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WELCOME ADDRESS

by
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In welcoming you to the fourth annual conference for architects, I should like to note what seems to me a significant direction which these conferences have taken.

The first conference was held in 1952 in conjunction with the Department of Mechanical Engineering, on the subject of Heating, Ventilating, and Air Conditioning of Small Buildings.

The second conference, in the following year, discussed many different aspects of school planning.

The third, in 1954, was on church planning, and an imposing list of architects and churchmen attended the conference and added their special knowledge to its content.

In March, 1955, a letter was sent to all those who had attended any or all of the conferences, asking them if they would prefer a conference on a definite building type, such as those which had been organized the two previous years, or a conference which did not emphasize such a particular subject, but which would be built instead around a broad sociological, aesthetic, and philosophical approach. A decided majority of this poll indicated that most people were in favor of a program organized along these latter lines.

The subject matter of the four conferences, which were developed quite individually and in response to the expressed desires of interested architects, has thus traveled from a specific physical and material field, through a consideration of functions, first educational, then religious, to a still broader discussion which it is our hope will relate physiology, psychology, and certain theoretical aspects of design, color, and form to particular architectural problems.

Any group of architects is inevitably going to translate theoretical concepts into possible solutions to specific situations. The bringing together of theoretical and practical insights into this business of the extension of personality which is architecture can be an exciting business. There is an impressive amount of professional competence and experience in a wide variety of fields represented by the experts who have been good enough to collaborate in building this program. I think that there is the possibility that the total result may go beyond analysis and discrimination (essential as these are) into the field of truly creative thinking, which a conference topic like the present one is aiming at.

WELCOME ADDRESS

by
Allen S. Weller, Dean
College of Fine and Applied Arts
University of Illinois

In welcoming you to the fourth annual conference for architects, I should like to call your attention to a significant direction which these conferences have taken.

The first conference was held in 1952 in conjunction with the Department of Mechanical Engineering, on the subject of Heating, Ventilation, and Air Conditioning of School Buildings.

The second conference, in the following year, discussed many different aspects of school planning.

The third, in 1954, was on general lighting, and a large list of architects and engineers attended the conference and brought their special knowledge to its solution.

Moreover, again, a letter was sent to all those who had attended any or all of the conferences, asking them if they would prefer a conference on a definite building type, such as those which had been organized the two previous years, or a conference which did not emphasize such a particular subject, but which would be built around a broad ideological, technical, and philosophical approach. A marked majority of this poll indicated that they would vote in favor of a program organized along these latter lines.

The principal topics of the four conferences, which were discussed quite individually and in response to the expressed desires of interested architects, have thus proceeded from a specific physical and material thing, through a consideration of functions, first educational, then religious, to a still broader discussion which this year will include psychology, philosophy, and esthetic theoretical aspects of color, light, and form as parts of the architectural problem.

This group of architects is invited to group its questions [illegible] and practical [illegible] to specific situations. The [illegible] of theoretical and practical thoughts with that [illegible] of the [illegible] of responsibility which is architecture [illegible] building business. There is an impressive [illegible] of professional experience and specialization in a wide variety of fields represented by the experts who have been good enough to collaborate in building this program. I think that [illegible] is the possibility that the local results may go beyond that [illegible] and [illegible] (important as these are), into the field of truly creative thinking, which is important [illegible] any moment now is coming up.

It is a great pleasure to greet you, for the University of Illinois, and more particularly for our College of Fine and Applied Arts, the Department of Architecture, and the Division of University Extension, which have collaborated in organizing the conference. We are glad you are here, and we hope that your visit will be pleasant and profitable.

INTRODUCTION

by
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New York City

It is a distinct pleasure to be in attendance at this Annual Conference for Architects. My pleasure is heightened in that I have been allowed to get up here and tell you why I feel so pleasant about it all. The program has allotted me a full hour. I won't need that much time. For though my pleasure in this occasion is unbounded, my capacity for its vocal expression is, happily, somewhat restricted. These remarks are obviously designed to create an initial climate of favorable attitude on your part. I shall need all this I can get, for what I have to say may not be at all what you would like or deserve to hear.

My principal theme is the architect's use or lack of use of the stimuli and resources which are everywhere around him -- to the end that we may have a better architecture.

This better architecture will not come unto being until it is a whole architecture conceived out of concern for the whole range of man's interests, activities, senses, ideas and aspirations. We do not generally have that kind of architecture today. Rather we have an architecture of parts -- an architecture often of brilliant parts -- but seldom assembled into satisfying wholes. Today our architects are too often purveyors of partial satisfaction, performers in the "arena of achievement limited".

Actually, each of us is three men. Mr. Lewis Mumford has identified the three as man acting, man feeling, and man thinking. The architect must be stimulated by man in each and all of these aspects before we can hope for an architecture which appeals to all three; and unless there is appeal for all three, we will not have a wholly satisfying architecture.

Today, for example, we are mastering thin shell concrete and this is a splendid thing. There is in it a powerful appeal to the mind (it is a wonderful expression of our century's abilities); its curved or undulating surfaces appeal powerfully to the senses as well. But I detect in some of our recent essays into this structural technique such a fascination in the thing for its own sake that man acting -- man the user of buildings -- is likely in many ways to be forgotten. Perhaps this is ever the case in first efforts and in first efforts we can and must excuse that passion for particulars which so easily precludes passion for wholenesses. But what can we say for those architects who continue to be so enchanted with, for example, glass facades -- certainly no new thing and not at all in the realm of first efforts any longer -- so absorbed with glass that office workers from Atlantic to Pacific are squirming in the afternoon sun. A kind of coast-to-coast roast. When fascination with a structural system or a material drives out consideration of man's comfort, the product is

not architecture but a cruel joke. A shining glass wall -- day or night -- can be a marvelously sensuous thing and it can appeal strongly to our minds, but it must not find its way into a building until the architect has projected himself into all its consequences and has satisfied himself that it is working well for man acting and feeling and thinking.

Men are creatures of enthusiasm and those most imaginative are often those most enthusiastic. Enthusiasms are consuming. They have a way of using up all our interests and energies and time while blinding us to those things which are not part of the original stimuli. This is what the architect must guard against constantly -- and from just about his second year in architectural school. My own observation has been that the first-year student generally sees separately the elements of whatever problem he is given and works separately with them. He struggles to make each part work, but seldom -- or only with the greatest pain -- can he bring the several considerations into harmonious unity. He is haptic; a kind of Grandma Moses of design. Everything is there but is unrelated. Thus, the plan may work for circulation but the load-bearing planes and points are a welter of confusion; each portion of the space may be well lighted, but the over-all fenestration pattern is a nightmare; or there is a place for everything in the plan but the perimeter changes direction so often it looks as if gophers had been at it.

But somewhere along in the sophomore year the boys make a discovery, and their joy is unbounded. The light has dawned and the art of architecture is seen in that clear dawn as a very simple thing. These days it sometimes seems that architects feel that all you have to do is get a shape -- say a square for the moment -- and within this shape you fit all the required spaces -- lopping a few square feet off some and adding a few where necessary. Sometimes eliminating one or two with the comforting reflection that our architecture is supposed to shape us just as we shape it. This is a beautiful game and any number not only may play, but are now playing. Windows are no problem either. You just count up the rooms that need daylight. If there are more that do than don't, you make all the outside walls glass. If it's the other way around, you make them all opaque panels. We have air conditioning, and we must express our time, and the devil take the hindmost <u>and</u> the inhabitants. The really humanized thinkers will make the building a hollow square and have a courtyard in the center.

This is the shape game and any shape will do as long as it is simple and uncompromising, or as long as it is a butterfly or broad-waisted hour glass shape. The currently popular harlequin shapes -- the elongated diamonds -- have not yet been accepted widely for plan use.

The shape game isn't limited to plan. We've got some very popular cross-sectional shapes going for us today with which you are as familiar as I -- and nothing necessarily wrong with them 'per se' provided the architect hasn't let his production occupy so much of his designing and selling energies that he has little left with which to cope with other considerations.

any embellishments but a great deal. A [illegible] [illegible] -- [illegible] -- not as a consciously [illegible] thing, but in the proper [illegible] to the whole, [illegible] [illegible] the way that a building [illegible] the architect has projected himself into all its consequences and has satisfied himself that it is [illegible] [illegible] and [illegible].

The [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible]. They have a way of eating up all our interest and [illegible] of so [illegible] which are not part of the original concept. This is true [illegible] [illegible] -- the [illegible] [illegible] [illegible] the [illegible] of [illegible] [illegible]. [illegible] the greatest [illegible] [illegible]. [illegible] [illegible].

The [illegible] [illegible] [illegible] [illegible].

[illegible] [illegible].

[illegible] [illegible].

The shape game is similar to the structural system game which has given rise to putting everything under a dome. Correlary to this, of course, is the fascination-with-big-spans phase of our development. We now have in this country, or on our drawing boards, some of the biggest spans for some of the least consequential spaces known to history. We put enormous spans over collections of 10 and 20 ft. rooms; and not because it saves money; simply because we are fascinated with our ability to do it. It is a real fascination, but a fatal one for architecture as long as it consumes our whole awareness.

Preoccupation with a shape, or a material, or a structural system is sophomoric. But while for sophomores it may be a natural phase of development -- for practising architects it is a restrictive perversion of talent and obligation.

Now I don't want to sound like Elizabeth Gordon, with her proscribed list of menacing shapes and colors and materials. I love squares as well as the next square, and glass and big spans. And the idea of an integrating shape, or space or structural system is to me not only fascinating but vital. I plead simply that we do not reach the integration before we have identified the parts; that we add love of analysis to love of synthesis. I look for a broader base of architectural stimuli. I believe that we must develop a wider range of interest and concern. We must have more facts in hand before we offer our answers.

We must know more about materials and methods, but most importantly we must know more about man. <u>This</u> is our spacialty. Architecture is the expressive organization of space -- for man. To accomplish a satisfying architecture we must know far more about man than we do and we must use better that which we already know. Architecture is homo-centric and when it gets away from that center it is something else -- fascinating, no doubt, for its creators, but crippling, and puzzling, and frustrating for men who use it or live with it.

We must observe man in what he does and learn how and why he does it. We must be concerned to know what he feels and how and why. We must find out what he knows, or at least what he deems important. For it is our clear duty to accommodate his activities, to appeal to his senses and to express his aspirations.

There is such a thing as the art of entrance, just as there is the art of dispersal, in which shape and size and color and texture play their full roles. But this is largely lost today in our preoccupation or ruled out by our preconceptions.

The complex act of seeing with all its pregnant possibilities for rich, human experience is virtually unexplored in terms of architectural space and form. The potentials of light and its modulation in intensity and color seem of little interest to architects in our time. Across the nation -- across the world -- even generally satisfying spaces are ineffectually illuminated, often with stiff, little stylish can fixtures. The problems of hearing often come as afterthoughts even in our auditoria.

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[illegible]

We seldom exploit what we already know about climatic matters and sun control is primitive, if it exists at all.

Our engineers have given us a wondrous catalogue of structural possibilities, but we have not found the means of expressing these visually in such a way that the inhabitants of our buildings -- and the passerby -- are able to participate in their high enjoyment.

We seem content with brutal shorthand statements; raw, fragmentary caricatures. We are preoccupied with shapes -- but not interested in their subtleties; not in their rich modulation through texture and color. Scale -- perhaps the most immediate of all visual effects in terms of power to produce human response -- is carelessly studied. We have bigness, but little sense of the grand; smallness, but little identity with man. Our efforts in polychromy practically begin and end with some primary color panels against neutral backgrounds; or the other school of unadulterated natural wood and masonry.

In the design of buildings and groups and towns, each of these matters -- and many more -- must be taken up point by point with respect to each element and each function, and each interrelation of function and element, if those who design would design for the whole satisfaction of man. Only after careful study of them all should be architect -- as a sensitive instrument of translative power -- permit his artistic integrating powers to function. But the architect cannot assay what he does not know and can never know what does not interest him. Somehow he must be helped to renew his interest in man -- the whole man -- all his needs and all his responses. And this is the clear duty of our schools, the A.I.A. and your architectural magazines.

If this has seemed to you a harsh judgment of our architectural shortcomings, let me say that it is also a confession of my own architectural sins -- and I've not named them all. Now, this is why I am particularly pleased to be here; because, despite its formidable title, this program promises just the kind of inquiry I need. Our speakers are a nicely compounded group of specialists in man and in design for man. Our speakers are men who, each in his own way and according to his own studies and experiences, know something about man and serving man which we do not -- but should.

I am an architect and you are architects, and to a degree we are all alike, we need all the help we can get, and this conference looks like a place we can get it.

THE PHYSIOLOGY OF SEEING

by
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University of Illinois
Urbana, Illinois

Physiological considerations enter into the design of a building in a variety of ways. The architect is concerned with such questions as the proper temperature for human confort, proper ventilation and lighting, all of which have a physiological basis. When attention is turned to the aesthetic aspects of architectural design, consideration of the physiological properties of the visual system become important, for it is through the eye and its related neurological structures that architectural forms are first perceived. What the neurophysiologist would like to do is describe all of the neurological processes which intervene between the formation of an image on the retina and the report that the viewer either enjoys or dislikes the structures which give rise to the image. With such information a physiology of aesthetics could be constructed. At the present time we are far from this ideal. Our knowledge of the nervous system is extremely limited, and it would be sheer speculation to attempt to describe anything but the first few events in the process of visual appreciation of form. For this reason, I shall limit my discussion to a description of the optics of the eye, including what we know at present about the photochemical processes involved in translating the visual image into patterns of nerve impulses which are then carried along the optic nerve to be finally projected onto the cerebral cortical mantel.

The optical functions of the eye can be described briefly by saying that the eye operates like a simple camera, although this analogy, like most analogies used to describe physiological systems, must not be taken too seriously. It is true that light entering the front of the eye is refracted so as to form an image of the external object on a light sensitive surface, but the refracting systems of the eye are by no means as simple as those found in a camera. Light entering the eye is first refracted by the cornea, and not by the lens, as in a camera, and since the greatest change in refractive index along the optical path occurs at this point, the cornea is actually the strongest lens in the eye. Behind the cornea, light passes through a fluid medium, the aqueous humor, and then enters the crystalline lens, where it is again refracted. Further refraction occurs as light leaves the lens and enters a gel-like medium called the vitreous humor. Thus the "lens" of the eye consists of three surfaces. To simplify this system for discussion, the actual eye is replaced by an abstract eye, called the reduced eye, which contains only one convex lens with refractive power equal to the total refractive power of the eye. The center of curvature of this imaginary lens lies 7.5 mm. behind the front surface of the cornea, and the image produced is formed 15.5 mm. behind the center of curvature.

The optical system of the eye has a great number of defects. It was Helmholtz who said that he would immediately discharge an assistant

who constructed an optical instrument which had no better precision than the eye. The eye has the usual limitations of other lens systems, such as spherical and chromatic abberation. These limitations are somewhat corrected by constriction of the pupil which eliminates the light rays entering the periphery of the lens. However, the pupil itself limits the resolution of the eye when the pupillary diameter is small. Diffraction of light at the edges of a pupil constricted to a diameter of 2 mm. can make a point source of light appear as a blurred image 0.012 mm. in diameter at the retina. In addition to these expected optical limitations, light entering the eye is scattered to some extent by the media within the eye. The optical axis is not in line with the normal line of sight, leading to an assymetry in the optical system, which is further distorted as the eye is focused on near objects due to a shift in the position of the lens as it thickens. The above description would give the impression that the image which is formed on the retina is a poor reproduction of the objects in the external world, however, there are compensations at the retina which tend to increase the acuity of the eye. Thus, overall acuity cannot be derived from measurements involving the optical system only.

Before discussing visual acuity, a topic which should be of interest to this group, we would do well to describe the light sensitive surface of the eye which is called the retina. The retina is a mantel consisting of layers of cells which covers the inside surface of the eye at the rear, forming a hemisphere opposite the lens. It is here that an image is formed by the lens. Light is detected within the retina by means of photochemical reactions which take place within small cells, called rods and cones, which are packed together side by side, forming a layer on the surface of the retina opposite that facing the lens. Present knowledge tends to favor the idea that this photochemical reaction gives rise to an electrical change across the receptor cell which in some way activates small nerve endings making contact with the rods and cones. Electrical changes can indeed be picked up across the retina as light falls on it, and, in the simpler eyes of horseshoe crab where receptor cells can be studied directly, light produces a marked electrical change across a single cell. The nerve impulse itself is an electrical change which is propogated along the axon or cable-like portion of the nerve cell in an all-or-none fashion much like the active region of a fuse travels toward the other end after one end of the fuse has been lit. Each time a nerve cell becomes active, one of these electrical impulses travels along the nerve fiber to its other end. The light induced electrical change across a rod or a cone could thus set up one or, if the change persists, many repeated impulses in the nerve cell connected to it.

The rods and cones are not connected directly to the optic nerve. One finds a close packing of cones in the foveal or central region of the retina, where visual acuity is greatest and where the image would fall if the eyes are turned directly toward the object. These cones are connected directly through an intermediate nerve cell to the so-called ganglion cells which give rise to the fibers in the optic nerve. Thus each cone in this region has its own private line to the central nervous system. In retinal regions around this central, "fine grained" region, the density of cones begins to diminish and rods also make [illegible] from the eye. [illegible] are somewhat [illegible] of the pupil which [illegible] the light rays entering the periphery of the lens. However, the pupil itself [illegible] the penetration of [illegible] the pupillary aperture is small. Diffraction of light at the edge of a pupil [illegible] in addition to [illegible]. In addition to [illegible] optical limitations, light entering the eye [illegible] within the eye. [illegible] optical system, which is [illegible] that the image which is formed on the retina is a poor reproduction of the object [illegible], however, [illegible] quality of the eye. [illegible] analysis the optical system only.

