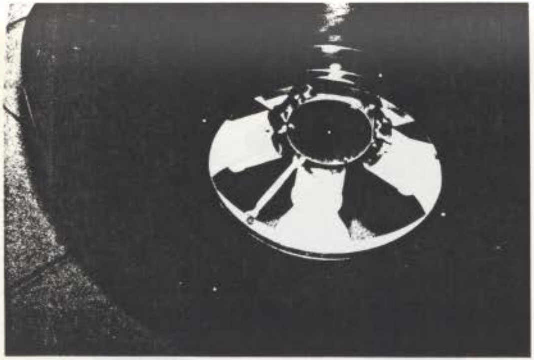


Figure 9. Lamp arrangement of sub-foyer luminaires as viewed
from below with the lens removed

As illustrated in Figure 9., the four supporting rods of the sub-foyer fixture attach to a central junction box which supports six ceramic sockets. Metal support straps also drop from the socket box to the inside rim of the brass reflector. Small lens retainer screws were set in the spun lip of the aperture.

The vestibule fixture (Figure 10.) is in character with the luminaires in the other public sub-space areas and is roughly half the size of the sub-foyer fixture in accordance with its confining volume.

Figure 10. Entry vestibule fixture

Figure 11. Stairwell luminaire

Figure 12. Third floor hallway luminaire

The more utilitarian areas of the building were not neglected by Whitehouse or Baker. This is apparent in the Stairwell and third floor hallway luminaires (Figures 11. and 12.).

Figure 13. Washroom luminaires

Baker continued to use the flattened globe reflectors that he used in utilitarian areas in the twenties at this late date; they appear in a back third floor hallway. Other commercial direct lighting globes he used show the stream-lined character of the Art Deco period, such as the washroom globes (Figure 13.).

The semi-indirect luminaires used in the reference room illustrated in historic photograph 6 were the same ones used in the State Capitol cafeteria. Refer to **A-8** for details on this luminaire. The semi-indirect luminaires illustrated in historic photograph 7 in the office area were also by F.C. Baker, as evidenced by the supporting shaft sleeve design, which is repeated on many other luminaires in the building. The reflector is most probably made of spun brass in keeping with all the other luminaires in the building. The hanging brass chandelier in the State Librarian's office (historic photograph 8.) is of the character of some of Baker's earliest work for Whitehouse at the Waverly Country Club in Portland, except for the unusual shades.

Ornamentation

Besides the tooled rings which appear on most of the spun brass reflective bowls in the building, an interesting program of appropriately 'Oregonian' ornamentation was devised for the building and lighting fixtures. The pine cone and needle stenciled frieze which lines the beams framing the vaults of the first floor lobby (Figure 14.) constitutes the prime ornamental motif Baker used in the lighting fixtures. The decorative brass shade collars on the main public space luminaires (Figure 15.) feature a 'rinceau' motif of a pine cone and needles. The character of the ornament is unusually angular for Baker; during the 1930s his principal ornamental motifs were more of a curvilinear nature as seen in his University of Oregon Medical School entrance lanterns, **A-9**. This collar appears to be cast with a good deal of hand finishing. The needle and pine cone motif is also featured on the flaring sleeve of the supporting shaft. This flaring ornament on luminaire shafts was a pervasive feature on the fixtures Baker designed for Whitehouse at the U.S. Courthouse in Portland in 1931, although they were based on the Egyptian palm leaf capitals. This direct correspondence of building ornament and luminaire ornament was also common to the U.S. Courthouse.

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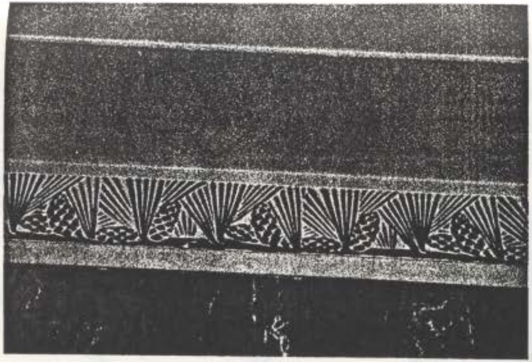


