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Esao Sumida

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TABLE OF CONTENTS

A CONCERT HALL

for

Albuquerque, New Mexico

by

Jimmy K. Sumida

BACHELOR'S THESIS

Presented to the Faculty of the Division of Architecture,
University of New Mexico, in partial fulfillment of the
requirements for the degree of Bachelor of Architecture.

The University of New Mexico

May 29, 1961

THESIS COMMITTEE:

John J. Heinrich

George S. Wright

Charles W. Tinnin

BACHELOR'S THESIS PROPOSAL

by

JIMMY SUMIDA

TITLE: A CULTURAL CENTER (Music Hall and Art Museum)

PURPOSE OF STUDY:

My attitude and beliefs I hold in architecture demanded a problem which met these demands:

1. A problem that adhered close to pure architecture
2. A problem that in some manner dealt with the cause of humanity
3. To study the relationship of the phenomena of space to sound
4. To study the building in relation to the site
5. To study the materials and form both from a functional and an esthetic standpoint
6. To study the traffic problem

LOCATION: Albuquerque, New Mexico (location within city to be determined later)

THESIS CONTENT:

1. To interpret the phenomena of space to sound
2. To interpret the building to the site
3. To interpret the study of traffic problem
4. To interpret the materials and form both from an esthetic and functional standpoint

5. To extensively develop the music hall, only

Approved:

John J. Heinrich

Chairman, Faculty Committee Department of Architecture, The University of New Mexico.

SCOPE

The problem is to design a cultural center in Albuquerque consisting of an art museum and a concert hall. The problem requires the establishment of a location and site planning of the massing relationship between the concert hall and the museum. Then, the concert hall is to be extracted for extensive development in design. It will be disciplined by elements which the research shall establish.

The major problems to be solved by this research work are:

a. Selection of a location based on rational analysis

b. Methods of attaining good acoustics

c. Architectural expression which will enhance and enrich the listening of music

d. Space requirements

It will be devoid of economical disciplines and disciplines of this nature, i. e., population studies in determining the seating capacity. That is, the design of this problem has been influenced more by intangible consideration, rather than a concern with economical and practical considerations.

And finally, the knowledge I have gained from this research work shall be pursued architecturally.

CRITERIA FOR SELECTION OF A LOCATION

Selection of a location for a concert hall demands more than a site with dramatic connotations. To serve its purpose, a concert hall must vitalize a city. It must hold the city together by bringing life into the people and the city. It must be strong and respective and also receptive. A concert hall must be a structure which unites the hearts of the people. A place where the people of a city proudly share life together.

It must be a place where all aspects of life are abound; cultural, commercial, and governmental. Each of these aspects must be elevated in the eyes of the people. Yet, kept in just balance to avoid a lopsided communal life. Only with this balance and elevation of all aspects of life can people take pride in a civil life.

A concert hall unbalanced by the overpowering commercial aspect of life that has no concern for people as people; public offices scattered and uncoordinated, possessing no dignity; and culture isolated from the people making no contact with the people, will only cause the disintegration of the communal life.

The task of revitalizing the city and embuing the city with life is part of the architect's responsibility, for he is the man who deals in a form of art that is in charge of the environment of man, the thing most influential in developing man's way of thinking and feeling.

A concert hall embodying such beliefs cannot be situated in any other place than the core of a city. And accordingly, the cultural center, which is to be an integral part of the civic center, must be situated in a central position.

For this problem we shall assume that the core of the city, which will house the center, will be redeveloped. This redevelopment will include the exclusion of automotive traffic from this area. To make this feasible, we shall provide for underground streets and parking and large parking structures.

In addition, the civic center will be zoned. Three basic zones will be designated:

1. Commercial area (offices, stores, banks)
2. Public offices (city hall, administrative offices for education, health, etc.)
3. Cultural center consisting of a concert hall

I shall undertake the designing of the cultural center as my specific problem.

A city which embodies the above ideas in its civic center will once more revive the cultural aspects of life. An aspect which has lost significance in our world, but an aspect which deserves a place of importance in any civilization.

ACOUSTICS

a) Acoustics and Materials

Scientific approach to control acoustics in a building is a recent innovation; yet practice has shown that scientific approach has never proved fully satisfactory.

Though science has been able to control the physical behavior of sound to some degree, they have failed to find methods to convey sound to audiences without some distortion.

When one tampers with sound in an attempt to increase its volume or to change the direction of the sound rays, the results has been a distortion of the original tone.

Sound, more than other phenomena, seems least receptive to control. It is not receptive to amplification. Sound is distorted by the ineffectiveness of the amplifiers in relaying all registers of frequency with equal magnitude, i.e., most amplifiers fail to relay registers of high frequency. This is the reason why recordings appear to have too much base tone.

Likewise, similar problems are encountered in using reflective elements to reflect sound. Reflective elements relay high frequencies, but low frequencies manage to penetrate through the reflective element. Thus, relayed sound results in unbalanced reception.

The selection of a reflective material should then be based on the material's ability to:

1. Reflect all registers of frequency (with equal magnitude)

2. Materials capable of enriching the tonal quality

3. Absorb sound

However, the above three points are not absolute abstract standards. Each one has to be taken into account in relation to the particular problem being worked on. For example, one may need a material with 100% absorbtion for one job and only partial absorbtion for another. In turn, this means that the materials cannot be selected beforehand, before the conditions are known. Each problem is a new problem and past experiences can only be a guide, not a scientific certainty.

b) Seating Capacity and Acoustics

Russell Johnson, acoustical engineer from Yale, tells us that there is a direct relationship between the space in volume (in cubic feet) and the capacity of an orchestra to perform within that space. In other words, if the volume of space exceeds 750,000 cubic feet, problems in obtaining satisfactory acoustics increases proportionally.

The situation is comparable to an attempt to double the loudness of a violin by simply doubling the size of its sound box.

The result is a louder noise, but one no longer has a violin and the tonal quality associated with this instrument.

Chamber music, string quartets, and solos are best acoustically when performance is in a small auditorium; full size orchestras are most satisfactory when they perform in auditoriums having around 300,000 to 700,000 cubic feet of space.

Reverberation timing is the main factor involved in determining the volume of a concert hall. It is found that varying activities demand reverberation of different timing. Russell Johnson has divided the activities into two categories:

1. Requiring relatively short reverberation time -- lectures, musical comedies, operas, assemblies, motion pictures and exhibition

2. Requiring relatively long reverberation time -- organ, orchestra, chamber music, voice, violin, piano and string instrumental groups

The latter group demands reverberation timing from 1.4 seconds to about 2 seconds, while group one is 1.4 seconds and lower.