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[illegible]

their appearance. At the extreme edges of the retina, very few cones are to be found; rods are proportionately the most numerous receptors. In addition to changes in receptor type, differences are also found in the nervous connections. A number of rods and cones may be connected to one intermediate nerve cell which, in turn, may make contact with a number of ganglion cells. This is of course an oversimplification of the actual picture. Some intermediate cells in the peripheral regions may transmit directly through to one ganglion cell, while others are specialized in the other direction to the extent that they run laterally across the retina for some distance, connecting one region with another. The picture that immerges from a study of the cellular structure of the retina is that in the fovea, or area of most acute vision, light sensitive cells are connected directly to the optic nerve, although some interaction between foveal areas may also take place. The grain of the retina seems to be here the important factor, while in the periphery, sensitivity to light is optimal. Correlated with this, one finds that the rods, present in greater numbers here, are far more sensitive to light than are the cones, and, in addition, light induced electrical changes across several cells can be summed to activate one intermediate nerve cell, thus effectively amplifying the action of the light.

The differences between peripheral and foveal regions of the retina are best seen in going from daytime vision to night vision. During the day, we can see objects very clearly, and we have little difficulty recognizing even relatively small objects. But at night, outlines are never distinct; vision has little acuity, but very small light intensities can be detected. During the day we turn our eyes directly toward the object we are viewing, so that the image falls on the fovea, but at night, objects can be best seen by looking at them out of the corner of the eye, so that the image falls on the periphery of the retina. The spectral sensitivity or the sensitivity to different shades of color also changes as the eye accommodates to night vision. During night vision the eye is more sensitive to blue light, indicating a shift from cone to rod vision. The rods are more sensitive to the blues than to the reds. This fact was used during the war to allow night fighter pilots to accommodate to night vision while carrying out their routine tasks. By wearing red glasses, they could use normal cone vision while allowing the rods, which are normally saturated and thus do not function at moderate intensities of light, to return to their functional state.

There is an interesting fact about the retina which you may have already noticed, namely, that we actually see through the blood vessels and nerve cells of the retina. The receptor elements, the rods and cones, are located on the surface opposite to that through which light enters the retina. The intermediate nerve cells and the ganglion cells form layers over the rod and cone layer, and the optic nerve fibers run transversely from various ganglion cells across the surface of the retina facing the lens. Blood vessels which carry nutritional requirements to retinal tissues enter the eye with the optic nerve and also pass across the surface facing the lens. We do not see these structures when using foveal vision, since blood vessels do not cross the fovea and there is a thinning out of the nerve cell their arrangement. At the extreme edges of the retina, rods [illegible] are to be found which are [illegible] numerous, however. In addition [illegible] in relative [illegible] differences are also found in the nervous connections. A number of rods are connected to one intermediate nerve cell which, in turn, may join with a number of ganglion cells. This is of course an oversimplification of the actual picture. Some intermediate cells in the peripheral regions are [illegible] through to one ganglion cell, while others are [illegible] to the [illegible] of the [illegible] that they are [illegible] the [illegible] for [illegible] connecting the retina with the [illegible]. The pathway that [illegible] from a group of the cellular elements of the retina to each of the fibres of the optic nerve [illegible] rods [illegible] in the optic nerve, although some [illegible] connect [illegible] with [illegible]. The groups of the retina [illegible] the [illegible], which is the [illegible], [illegible] of the [illegible] with [illegible] that the [illegible] on [illegible] are the [illegible] to light [illegible], and, in [illegible], [illegible] cells [illegible] and intermediate nerve cell, were effectively amplifying the action of the light.

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There is an interesting fact about the [illegible] that we may [illegible]. [illegible] of the retina. The [illegible], the rods and cones, are [illegible] on the [illegible] to [illegible] the light [illegible]. The intermediate nerve cells and the ganglion cells [illegible] the [illegible] and the optic nerve [illegible] from [illegible] the [illegible] of the retina [illegible] the lens. [illegible] the [illegible] to [illegible] the eye [illegible] the [illegible] and [illegible] the [illegible] the lens. [illegible] [illegible] [illegible] the nerve cell layers in this region. Normally we do not see the blood vessel and nerve cells in other areas of the retina, but the outlines of the blood vessels can be seen if a strong light is beamed on the peripheral areas of the retina.

Using the above described properties of the optical and photosensitive elements of the eye, we can attempt to form a picture of the manner in which the eye responds to patterns of lines, shapes and gradations of light intensity. It would simplify matters to describe a building and its surroundings in terms of such patterns. For instance, the corner of a building would be imaged on the retina as a sharp variation in light intensity. If both sides of the corner were equally illuminated, and if no change in texture took place at the corner, the corner would probably not be seen. Of course, such factors as perspective would have to be taken into account in this case. The presence of a corner could probably be inferred if two long walls intersected at this point, but changes in light intensity are probably the most important cues. Textures of surfaces could be differentiated on the basis of differing reflective power, which would give rise to different intensities of light, or differences in the pattern of shadows cast by imperfections in the surface. The perception of distance might also be related to variations in light intensity and the ability to distinguish between two closely spaced shadows. Shadows on a brick wall, for instance, will appear closer together at a greater distance.

The basic questions then concern the ability of the eye to discriminate between differing light intensities and the degree to which it can resolve abrupt changes in intensity. We need not concern outselves with scotopic or night vision, in which case the absolute threshold to light is lower. The dark adapted eye is able to detect extremely small quantities of light. But buildings are usually not designed to be seen at such light intensities.

At light intensities normally present during the day, the eye is light adapted, and visual acuity is greatest when the image falls on the fovea. Acuity falls off rapidly in extra-foveal areas. At an angle of 5 degrees on either side of the line of vision, which passes through the center of the fovea, acuity falls to one half of the central foveal acuity, and at the extreme periphery or 90 degrees away from the line of vision, the relative acuity falls to 2.5%. The fovea is 1.5 mm. in diameter and is rod free over a region 0.6 mm. in diameter. A building 20 feet high located 200 feet from the eye would give rise to a retinal image 1.5 mm. high which could cover the fovea when the line of sight is directed toward a point on the building 10 feet from the ground.

There are several factors which influence visual acuity. We have already mentioned the fact that the eye has several inherent optical limitations to good definition in the image. Another factor of considerable importance is retinal grain or the spacing between the receptor elements. As in photography, the fineness of detail will depend on the distance between photosensitive elements. In the retina, an additional factor enters into the picture. Retinal grain also depends on the neural connections to the receptor units

and the amount of interaction between adjacent areas. There is good evidence to indicate that one area of the retina when stimulated is capable of enhancing or reducing the response obtained from another area. Direct measurements have been made of the response of single ganglion cells (origin of the optic nerve fibers), and it was found that this response is markedly altered by stimulating the receptor connected to adjacent ganglion cells. This phenomenon is probably responsible for the sharpening of contours between regions of differing light intensity.

Certain stimulus factors also determine the degree of visual acuity. The background intensity may determine whether or not two differing intensities can be distinguished, since the difference which is just noticeable is smallest at moderate light intensities and becomes larger at both high and low intensities. The relative size of the stimulated areas is another factor, as is the duration of exposure. Acuity falls off at shorter exposure times. If a building is seen for a short period of time, small differences in shading may not be noticed.

I shall not attempt to give absolute values for the just noticeable differences detected under the conditions mentioned above. These values are available in any of a number of textbooks dealing with the physiology or psychology of vision. However, I believe that it might be of interest to describe quantitatively the limits which have been found for resolution of lines on a surface or the ability to resolve two closely spaced lines or points. Such considerations are central to the question of how much detail can be seen. If two bright lines are brought close together under optimal illumination, it is thought that they can be seen as separate lines as long as a row of cones remains unstimulated in the region between the retinal images of the lines (dark lines on a bright surface would require a row of stimulated cones between the shadows cast by the lines). But the picture is not as simple as this. The image of the lines will not be sharply defined, but, due to diffraction and light scattering, will have fuzzy edges; the light intensity will change gradually off to the sides of each image, so that images may actually overlap. The criterion must then be defined in terms of the smallest difference in light intensity falling on adjacent rows of cones which will allow the images of the lines to be seen as separate images.

This can best be described in terms of the minimum width of a line which can be detected. The narrowest wire which can be seen by a subject under optimal illumination is 0.04 microns in diameter. The shape of the image formed by this line on the retina has been calculated and a difference of 0.95% in illumination was found between the cones at the center of the image and the adjacent row of cones. This turns out to be close to the smallest difference in light intensity which can be detected by the eye. The minimum separable distance between two lines, on the other hand, is of the order of the diameter of one cone, suggesting that a row of cones must be interposed between the images of two lines before the lines can be seen as separate lines. The same sort of reasoning would apply to the detection of boundries between two adjacent areas of differing light intensity.

The sharpness of this boundry would depend on the number of cones differentially stimulated along the boundry line of the image. At low light intensities, for instance, only a few cones along the boundary might be subjected to a difference of 0.95% in illumination and the boundry would not be well defined.

The question which most of you are probably asking at this point is what limitation do the above considerations place on design, if any. A few simple calculations will, I think, clarify this point. We have said that the minimum distinguishable distance between two lines on a surface is determined by the separation of cones on the retina. There has to be one row of unstimulated cones between the rows of cones activated by the lines. The minimum separable is of the order of the diameter of one cone or about 2 microns. Thus, on the building which we used aobve as an example, two lines will be seen as distinct lines if their retinal images are separated by two microns or if the lines are separated by about a quarter of an inch on the wall of the building 200 feet away. A line on this building can be detected if it is 0.005 inches in width, using the data given above for a fine wire viewed under optimal illumination. The retina requires a difference of 0.95% in illumination between one cone and the next before a gradation in light intensity could be detected. This would mean that, on our imaginary building, the light intensity would have to change by 0.95% within a quarter of an inch; shadows on the surface of a wall caused by surface imperfections would have to meet this requirement in order to be detected.

The above limitations would place restrictions on the amount of detail which could be used in building design, but it would seem that these restrictions are not too stringent. It would seem to me that the material used would probably place greater limitations on detail. It would be difficult to carve a pattern of lines on a block of stone in which the lines were closer than one quarter of an inch, and such detailed patterns would not be placed on the building so that the pattern would have to be viewed from a distance. If, for instance, the pattern could be viewed from a point 20 feet away, the lines could be distinguished as separate lines if they are only 0.025 inches apart. Of course, the above considerations are all based on the assumption that light intensities are optimal for daylight vision. A rather obvious example of the effect of lowered intensity is that of a detailed pattern located in a dark corner of the building. Details within the pattern may not be appreciated by the viewer because visual acuity falls off very quickly as illumination is decreased.

Up to this point we have made no mention of the fact that in normal vision use is made of both eyes; vision is seldom monocular unless we are viewing specimens under a microscope. New factors arise when binocular vision is discussed, because identical images are presented to two retinas. There will be slight differences in the position of these images in each eye due to the fact that each eye will be directed toward the object from a slightly different angle. This is especially true when near objects are viewed.

The divergence of this [illegible] would depend on the [illegible] of cones differentially stimulated along the boundary line of the image. At low light intensities, for instance, only a few cones along the boundary might be stimulated by a difference in light to excite them and the boundary would not be well defined.

The question which must be asked is probably [illegible] [illegible] the limitation on contrast [illegible] along an edge. [illegible] simple calculations will, I think, clarify this point. We have said that the minimum discriminable difference between lines on a surface is determined by the separation of cones on the retina. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] about 2 minutes. [illegible], on the building which we want to see at, for example, two lines will be seen as distinct lines if their retinal images are separated by [illegible] or if the lines are separated by about a [illegible] of an inch at the [illegible] of the building, [illegible]. A line on this building [illegible] [illegible] [illegible] [illegible] [illegible], using the data [illegible] [illegible] [illegible] [illegible] [illegible] illumination. [illegible] [illegible] a difference of [illegible] in illumination between one cone and the next [illegible] [illegible] light intensity could be [illegible]. This would mean that, on our imaginary building, the light intensity would have to change by [illegible] within a quarter of an inch on the surface of [illegible] change by surface [illegible] would have to meet this [illegible] in order to be [illegible].

The above [illegible]

Up to this point, we have [illegible]

Let me digress for a moment to discuss the sequence of events which occurs when the eyes are turned toward a near object. Three coordinated changes, called the fixation triad, take place. The lens thickens by bulging at it's anterior surface; by this means the image is kept in focus on the retina. The pupils constrict so that only light which passes through the center of the lens is used to form the image, and thirdly, the external muscles of the eyes turn each eye toward the center so that its line of sight will intersect the line of sight from the other eye at the object. Since the line of sight passes through the fovea, the image formed in each eye will be centered on the fovea.

Imagine for a moment what would happen to the images of objects located farther from the eye than the object which is brought into focus by the above mechanism. As the focal object is moved closer to the eye, the image of the farther object will fall progressively farther out on the retina, moving in the opposite direction in each eye. This situation will lead to stimulation of different sets of retinal receptors for each position of the converging lines of sight. How then does the central nervous system detect only one image rather than two?

The retina of each eye is connected to the central nervous system such that there are corresponding points on each retina. When light strikes these points, the sensation produced will be the same as that produced by stimulating that point in one eye only. In other words, these points are equivalent as far as the central nervous system is concerned. Thus the image produced on the fovea by the convergence of both eyes will fall on sets of corresponding points, and only one image is perceived by the central nervous system. This is not true, however, for the images of objects located at a greater distance. As mentioned above, these images will fall farther out on the retina as the eye is turned to nearer objects, and thus cannot fall on corresponding points. If we perceived these objects at all times, we would see them double. But the input from only one retina is used for images falling on the periphery of the retina (apparently both eyes are used for foveal vision); the input from the other retina is suppressed by unknown mechanisms. Perhaps one of the actions of certain intoxicants is to block this suppressing mechanism.

Even though the inputs to both retinas are not used by the central nervous system in forming a picture of the external world in the case of extra-foveal images, these inputs become important in judging relative distances of objects. The horizontal displacements of retinal images with respect to the fovea is apparently one of the important factors in appreciation of perspective; vertical displacements are not as important.

There are other factors which enter into distance perception. Other stimulus factors, such as the gradients of distance between shadows on receeding surface, can be used as cues. In addition, the amount of contraction of the external muscles of the eyes may enter as a factor. All skeletal muscles of the body contain receptors which detect the amount of stretch or contraction of the muscle; the same is true of the external muscles of the eye. That this factor is important

Let us discuss [illegible]

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in recognition of objects is indicated by experiments in which the cortical regions regulating eye movements were removed from one side of the cortex of a primate. After the operation, the animal is unable to recognize an object when it is brought into the field of vision on the opposite side. The perception of light has not been interferred with, but the area of the cortex in which proprioceptive or muscle senses are integrated has been destroyed. Recognition would therefore be a function of both types of stimuli, the light falling on the retina and the amount of contraction of the external eye muscles. The animal's space sense is also disturbed, since he will circle (turn his body) toward the side which has been damaged, as though part of his picture of the external world has been removed, and he is trying to compensate for this loss.

It is hard to assess the precise role which the muscle senses play in distance perception and space sense. It is easy to see how they may enter, though. A building is rarely "taken in at one glance" but is scanned by the eyes. Thus the viewer will see a series of pictures of the building, and both the retinal image and the degree of external muscle contraction will change from picture to picture. When the eyes are directed toward more distant parts of the building, the degree of convergence of the eyes will be less, thus the pattern of muscle sense inputs will be different than that present when nearer objects are viewed.

Another important feature of the visual experience is the perception of color differences. Our picture of the physiological basis of color vision is far from complete, and thus I shall not discuss this aspect of vision in detail. It is thought that there are three basic receptors, in all probability cones, which are sensitive to each of the primary visual colors - red, green and purple. According to the earlier views, the sensation of white and gray is due to the simultaneous activation of all of the primary receptors. Black is thought to be due to the absence of activation. The picture is far more complicated than this, however. There are certain facts which do not fit into this scheme. When activity in individual nerve fibers in the optic nerve is examined, it is found that all receptors respond to a wide range of colors when the light intensity is low, corresponding to night vision. When the light intensity is increased, a wide response pattern is also obtained in many cases, the maximum response being shifted to the red end of the spectrum; however, there were units which responded to three rather narrow ranges of color, one in the red, one in the purple and one in the green range. These units do not respond to single pure colors, but show a distribution of responses, the response falling off to each side of a specific color.

Color then probably depends on the response in the retina of specific receptors, and color combinations are probably the result of combined activity of these units. Perhaps combination of colors may arise when several different receptors activate one optic nerve fiber. As mentioned above, in many retinal areas a single cone does not have its private line to the cerebral cortex but shares an optic nerve fiber with other cones. Colors are not only combined at the level of the retina but also at the level of the cortex, since it has been

The recognition of objects is lost also by experiments in which the cortical regions regulating eye movements were removed from one side of the cortex of a primate. After the operation, the animal is unable to recognize an object when it is brought into the field of vision on the opposite side. Its perception of light has not been interfered with, but the area of the cortex in which proprioceptive or muscle senses are integrated has been destroyed. Recognition would, therefore, be a function of both types of stimuli, the light falling on the retina and the sequel or combination of the external eye muscles. The animal's space sense is also disturbed, since it will always turn its body toward the eye which has been damaged, as though part of his picture of the external world has been deleted, and he is trying to compensate for this loss.

It is hard to stress the part to which the muscle senses play in distance perception and space sense. It is easy to see how that any object, though. A building is rarely taken in at one glance but is scanned by the eyes. Thus the vision will give a series of pictures of the building, and both the retinal image and the degree of external muscle contraction will change from picture to picture. When the eyes are directed toward more distant parts of the building, the degree of convergence of the eyes will be less, thus the pattern of muscle sense impulses will be different than that present when nearer objects are viewed.

Another important feature of the visual experience is the perception of color differences. The theory of the physiological basis of color vision is far from complete, and thus I shall not discuss this aspect of vision in detail. It is thought that there are three types of receptors, in all probability cones, which are sensitive to each of the primary visual colors - red, green and purple. According to the earlier views, the sensation of white or gray is due to the simultaneous stimulation of all of the primary receptors. Black is thought to be due to the absence of stimulation. The picture is far more complicated than this, however. There are certain facts which do not fit into this scheme. When activity in a single optic nerve fibre in the cat's eye is recorded, it is found that all respond to a wide range of colors when the light intensity is high, corresponding to daylight vision. When the light intensity is decreased, a wide response pattern is also obtained, in many others, the maximum response being shifted to the [illegible] part of the spectrum however. There were units which responded to three rather narrow ranges of color, one in the red, one in the purple and one in the green range. These units do not respond to single pure colors, but show a distribution of responses, the response falling off on each side of a specific color.