Figure 14. Pine cone and needle lobby frieze

Figure 15. Luminaire with pine cone and needle shade collar

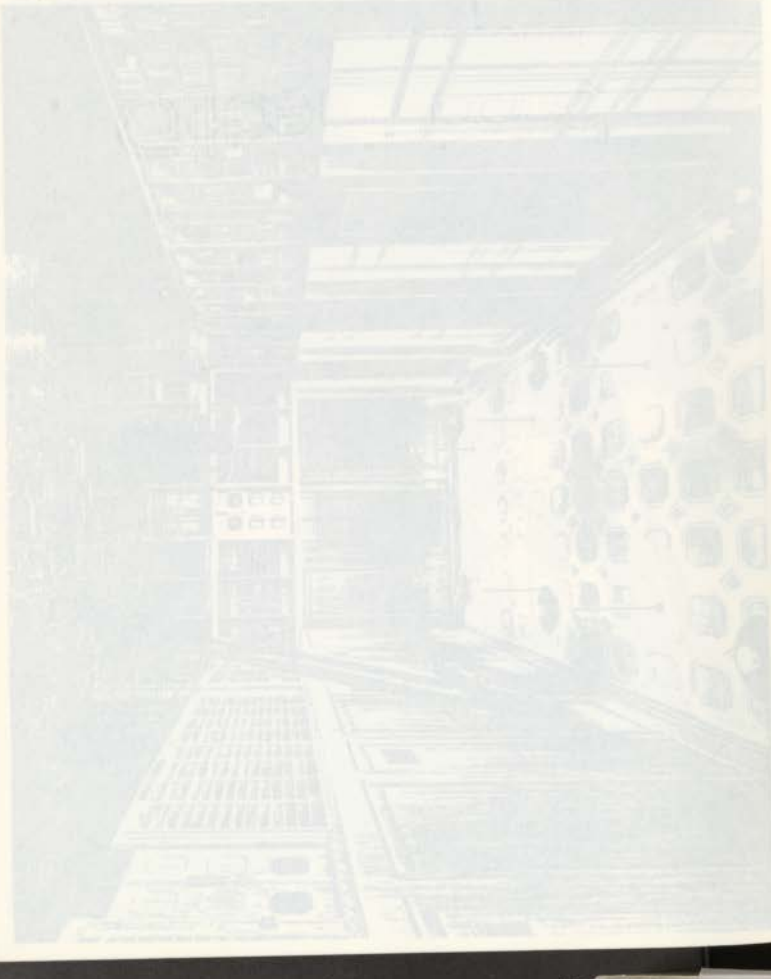
A-10
photograph 1.

A-10
Photograph 2.

A-10
Photograph 2.

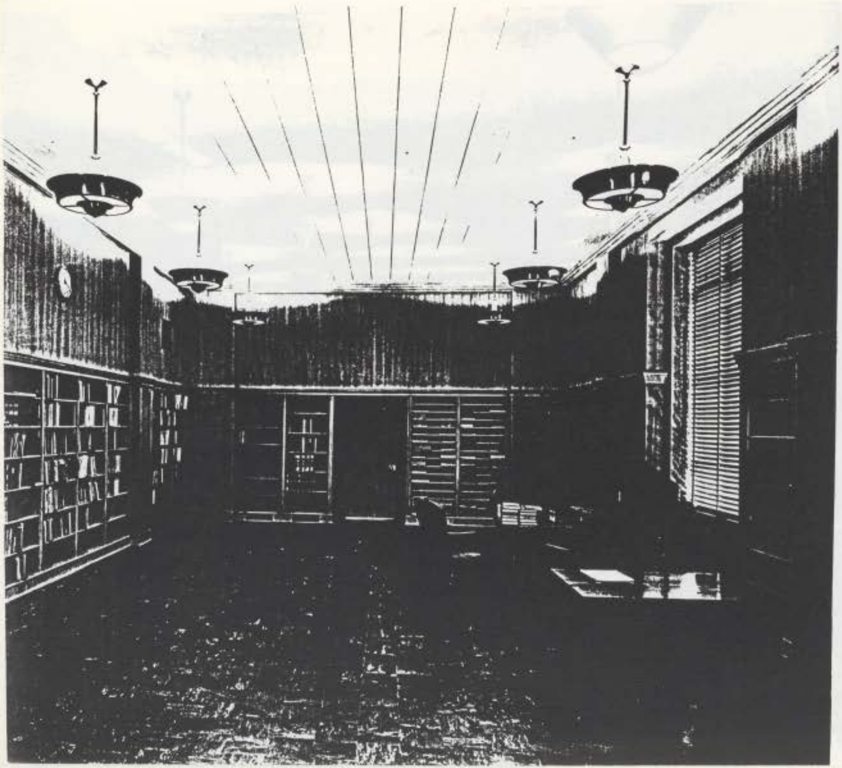
A-10 photograph

A-10
Photograph 4.