Therefore, the type of activity this building should house must be established. It is essential to good acoustics that this decision be made without compromise. That is, if the building is designed specifically for orchestra, one must not compromise with practical considerations etc., and formulate a design which

allows for the housing of other activities. For if one does this, then the building ends up being a conglomeration which is not suitable for any kind of activity.

For the above reasons, I will design for activities which demand reverberation ranges of 1.4 seconds to 2 seconds. This means a building containing 300,000 to 700,000 cubic feet of space and a seating capacity ranging from 1,000 to 2,000 seats.

In designing a building of this nature one must not only take into account the physical problems spoken of above, but must also recognize the psychological factors.

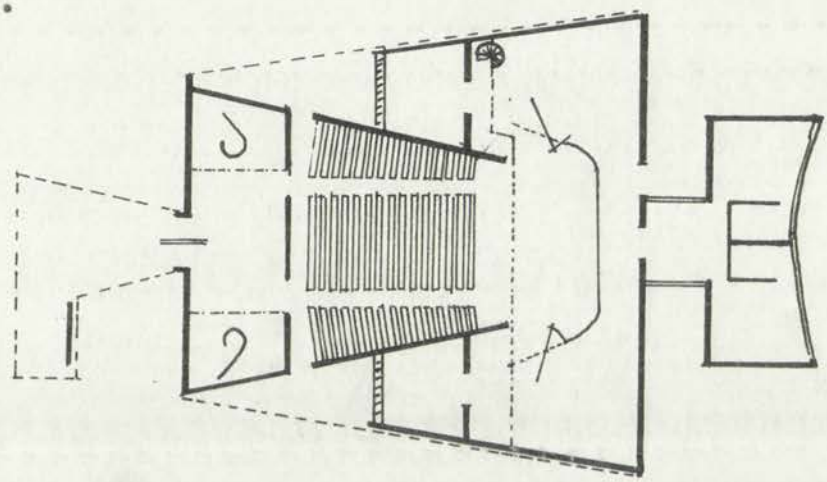
A musical performance is not an art which depends upon sound alone, for in any performance there is the problem of creating intimacy between the performer and the audience. To maintain the desired intimacy it is essential to control the size of the audience. When the audience becomes a crowd the problem is magnified.

c) Shapes and Forms in Acoustics

Recent designs in concert hall have been careful in shaping the form which would be conducive to good acoustics. In regard to forms there are two schools of ideas:

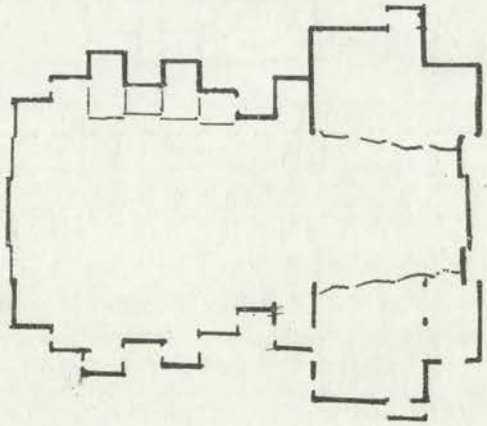
The ideal proportion has been found to be 2:1 of length to width, and due to the fact that the time lag between the reflected sound and the direct sound is from 20 to 40 millisecond. In order to achieve this ideal time lag, ceiling reflectors must be kept at a height of about 25 feet from the floor and the width from wall to wall should not exceed 85 feet.

The other ideal shape employed frequently is the fan shape.



Though this form has been mentioned as a good form acoustically, justification seems to be lacking.

The most recent innovation is the form designed for the Clowes Memorial Hall, Indianpolis. The principle here is to break up the wall in this fashion:



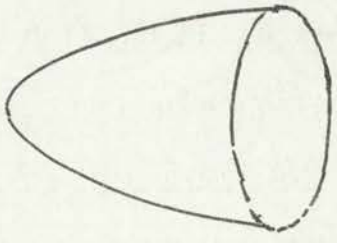
The justification of the Clowes design is that it allows for proper reverberation time and also because of the narrow shape, one gets the proper time delay between the direct and the reflected sound.

The Clowes design, in general, is the most satisfactory in solving the acoustics problem.

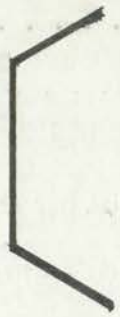
d) The Orchestra Shell

The important thing in the design of an orchestra shell is that the shell is effective in sending the sound out towards the audience, as well as making it possible for everyone within the orchestra to hear one another without any interference or distortion in the sound.

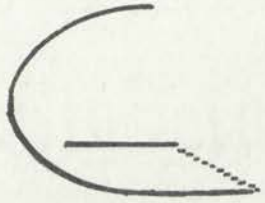
The form which best answers these requirements is a three dimensional eliptical form.



and the convention stage form



For additional effectiveness the orchestra shell should be unattached to the platform upon which orchestra sets.



The above theory is similar to the principle used in the construction of the diaphragm of a loud speaker. Any interference on the diaphragm will blur the sound. My theory maintains that an orchestra shell should also be free from this kind of interference.

WRITER'S PHILOSOPHY

Music and Architecture

a) Introduction

Many artists have envisioned architecture and music as being the most closely related of the seven arts. The only element which separates these two arts is perception. While one is a visual art the other is an audio art; but the essence, the way in which the artist conceives the ideas, the feelings, and the expression is the same.

This semblance of essence becomes most evident in the linguistic expression of the principles of both the arts, such as scale, balance, rhythm, proportion, movement, etc. And with the birth of a new epoch, the 20th century, we again awaken our abilities to see, imagine, feel, think and sense in like manners. However, each age expresses its own emotions, beliefs and ideologies. In the 20th century, in architecture and music, we find the emergence of new ideas, new words, and new methods of expression. These new thoughts are symbolized by words such as dissonance, contrapuntal, discord, and dynamics. Words, meaning and principles to express our age as rhythm, balance, etc., have symbolized and expressed the past.

It is no wonder then that the innovative architects of our time, Frank Lloyd Wright and Le Corbusier, have attempted

to convey this visual art in terms of, or in relation to, musical terminology. Frank Lloyd Wright once said, "Architecture is an eye music and music an ear music."