Color then probably depends on the responses in the retina of specific receptors, but color constancy is probably the result of combined activity of these units. Perhaps a conception of colors may arise when several different receptors activate one optic nerve fiber. As mentioned above, in many retinal areas, a single cone does not only activate fibers to the cerebral cortex but shares an optic nerve fiber with other cones. Colors are not only combined at the level of the retina but also at the level of the cortex, since it has been found that simultaneous activation of cones located at corresponding points in each eye by different colors results often in perception of a mixture of the two colors. This mixture can only occur in the cortex.

We have said little about the role that the central nervous system plays in vision. The visual image which falls in the retina is translated into a series of pulses, essentially, which can vary only in the frequency or number of pulses per second in any one optic nerve fiber. The amplitude of the response is not determined by the stimulus. Information concerning the external world contained in the retinal image is thus transformed by the retina into a pattern of pulses distributed over a number of nerve fibers; it is this information upon which the central nervous system must operate to form our subjective perception of the retinal image.

The retina is connected to the central nervous system in the following manner. The optic nerve carries fibers to the thalamus which acts as a relay station. Each optic nerve fiber activates one or more nerve cells at this point, and the axons or nerve fibers which arise from these cells pass through a bundle of similar fibers which projects to the surface of the occipital region of the cerebral cortex. Patterns of nerve impulses are here spacially displayed on the surface of the cortex. This is the area of direct visual projection, and if this area is removed surgically, a person will be unable to see even though his retina is intact.

Pattern discrimination is apparently dependent on this area of the cortex, i.e., on the projection of retinal spacial relations onto the cortex, for, even in lower animals, where responses to relative brightness of light can still occur after removal of the occipital cortex, pattern vision is totally lost.

The method by which the central nervous system constructs a subjective image of the outside world, with all of its components of pleasure and dislike, is not known. We know that there are other cortical areas adjacent to the projection area which are involved somehow in vision. The cortex of a patient whose cerebrum has been exposed for removal of a tumor or the like can be directly stimulated, and actual visual experiences can be so produced. When certain occipital regions are stimulated, the patient may report that he sees an entire scene as though he were looking at it, but we have no information as to the manner in which the cortex converts the projected retinal image under normal conditions into a subjective experience like that reported by the patient.

It seems evident from description which I have given of the physiology of the eye that the visual system does not place serious restrictions on architectural design. The image which is formed on the retina is not perfect; there are a number of optical distortions in the system, however measures of subjective visual acuity, which would involve both optical and neurological structures, indicate that the eye is constructed so that such distortions are compensated. Contours are sharpened by interaction between one area of the retina and adjacent areas. Retinal grain is finest in the region where optical

[illegible]

[illegible]

The pattern [illegible] following manner. [illegible] of the cortex. [illegible]

[illegible] the cortex [illegible]

[illegible]

[illegible]

distortions are minimal, and the mechanics of the eye are arranged so that this area is used in vision requiring the greatest acuity. When we examine an object in detail, our eyes are turned directly toward the object, and detail is best seen in the region on the object around the point at which vision is directed. To examine other regions of the object in detail, we must redirect our vision toward the new region. The eye does not behave like a camera where the entire image is focused on a photosensitive plate which has uniform sensitivity over the entire plate.

In spite of the imperfections in the system, the subjective picture of the external work obtained by way of the eye is very accurate. It correlates well with the impressions which enter by way of the other senses. The subjective reactions of pleasure and dislike which a person shows when he views a building will also depend on factors other than purely visual factors. What he feels may be the result of his background, his training and the social pressures to which he is exposed. But the picture of the building which enters by way of the visual system is in all probability a true picture under normal conditions; subjective factors enter higher up in the hierarchy of activity of the central nervous system. Our description of the aesthetic aspects of vision must at present remain incomplete, for we have little information regarding the nature of these higher hierarchies of activity.

PSYCHOLOGY OF AESTHETICS

by
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The orientation of psychological research to architecture is not very direct. The materials of the arts of music and painting such as sounds, colors, shapes, etc., are operationally simpler than planes and slants in third dimension which characterize architecture. Of course, aesthetic principles cut across all the arts, so nothing is lost, really, but by the same token, specific particulars which are important to a special class of art fail to develop their full significance. Fortunately, an important aspect of architecture is that the surface outline of the main entrance to a building is dominant in perception and memory. Therefore, the important information from the work of painters and scientists obtained from experiments in two dimensions is transferable to the surface planes in architecture. In psychology, there is now a turn in interest to solid areas in space, but so far this work is focused on perceptual theory rather than aesthetic implications. At this stage of psychology, the most fruitful inferences about the aesthetics of buildings are those that can be extrapolated or predicted from the theoretical implications of the psychology of perception.

In view of the unstructured nature of psychology with reference to architecture, this lecture is organized around the broad topics of meaning and perception. This order is not logical, psychologically, but it makes sense to discuss aesthetics by beginning with meaning on the principle of easy things first.

Three kinds of meaning--association, sign and expression.

The term meaning requires clarification. The most superficial meaning of meaning concerns the range of associations which are initiated by stimuli. Of course, such associations have more or less aesthetic value because they carry feeling and contribute to the feeling--meaning complex associated with a work of art. Associations from memory are not the sort of responses that sensitive artists profess, but they are unavoidable in the presence of objects and events. Art objects are not exceptions to this fact of life. In art, the sur-realists are probably trying to tap this area of conscious and unconscious associations in the form of art. In the aesthetically inclined, these associations are more sensibly related to the art object and are, in some measure, normally elicited by all art, but especially by the representational examples of art. In abstract art, the amount is less, but rarely zero.

Psychological research in aesthetics has made a definite contribution to this problem of meaning. By the statistical method of factor analysis, psychologists have established a general factor in aesthetics which is present in some amount in all people regardless

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by

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of the nature of their associations. This general factor is like the general factor used in the concept of intelligence. In addition, they were able to factor out two opposite kinds of association responses. These findings confirm current beliefs about the nature of aethetic response, but now, for the first time, popular opinion is scientifically valid. The following quotation is taken from one of the leading workers in psychological aesthetics in England.

> "....it may be said that it is now well established that there is a general factor of aesthetic productions and valuations within cultural patterns and groups. It is not likely that the general factor would lead rigidly to interracial and intercultural uniformities, any more than the existence of a general principle of morality in human social life leads to absolute uniformity of moral behavior....In addition to the general factor, all kinds of pictorial art, music, and literature studied reveal a bipolar factor. This contrasts the more colorful, emotionally expressive, impressionistic or expressively distorted kinds of art with those which are more subdued, more accurate in representation and less colorful. The first group are generally liked by extraverted and the second group by introverted people, and often the contrast lies between the romantic and the classical in artistic productions and in aesthetic attitudes and valuations." (14)

There is another meaning of meaning which is incompatible with the aesthetic attitude, though it is of great significance to other disciplines. This is the meaning of things as signs to reach goals whereby buildings serve merely as signals or sign posts, directing us to places we intend. Thus the church steeple merely has the cursory recognition value that we are correctly oriented in space. Such associations are not contemplated for themselves, but merely gleamed at for practical ends. The associations of the first type, however much they may wander, tend to return to the stimulus object in the contemplation of the object. Meanings as signals are too transitory to affect us aesthetically. Time is a significant variable in aesthetic appreciation.

The third meaning of meaning is of special significance to aesthetics. It is the meaning of significance which is said to reside within the art object. The aesthetician's term is expression, and from here on we shall use the word expression with the understanding that ordinary associations usually constitute a part of the expressed feeling. When it is said that beauty is feeling objectified or that beauty is "significant form", "expressive form", "plastic form", or "plastic unity" or "organic unity", we are indicating the intrinsic meaning of meaning as expression. Such definitions may be too exclusive of contextual associations, but they do point to an essential variable in the concept of expression, though not the only variable. Meanings as associations and signs give a stable, constant world, in which we can live, but they do not contribute primarily to an aesthetic world. It is due to meaning as expression that we can say that art is the language of emotions.*

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* Susan Langer had proposed that expression is a symbol of feelings. C.W. Morris discusses expressions as signs. See Szathmary's (18) criticism of aesthetic expression as symbol or as sign.

Let us now turn to the problem of expression in aesthetics. I would like to present a study on the expressive value of music and color. The musical part is not germane to this talk, but since music and color seem to express feelings and emotions in strikingly similar ways, and since the similarity is supported by substantial empirical evidence, the facts seem significant to me. Actually, as on most questions of aesthetics, the practicing artists in their various specialties already know through experience facts which scientists are compelled to rediscover quantitatively. Practical knowledge, however, does not necessarily preclude the need for seeking assurance by scientific methods.

The experiment consists of two parts. In the first part, 243 students in elementary psychology, divided into five sections, were presented with ten musical phrases lasting between thirteen and forty-five seconds. The phrases were short enough to remain relatively unchanged in mood of the music. No attempt was made to select clear representatives of particular moods. The selections were taken from classical music. The students listened to all the selections once to become familiar with the general nature of the music. On the second hearing, they indicated the dominant mood suggested by the music by checking one of eight groups of descriptive adjectives.

A (solemn)	B (sad)	C (tender)	D (leisurely)
spiritual	pathetic	dreamy	lyrical
lofty	doleful	yielding	leisurely
awe-inspiring	sad	tender	satisfying
dignified	mournful	sentimental	serene
sacred	tragic	longing	tranquil
solemn	melancholy	yearning	quiet
sober	frustrated	pleading	soothing
serious	depressing	plaintive	
	gloomy		
	heavy		
	dark		

E (playful)	F (gay)	G (exciting)	H (vigorous)
humorous	merry	exhilarated	vigorous
playful	joyous	soaring	robust
whimsical	gay	triumphant	emphatic
fanciful	happy	dramatic	matrial
quaint	cheerful	passionate	ponderous
sprightly	bright	sensational	majestic
delicate		agitated	exalting
light		exciting	
graceful		impetuous	
		restless	

These words were arranged in a previous study by Hevner's (4) subjects in the form of a circle so that words rather similar in meaning are in adjacent groups, while words of opposite meaning appear on opposite sides of the circle. The words in A are therefore meant to be psychologically as close to the words in H as they are to the words in B. The groupings of words are best labelled as follows: A, solemn; B, sad; C, tender; D, leisurely; E, playful; F, gay; G, exciting and H, vigorous.

After the students rated the tenth selection, they were given new instructions and the records were played a third time. After each selection they were asked to check, A, whether they actually saw colors accompanying the music. They listened with closed eyes and relaxed attitude. They checked B if they did not see colors, but did have thoughts or feelings of color. In case they experienced neither of these relations, they were asked to check C, and then simply to state in the alloted space what color or colors they were inclined to think most appropriate to the selection. Students who checked either A or B were also asked to describe the color or colors experienced. (13)

Figure 1 shows the tabulated results in the form of bar diagrams. The number of the selections is indicated in the left margin. The selections are arranged in the order of their central tendencies. In the first column of bar diagrams, the mood responses are indicated by the letters of the word groups. In the second column the color responses are given. The third and fourth columns are plottings which were in terms of black and white and impure colors such as brown, pink, etc.

Two of the selections, VII and IX, were confused in mood and were also confused in color. Selection IV has a flat histogram for spectral colors because most of the judgments were black and gray.

Perhaps the most striking feature of Figure 1 is the fact that the peaks of all three of the visual continua tend to vary systematically with the mood of the selections. Selection VIII is tender (C) and blue; V is leisurely (D) and green; I is gay (F) and yellow; III is exciting (G) and orange; VI is both exciting (G) and vigorous (H) and red. In the black-white series, the mood moves from white to black as the selections go from tender to sad. The trend in the mixture of colors is less pronounced, but still the light mixtures concentrate on the tender, leisurely selections, and the dark mixtures on the solemn and sad selections.

Some basically similar mechanism behind the color responses of all the students was indicated by the fact that the forced judgments (checking C) were so similar to the judgments of those who said they saw colors. The ambiguous selection suggested that the mood response itself might be rather directly involved, since those who described the selections as of different moods also tended to name different colors in a consistent way. It seemed worth while to determine whether purely verbal associations to Hevner's word groups would correspond to associations made to music. A group of 105 students who had taken part in the first study acted as subjects. They received the following instructions:

> In this study we are trying to find what colors people associate with certain moods. You will find below eight lists of adjectives, arranged in groups of similar meaning. Read the lists of adjectives, and then write below each list the color or colors that seem best to go with the list as a whole. Please write a color or colors for each group of adjectives, even though the judgment seems forced.

[illegible]

Figure 2 shows the [illegible] ... In the third column [illegible]

[illegible]

Perhaps the most striking feature of Figure [illegible]

[illegible]

[illegible]

[illegible]

In Figure 2, the histograms from this experiment are in the first column.

The similarities between the sets of histograms are striking. In almost every case the central tendency is in the same position, and even irregularities in the histograms are duplicated. Blue and purple show shifts of one step in the position of the mode. The patterns for orange and gray are much more definite in the word responses. The word responses in general show more exaggerated central tendencies and less spread. The lack of pattern in musical responses for white, brown and pink is duplicated in the word responses.

One striking fact which appeared in the responses to single selections, in the total responses to music, and also in the responses to words, was the systematic relationship between position on the mood circle and position on the spectrum.

The trend is clearest in the responses to the word groups. Red has its mode at G (exciting), orange at F(gay), yellow at E (playful), green at D (leisurely), blue at C (tender), purple at A (solemn). Black is heavily concentrated at B (sad). The average positions appear in the figure on the <u>inside</u> of the circle. Black is inserted in the parentheses, even though it is not in the color circle, because it showed such a heavy concentration in the sad and solemn region of the mood circle.

Attempts to relate the color-circle with mood studies have been made before. The conceptual circles presented by Luckiesh (11) in the frontispiece to his <u>Color and Colors</u>, are quite similar to ours. The work of Ross (15) is more directly related, as he used a variation of the same Hevner circle. His placing of the colors appears in Figure 3, on the outside of the circle.

Ross projected colors on a screen with a standard stereoptican, using 27 theatrical gelatins. His subjects checked single words of the Hevner word lists. He then determined which gelatins were most often described by the words of a given group. These gelatins were also rated as warm and cold by the subjects, and he found that warm and cold colors were at opposite sides of the word-circle. A circle of wave-lengths which satisfied the requirements of a true circular scale (that opposite ends of a diameter should be complementary) also divided warm and cold colors. Warm and cold colors are also approaching and receding, and light and heavy.

In view of the differences in procedure, the similarities in results of the two studies are striking, suggesting strongly that the general circularity is not a chance result. There is, indeed, little reason to expect that a mathematically determined color-circle should combine precisely with Hevner's word-circle. People are not mathematically accurate in the colors which they regard as complementary (a fact which has forced some investigators to say that people prefer "near complementaries").

In Figure 5, the [illegible] in the first column.

The [illegible]

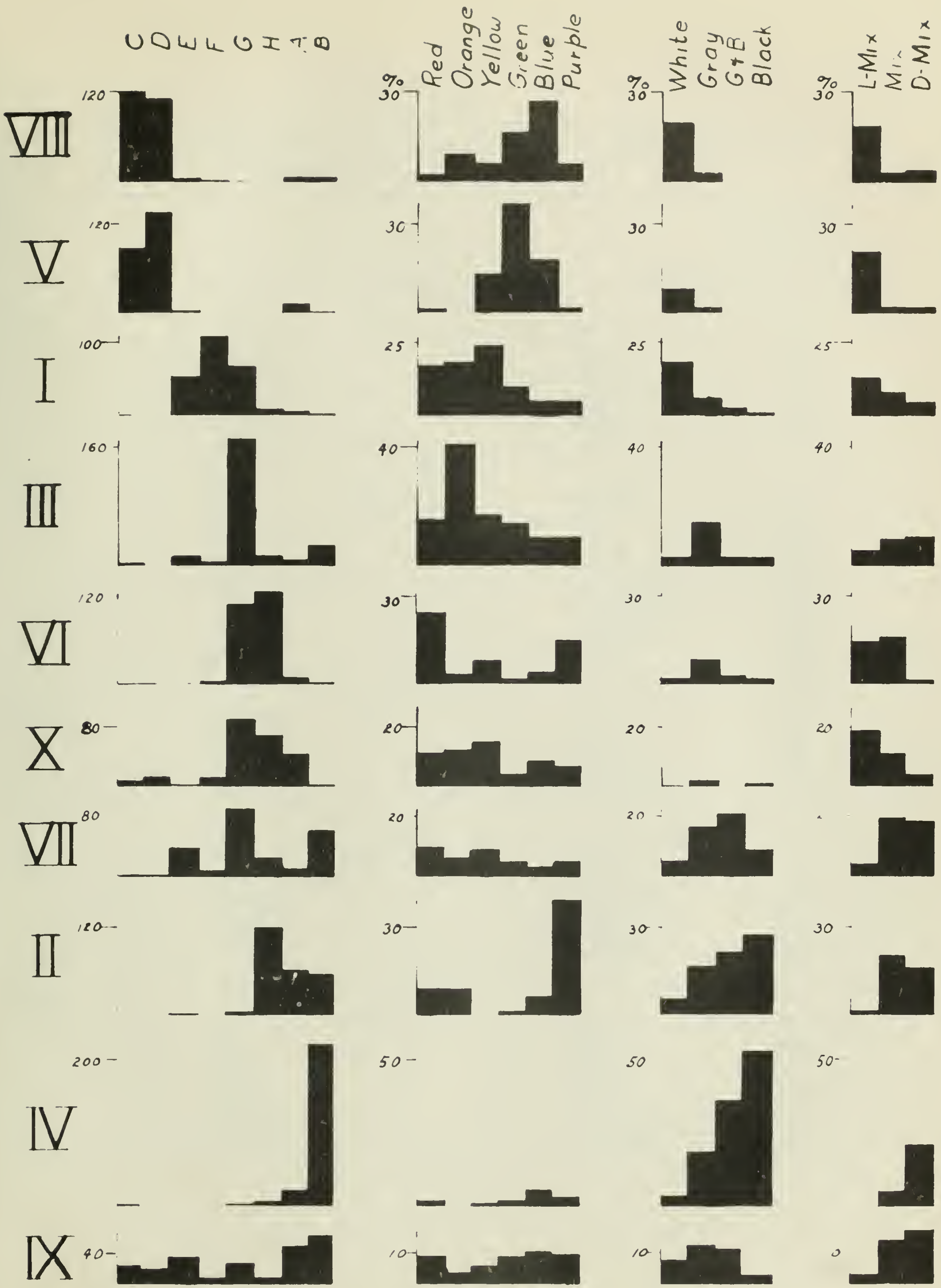
The [illegible]