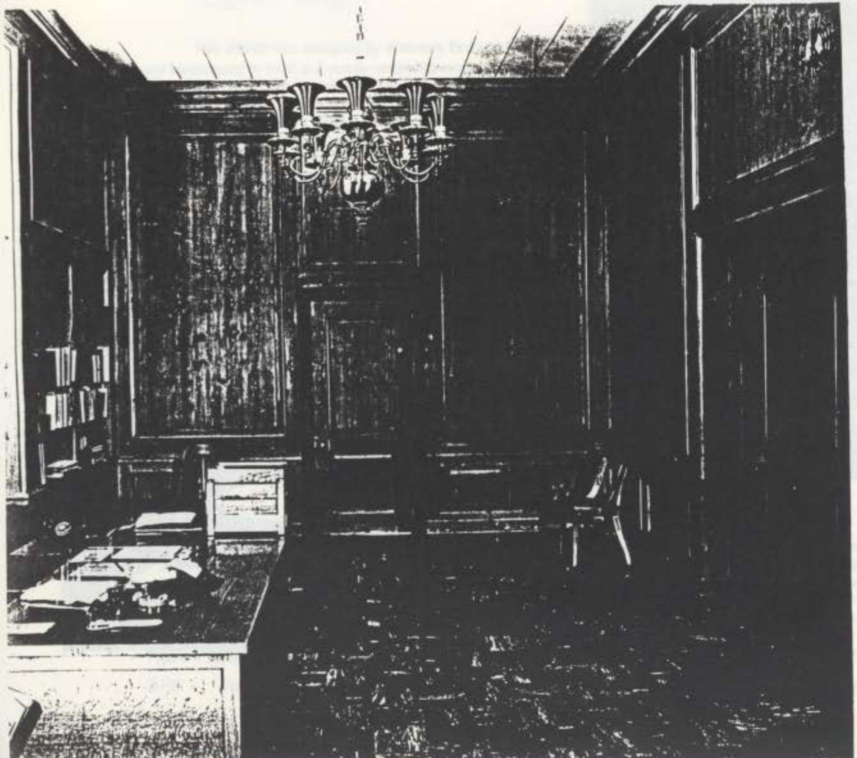
A-10 photograph 5.

photograph 5. Boychuk Photo



A-10 photograph 6.

A-10 photograph 7.



A-10 photograph 8.

First Congregational Church, Eugene, Oregon

This church was designed by Wilmsen, Endicott Architects and constructed in 1952 in a strictly modernist mode; the closest thing to building ornamentation is the exposed glue-laminated timber frame and some applied wooden slats at the altar end of the church. The colored glass windows and the wood-surfaced walls and roof lend the space a rich warm hue, which is enhanced by the bright yellow glow emanating from the inverted bowl reflectors of the eight Baker fixtures installed in the church. The lower spun brass reflector bowl is suspended from the supporting shaft, which terminates in a junction box supplying several incandescent lamp sockets. The lower bowl reflects light into a very large inverted spun brass bowl with a white enamel interior reflecting surface. A large turned brass collar on top of this bowl helps maintain a level setting. Because of the intensely bright light source, only small perforations in the lower brass bowl could be tolerated as a direct light source. These perforations and the brass collar are the only 'ornamental' elements of these fixtures and is quite in character with the architecture. After the Second World War, the elimination of ornamental detail from architecture and an evolving architectural preference for inconspicuous concealed or recessed commercial fluorescent fixtures, forced Baker into the specialized market of

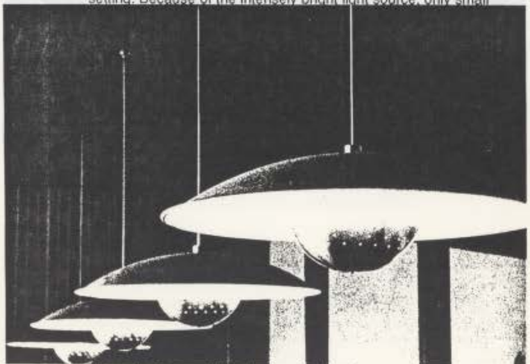


Figure 1. Suspended luminaires in church

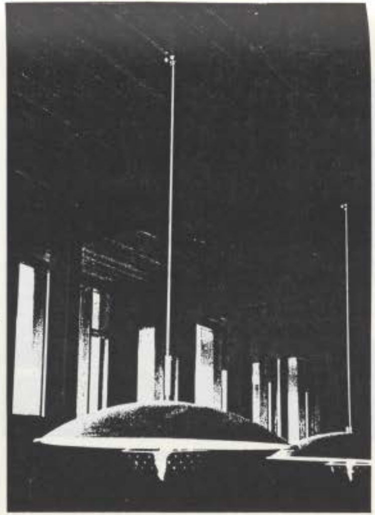


Figure 2. Church luminaire

custom designed church luminaires. This was one of the few remaining building types where the lower light intensity levels associated with incandescent lighting, were still tolerable and where the exposed luminaire was still accepted as a part of the architectural ensemble.