The painter, Sir Joshua Reynolds said, "Architecture is frozen music." The "Dictionary of Modern Painting" brings out this relatedness in architecture and music by pointing out that architecture and music are the only arts which in their true innate state, belong to the abstract arts.

The semblance of these two arts was intensified with the initiation of a new language in architecture. This language is known to us as space. The initiation of this language has enabled architects of our age to see beneath the outward forms of architecture.

This innovation has enabled architects to make forms the instruments of space, as in music, the musical instruments are the instruments of sound. This means that architects may now express plastically that which they conceive.

This has been a source of stimuli to the architect in liberating his imagination to sense architecture with a fullness of feeling. Architecture now can be conceived of as a composition of a spatial symphony; where the light and the delicate spaces play against the harsh; where volume is intensified and lowered through light and darkness.

b) Spatial Harmonics

The conventional order of principles of harmonics; rhythm, balance, proportion, scale, etc., allows the making of a composition which is but too well organized and seems out of harmony with our time. People now long for compositions which deviate from the symmetrical and well disciplined harmonics. They look for harmonics which allows for the element of surprises, the unexpected, and for excitement in composition.

Rules and principles have been developed to obtain harmonics which allows the making of a composition embodying these elements. Namely, these principles are dynamics, dissonance, discord, and contrapuntal.

1. Dynamics can be said to correspond to a newly evoked conception of our time.

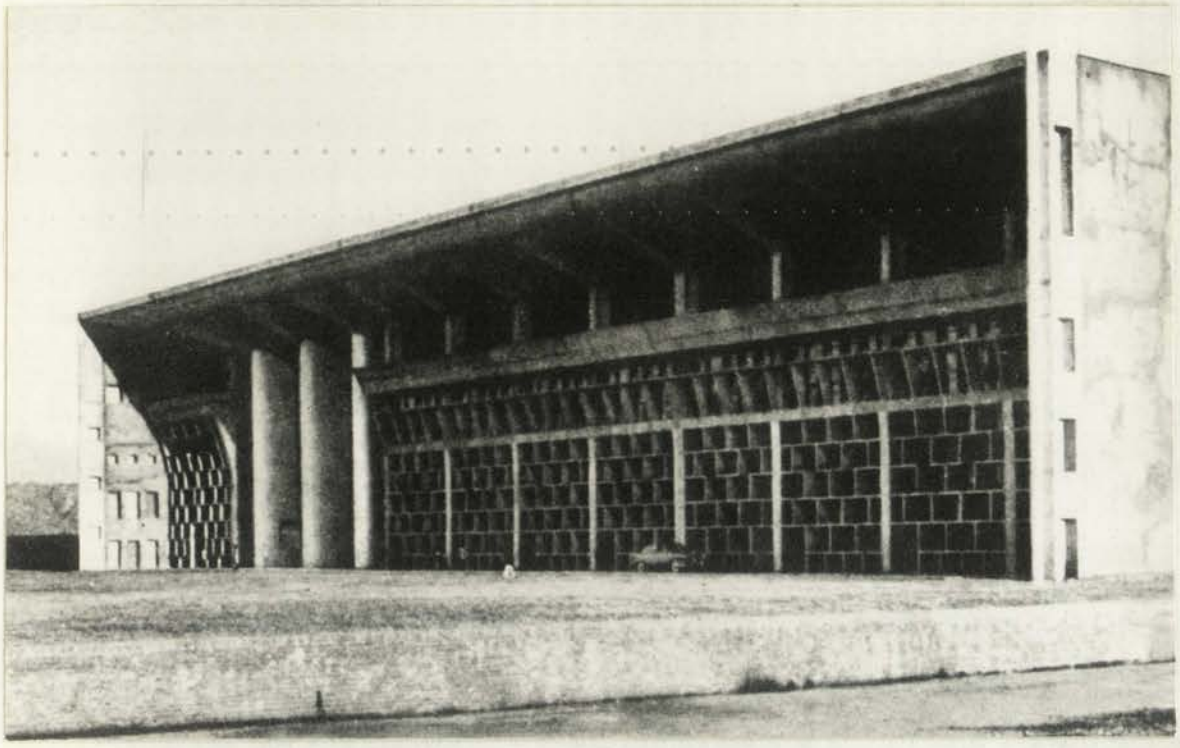
   For the most part, we no longer compose within the conventional modes. We do not envision compositions as a total entity in itself, having a beginning, middle, and an ending; but an entity which becomes dependent on its environmental surroundings to the extent that a building cannot be extracted from its surroundings without destroying its essence.

   We now compose by creating transitions from the surroundings to the building. And the building becomes

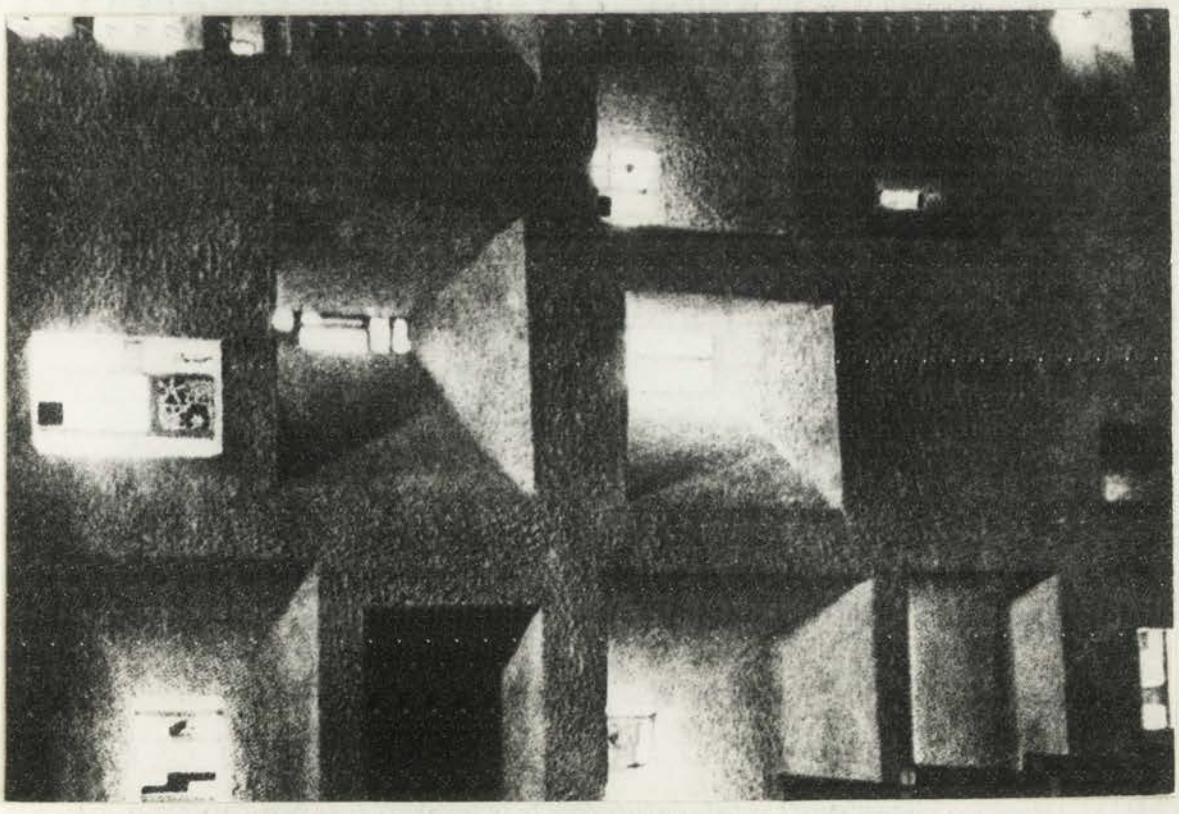
not merely a mass resting on earth, but a building which spreads influence to its surroundings. We do this by creating with forms in a manner that allows them to caress, to embrace, and to touch space. We do this by varying the intensity of spaces, such as by building up to crescendos, and by activating space so that it reaches out, moves and seems forever changing. The above ideas have come to be known as dynamics of space.