The [illegible]

Attempts to [illegible]

Some [illegible]

As [illegible]


C D E F G H I B
Red Orange Yellow Green Blue Purple
White Gray G+B Black
L-Mix Mix D-Mix
%
VIII
V
I
III
VI
X
VII
II
IV
IX
120
100
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200
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25
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10

TABLE 2

RELATIONSHIPS COMMONLY OBSERVED IN THE PHOTISMS OF PHOTISTIC VISUALIZERS, WITH THE CORRESPONDING CONSISTENCIES ON THE GROUP POLARITY TEST

					% Consistency in group test
		A			
LOUD	...... large	SOFT	...... small		.92
	...... near		...... far		.92
	...... angular		...... rounded		.83
	...... thick		...... thin		.72
	...... dark		...... light		—.81*
		B			
MELODY	...... light	HARMONY	...... dark		.87
	...... thin		...... thick		.83
	...... near		...... far		.82
	...... distinct		...... blurred		.82
	...... figure		...... background		.80
	...... moving		...... stationary		.78
	...... angular		...... rounded		.78
	...... small		...... large		.75
		C			
HAPPY	...... distinct	SAD	...... blurred		.96
	...... light		...... dark		.96
	...... moving		...... stationary		.94
	...... thin		...... thick		.82
		D			
FAST	...... light	SLOW	...... dark		.97
	...... thin		...... thick		.96
	...... moving		...... stationary		.94
	...... small		...... large		.85
	...... distinct		...... blurred		—.64*
		E			
TREBLE	...... light	BASS	...... dark		.98
	...... up		...... down		.98
	...... small		...... large		.97
	...... thin		...... thick		.94
	...... distinct		...... blurred		.76
	...... angular		...... rounded		.74

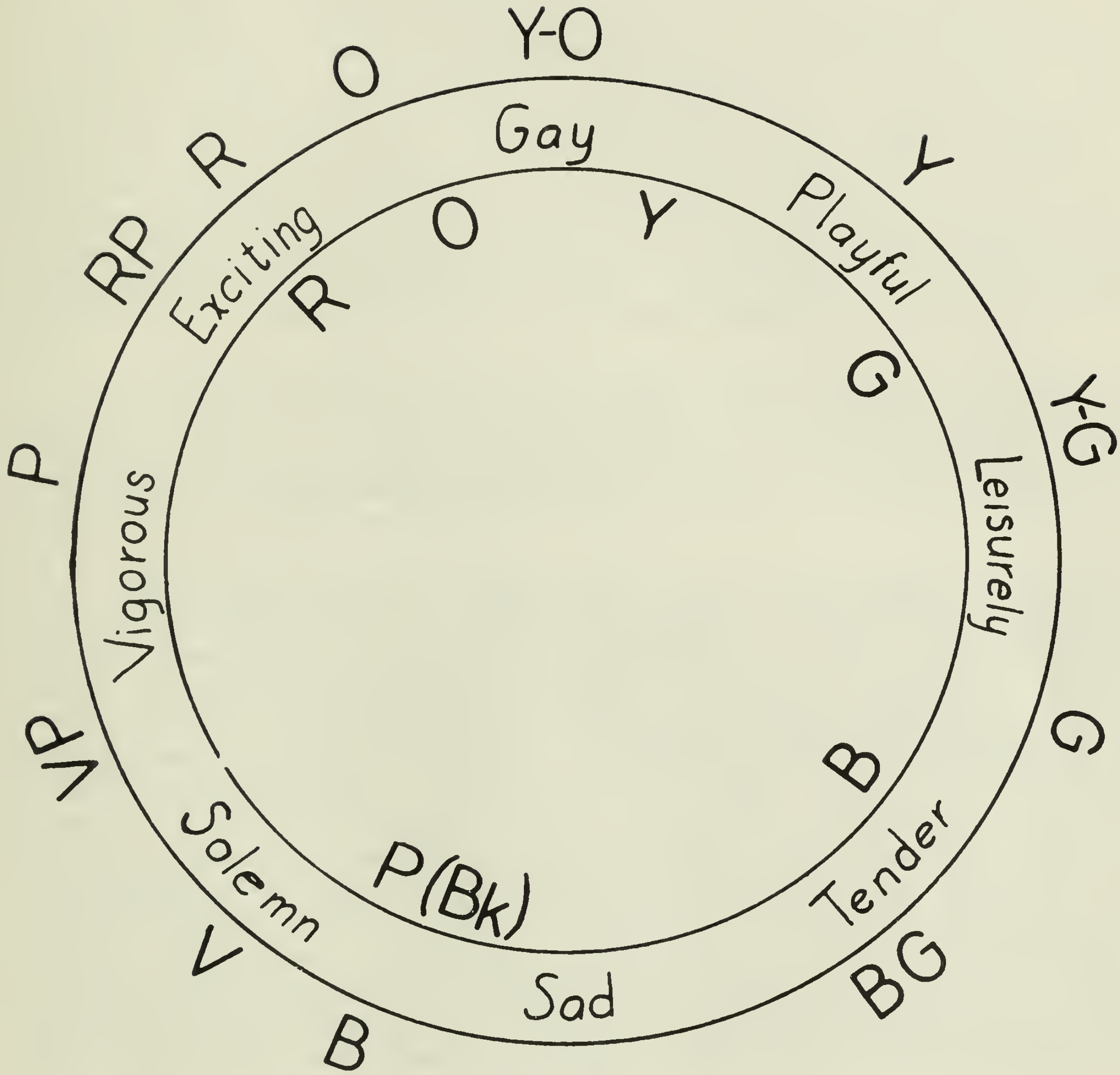

FIGURE 3

THE MOOD-CIRCLE AND THE COLOR-CIRCLE

Expression in line and shape. The pleasing expression of bisecting lines, rectangles and various shapes is well known as the Golden Section. (1) Over the centuries the Golden Sector has had fanatical supporters. In our time its modern version, "dynamic symmetry", raised the hope of a magical formula. Receiving but causal interest was the empirical evidence for what seemed obvious--the expressiveness of lines. Thus, lines with big curves moving downward are sad; small curves moving upward are merry. The linear properties for at least thirteen moods have been characterized experimentally. In the literature of aesthetics the role of vertical lines, horizontal lines, oblique lines, curved lines, etc., in expressing emotions and subtle feelings is voluminous. In architecture, the contour line has no peer in the quality of expressiveness. In a recent article Michelis (12) has shown the wide spread tendency of the ancient builders to curve contours for aesthetic effect and not merely to correct for illusions, as is generally claimed. In our time, we have discovered the expression of function which may be defined as the expression of the object or a building as a whole. The spirit of civilizations is said to be expressed in the functional properties of its architecture.

A generalization that can be drawn from the above examples of expression of moods by various stimuli is that all stimuli, conscious or unconscious, in performing the expressive function became organized in polar or complementary relations whether or not the stimulus continua are such in their own right.

Expression does not always have to be a feeling or emotion. Colors are expressive in their own right. Katz's (7) brilliant experimental analysis of the modes of appearance of colors as film and surface color has established two orders of color experience. Surface colors are colors of objects. They express the qualities of hardness, compactness and substantiality. These qualities are abetted by the texture of the object. Film colors are more luminous--are spongy and thick. They exert pressure or are insistent. Film color has a space-filling "quale" unconnected with an object, while surface color is an attribute of an object. Therefore, surface color is the object color. Best examples of film color are spectral lights seen through a spectroscope. In nature, sky color is film. Katz, among other modes of seeing color, describes voluminous or bulky colors which are like film colors in three dimensions. Bulky colors are seen only when objects are visible through them. All colors appear as surface, film or bulky.

In painting, experiments with illumination, as in Rembrandt, show appreciation of film color. More direct in their efforts were a group of impressionists who are called luminists and pointillismists. Among them are the names of Pissaro, Monet, Seurat and Signac. These artists wished to reproduce light and color in its purity. They succeeded only too well, and they did this years before Katz told us about film colors. Critics of luminism pointed out the unreal appearance (loss of object), the lack of form, filmy, flimsy, confetti-like character of their products. The critics' description indicates the nature of the expressive qualities of film colors. With the increased use of artificial illumination in architecture the control of film and surface colors and their blends is a promising medium for aesthetics not yet

fully appreciated. The effect of color and shape in combination is another area about which we know little definitely. Such local decorations as illuminated triangles in color may well be used in architecture. Kandinsky (6) in his art for spiritual harmony offers his subjective experiences as guides in this area.

Perception

Empathy. The dynamic effects of perception commonly called empathy is a translation of the German "Einfuhlung" (feeling into). The word empathy actually means a psychological theory of how perceptions express feelings and emotions. The theory is attributed to the German psychologist Theodore Lipps. Langfeld (10) who is the theory's contemporary advocate explains empathy in the following words: "....when we see an object such as a column or a spiral or an arch, we realize from our previous experience how it was constructed. We have an idea of forces, tensions, etc., involved. There are then induced in our muscles and joints sensations of strain and movement similar to those which we should have if we built such objects. The ideas of these sensations are then projected into the object and these give it life. They are no longer our own sensations, but attributes of the object. It is not the mere perception of the form which directly calls up ideas of one's activity and which in turn is directly projected into the object; for it is first necessary that we have this knowledge of the processes of construction, before we can have the ideas of movement." The transition from muscular to mental empathy is shown in the following quotation from Lipps, selected by Arnheim (1): "When I project my strivings and forces into nature I do so also as to the way my strivings and forces make me feel, that is, I project my pride, my courage, my stubbornness, my lightness, my playful assuredness, my tranquil complacence. Only thus my empathy with regard to nature becomes truly aesthetic empathy."

Gestalt psychologists brought empathy, which was almost forgotten, into prominence by severely attacking it. They took exactly the opposite position. Ever since Wertheimer proved that apparent motion has nothing to do with eye movements, Gestalters have been suspicious of motor factors as determinants of perception. Are the expressive qualities in the object? Yes and no. They are not in the stimulus which is merely an array of light waves. The rays strike the retina and electro-chemical energy is propogated to the brain where it establishes a field of force on the cortex (according to Gestalt psychology). This field encounters resistence from the already existing field of force. A process of stress and strain is set up as the new stimulation is establishing itself. The greatest strain would be around the boundaries of the stimulated area. The boundary, consequently, becomes defined in terms of least energy necessary to maintain itself. Hence the boundary tends to take the simplest form possible under the given conditions. When this happens, tension in the system is reduced. A boundary surrounds forms or configurations and this interest in the form properties of the cortical field gave Gestalt psychology its name. Gestalt means form or configuration in German.

tally organization. The effect of color upon space is considerable. Colors have weight, which is more difficult to interpret. There are associations of a [illegible] character with colors that must be taken into consideration. [illegible]

[illegible]

Empathy. The esthetic attitude of [illegible] is a translation of the German "Einfühlung" (feeling into). [illegible]

[illegible]

[illegible]

Within the boundaries there is a similar process of strain and stress until the field becomes structured into a unified pattern in which the whole determines the parts. Therefore, the whole is more than the sum of parts. It is a unique entity. This brain pattern is the correlate of phenomenal experience. Everything is related to everything also in the brain field and in the phenomenal field. A peculiar kind of relation which is not known stands for expressive qualities. Similar strains or dynamic relations are set up in the brain field by different kinds of stimuli such as zig zag lines in vision and staccato in sound. Because they set up similar kinds of energetics in the different parts of the brain, they are recognized as similar. "All sea gulls look as though their name were Emma." Things look the way they feel. (9)

In discussing expressive qualities, Koffka (8) made some interesting philosophical speculations. Locke divided reality into primary and secondary qualities. By secondary qualities he meant such things as color, sound, taste, smell, etc. Koffka proposes tertiary qualities such as fast, slow, large, small, hard, soft, etc. Among these tertiary qualities are some which look like the expression of faces. Hence, this special group is known as the physiognomic qualities of expression. Aesthetics is concerned with the physiognomic properties of objects. If we say that art is primarily concerned about the representational properties of form and their expressive characteristics, we have also defined Gestalt psychology.

Many psychologists, certainly the great majority in America, cannot accept the hypothetical construct of the brain field which is the citadel of Gestalt psychology. No one denies its refreshing influence on perception. It is not merely a theory--it introduced new approaches in research, new discoveries and reformulation of neglected problems. In real life, things tend to look constant in size, shape and color, in contradiction to the law of retinal image. Gestalt psychologists showed us when the law of constancy applies and when the law of retinal angle is the determinant of perception. They pointed out the difference in looking at things naturally and in looking at them through a reduction screen. In color, they made an important distinction between film and surface color. They were able to do this by making material or phonomenological observations scientifically respectable.

Their major contribution concerns the structure of form which is also the central problem of aesthetics. The relation of figure and ground, conditions of figure formation and of their stability, why perceptual factors tend toward greatest simplicity and least energy, how tensions are created in perception and how they are relieved, are examples of this. In the larger field of the organization of forms, they introduced the organizing factors of closure, similarity, nearness, contiguity and common fate. Artists use similar principles of repetition, rhythm and sequential flow. Psychologists are now in agreement that the first vision is innately primitive figure and ground, but it takes months of learning to identify the perceived figures. The proof of these facts is based on Senden's (16) exhaustive work on congenitally blind cataract cases studied after operation.

A convenient way to classify psychological theories of perception is in terms of the words central and peripheral theories. Thus Lipp's theory of empathy is peripheral because it admits kinaesthetic responses as a prominant factor; Gestalt theory is central because it does not need peripheral feed-back. In 1709 Bishop Berkeley amazed the philosophical world with his startling contention that the distance of objects depends on the sensory cues produced by muscular contraction in converging the eyes to focus on an object. In effect, what Berkeley did was to give a muscular cue a dominant role in space perception. Hitherto, only sensory cues were considered, excepting Descartes notion of triangulation, which was rather mystical. Even though convergence and accommodation have been largely discounted as cues of space, muscular or motor determinants have played a prominant part in psychology, ever since Berkeley brought muscles into the sanctity of the mind. Werner and Wapner, Gestalt orientated psychologists, recognized the role of muscle tensions in their theory of sensory-tonic perception.

Werner and Wapner (20) asked the question, "How can two such different things as mental events and motor (tension) events be equivalent?" They had subjects look at a luminious rod in a dark rod. On stimulating electrically a muscle in the right side of the neck, the rod moves to the left; if the left muscles are stimulated, the rod moves to the right. Meanwhile, in Innsbruck, Kohler did some extraordinary experiments (9). He and his subjects wore glasses with split lenses: the upper half distorted vision; the lower half was simply plain glass. If he looked through the upper half of the spectacle, he saw things displaced and distorted. After wearing these glasses for 50 days, things began to look normal, but on taking off the glasses, every time he glanced up he saw a distorted field. This continued for 40 days. Another experiment consisted of glasses that were split in such a way that everytime one looked to the right, one looked through a blue filter; in looking to the left, the line of regard passed through a yellow filter. After a long period of habituation, taking off the glasses tended to color objects toward blue whenever one glanced to the right, and objects were yellow on glancing to the left. This also persisted for a long time. Werner and Wapner consider evidence of this kind as demonstrating that sensory and motor factors are equivalent. Their sensory tonic theory is really an organismic theory since this kind of equivalence involves the whole organism. Their conception is that there is an essential similarity or equivalence between functional parts of the nervous organism. According to this theory, stimulation is always sensory-tonic stimulation.

Another group of psychologists studied the effect on perception of objects due to different motivations. They found that size, recognition and configuration of objects changed with variations in motivation and personal values. These experiments, however, were done under conditions of perception which were ambiguous rather than clear cut. Even so, they did produce evidence that perception is influenced by the condition of the organism in some measure. At Dartmouth and Princeton (17) the conclusion drawn from work on the Ames demonstrations is that the perceived object is determined by our particular past experiences. Past experience controls perception by the assumptions

they and we set up. The location of a billiard ball depends on whether we assume it is a billiard ball or a ping pong ball. The measured distance varies accordingly.

The changes in the perception of the object by non-visual factors is important to aesthetics because these changes are definitely seen and not merely inferred. Whether the reported expressive qualities are directly experienced or merely suggested, is difficult to determine by introspection. Aesthetic theory has split more on this issue than on any other. Probably the aesthetically sensitive approach vivid illusion whereas the relatively unaesthetic are confined to cognitive suggestion. This would account for the fact that a part of the population is compelled to stay by the art object and is further reinforced by vivid feeling tones. The other part of the population, reacting primarily on the meaning level, is finished as soon as recognition of the object, in various degrees of subtlety, is obtained.

It is a well-known fact that individuals differ in the amount of measured illusion obtained with typical visual illusions. Perhaps individual differences in susceptibility to typical visual illusions is one essential factor in the aesthetic response (19). If an experimental correlate for the aesthetic attitude should be found in terms of susceptibility to appropriate visual illusions, it would answer many questions which are now a matter of personal opinion. One question is, "How widespread the aesthetic sensitivity in the population?" Another is, "To what extent is aesthetics educable?" These questions are important, especially for architects who have the problem of designing new conceptions and worry about their acceptability by the public.

Perception of Surface in Three Dimensions

Let us return for a further appraisal of Gestalt psychology. It is obvious that the kinds of dynamic relations that Gestalt has emphasized are important to painters. Painters, as artists, must represent reality on a two dimensional plane or the so-called picture plane. For architecture, the Gestalt findings are not as pertinent. Architects deal with massive substantial objects in real space. The problem of figure and ground is of limited value to them except probably in the case of windows and entrances--whether they should be featured as figures or diminished as ground. Modern architecture deals largely with areas and their important variables which are of the nature of scale, surface, texture, edges and slant. At Cornell, Gibson (3) and his students are investigating these variables. This approach in research is in its infancy, but a few studies are available. In one, he finds that when patterned surfaces are photographed from various angles, and these pictures are later viewed by subjects through a reduction-screen setup (looking at them through a tube), definite impressions of slant are obtained, the denser portions of the patterns appearing farther away. In the same publication, he reports that regular texture is superior to irregular texture in judging the correctness of slant. (4)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Gibson's theory* of space perception is based on the idea that the primary datum of perception is surface. The stimulus for surface is a gradient of texture in the retinal image, whereby a grain of surface becomes finer at a distance. Geometrical perspective is a special instance of varying texture--density. When the gradient is zero, but it does not change from coarse to fine, the impression is a frontal plane. When there is any gradient of texture, it may decrease upward, from left to right, from right to left, or downward, and these are the four conditions, respectively, for a floor, a left-hand wall, a right-hand wall and a ceiling. A sudden change in the gradient of texture is the impression for a contour or edge. "If the physical surfaces have regular structures peculiar to them, as wood, cloth, or earth have, the regularity will be projected in a focused image, and this repetitive character of the stimulation, in turn, may well be the basis for the perception of surface."