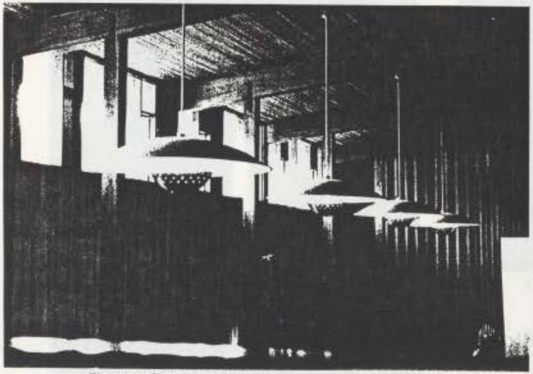


Figure 3. Church luminaires

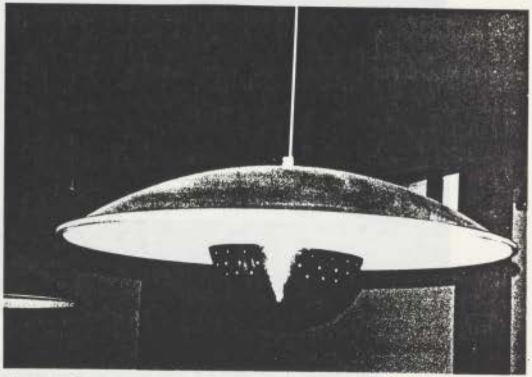


Figure 3. Church luminaires

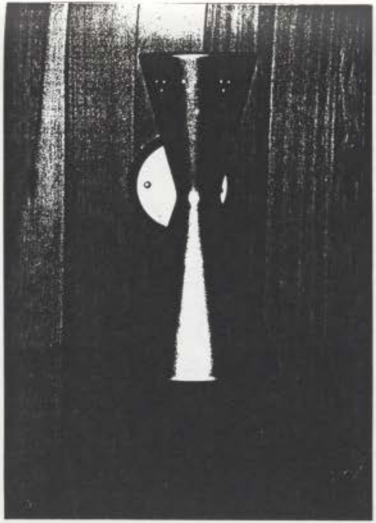


Figure 5. Wall lights in church

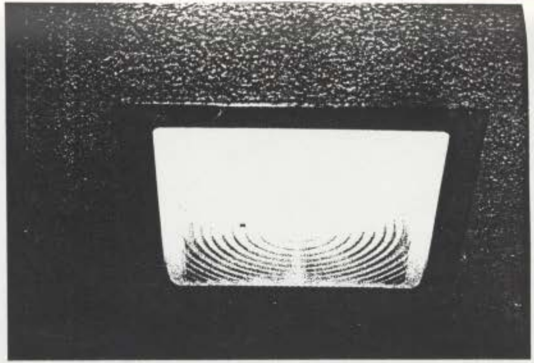


Figure 6. Vestibule ceiling fixture

The wall lights in the sanctuary (Figure 5.) are of sheet brass and were most likely commercial fixtures which F.C. Baker sold in his lighting shop. Similar perforated sheet brass luminaires were used by Baker in the First Presbyterian Church in Eugene in this later period. The material and perforations in the shade help relate it to the suspended luminaires.

The vestibule recessed ceiling fixtures (Figure 6.) are quite inconspicuous, with only the molded refracting lens providing some decorative relief. It is likely that these were also commercial fixtures used by Baker to compliment the custom-designed luminaires he was suppling at this time.

Appendix A: Civic Stadium Site Maps and Additional Figures

Figure 73: Accessed via Googlemaps.com.

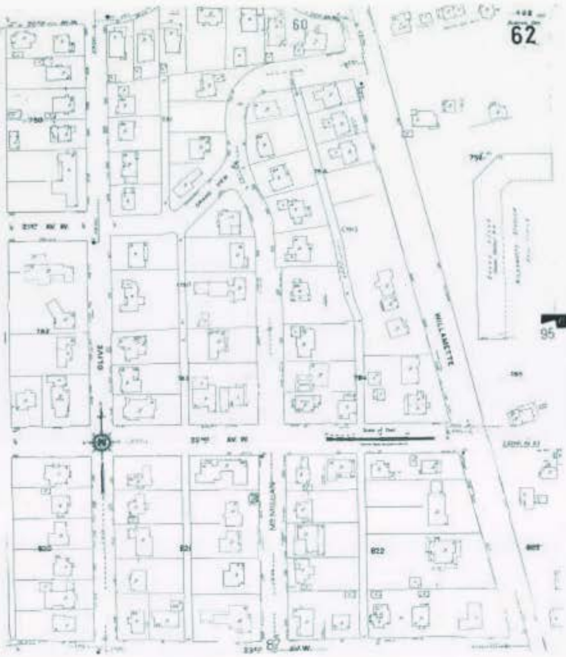


Figure 74: Sanborn Fire Insurance Map 1962, Sheet 62.