The theory of dynamics of space has penetrated into the interior of the building. We no longer have compartments of space with well defined forms, but we have learned to create plasticity of space. Plasticity which means movements of space which intervenes and integrates all space.

2. Dissonance is best expressed by Le Corbusier in his use of dissonant spatial organization to produce effects of uneasements and tension. Le Corbusier differs from Wright's approach of destroying the box. Le Corbusier approaches the problem by seeing how suggestive he can make the form in losing identify of itself without actually doing so.



Le Corbusier cleverly deviates from the conventional principles of harmonics to get dissonant spatial harmonics.



From the diagrammatic study of his book "The Modular", we are made aware that the placing of these forms are not haphazard, but have been worked out on his modulation scheme.

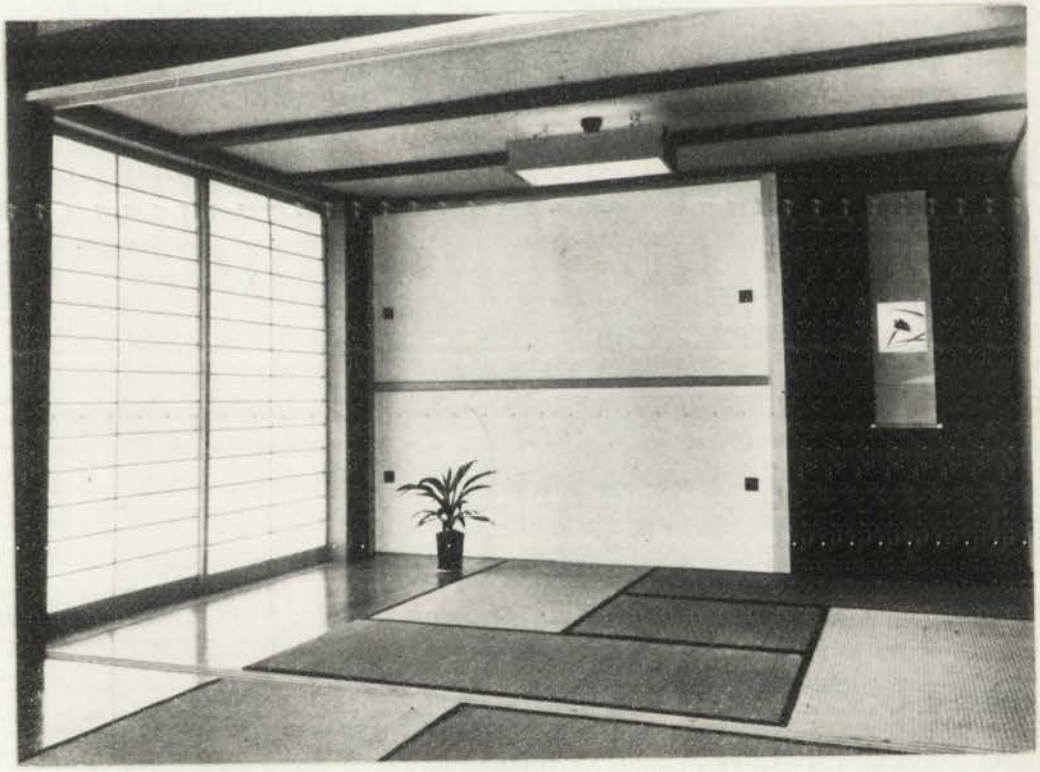
3. Discord is another principle which we employ extensively in art today. *"Discord is extreme contrast or difference. Discord is a combination of total unrelated units."

The most common use of discord is in the use of color and in shapes of form. An example of this is this sculpture.

*Quoted from Art of Color and Design

4. Contrapuntal can be defined as the overtones of space. Reflective or inversion overtone space is created by the use of reflective elements, such as reflective pools, mirror, etc.,

Another overtone of space is created by the use of translucent elements which tranquilizes or subdues the space.



Repetitive overtones are created by the shadows cast on surfaces.

The employment of these principles is not exclusively limited to our age. The above suggestions are but a few of the possibilities.

SPATIAL MODULATION

Tonic key in music is comparable to an established proportion in architecture. While modulation in music is movement from one key to another; in architecture, modulation is the movement from one proportion to another.

The Greek Parthenon can be said to be a composition composed in a single key, for the proportion throughout the composition

is the same. With progress in time, modulation in harmonics have become more fluid as well as more complex.

Scholfield, author of "The Theories of Proportion in Architecture" classifies proportion into two main categories: 1) Commensurable proportion and 2) Incommensurable proportion.

1. By commensurable proportion Scholfield means, proportion whose properties are possessed by geometric progression based on whole number alone. In this kind of proportion the ratio of the sides of the rectangle remain the same. In other words, in a geometric progression of a commensurable proportion, the adding of linear proportions together to form larger dimensions will result in a pattern which always maintains the same proportional relationship. In this, Scholfield emphasizes the inflexibility of the commensurable proportion.