Gibson took on the task of organizing all the work that has been done in perception. He comes out with three kinds of perception which he calls the <u>visual field</u>, the <u>visual world</u> and <u>schematic perception</u>. The visual field is the world of classical studies of perception; the visual world is his own theory of space perception and schematic perception is the world of hurried perception. Let us dispose of the schematic world first and spend more time on his dichotomy of visual field and visual world because in this distinction, Gibson makes a fundamental break with tradition. By schematic perception Gibson refers to such influences as mental set, past experience and motives in determining perception. Actually, he implies that such events are not really perceptions in the literal sense. Perceiving of everyday life is often a matter of glances or faint and ill-remembered impressions, and the results of perceiving under poor conditions are therefore, truer to life than the results of optimal presentations. The percept is reduced as a cue for action. Perception of everyday life is often very schematic. In common speech, man tends to see things in his own way. But perception can be literal whenever the observer needs to discriminate. Under favorable conditions it can be surprisingly exact, as experiments in the laboratory demonstrate. Perception is not always or necessarily distorted by needs or effected by purposes. It is not fated to be stereotyped or assimilated to social norms. Misperception is not a consequence of sensory organization, but of the inattention of the perceiver or the weakness of physical stimulation. The detection of witches by the citizens of Salem, Massachusetts, is a case of gross misperception, but it does not always happen.

The visual field and the visual world are different worlds having different properties, but they work together. The visual field is the kind of perception we get by analytic observation or by "introspection". The visual world is obtained by another method of observation which is known as "phenomenological". The former yields a limited and fragmentary world; the latter yields a world which is all of one piece, constant and stable. The phenomenological world is the one that needs to be explained.

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*The following analysis is taken from Gibson's book, largely in his own words.

A word about analytic and phenomenological introspection. The former is conducted under limited controlled conditions. One thing is observed at one time. From these fragmentary observations, conducted under experimental isolations, specific data are derived. From a series of such specific introspections of observed phenomena, a whole conception is built up. This kind of analytic introspection has led to the theory of cues in perception. Introspectionists tended to work in dark rooms in which the background stimuli were largely eliminated. The Gestalt psychologists objected to such limited observation and introduced the phenomenological approach or introspection of objects in their natural settings. This led to the notion of totalities or configurations which are more than merely the sum of parts. Gibson goes along with the Gestalters in their method and their interest in larger unities, but he prefers retinal to cortical determination.

The visual world is the stable, panoramic world of everyday life. The visual field is more like the world would be if it were a mere copy of the retinal image. The visual world is Euclidean--parallel lines do not meet at a point. In the visual field, parallel lines do converge to a point. The visual world is all around us; it is panoramic. The visual field is oval in shape and extends about 180 degrees laterally and 150 degrees up and down. The visual world is unlimited. In the visual field, the point fixated looks clear; points away from fixation are blurred. The visual world is clear in its entirety. The visual world does not shift as we move around in space. Even moving the head and eyes does not disturb the world's stability. However, if we move the eyes by pressing the eyeballs, the world shifts. We are observing the visual field. The world of shape, size and color constancy is the visual world. Gibson points out that not only psychologists, but artists, in the use of perspective in their drawings, are depicting the visual field. The camera does likewise. Objects become smaller and lines converge at the horizon. He believes that our predilection to think in terms of pictorial representation has delayed study of the visual world as opposed to the visual field. There is the large problem of how we see the world as stable while shifting our eyes from one part of the world to another. We do not know what the psycho-physical correlates are by which this process is negotiated, but Gibson believes they will be found. Gibson examines the classical cues of distance and shows how they fit the concept of a gradient. Aerial perspective is, for the most part, a simple gradient of hue--a gradient running toward the violet end of the spectrum. A visual field seen by both eyes, always contains a gradient of double image. Other cues are paralleled in the same manner.

Gibson's theory is radically new. It has wide systematic scope and it has been thought out in detail. Most of the evidence is in the form of ingenious drawings based on geometric perspective which are experiments of their kind. Most psychologists have not regarded the possibility of locating all the perceptual correlates in the retinal image. However, if this theory leads to research, we may obtain much valuable data just as Gestalt psychology did, in spite of the inacceptability of its basic hypothesis by most psychologists. Gibson's proposal calls for new types of research, involving slants and planes. This may be saying, simply, that such research is architecture.

[illegible] qualities. The [illegible] [illegible]. His theory is concerned mainly with [illegible] [illegible] conditions. The theory is developed in two stages. [illegible].

The visual world is [illegible] [illegible] [illegible] [illegible] [illegible]. The visual field is more like the [illegible] [illegible] as if it were a [illegible] of the retinal image. The visual world is [illegible] [illegible] lines do not [illegible] [illegible]. In the visual field, [illegible] lines [illegible] to a point. The visual world is [illegible] [illegible] it is [illegible]. The visual field is oval in shape and [illegible] [illegible] [illegible] [illegible]. The visual world is [illegible]. In the visual field, [illegible] [illegible] [illegible] [illegible]. The visual world is [illegible] [illegible] [illegible]. The visual world does not shift [illegible] [illegible] [illegible] [illegible] the head and eyes does not disturb the world's [illegible]. However, if [illegible] the eye by pressing it [illegible], the world shifts. [illegible] the visual field. [illegible].

[illegible] theory is [illegible] [illegible]. [illegible].

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GENERAL THEORY OF COMPOSITION

by
Gyorgy Kepes
Professor of Visual Design
Massachusetts Institute of Technology
Boston, Massachusetts

Mr. Kepes was unable to attend the Conference, due to illness.

COLOR AND ARCHITECTURE

by
Nicholas Britsky
Professor of Art
University of Illinois
Urbana, Illinois

For the next forty minutes or so, I would like to put before you some observations, some facts, and some illustrations on color and the use of it in architecture. As you suspect, the observations will be those of an artist -- but one who has been interested in the use of art in architecture for the past twenty years. The facts I have excavated from color specialists such as the Munsell Color Co. of Baltimore, Md., Faber Birren, and Maitland Graves. The examples are kodachromes of some interesting and uninteresting uses of color and art in architecture.

Before I talk about the present, let me set the background for it with a few words about the past. One of the curious things about the history of architecture is how it has slighted color.

Possible it's because weatherproof color was not available; possibly it's the work of historians and architects themselves, people like the often-quoted Lisle March Phillips. Surveying the work of the past, he said, "Form has dominated art wherever and whenever the intellectual faculty was dominant in life; color has dominated art whenever and wherever the emotional faculty dominated life. So it seems natural that Western temperament, intellectual rather than sensuous, should excel in form rather than color; while the Eastern, sensuous rather than intellectual, should excel in color rather than form".

It is doubtful if a Buddhist or a Brahman is less intellectual than a Frenchman or an American.

The available facts prove that the beauty of Egyptian, Chinese, and Greek art was not solely due to aesthetics, but function also. Art was functional and practical because it was symbolic. Color had a meaning, just like form, in that it expressed the needs of their life. A great deal of the color symbolism we know now was originated by these people; white--good; black--evil; yellow--sun; green--water; blue--heavens; red--man.

The early historical style that seemed to impress American architects most was the Greek style. We still marvel at the subtle way they used proportion. We liked the style so well that we built banks, railroad stations, churches and private houses with it--whether they were functional or not. Nowhere in this revival was there any noticeable use of color. Yet the Greeks used it. Most of the color and art they used appeared on the entableture and the capital.

Here's a brief excerpt from the report of one archaelogist named Frederick Poulson: "When the reliefs were discovered they were richly painted and still the colors have not all faded. The figures are

treated in blue, green and red. The clothes are red with blue borders. Clothing colors are changed when two or more garments or armor are worn. Helmets are blue with red ornament stripes on edged to pick them out from the blue background."....so he goes on in detail.

Available as the information was, many people refused to believe or like it. Auguste Rodin, the sculptor who was greatly influenced by Greek sculpture, upon reading of their use of color, was said to have struck his breast and said, "I feel that these were never colored." There is also evidence that the color was white-washed by disapproving museum curators.

As Greek architecture migrated to Rome, use of color declined. It continued to decline with the Byzantine, where it was used primarily on the interior.

The Renaissance can best be summarized in the words of Ralph Adams Cram, writing in his introduction to Solon's "Polychromy", he said, "The complete loss of color out of architecture is one of the curious phenomena of the Renaissance, casting its drab shadow in lengthening lines and ever-increasing gloom over the art of building in modern times."

It has been over 500 years now; it's a long time to be gloomy.

Now as we survey the contemporary scene from the standpoint of color -- and here I mean the integrated use of color -- color with character and personality -- and well organized -- I think you will agree with Cram that it still is drab. Think of your train or auto trip to here -- gray and a little of barn red. Commercial building tries to use some color, especially the gas station and there it shouts. During the World's Fairs we see some braver use of color, but there it dies.

Almost everyone likes color but we still don't use it with conviction. I think tradition makes us afraid of it, habit, or what people will say, or that we're intellectual rather than sensuous. It certainly is not because it's poor design.

When we speak of good design, we think of three important elements. Function, Beauty and the Human Being, the consumer. Now let's relate these three considerations of good architecture to the inherent characteristics of color and see how it can or has helped them.

(When we speak of color from now on, please remember that appropriate and adequate lighting works hand in hand with it.)

Color can make shapes look larger or smaller. Because the focus of the eye is not the same for all hues, the colors of the spectrum will appear near or far, large or small accordingly. For example, red focuses normally at a point behind the retina. To see it clearly, the lens of the eye grows convex, pulling the color nearer and thus giving it apparently larger size. On the other hand, blue focuses at a point in front of the retina, causing lens to flatten out and push the color back, making it look smaller. According to W. Allen Wallis, yellow is seen as the largest of colors, then white, red, green, blue and black the smallest.

This is scientific proof of an aesthetic fact painters have long used. French Impressionists described form with it. Moderns still use it. Warm colors project forward -- cool colors recede. Light values move forward, dark ones recede. Hence, if you want a room or wall to appear larger than it is, paint it light yellow; to make it smaller -- blue or dark green or black.

Red, orange and yellow form a sharp clear image on the retina -- blue and green tend to appear blurred. Using this information, the painter Wassily Kandinsky wrote that warm colors such as yellow, orange and red were best suited to sharp angular forms and the cool colors for soft round forms.

Darker colors are heavier than lighter. Pure color is heavier than gray color. Warm color will push cool color back. Hence, where structure and solidity are to be implied, deep colors serve best for the base and light colors for the super structure. This is an excellent example of integrated color - color with a meaning.

Meaning and form and color......For a good many years now Art teachers have been conducting simple exercises in word-form and word-color relationship. We give them a variety of words and ask the students to express them in line. Words like strength, uncertainty, happiness, peace, anger, grace...

The interesting thing about this is that there is a high degree of agreement on the interpretation of the words. However, when I try it with colors, the percentage of agreement is much less.

During the last war, color played an important part in camouflage. Basically, it consisted of breaking up known forms into smaller shapes by the means of contrasting color pattern. By adding texture to the contrasting color and relating it to the background, large structures could be made inconspicuous or even lost in its surroundings.....Now, I'm sure at some time in your career, you have designed a building that you would like to hide. If you will form a line on the right here after the talk, I'll be glad to pass on my military secrets.

Now, I would like to quote you some case histories. D. B. Harmon of Texas has done very important work in the school field with light and color. He used elaborate before and after tests. Higher light levels, better control and distribution of light, brighter colors and more imaginative use of desk arrangement were his means. He writes, "In May, six months after the rooms had been redecorated and rearranged, the children were given the medical and nutritional examinations and the visual and psychological and educational tests. At this time only 27.8% of them showed refractive eye problems -- a reduction of 57.1% from six months previously. Nutritional problem dropped 39.5% and chronic infection reduced 30.9%. In addition to the apparent well-being resulting from this better use of light and color, comparable results were obtained in educational achievement."

One case I heard of functional decoration was where the architect allowed the kids to choose the colors for their classrooms. As you might suspect, they chose vivid colors and in some cases, wild. The kids loved them, but their teachers became nervous wrecks.

Probably the most stubborn people to convince about color have been hospital authorities. Until recently, the conception was that white was the only antiseptic color. Some still think so. They dressed you in a white nightgown, put you on a white bed, covered with white sheets. So you stare at the white walls or ceiling or look out a window with white drapes. Then the cold indifference of the whiteness creeps into your bones and a nurse and doctor dressed in white and sardonically quip "And how does our Mr. Quimby feel today?"

A hotel man, C. C. McLean, who as a patient revolted at this atmosphere has been responsible for many improvements along the color line. He is now consultant on hospital decoration to the President's Commission on the Health Needs of the Nation. He has insisted on color on walls and furniture, prints on drapery and murals on ceilings, especially in the children's wards. His most popular innovation is the posting of Norman Rockwell's Saturday Evening Post covers on the ceiling of the blood donor rooms. His only problem is he's run out of covers.

To the surprise of the hospital authorities, this speeded up the recovery time of the patients and improved the morale of both patients and hospital staff. (Functional use of art and colors)

That color can have a soothing or an exciting effect was demonstrated by a physician, Felix Deutsch. He chose a room overlooking a garden. Glass panes of windows were composed of different colors. Colored artificial light was employed in the room -- warm red and cool green.

The subject was left alone in the room for half an hour and asked to look out the windows. After that subject was asked questions about general feeling and associations. Process was repeated daily. Sample Case History: Medical therapy did not help this patient. She complained of anginal fear, shortness of breath, air hunger, palpitations of the heart. She feared a return of a spasm which years ago caused her to lose consciousness.

This patient was placed in a red environment -- green was repulsive and excited her. At examination her pulse rate was 112. After four sessions, her pulse rate remained at 74. Patient said she felt a comforting warmth. Insomnia disappeared, calmness restored.

There are many such case histories of the therapeutic value of color and light.

By tying electrodes to human tongues to measure the flow of saliva, an experiment was conducted to determine which colors were most appetizing. Vermilion proved most appetizing (probably due to association with rare cut of beef, apple, cherry). Then came orange, peach, brown, buff, warm yellow, clear green.

National Industrial Conference Board sent a questionnaire to 350 companies who used good color on a small scale or large scale.

64.7% said color improved lighting.
27.9% said production increased.
30.9% said work improved.
19.1% said it reduced eyestrain and fatigue.
14.7% said it reduced absenteeism.

Churches: Here, I think is a big area, one that would take an hour to discuss adequately. Briefly, it's an ideal place to use color aesthetically, emotionally, thus functionally. Things are looking better in this area, but if you look at interior church design, in general you have a perfect illustration of the gloom Mr. Cram speaks of. The light and color, which should have added the happy and hopeful experience that religion is, was missing. However, as I said, I believe it is slowly creeping in.

Why does a human being like certain colors and what kind of a person is he if he likes them? There are a lot of statistics on this subject compiled by psychologists, doctors and decorators.

You have probably noticed how brunettes lean toward the red and warm hues and blondes toward blues and greens. Dr. E. R. Jaensch, a psychologist, found that this is because brunette Latins come from warm countries where they had to adapt to intense light and warm color environment. Nordic blondes come from cooler color environment and less light. Jaensch deduced that the deciding factor for color preference was sunlight or lack of it. This, then places the world population into either the warm or cool color preference category -- or a combination of the two.

Why so many adults like blue and green -- fluids in the human eye grow yellowish with age and filter out blue light. Lense of a child absorb about 10% of blue light; that of an old man 85%. Hence, human eye now thirsts for blues as the lens proceed to filter more out. The order of preference in maturity is blue, red, green, violet, orange, yellow. It remains thus nationally and internationally. T. R. Garth found that American Indians liked red, blue, violet, orange, yellow. Fillipino's order was red, green, blue, violet, orange, yellow. Negroes' was blue, red, green, violet, orange, yellow. (Same as whites).

Women's order of appeal is same as male except they put yellow 5th and orange 6th. Almost the same is true in insane people (no reflection on the fairer sex). The order is blue, green, red, violet, yellow, orange. Green was liked by male patients, red by female. Warm colors appealed to the morbid patients and cool colors to the hysterical ones.

According to an article by Faber Birren, a color specialist, your personality can be analyzed from your color preference. I have the article here, so let's take a moment and try it and you be the judge of its accuracy.

If you were to choose a color, which is your favorite -- how many of you would choose blue?......yellow?

When you stop and think of how concerned the human being is with the looks of things in his life, you realize the importance of beauty to him. When he selects his clothing, furnishings, his car, his house -- even his wife, he is very concerned with looks.

I'm sure you all have your own ideas as to what constitutes beauty in architecture. I would like to say something about what you would call decoration. Choosing art for your design and choosing a color scheme.

A still somewhat neglected area of aiding beauty and color in architecture is the use of art in it. Cost is the big argument but poorer countries than ours somehow allocate 2% of the building cost to decoration and it seems to work. My own experience with this has been that art here becomes an afterthought and is submitted after the building is completed or already bid on. Then it becomes an added expense. The use of art, in order for it to be integrated with the architecture, should be planned for on the boards and submitted as part of the design.

The work of the artist should be harmonious with the architecture so that the art and architecture read as one. Not all artists are suitable for this work -- he must have a feeling for the architecture and his style should enrich the flat wall but never puncture a hole in it with deep perspective.

There is no scarcity of color samples or color schemes. Every paint manufacturer makes them, paint stores have color books, department stores have color consultants.

One trouble with some available color samples is that they are bland -- have that watered down look. (Kemtone).

The only fault with available color schemes, if they're not bland, is that they're a formula and are common. Since the architecture is not a formula design, the functional color for it should not be a formula either. Hence, the necessity for selection.

As far as determining the aesthetic preference in color combinations, people, including artists and designers, like (1) closely related colors (2) complimentary colors or (3) single colors or monochromatic.

With single colors, those variations are best which represent clear cut expressions of colors, i.e., pure hues should be rich and intense, pastel tints should have a light delicate quality; shades should have a deep, autumnal quality. Where a color is on the borderline, ugliness may result. Thus, a little white added to red may weaken its appeal. However, if enough white is added to shift the sensation from full color to a tint (pink), appeal is restored. Red with a touch of black may seem dirty, but with enough black added to shift the sensation to deep shade of maroon, beauty again is evident.

Requirements of a good color scheme:

(a) Please the designer and consumer
(b) Be appropriate for use
(c) Have variety or interest
(d) Possess unity (with itself and architecture)

Now let's say a word about each of these requirements: What pleases the designer will depend on his training, ability, background, heredity, knowledge of problem. Your knowledge of the consumer here is very important.

A scheme is appropriate if it is psychologically and aesthetically harmonious with the purpose of the scheme. A display would not take the same scheme as a study.

Variety and interest. Color interest is color contrast or diversity produced by: (1) Variety of hue (color). (2) Variety of value (lightness or darkness in a color). (3) Variety of chroma (strength or intensity of a color). (4) Variety of area.

Unity: Unity is a feeling of cohesion, oneness, consistency, integrity. It is the most important principle of aesthetic order. Color unity is as essential to design as color interest.

Here dominance plays a most important part in achieving unity. Equality of conflicting or competing visual forces will produce incoherence, chaos. As for example, a half-yellow, half-blue room in which each color is equal in value and chroma. To create unity, one of the colors would have to be made dominant by increasing its area. Hence, the plan of color areas or quantities is as essential as planning the lines, values and chromas.

References: Faber Birren - "New Horizons in Color"
Maitland Graves - "Color Fundamentals"

COMPOSITION IN SPACE

by
Milton Horn
Sculptor
Chicago, Illinois

All form that possesses volume, whether the volume be a solid, or an envelope, or a skeletal structure, occupies space beyond the flat surface. These forms have myriad views. In man, animal, insect and plant life these myriad views constantly vary in each. Think of the changing silhouettes of the one volume apple as you turn it, or the changing silhouettes of the many volumed romping kitten. Watch the movements of your neighbor, for that matter, as he shifts in his seat. All animal life above a single cell is composed of more than one volume and even the amoeba continually changes its shape, projecting forms in space in order to achieve locomotion. All living creatures continuously shift their volumes in space in opposing and spiral actions. Thus nature continuously recomposes their patterns in space. And as we cannot fail to see that all animate and inaminate forms set up a measurement, measure and are measured by space, so we cannot fail to see that form and space are at once reciprocal in their relative relationships.

We also see that in animal and plant life the very volumes of which they are composed in space reveal upon their envelopes structural movement from within (see the cross section of the shave grass also called the scouring rush), i.e., these inner forms project from within the volumes and make themselves felt on the undulating surface of the volume, clearly illustrated when one looks at the Australian bottle brush. It is in the structural projections of these forms that the sense of metamorphosis and life are evoked. In all great architecture and sculpture the volumes always have a sense of innerness.

The surface, which is the threatre of operation for the painter and the graphic artist, is not the space of the architect and sculptor, though the painter may create the illusion of three dimensional space; the illusion, once established upon the surface, remains unvarying in the painting, though it may set up varying emotional impacts.

The architect composes volumes in space and of space. The volumes are defined by enclosing planes that are walls. Whether the planes be opaque or transparent they, nevertheless, define the volume in space and of space.

The sculptor also composes in volumes, which he balances and juxtaposes and he too treats open spaces between volumes as forms, but for purely aesthetic reason. Whether his volumes are free standing (sculpture in the round), or projections - in height, width and depth - from a wall surface (reliefs), they are constructed of numerous structrual planes, which change when see from various angles. The edges of the structural planes break up the light revealing an illusion of an inner structure.

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To the architect and the sculptor the plane is a facet of a volume. That very plane may assume a sense of life, or be merely a cold surface. Depending on the architect's use of forms that project and move as if of the plane and beyond the plane, the forms act in space and set up new form color and new scales of measurement. (See the masonry walls in Wright's Taliesin, Wisconsin). If sculptured relief is used, which evokes organic forms, a new meaning is fused into the fabric, a sense of a living presence. (See West Facade St. Zeno Maggiore - c. 1135 - Verona, Italy).

When the composition of the volumes and their planes and the forms within the planes interact and measure space, transcending calculable measurement, it has the power to move the spirit of men. Only then are we dealing with composition in space that is the concern of the architect and the sculptor. It is at this point that it transcends the measurements of science and enters where the spirit of man measures. This is what differentiates the sculptor's work from the works of the plaster caster from life, or the manikin maker, and the architect's work from the carpenter, or the mason who puts form in space and encloses space, or the steel erecter who sets up skeletal structures in space and defines space at the dictates of the engineer. It is only by understanding the function of the sculptor and architect that anything we say concerning creative composition in space has any validity, and it is possible, you know, to clear the air of a good many erroneous concepts that envelope both sculpture and architecture with a dense smog.

The creative function of the architect and the sculptor is the same as that of the poet, the composer of music, and the painter. They are all facets of the same activity of man: the mythmaking activity and not the activity of virtuosity alone.

Now, the word myth has lost its meaning, like many other words seem to have done in our time. Here I use it to denote the act of man's creations in form, creations that transcend codification, or confinement within formulae or theories. The mythmaking activity's function is to evoke within man's spirit the sense of belonging, the sense which projects to him emotionally the mystery in which he is enveloped. It is always on the point of being revealed to him. It is in that sense of his being on the point of grasping that enfolding mystery that keeps man in spiritual scale to the universe. These facets of mythmaking are never indiscriminately sculpture, or poetry, or architecture, or music - one or the other. So structural are they in their nature to the function that is theirs to perform that, while they must collaborate towards the elevation of man's spirit, they never can replace each other, no more than the arm can replace the head, or the foot the ear. The more science expands the physical universe the greater is the need for the mythmaker to increase the scale of the spirit.

This seems to be the function little grasped in our time, considering all the attempts made in the search for the new. So much confusion going on! There is a difference between a new automobile and a new work of art. A machine is new only in point of time, soon

To the architect and the sculptor the place is a [illegible] volume. This very place may become a source of light, or be merely a cold surface, depending on the [illegible] use of [illegible] [illegible] the same as it is the [illegible] and around the place, the forms are in space and act on one. [illegible] (see the mastery within [illegible] [illegible]). If sculp- [illegible] Gothic form, a [illegible] [illegible] [illegible] [illegible] [illegible].

Since the [illegible] of the volumes and their [illegible] and the forms within the place [illegible], [illegible] calculable measurement, it was the [illegible] to [illegible] the [illegible] of man. Only then are we dealing with composition in space which is the [illegible] of the architect and the sculptor. It is at this point that it [illegible] the measurement [illegible] [illegible] the [illegible] of man measures. This is what [illegible] the [illegible] the truth of the [illegible] [illegible], or the [illegible], and the architect's work from the carpenter, [illegible] in space and [illegible] [illegible], or the [illegible] [illegible] [illegible] in space and [illegible] [illegible] of the [illegible]. It is only by understanding the [illegible] of the [illegible] and [illegible] that anything we say [illegible] [illegible] [illegible] in [illegible] validity, and it is possible, [illegible], to [illegible] [illegible] [illegible] with a [illegible].

The creative [illegible] of the architect and the [illegible] in the same as that of the poet, the composer, the [illegible], and the [illegible]. They are all [illegible] of the [illegible] [illegible] and the [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] of [illegible] [illegible].

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Even its very fragment carries the spirit of the whole, transmitting emotion to the spirit of man. A fragment of a great organic sculpture or architecture is like a flower torn from the plant. (Yaksi Torso, from one of the gates at Sanchi, India, 100-50 B.C., now in the Boston Museum, or the Mayan ruins of Chichen Itza in the Yucatan, 11th century A.D.).

In our century, with this forgotten, newness in art means new materials shaped into forms borrowed from other disciplines and misapplied. Inorganically formed forms are accepted for organically created forms when they are theory coated with psuedo-science. Inorganic fragments, which were never part of any whole, are passed off for wholes. Blowing up one of the ingredients inherent in a work of art that alone is invalid, theory coated fragments are fed to spiritually fragmented man.

Mechanical constructions are unable to evoke the myth image of oneness that orientates man to the universe, but the poet, in words, can sometimes wrap them in the imagery of organic forms and by his new image evoke meaning <u>not</u> inherent in the construction itself. Compare Lippold's "Reunion" (construction in copper, brass, nicrome, enameled wire) with the graceful sweep of the 2,150 ft. long pipeline suspension bridge over the Mississippi with its stabilizing cables that hold the pipelines against the wind. In the latter form, function, integrity and precision are one; it possesses a handsomeness, which is other than the beauty of art. In the other, what?

In an ear oriented time man's visual perception is numbed from lack of use. The vital factor that enables him to draw from all life around him the essence which he is to distill into a myth image is dulled. It is much easier to acquire a set of values set down by others and transmitted to us by ear than to have the courage to make judgment from one's own visual perceptions and experiences. Accepting the reign of mathematics and technology, too many have become submissive to them forgetting that the function of these disciplines is different from that of art. It is as if we were to confuse the function of the human spirit with the function of bread. Bread is essential to sustain the body, but without spirit what is the body worth?

The divorce of sculpture from architecture has been one of tragic consequences to both. Architecture, approximately during the last 100 years (excepting the creations of some powerful masters) has oscillated between a superficial ecclectism based upon little true comprehension of the architecture from which it drew and a spiritual insecurity that caused it to disown its mythmaking function. Between these two poles it did not know how to use the sister art of sculpture as an ally. Sculpture, divorced from architecture, had little soil to grow on. It was forced to draw from the air its scale, its form and its message. With some powerful exceptions, sculpture too suffered from insecurity and in many cases leaned either on ecclecticism, or literature, and

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more recently some of its weaker practitioners have been leaning on various aspects of science, from technology to psychology, for inspiration, depending upon scientific verbiage for justification.

The confusion of functions, the predominance of ear reception over eye perception and experience, the reign of the word over three dimensional form in our time is illustrated in Giacometti's bronze "City Square." Here is a literary concept of space put into bronze. Upon a bronze plinth 25" long are five tiny, sticklike figures that move on its surface like a number of actors on a platform. Outside this stage nothing exists. It does not set up a scale between its totality and the environment in which this bronze may be placed by accident. It does not evoke that space measuring, scale giving sense of sculpture. Jean-Paul Sartre, in his article in praise of Giacometti (Art News, September, 1955) titled "Giacometti in search of space" said, "And just what is that enclosing distance - which only the word can cross - if not the idea of the negative, the void?" ".... A figure by Giacometti is Giacometti himself producing his small local nothingness." To these matchlike figures a uniqueness and originality have been attributed. But compare these matchlike figures with the 9-1/2" high Etruscan bronze of a "Warrier" of the 6th century B.C. Observe the interplay of these slender life-possessing forms, the scale of the solids against the open spaces, which also become forms in this case (as it does in all true sculpture), the articulation of the joints, the interplay of scale which is set up between the slender forms and the broad surfaces of the crest of the helmet and the shield. What the Giocometti seems to have, by comparison, is the "originality of incompetence" and the emotional impact of one weeping in his beer.

Another example of our earmindedness over eye perception is illustrated in the late Gaston Lachaise's relief over the entrance to the International Building at 45 Rockefeller Plaza, New York, commemorating the workmen who built Rockefeller Center. Using a pier between fenestration above a doorway as if it were a cable, Lachaise portrayed two workmen riding up on a steel beam. What he did not realize was that the wedge shape that these two figures make over the void below conveys the sense that the sculpture is about to crash down upon the heads of those who have to go through this doorway. Compare this with another treatment of a sculptured form over a void where the logic of the eye was given as much consideration as structural logic: Gate of the Lions at Mycenae. Literary motifs from a people's mythology have always been used in sculpture, but they were only a jumping off point for a creation whose language was three dimensional form that had to function in actual space environment. The shape, proportion, and treatment of the sculpture was governed by the actual space it had to inhabit and the function it had to perform in the total fabric of the whole. (A freize on a Greek Temple wall, a portal of a mediaeval cathedral, a fountain in a city square).

The influence of the mathematician's three dimensional model on sculpture can be seen in Antoine Pevsner's "Dynamic Projection in the 30th Degree",(brass and oxydized bronze, 8'4" x 7'4", 1950-51) designed as sculpture for the campus at the University of Caracas, Venezuela. Here there is a confusion between the function of a mathematician and that of the sculptor, as well as a confusion between a form that describes space physically and a form that occupies [illegible] have been leading to [illegible] aspects of [illegible], from [illegible] to [illegible] [illegible].

The invention of [illegible] "Sixty Square." [illegible]

Another example of [illegible]

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space while spiritually orientating the human spirit in space, which is one of the functions of the mythmaker. Would the architect not have done as well if he came to the Mathematics Department here at the University and selected one of the three dimensional mathematical models exhibited in the hallways, enlarged it to the required scale, and placed it on a base? Their kinetic movement describes form movement in space and has a mechanical handsomeness. Webster defines handsome as "more than pretty and less than beautiful." Among the peoples, who have had a long cultural tradition, the word beautiful, or its equivalent, is reserved only for great architecture, great sculpture, great painting, great music and great poetry. The word lovely is reserved for someone lovable, like a lovable girl, and the word handsome for a machine, or a being - a handsome man, a handsome horse, a handsome bird - referring to their physical appearance, but not to the quality of mind or spirit. No man can create a form that does not in some aspect evoke semblance to a form that already exists, whether the form be drawn from life or from a mathematical construction and even the mathematical construction is a diagrammatic symbol of or for another form. The purity of form for form's sake ignores the function of form for man's spiritual sake. We know there have been periods in the history of man when the spirit of man was given little consideration. Even during such times there were great individual works of art created by individuals who, Prometheus like, kept the fire from dying. But the forms they created were never for form's sake alone. In the greatest periods of art - ancient Egypt, Greece, mediaeval Europe, pre-Columbian America - the united efforts of architect and sculptor embraced and lifted man to a spiritual dignity, despite often economic and social oppression. Collaboration of the arts during the great periods did not mean sacrifice of individuality. What it meant was mutual purpose and spiritual compatibility. On the walls of Chartres we can distinguish one master sculptor from another though each plays his part in the fabric of the whole. The same is true of the architects: each part of the cathedral that developed and grew during the course of centuries bespeaks its specific time and creator, yet there seems to be a common stream of spiritual metamorphosis.

The visual, three dimensional poem that the true artist creates acts as intermediary between man and the whole of life. It integrates him. It gives man the feeling that he is a vital and organic part of the vast scheme of things. This need is so universal that we see it almost everywhere in the world. Here is an example of an African chief's house in Fumban. See how the sculptor has shaped the supporting columns with figural forms. Their proportions are the result of their function and the space they occupy in the fabric of the archiarchitecture. See how they interrelate structure and man physically and spiritually, as we see in this slide showing the indwellers seated in front of the house. This building is not merely an enclosure, a shelter for the body, but an embracing element for man.

Again, look at the west portal of Chartres. See how the sculpture conveys the feeling to the eye that the structure is strengthened and animated by the projecting figural images which are an integral part of the tall, slender supporting columns that bear the arches, lintels and tympanums of the facade. Through these portals a man does not enter a mere enclosure where he mutters his prayers alone in

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isolation and unenclosed by love. Within these walls he is embraced by the spirit, for the architects and sculptors were true poets: mythmakers to the spirit.

Architect and sculptor working together can release each other's imagination, permitting greater freedom in handling vast spaces, aesthetically, without dwarfing man. One of the most dramatic examples of this is the great baroque altar of St. Peter (1656-65) by Bernini. Here the vast height of the interior takes on a humanizing scale by the rich sculpture that gathers and plays with the light and fills the whole with a sense that man is being lifted up to the greatest heights of spiritual glory.

Man has an eternal need to impose an image of order on turmoil itself in order that he be not spiritually engulfed, or crushed by it. This we can understand when we see a group of men standing before the sculptured Great Dragon Wall of the Ming Dynasty in Peking, China. Though the fabulous forms intertwine and writhe as if by an inner force of volcanic power, there is a humanizing spirit that predominates over the whole. At times man will carve mountains setting up a spiritual ladder between himself and the infinite, as we see in this great Buddha in Honon Province, China, carved c. 672-675 A.D. It is about 26 ft. high without mandorla and base. The Rushmore monument does not come in this category. It is not size alone that gives to this Chinese sculpture spiritual scale.

The contemporary sculptor has a difficult problem. The space he is called to humanize may be a great unrelieved wall, slick in surface and unbroken in texture and along with this he has a budget to cope with that limits him to a limited space upon the vast area. To bring this (comparatively) vast surface into scale with man and to set up a kinship between man and the wall is no easy problem. The whole space then becomes a form and the point of the location of the sculpture must set up a measurement of utmost aesthetic precision. I know only of one place in the history of art where a similar problem occurred, though on a much smaller scale, i.e., in some Chinese landscape paintings of the Sung Dynasty. With the touch of a brush on an intuitively selected spot on a (comparatively) vast surface of a scroll one tiny image, mountain, bird, or man animated the whole surface. While this was created for the enjoyment and contemplation of a single individual in the quietness of his room, a sculptured form on an architectural facade in a city has to serve as intermediary between the turmoil of the city, the efficiency of the building and humanity. In this complex environment it must convey to man a sense that he is <u>not</u> faceless and insignificant.

The sculpture on the City of Chicago's Parking Facility #1 (Shaw, Metz & Dolio, Architects, Milton Horn, Sculptor) is a case in point. On the unbroken, glazed brick wall facing north on an area of 7,324 sq. ft. the sculpture that occupies 168 sq. ft. is located 17 feet above the sidewalk, 8 feet from the eastern edge of the lift shaft and 29 feet from the western edge of the lift shaft. Within the 12 ft. x 14 ft. space that the whole sculpture occupies is the figure of "Chicago" which has the scale of a 24 ft. figure. The relief projection at the top of the sculpture is 30 inches while the bottom of the sculpture has only an 8 inch relief projection.