2. By incommensurable proportion he means proportion whose properties are not possessed by geometric progression based on whole numbers alone, but the geometric progression which possesses a wide range of additive properties. A good example is the theory of modulation developed by Le Corbusier.

The invention of the incommensurable proportion has given architecture new freedom in composition, just as the introduction of a new key in music has given music a wider range of freedom.

In the relationship of one key to another in music (modulation), we find that there are certain combinations of keys which go well together without any uneasement, and generally speaking these are the cluster of neighboring keys. We also find that in architecture there are certain proportions, in certain arrangements, which makes for a pleasing composition.

However, we of the 20th century identify ourselves with a new approach to harmonics. Contemporaries in music; Stravinsky, Schoenberg, Copeland, and others are the source of the origin of dissonant modulation. They have combined keys which are not consonant of one another and the combination of these keys have given music new tones.

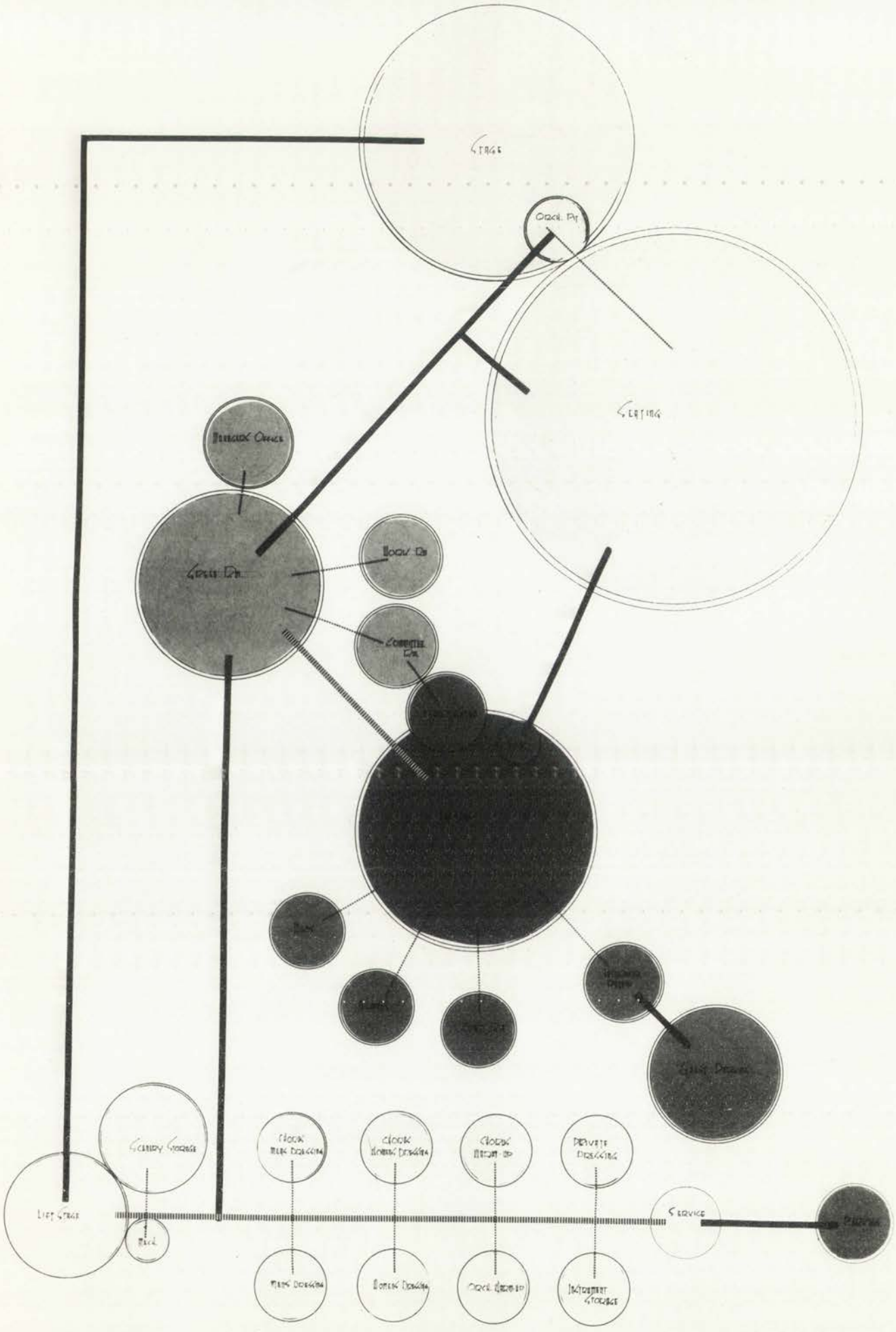
Likewise, architecture is witnessing a similar innovation in harmonic structures with Le Corbusier leading the way.