This makes the whole form burgeon from the building as one looks up from below and at the same time overcomes the problem of foreshortening. The sculptured form is an irregular, silhouetted shape that counterpoises the severe geometry of the building. Here and there, through open areas in the sculpture, the gray brick wall is revealed.

The need for organic sculpture as a counterpoise to severe geometric architecture is also illustrated in the beautifully handled Barcelona Pavilion by Mies van der Rohe where Kolbe's bronze woman heightened the beauty of the whole design. Its scale and precise placement in the pool seemed to animate the whole structure with a living presence. Could a work like Georges Vantongerloo's "Space Sculpture," in new silver, 1935, do the same to Mies van der Rohe's 860 Lake Shore Drive Building (Chicago)?

An example of the use of figural sculpture in a glass house is the large group of two women by Elie Nadelman in Philip Johnson's house in New Canaan, Connecticut. Of this Mr. Johnson said, "The worst thing that could happen to dematerialized sculpture is to put it in a dematerialized house - for example, to use Mr. Lippold's sculpture in my house. I used sculpture to weight the house down, and to get a space definition. When I wanted a piece to emphasize the space, I used the Nadelman because it is a vast and heavy accent, the opposite of dematerialization, and happened to integrate with what I had." (Art in Modern Architecture", Eleanor Bitterman, p. 138).

The disregard for man is illustrated in the use of forms on the walls of the dining room in the Graduate Center at Harvard University (Walter Gropius, Architect, Hans Arp, Plywood decoration). Tied down by academic preconceptions about "modern architecture," impersonal, free-forms were gigsawn out of plywood having only the physical dimensions of size and thickness. They are attached to the wall like foreign bodies designed, as it seems, for the dehumanized man. In contrast to this, let us see the beautiful little Chapel of Faith in a crematorium in Sweden (Gunner Asplund, Architect, Ivar Johnson, Sculptor) with its deeply moving, sensitively handled sculptured wall above a dais upon which the coffin rests. Upon the white wall white figures burgeon and move in beautifully handled space and scale, conveying a belief and faith in the eternal rebirth of the human spirit.

Often rich and fantastic details in architecture are the result of the ingenious use of materials and great aesthetic sensibility of the architect. We see this in the arrangement of the rafters - bracket systems (masu-gumi) in Horyu-ji Temple near Nana (Japan, 607 A.D.) and in the works of the Spanish architect Antonio Gaudi (1852-1926). But neither the Japanese nor the Spanish master considered these decorative structural forms as substitutes for sculpture. We can see this from the brilliant use of figural, animal and plant forms integrated in their architecture that gives to their buildings an additional dimension measured by the spirit of man. On this subject our contemporary master, Frank Lloyd Wright, said, ".... 'Painting and sculpture that is architecture could enter where I am compelled to leave off for want of more highly specialized technique.' .... To carry the building higher in its own realm is the rightful place of painting and sculpture wherever architecture is concerned." (Architectural Forum, January, 1938, p. 34).

The people at all times have an impelling need for the mythimage. This is a universal and timeless human need. It is our function, architect's and sculptor's, to resume our role of mythmaker. Together we must create the concrete mythimage, which is not the province of the mathematician or the engineer. While technology and science have increased man's physical comfort and extended his life span, they have also fragmented man spiritually. It is for us to create the humanizing and embracing forms that are scaled to the highest peaks of the human spirit. In it we shall again stir man's imagination, convey to him the sense of wholeness, and affirm his significance. Unless we do this, we renege our responsibility.

Due to technical difficulties encountered in recording the Panel on ARCHITECTURAL FORM, which took place on Wednesday morning, October 19, 1955, it was not possible to include it in these Proceedings.

The Panel was one of the highlights of the program and was made up of the following men:

Turpin C. Bannister, Department of Architecture, University of Illinois, Moderator.

Paul Rudolph, Architect, Sarasota, Florida.

Paul Thiry, Architect, Seattle, Washington.

James M. Hunter, Architect, Boulder, Colorado.

Theodore Karwoski, Dartmouth College, Hanover, New Hampshire.

James M. Fitch, Columbia University, New York City.

Milton Horn, Chicago, Illinois.

SOUND CONTROL IN BUILDINGS, AN ART AND A SCIENCE

by
Paul E. Sabine
Consultant in Acoustics
1109 North Weber Street
Colorado Springs, Colorado

Presentation by Linwood J. Brightbill
Professor of Architecture
University of Illinois, Urbana, Illinois

Acoustics is one of the many branches of technical and scientific knowledge for which the architect has to rely upon the aid of specialists in fields other than his own. It has been my good fortune to broaden my own outlook as a physicist through association with many of the well-known architects of what is now a former generation.

The names of Bertram Goodhue, Raymond Hood, Eliel Saarinen, Ernest Graham and Paul Cret, are a few that come immediately to mind.

With that last name I recall one of the most vivid and valiant personalities I have ever known. My last conference with Paul Cret was carried on by means of pencil and paper, at a time when he could neither speak nor hear. But, in spite of the limitations of so difficult a medium of communication, his refreshing humor and dauntless spirit kept flashing through. I still keep his pencilled notes and sketches from that conference as a treasured possession.

It is for this and many other rewarding contacts with members of your great profession that I take pride and pleasure in speaking to you.

To attempt to cover the entire field of acoustics at this time would exceed my limited powers and tax your patience. I shall accordingly confine my remarks to a brief historical sketch of the origin and development of that branch of acoustic science that should concern the architect in the design and interior treatment of audience rooms.

In order to save time, I have asked the Acoustical Materials Association to furnish a supply of their booklet, "The Theory and Use of Acoustical Materials." This contains the subject matter that would ordinarily be presented on lantern-slides in a talk of this kind, and has the advantage of being a permanent record, which can remain in your files for reference when needed.

Prior to the year 1895, the control of sound in buildings could not properly be called either an art or a science. It was not an art, since there were no established canons of taste by which the acoustic properties of a room could be evaluated, nor any specific skill by which desired results could be obtained. Having no adequate theory nor any experimental basis for such a theory, it was not a science.

Fortunately for the architect, the problem of securing satisfactory conditions in auditoriums was not then of vital concern in the design problem. Fortunately for him, also, was the fact that structural limitations before the days of steel truss construction operated to give an acoustically desirable relation between the total volume and seating

capacity of an auditorium. Rear-wall reflections of sound, a frequent source of acoustical annoyance in modern halls, did not occur in the old time opera house or concert hall, because the rear walls were pretty well covered by people seated in the tiers of balconies that went practically up to the ceiling. Just as backaches and visceral displacements developed in the human species in its evolution from the quadruped to the biped status, so troublesome acoustics was a part of the price paid for the advantages of modern materials and methods of construction of large audience rooms.

Even before architectural acoustics had been developed as either an art or a science, there were many audience rooms both in this country and in Europe that had deservedly good reputations for their acoustic properties.

Among many that might be mentioned, La Scala Opera, the Leipsic Gewandthaus, Carnegie Hall, and the old Chicago Auditorium, are outstanding. It would be difficult to find a single architectural feature common to all of these, and to which their acoustical virtues could be ascribed. It would be even more difficult to cite a single cause common to other rooms of the period that had notoriously poor acoustic properties. There are more ways of being vicious than of being virtuous.

Architectural acoustics as a science had its beginning in the year 1900, when there appeared in the American Architect a series of articles by Wallace C. Sabine, then a young Harvard physicist. These gave the results of a series of experimental and theoretical studies carried on by him in the five years just preceding. He had been trying to discover the causes of the very poor conditions for hearing in the lecture room of Fogg Art Museum, which had only recently been completed at Harvard. When his research was begun there was no adequate theory of room acoustics, nor any apparatus available for quantitative study of the problem. Sabine, therefore, carried on many experiments in many rooms of widely varying shapes and sizes, using only a set of organ pipes covering the desired range of frequencies as sound-sources, and his unaided ear as the sound-receiver. From the results of this work, he developed a quantitative solution of the problems of reverberation, together with methods for measurement of the various physical quantities involved in the practical application of the theory to the control of sound in rooms.

In his first paper, Sabine states concisely the conditions necessary for good hearing in auditoriums. "It is necessary," he states, "that the sound should be sufficiently loud, that the simultaneous components of a complex sound should maintain their proper relative intensities and that the successive elements of either speech or music should be distinct, free from each other and from extraneous noise."

This marked the beginning and set the goal of a new branch of physical science. From this beginning, Wallace Sabine carried on, during the rest of his crowded life, a program of research that gave a firm scientific basis for the experimental study of the control of sound in rooms.

In the earlier years he had a virtual monopoly of the field, but was soon joined by Professor F. R. Watson, at the University of Illinois, and by Professor G. W. Stewart, first at Cornell, later at the University of Iowa. Up until the early twenties, these three men did most of the active research in the acoustics of buildings.

Having no instruments for measuring the minute quantity of energy in sounds of ordinary intensities, Sabine developed the technic which Floyd Firestone irreverently has called the "toot and listen method." From long experience with this method, I can testify that the "tooting" is easy, but the "listening" in a highly reverberant Sound Chamber is a severe trial of the faith and patience of the listener.

Wholly objective methods became possible in the early nineteen-twenties with the development of vacuum tube circuits for the amplification and measurement of the minute electrical voltages generated in telephone receivers by sounds of ordinary intensities. Along with this came electro-acoustic transducers, microphones and transmitters capable of giving undistorted transformation between electrical and acoustical impulses. Important among these was the condenser transmitter (invented by E. C. Wente, and developed at the Bell Telephone Laboratories), which give undistorted electrical responses to acoustic signals.

Electrical oscillators, amplifiers and loud speakers were developed to give acoustical signals easily controlled in both pitch and intensity. Developments in radio transmission and reception have proven to be both an impetus and an aid to the solution of acoustical problems. Hearing aids that are really worthy of the name came into existence only after the application of electronics to the alleviation of this all-too-common human ailment, impaired hearing.

With these marvelous technical developments, acoustical research was transformed from a sort of scientific no-man's land into a happy hunting ground for "boffins", who rely on knowledge gained from meter readings.

In 1929, the Acoustical Society of America, was organized with a charter membership of 450. In 1954, it celebrated with considerable fanfare its 25th Anniversary, at which time it had a total of 1743 active and associate members. The society's sustained activity is due in no small measure to its efficient secretary, Wallace Waterfall, now serving his 26th year in that capacity.

The society's Journal, originally an anemic publication issued semi-annually, has become a bi-monthly periodical of some two hundred pages under the able editorship of Floyd Firestone.

Since the early twenties, there had been a rapid development in the invention and production of commercial sound absorbent materials which have taken the place of the hair felt that was the original means of controlling excessive reverberation. About 1930, a trade organization of manufacturers and distributors of these materials was effected under the name of the Acoustical Materials Association. Among its principal objects was the standardization of test procedures of their materials, the setting up of ethical advertising methods, and the

exchange of technical information of common interest to its members. This Association issues at three year intervals, a technical bulletin, giving the results of tests on acoustical absorptivity, flame resistance, light reflection, and other data on materials manufactured and marketed by its members. The history of architectural acoustics is a splendid example of the practical application of the work of scientists to the enhancement of human life, rather than to its destruction.

So much for the origin and development of a relatively new branch of physics. It will, I trust serve a useful purpose in convincing this group of architects that one who is really expert in this field operates from a basis of scientifically established fact and theory. Having myself retired from that field, I feel free to advise the architect charged with the design of an important auditorium or concert hall, to call for consulting service from one who has made a special study of problems that are not covered by his training as an architect. This may not guarantee the architect the creation of an acoustical dream, but it will save him from being responsible for designing an acoustical nightmare.

Apart from the overall matter of auditorium design, there are a number of minor faults which may be avoided. Repeatedly in the course of thirty years of being consulted on acoustical problems, I have encountered the poor hearing conditions in an audience room due to what may be called a "meal-sack stage."

An early instance of this was the heavily draped stage at Ravinia Park, on Chicago's North Shore. This was originally used for outdoor opera, and had the usual accessories of canvas flats and backdrop. Dressed in this fashion, the stage was too small for the summer concerts by the Chicago Symphony Orchestra. As an emergency measure, the orchestra was placed in a setting of heavy burlap. Under the open air conditions, the strong absorption of sound by the stage draperies resulted in an extreme failure of the music to meet the first condition for good hearing, "sufficient loudness." The heavy fabric hangings were replaced with an open set, made of light plywood panels. The result called forth the commendation of the leader of the orchestra and the management.

A number of indoor applications of the idea have proven equally satisfactory as a replacement for the draped stage. The case of the Louisville Memorial Auditorium comes to mind as a notable example. While the draped stage is a quick and easy solution of the problem of providing for amateur theatricals and musical performances in Town Halls and High School auditoriums, nevertheless, it affords little encouragement and help for the ill-trained voices of youthful actors, and is a discouraging element in the staging of dramatic or musical performances by local talent. Provision of a stage setting, easily set up and removed, that would be more highly sound-reflecting than canvas would be a distinct contribution to the pleasure of both performers and audiences in plays put on by Little Theater groups.

The acoustic qualities of small rooms are not produced by partitioning off with canvas a small area on a large stage. The fine Arts Center, in Colorado Springs, has a beautiful, small theater, with a [illegible] of a national Association of Women, attached to its program. [illegible]

[illegible] relatively new methods of storage, of utility, [illegible]

Apart from the overall matter of [illegible] design, [illegible] particularly in the matter [illegible] what may be called a "test-bed" stage.

An early instance of this [illegible]

[illegible]

[illegible]

fairly large stage. This has a full stage setting of canvas used for solo and small group musical performances. I was somewhat puzzled by the fact that the musicians of the La Salle String Quartet, who gave many concerts there, chose to sit at the extreme rear of the stage, rather than well forward, where a mere acoustical expert might have placed them for the best musical effect. The members of the quartet told me that they heard the ensemble much better there than at a position downstage. The puzzle was solved when I learned that they were playing in the upstage position only a few feet from the heavy fire wall back of the canvas. The latter had little effect in hindering the passage to the wall and its return after reflection from the wall. The players were hearing their own music by reflection, much as an actor can see his own performance by rehearsing before a mirror.

There is obviously a possible oonflict between sufficient loudness and the separation of the successive elements of sound in connected speech and music. The latter is accomplished by applying absorbent materials to wall and ceiling surfaces of the audience room to reduce reverberation. Fortunately, the conflict can be resolved by effecting a compromise in the amount and location of the sound absorbent treatment applied. Absorption of sound near the source will produce an undue reduction of the general sound level in the room and decrease the intensity of sound coming directly from the source in relation to that reflected from the bounding surfaces. On the other hand, application of absorbent material on wall and ceiling areas removed from the source can effectively control excessive reverberation without seriously reducing the general loudness level. Rear wall treatment has the further advantage of decreasing the intensity of possible annoying echoes in the front of the room by reflection of sound from rear wall.

The design of a modern Protestant church probably presents the architect with his most difficult acoustical problem. Hearing and understanding the sermon is an important element of Prostestant worship, and conditions looking to this end seldom are compatible with traditional architectural features of church design. The architecture of the modern Protestant church is the outgrowth of two more or less conflicting traditions. Puritanism expressed itself in the severity of the New England meeting house, rectangular in plan, often with shallow balconies at the sides and in the rear. With plain walls and ceilings and height no greater than necessary for headroom above the galleries, this type of church was acoustically satisfactory with a fair-sized audience. In time, the increase in the size of churches has not always been attended with a corresponding increase in church attendance. A church designed for an average attendance of one thousand, but with an actual average attendance of five hundred may well acquire a reputation for poor acoustics, which will, in time, lead to still smaller attendance with resulting worse acoustics. I have a depressing memory of attendance at church in a famous New England meeting-house at which the last stage of this process had been reached. Intellectual quality of the congregation was high, its numerical quantity was quite low.

[illegible]

[illegible]

[illegible]

[illegible]

In the liturgical branches of Protestantism, the medieval tradition of a cruciform plan and Gothic interior generally prevails. Since the form and content of worship is largely that of familiar ritual, less emphasis is laid upon the spoken words of the sermon and good hearing conditions are perhaps less mandatory. The pew would seem to have full confidence in the orthodoxy of the pulpit, more so than in the old New England meeting-houses where the minister might be called to account by the deacons if his orthodoxy was not beyond question.

In liturgical worship, the prolonged reverberation of the cathedral type of church adds to the awe and solemnity of traditionsl forms of church music, thus making the satisfaction of the choir master and the organist offset the rector's lack of satisfaction with acoustical conditions. Increased loudness by more vociferous preaching, or by electrical amplification of a public address system, may increase rather than decrease, the difficulty of understanding connected speech in a too reverberant church.

This conflict between conditions for ample loudness and sufficient clarity of speech sounds is distressingly shown in a college chapel of beautiful English Romanesque architecture that came to my attention some time ago. To reduce reverberation a two-inch layer of cork had been applied to the entire ceiling of the nave. Hearing conditions are poor throughout the entire main body of the chapel, with the result that compulsory chapel attendance tends to be largely devoted to social rather than religious activities on the part of the students, and becomes a serious trial of the faith and patience of the chaplain. The situation is made even worse by the fact that the cruciform plan of the chapel is inherently bad for the hearing and understanding of speech.

This fact was explained by an experience with the acoustics of a Prostestant church in Buffalo, some thirty years ago. This might be called a controlled experiment to find out why hearing is generally poor in the area just back of the crossing in a church with the cruciform plan. Due to the limited size of the lot on which it was built, the church in plan was a cross with a single arm. It had the usual chancel, but a recessed transept on the left side only. The right hand wall was a continuous unbroken surface throughout its entire length. The chancel was approximately circular in plan, with the pulpit against the front wall of the nave and to the right of the chancel opening.

The acoustic properties of this one-sided church were equally one-sided. Complaints of difficulty in hearing came generally from people sitting on the recessed side of the church, just back of the recess. Reports of hearing conditions on the opposite side were much more favorable. Sound pulse photographs made by Floyd Firestone, in a plaster model of the plan of the church went far in explaining the difficulty in this particular church, and shed considerable light on the matter of the generally poor acoustic properties of the cruciform church. On the side where hearing is fairly good, the direct pulse is followed closely by the one reflected from the front wall directly back of the pulpit, as well as by the one reflected at grazing incidence from the unbroken side wall. All such reinforcement by reflection is lacking on the recessed side, while the time delay

between the direct sound and that reflected from the interior of the chancel is great enough to produce a doubling rather than a reinforcement of the direct sound from the pulpit.