SPACE REQUIREMENT

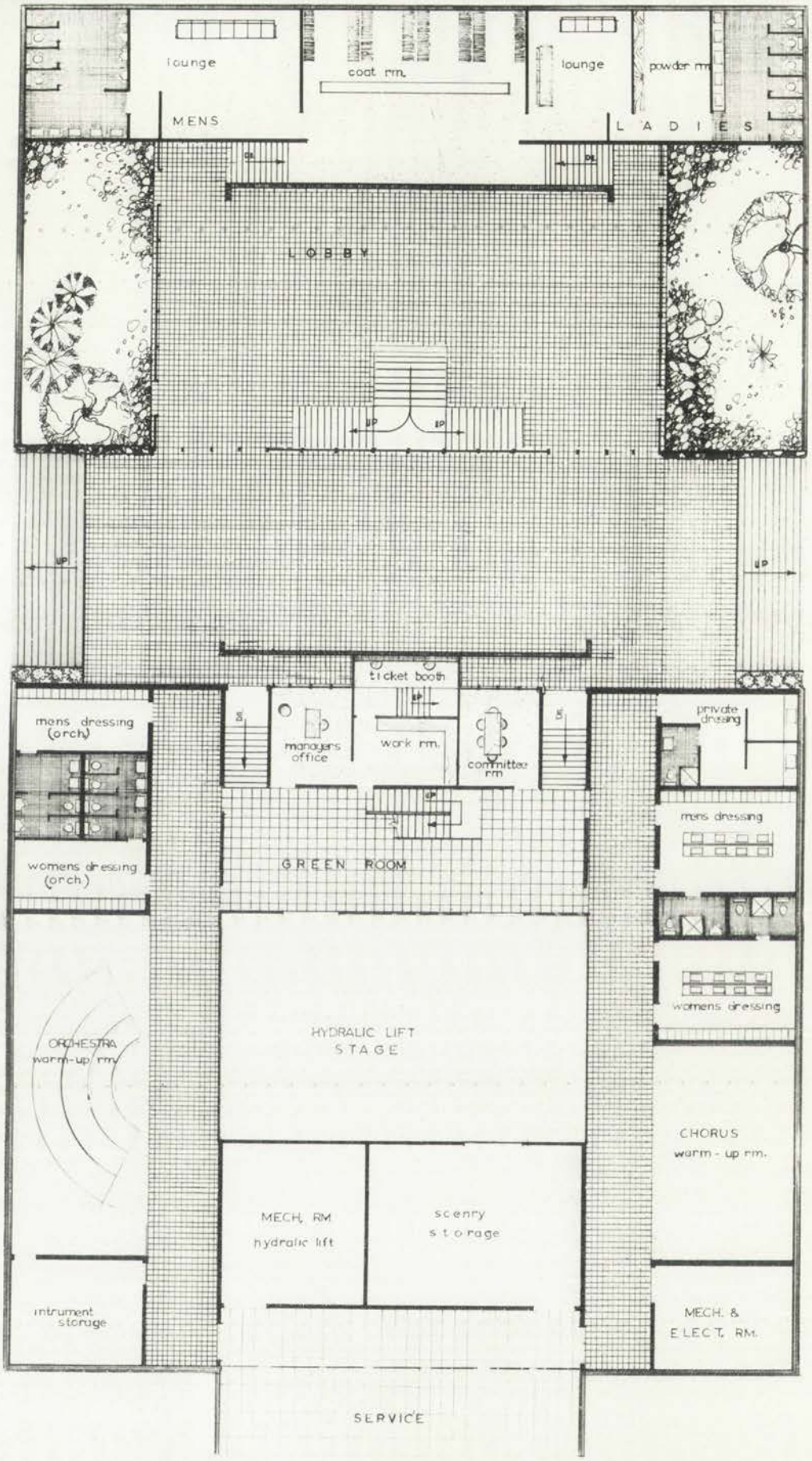
1. Seating - 1,200 seats -- 300,000 cubic feet ---------- 8,000 sq. ft.
2. Stage ---------- 4,800
3. Lobby ---------- 4,000
4. Ticket Booth ---------- 100
5. Ticket Office ---------- 250
6. Manager's Office ---------- 250
7. Work Room ---------- 180
8. Coat Room ---------- 200
9. Men's Toilet ---------- 500
10. Women's Toilet ---------- 500
11. Custodian ---------- 100
12. Storage ---------- 200
13. Orchestra Warm-Up Room ---------- 2,000
14. Orchestra Dressing Room
    a. Men ---------- 600
    b. Women ---------- 600
15. Chorus Warm-Up ---------- 1,000
16. Chorus Dressing
    a. Men ---------- 400
    b. Women ---------- 400
17. Lighting ---------- 100

18.	Storage	300 sq. ft.
19.	Library	150
20.	Green Room	500
21.	Instrument Storage	300
22.	Mechanical Room	600
23.	Committee Room	200
24.	Lighting (behind stage)	100
25.	Employee Dressing	
	a. Men	250
	b. Women	250
	Total	27,030 sq. ft.

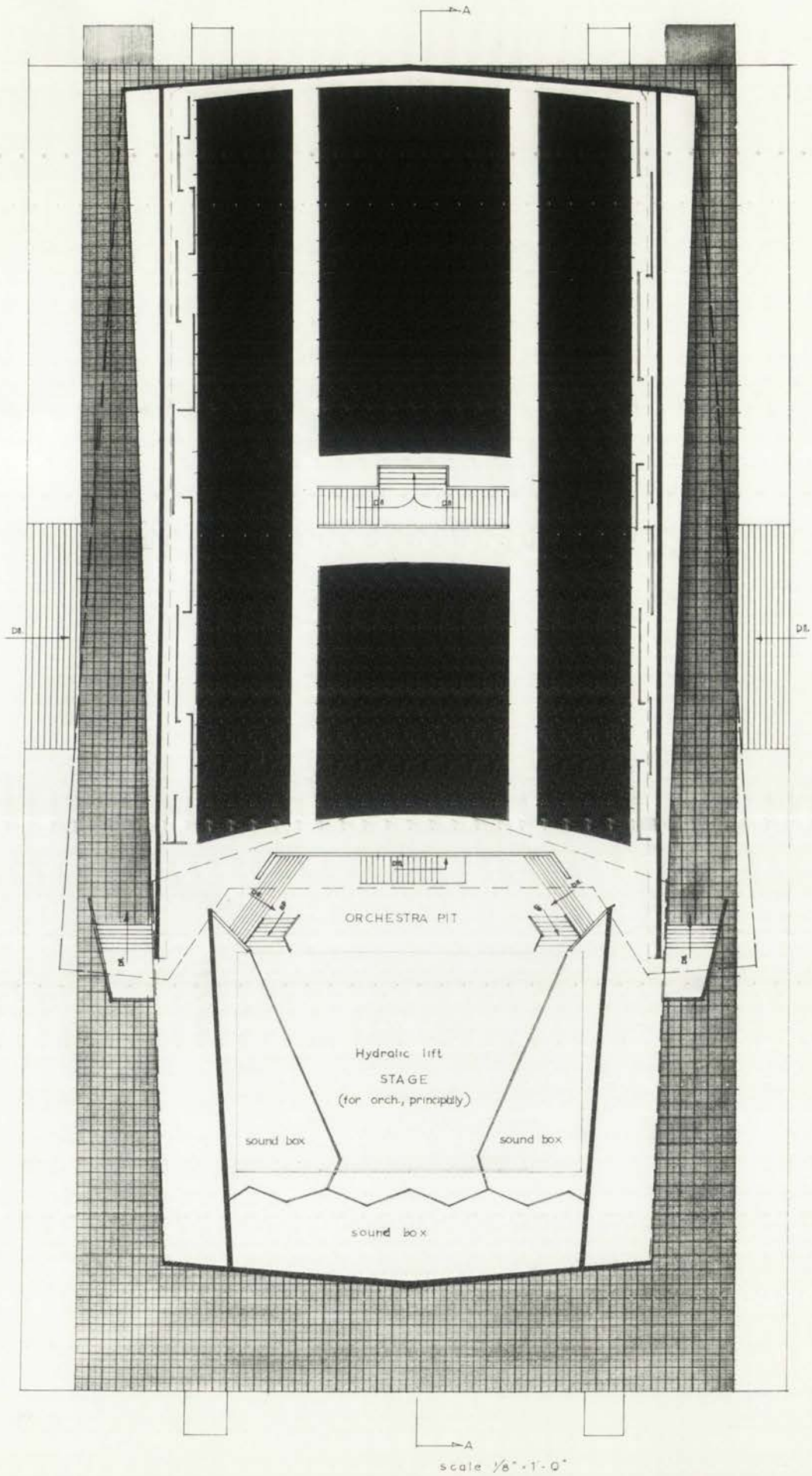
1.	Parking	35,000 sq. ft.
2.	Museum	15,000
3.	Concert Hall	27,030
	Total	76,500 sq. ft.



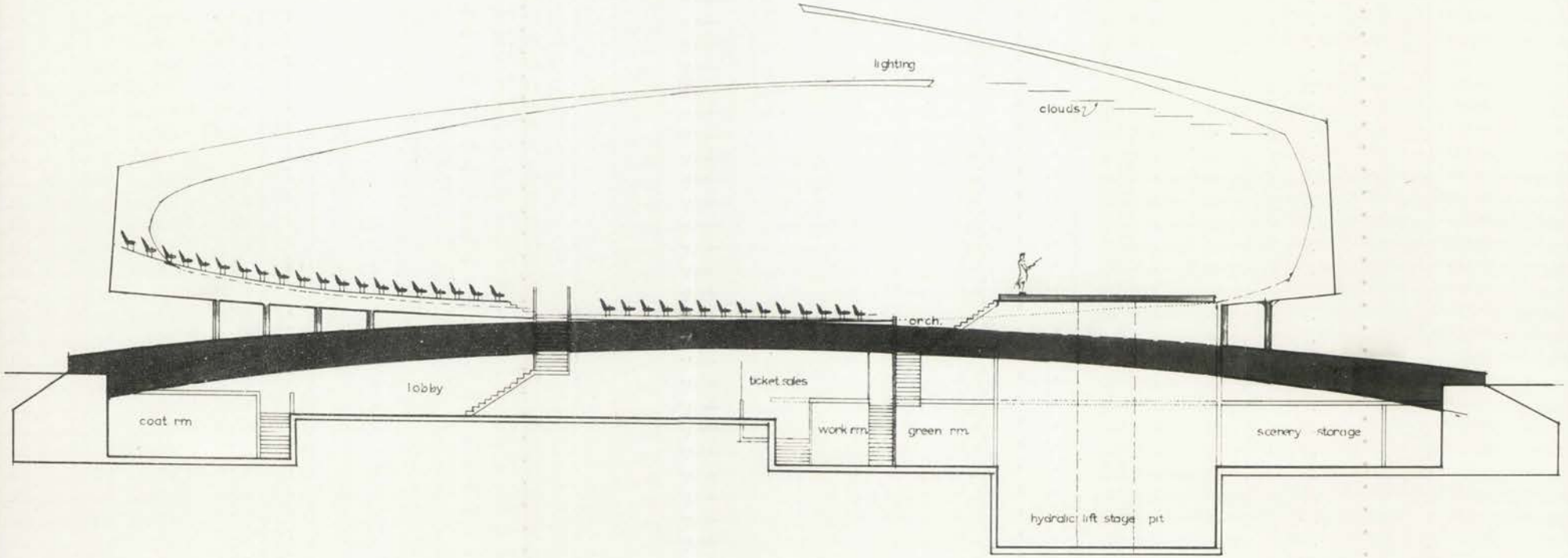
DIAGRAMATIC CONCERT HALL LAYOUT


lounge
coat rm.
lounge
powder rm
MENS
LADIES
DN
DN
LOBBY
UP
UP
UP
UP
ticket booth
UP
mens dressing (orch)
DN
managers office
work rm.
committee rm
DN
private dressing
UP
mens dressing
womens dressing (orch.)
GREEN ROOM
womens dressing
HYDRALIC LIFT STAGE
ORCHESTRA warm-up rm
CHORUS warm-up rm.
MECH. RM hydralic lift
scenry storage
intrument storage
MECH. & ELECT. RM.
SERVICE
N

SCALE 1/8"-1'0"

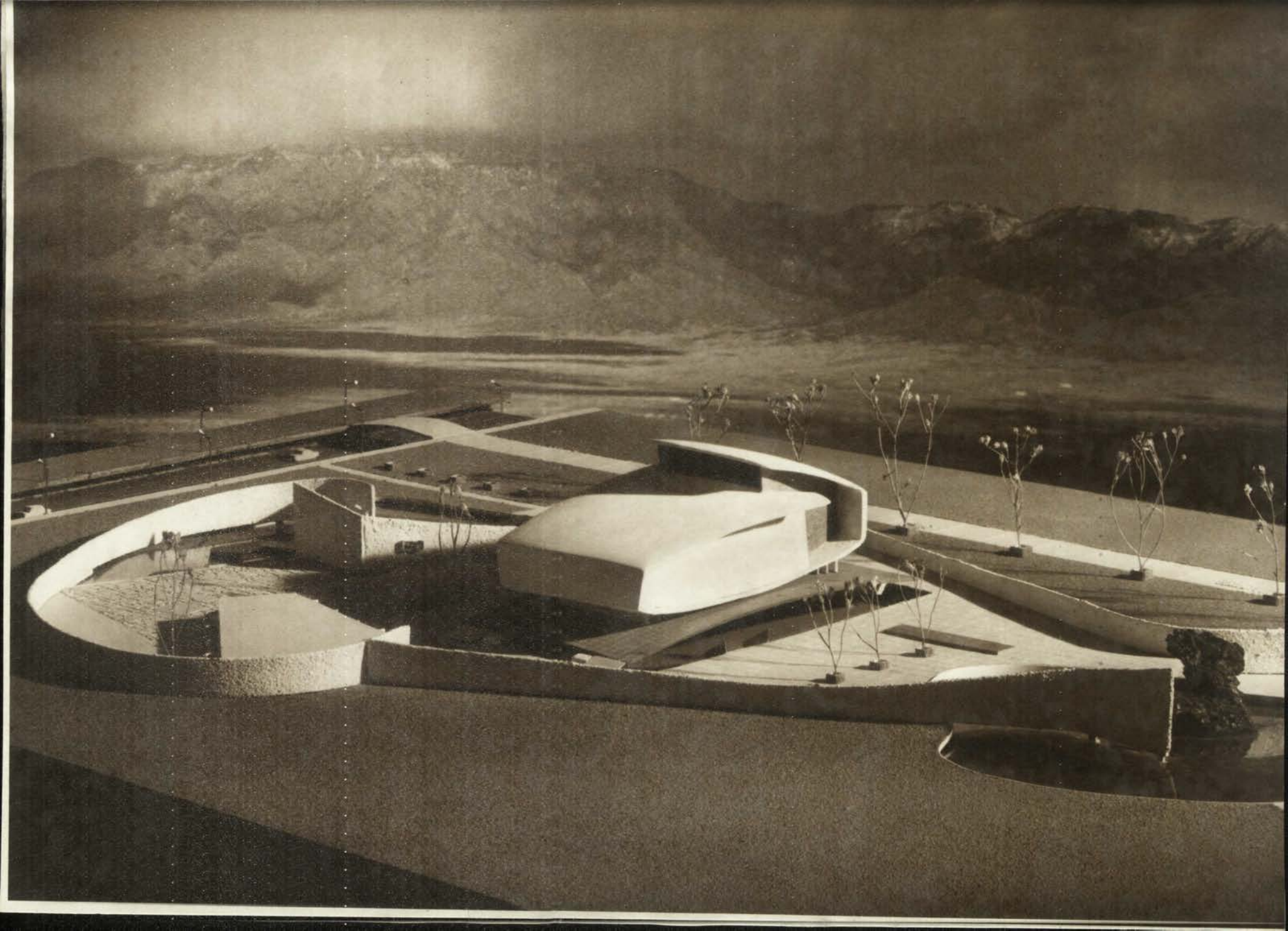

A
A
DR.
DR.
ORCHESTRA PIT
Hydralic lift
STAGE
(for orch., principlally)
sound box
sound box
sound box
N

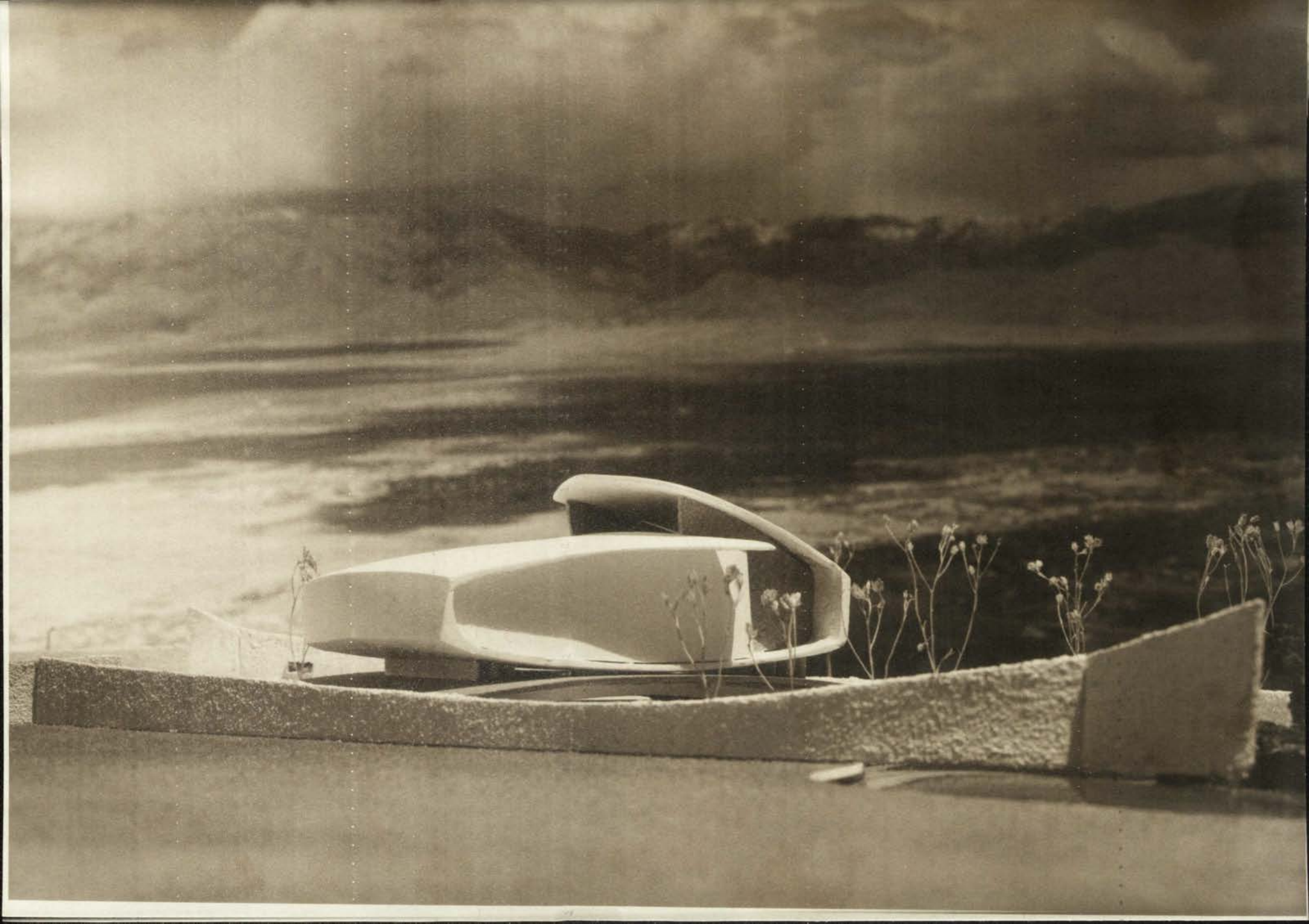
scale 1/8" - 1' - 0"



SECTION A-A

scale 1/8" = 1'-0"





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The Modular II, Le Corbusier

The New World of Space, Le Corbusier

Creation is a Patient Search, Le Corbusier

Architecture as Space, Bruno Zevi

Arts of Color and Design, Graves

Introduction to Music, H. H. Miller

INTERVIEWS TAKEN FROM

Mr. M. Bonney, Conductor of Albuquerque Civic Symphony

Dr. Kurt Frederich, Conductor of UNM Orchestra

Dean Stein, Dean of College of Fine Arts UNM

Dr. H. H. Miller, Professor of Music UNM

Dr. Blankenship, Chairman of Department of Music UNM