The actual photographs naturally are more convincing than this description, but from them one can get a very clear idea of the causes of difficulty in understanding connected speech in the area just back of the crossing in the cruciform church. A theater with the acoustic properties of this type of church would soon go out of business.

The installation of a public address system with sound amplification might appear at first glance to be a complete cure for insufficient loudness in an auditorium. But in very large rooms where this difficulty is most frequently encountered excessive reverberation is still apt to be a contributing factor. In this case raising the sound level by electrical amplification, while making the sound amply loud will decrease the intelligibility of speech due to the overlapping of successive syllables by reverberation. The natural reaction in cases where one loudspeaker doesn't do the job, is to use two or more which may lead to still further difficulties arising from the fact that the same sound is produced simultaneously from two sources at different locations.

There was a fine example of this in a large civic auditorium where two loud-speakers were mounted one on either side of the stage. The sound was quite loud enough, but in the best seats, or what should have been the best, considering the price, members of the audience were disagreeably aware of the disadvantage of binaural hearing under such conditions. When the head was turned toward the left-hand side of the stage the left ear had all the advantage, while the right ear was in the sound shadow cast by the listener's head. Turning the head reversed the situation. In this case, two ears were not better than one.

Binaural localization of a sound source fails in the case of sound coming from a source located in the meridian plane of the listener's head. Hence, replacing the two speakers by a single speaker placed at the top of the proscenium arch proved to be an adequate solution of this problem.

Lest this rambling talk seem to bear down too heavily on acoustical difficulties and failures, let me brighten up the picture by citing the case of Grace Episcopal Church, in Colorado Springs, where I attend services more or less regularly. Let me hasten to add that I can claim no credit for the highly satisfactory conditions for hearing in this beautiful building; I wish I might. The church is cathedral-like in its dimensions and in its interior surfaces of stone and hard plaster, and in its acoustics as well. The reverberation is prolonged, a fact much to the liking of the organist and the choir. They would veto any proposal to make speech more understandable at the expense of the music. A splendidly designed public address system goes far toward meeting the situation. Microphones are located at the high altar and at the lectern and pulpit. A single loudspeaker is mounted, practically out of sight of the congregation, at the top of the second roof truss at the front of the nave. The sound is beamed downward and well

toward the rear of the church. It is monitored from a seat in this region. The level is kept fairly low, but the speaker's words are sufficiently loud to be easily understood in this part of the church, and since they come from overhead, they give the illusion of having come directly from the priest in the pulpit. The rector has a proper microphone technic, with a quiet, deliberate delivery and clear enunciation. This parishioner, who does not use the hearing aid he should, hears and understands the rector's sermon. One regrets to report that this is not equally true of some of the visiting clergy, whose microphone technic leaves something to be desired. I don't know whether this is a part of the training in modern theological schools, but it well might be. The best sound system in the world will not enable a hard of hearing listener to hear and understand a poorly delivered sermon. This may account for a tendency toward somnolence on the part of some older members of a congregation.

It may seem that in the foregoing undue emphasis has been placed on the acoustics of churches to the neglect of other types of auditoriums in which acoustic properties are equally important. The reason is obvious. Poor conditions for hearing in a theater, lecture hall or concert hall will have an adverse effect on box-office returns. A theater with acoustic properties as poor as those of many churches would soon go out of business. For this reason the wise architect will not neglect acoustical considerations in the earliest stages of designing a theater or concert hall.

It is painful to recall the many instances in which the architects have presented me with a set of completed plans for an important auditorium with a request for advice as to the amount, kind and location of the absorbent material needed to give desirable acoustic properties to the completed room. Acoustical treatment may salvage a design that would otherwise be acoustically intolerable, but it will not produce a completed room whose excellent acoustic properties will be a source of pardonable pride to the architect.

And this brings us back to the place of acoustics as both an art and a science in a school of architecture. Doubtless one is carrying coals to Newcastle in stressing the desirability of a thorough training in both the theory and practice of acoustical science in the University in which the valuable pioneer work of Floyd Watson was carried on for so many years. The teaching of acoustics as a branch of architectural training is probably not an over-crowded field, and I can assure the young man who has a healthy appetite for new problems that he will have plenty of this kind of fodder in architectural acoustics if he is willing to reach for it. To all such, may I say happy hunting and the best of luck.

THE EXPLOITATION OF MODERN MATERIALS

by
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University of Illinois
Urbana, Illinois

About two or three decades ago, the so-called battle of the styles was waged. For some of us here who were contemporary with it, it was a time of change, self-examination, and struggle. For many of us here, say 35 years of age or less, it was merely a legacy of freedom from formalistic dogma, from forms that, it had been decided, no longer held any meaning for us today. It meant a freedom to exploit our modern materials. According to your individual preference, and according to the examples shown, you can take the word exploit to mean "maximum use of" or, if you wish, "taking unreasonable advantage of." There was also now freedom to explore space effects and form relationships made feasible by the availability of our modern materials.

Barcelona Pavillion - Van der Rohe

This is an example of early experimentation with space. "The boundaries become fluid, space is conceived of as flowing: a countless succession of relationships," - continuum. This is promising and exciting.

But what if enclosure (from weather) must be maintained? The answer is glass: enclosure and space continuity - visual space continuity. Glass is truly one of our most significant modern materials.

Nesbitt House - Neutra

This is an example of glass used at its most transparent. Note that even the glass-holding devices are visually non-existent. The boundaries of the glass are caused by ends of partitions, the counter top, and the lintels, rather than any elements which are needed to hold the glass.

Florsheim Shoe Store, Chicago - Ketchum, Gina, Sharpe

The contribution of the store designers in the disappearance of a barrier between inside and outside has been great. This particular example is an essay in many of the devices which may be applied to this. 1) the glass itself: visual nothingness, the minimum barrier. 2) Elements carrying through: the brick plane, the louvered ceiling, the line of columns. Note also that the necessary use of exterior materials on the inside further breaks down the barrier through association. This is an interesting by-product of the search for visual continuity and relating inside and outside. Through experience, we have become used to experiencing outside materials outside, and when we experience outside materials inside, the barrier between inside and outside becomes even more ephemeral. 3) Contrast of glass with great solidity, i.e., the brick plane. This makes the glass an even greater visual nothing.

With the many devices at our disposal for extremely fluid space, we must tell ourselves that free interrelation of space implies control (just as democracy implies responsibility).

Johnson House, Cambridge

Here is an example of space control for privacy. Incidentally, we could talk for quite a while about glass relative to this problem of privacy, but I don't think we will. Note in this example the solid reality of the wall, next to the sidewalk, relative to the glass barrier, so that the wall becomes the primary space definer.

House, Williamstown, Mass. - Breuer

Here is an example of space control for "sheltered feeling". In the face of an overwhelming view of tremendous spaciousness, the architect introduces that low terrace wall of stone in an effort to partially contain the interior space.

Under certain conditions, it should be realized that glass can be highly reflective as well as transparent.

Through a Window of the U.N. Conference Building

This amazing photo which I took from Life magazine illustrates reflection in glass quite eloquently. We hear a lot of talk recently about space-time in architecture. I think we have all had the experience of entering a building through a door in a wall of glass. A glance at the glass reveals at once where you are going, and where you have been. This is a rather amusing example of space-time in architecture. There is really nothing involved about the phrase. After all, people move through a building, approach a building, and walk around a building. This is space-time. The sun moves across the heavens as a day goes by. The seasons roll around as a year goes by. This is space-time, too. When one thinks of these things, one can realize the enormous potential in building as sculpture!

The conditions effecting reflectivity are (1) relative light intensities on either side of the glass - plus the observer's position, (2) angle of vision - observer to glass to object. While I am mentioning reflection from glass, it might be worthwhile to note that a glass wall bounding a room at night becomes a black shiny surface to people inside the room.

Johansen House, New Canaan, Conn. - Sketch

This sketch by a young architect in Connecticut illustrating a part of one of his houses points up another facet of the use of glass. Glass makes possible a high degree of articulation. "To get this sharp definition, there are sheets of glass that separate the roof plane from the floor plane, strips of glass that separate the roof plane from the plane of an exterior wall panel......". Another example, Saarinen's new dome at M.I.T., owes much of its effectiveness to a similar application of glass.

[illegible] with the wide variety of [illegible] glass [illegible], we must [illegible] [illegible] should be [illegible] [illegible] properly.

[illegible]

[illegible] glass [illegible] [illegible]. [illegible]

[illegible]

[illegible] glass [illegible] [illegible].

Under certain conditions, it should be realized that glass can be highly reflecting as well as transparent.

[illegible]

This [illegible] glass [illegible] [illegible] of glass [illegible] [illegible]!

[illegible] reflection [illegible] glass [illegible] inside the room.

[illegible]

[illegible] glass.

Lever House - Skidmore, Owings, Merrill

Glass makes a building look light. While I have this slide on the screen, I would like you to note again the impact of reflection. Notice that this building looks even more dramatic when the windows are mirrors, since the spandrels are faced with a reflective but opaque material.

I would like to let this serve to bring us to another characteristic of much of the new work - lightness or weightlessness. The sources from which this new weightlessness is derived are (1) our recent relatively-light structural materials, along with an increased understanding of their capabilities, (2) aesthetic know-how. Dramatic impact through contrast with the usual or expected, (association again).

Kaufman House - Frank Lloyd Wright

This is a very good example of the use of a cantilever for dramatic impact. I suppose that it is the lack of apparent support that makes this building so startling.

A House, New Canaan, Conn. - Breuer

This building is a rather complete investigation in weightlessness, here expressed as a sort of hovering quality due to the incorporation of all possible devices to divorce the building from the ground. There is the application here of the idea of the "prisme pure". The "prisme pure" is an early constructivist concept. We have the precise building cube unencumbered and free of all contingent forms. The effect is abetted by a rather cagey differentiation between materials. Note again the cantilever, the cables in tension, and the hung stair.

Chamberlain House - Gropius & Breuer

Here is another study in weightlessness, the cantilever and the "prisme pure".

Savoye House - Le Corbusier

Here is a better example of the "prisme pure", closer in time and location to the original constructivist concept. I should like to call particular attention to the handling of the windows. In the first place, the necessary spanning structure is hidden. It is very definitely not expressed. Then, too, the windows are set at the exterior surface of the wall. The result of this is no apparent thickness through the wall, no heavy shadows. All of this then, in still another manner - weightlessness. In this case, a "papery", almost unarchitectural quality of lightness. Incidentally, these windows are not the same thing as tying together a bunch of holes-in-the-wall with a continuous limestone frame.

A feeling of weightlessness can also be achieved through thinness of supporting structure.

Johnson House, New Canaan, Conn.

This is an example. Note the elegance inherent in the thin steel members. We might note in passing as pertinent the contrasting brick guest house.

Ministry of Health and Education Building, Rio de Janerio - Neimeyer.

This is another example. Note the girth of the columns, a rather dramatic exercise in 1/5 ratio. Those columns suggest a lot of things we can talk about. For instance, what about the academic insistance on an appearance of strength for supporting structure? These columns grew out of another approach. I think it was Corbu who phrased it as "Exploitation of Function". This is really the emphasizing of what a thing naturally wants to be. As a matter of fact, this approach, which might also be termed expressionism, is undoubtedly at the seat of much of the new work. We can conjecture that the architect from a structural standpoint came up with a column which was adequate but which looked too thin. He looked at it and perhaps said to himself, "Maybe there is something in this thinness." Having found something in the thinness, maybe he went ahead and made the columns appear as thin as possible.

Same Building

Here is the same building from a distance. Space-time again. The Brise-Soleil becomes a texture at a distance. This is a good illustration of the effect of distance upon surface aspect.

Taj Mahal, Agra

Here is weightlessness achieved through still another device: the reduction of heavy shadows. In this case, the reflection of brilliant sunlight from the white platform up into the shadow areas washes out the shadows. The result: a floating quality.

I hope that this slide talk has been of interest to you. I have tried to show with these examples some of the possibilities inherent in the capabilities of a few of our newer materials. It has not been my intention, as you can see, to judge, but merely to cite examples and to examine in some detail a few of the new effects. After all, a primary cause of architectural form may be found in the materials available to us, and new forms of lasting significance often as not arise out of the use of new materials.

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INFLUENCE OF RECENT STRUCTURAL DEVELOPMENTS ON ARCHITECTURE

by
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Mr. Severud gave a very stimulating talk on Wednesday afternoon, October 19. Mr. Severud makes a practice of speaking extemporaneously, without notes. Due to technical difficulties in recording, it was impossible to transcribe Mr. Severud's talk, and it is a matter of regret that it cannot be included in these Proceedings.

INTEGRATION OF CONTEMPORARY AESTHETICS AND BUILDING TECHNIQUES - A SUMMARY

by
James Marston Fitch, Jr.
Professor of Architecture
Columbia University
New York City

It may, at first glance, seem paradoxical to link together two men such as Thomas Jefferson and Frank Lloyd Wright. They appear, superficially, so disparate, so unalike: Jefferson, the cool, objective Classicist; Wright the passionate, subjective dissenter. The idioms they employ, the architectural styles they work in, the very language of their creative effort, seem as far apart as Eskimo and Egyptian.

Yet it is my feeling that these two architects have played very similar roles in the development of our country's domestic architecture. They are not even very far apart in time, incredible as it seems to say so: Wright was born only 43 years after Jefferson's death. The points of their similarity are many and important. Each, for his time, has been the inventor of new concepts of comfort, amenity and grace. Each has sought to democratize these concepts, to make them actually available to wider circles of Americans than previously. And each has accomplished this through the widest and most imaginative use of the technical and cultural resources of his time.

They have, of course, one great difference: the forms of their architectural vocabulary. Jefferson came at the very end of the pre-industrial Western world, when the fertilizing impact of science upon technique was scarcely a dream. Wright appeared at the very moment of maturation of this process. For Jefferson, therefore, the old language of classic form was entirely adequate. For Wright, on the other hand, the invention of a completely new language was mandatory. But even this difference has this similarity: they have both become world-historic figures precisely because of their timeliness. Each speaks the quintessential language of his epoch.

Jefferson's houses express a way of life which is, in some respects, more remote to us than that of the Romans. To fully appreciate them, therefore, it is necessary to see them in their context. All of us tonight are familiar with the great old houses of the Middle Atlantic Seaboard--especially those which are so admirably preserved by the various antiquarian societies. These houses reflect their owners' efforts to live comfortably within the characteristic social and economic conditions of their times. But as they exist today they are but the polished relicts, shorn of all the cumbrous and ugly system which supported them. For the salient characteristic of their society was, of course, handicraft production by slave labor.

The plantation was, to an extent almost impossible to realize today, a self-contained manufactory. And the great house was the center--but the center only--of a whole network of shops and offices for ginning, dyeing, weaving; for tailoring and shoe-making; for

blacksmithing and wagon-making; for woodworking, carpentry, nail-, brick-and lime-making. All these operations and a host of others were essential to the existence of the great house. But on top of them were superimposed all those directly concerned with housekeeping and family care: cooking, baking, butchering, distilling, milling; washing, cleaning, sewing and mending, etc.

Few of these processes are beautiful, even today. And in Jefferson's time they ranged from the merely unattractive to the squalid and noisome. If to this fact we add the one that, for reasonably efficient operation, they had to be located relatively close to the great house, we can begin to understand how great an amount of ingenuity it took to live well and beautifully in Eighteenth Century Virginia.

This is the central contradiction which Jefferson tries to solve in all the houses which we can surely attribute to him: Bremo, Barboursville, Poplar Forest, Farmington. And it naturally reaches its highest expression in his own home at Monticello. If we study this lovely complex with the attention it deserves, (Slide 1) we will see how accurately it reflects the architect's philosophy toward life.

First, toward work. Jefferson had no fear and no contempt for work. In 1818, at the age of 76, he was following a daily schedule on the University at Charlottesville which would prostrate most of us here tonight. But neither had Jefferson any romantic illusions about the sordid aspects of most manual labor. Least of all did he approve of forced labor. He was, unless I am mistaken, the first man in all human history, to draft legislation for the complete abolition of slavery. But he was, after all, the master of a big, slave-powered plantation. And around this paradox revolve many of his most characteristic architectural devices.

Thus, wherever he can save or eliminate labor, for either humanitarian or esthetic reasons, we find him doing so. Monticello is full of machines for this purpose: wine lifts, (slide 2) double-acting doors, (slide 3) weather vanes with inside dials, self-winding clocks. But where he cannot eliminate labor, he tries to make it as pleasant as possible for both served and servant. The whole service level of Monticello is organized around all-weather communication passages, dry overhead, dry underfoot. It is hard to imagine any item of daily use which cannot be reached comfortably without ever having to go out into the weather. By this device, he achieves a level of comfort and convenience for the servants which none of the other great houses of the area can approach.

But notice one thing further: where he cannot eliminate hard labor or unattractive processes, he conceals them completely from the eyes, ears and noses of his family and guests. And this is why the entire service system at Monticello, unlike those at Mount Vernon or Westover, is completely submerged below the main living floor. (Slide 4) Here Jefferson has manipulated his contours in such a canny fashion that not a single window of the main house looks out on anything save landscaped vistas. Not a single aspect of domestic activity--drying clothes, washed dishes, burned bread or curried horses--can be seen, smelled or heard in the main house. And yet--mark this!--he has not [illegible] and [illegible], [illegible] surgery, making [illegible] and instruments. All these occupations and a host of others [illegible] [illegible] by the [illegible] of the great houses. And on top of these were [illegible] all those [illegible] [illegible] with [illegible] and family [illegible]: [illegible], [illegible], [illegible], [illegible], [illegible], [illegible], nursing the [illegible], etc.

Few of these [illegible] are [illegible], most [illegible]. [illegible] [illegible] [illegible] [illegible] from the [illegible] [illegible] in the [illegible] and [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible]. The [illegible] [illegible] [illegible] [illegible] to be [illegible] [illegible] [illegible] the great [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] in [illegible] [illegible] Virginia.

This is [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible], [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible]. If we [illegible] this [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

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Thus, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], [illegible].

[illegible] [illegible].

buried the servants in clammy malodrous vaults. The passages and storerooms are dry, well-lighted and airy. The kitchen, dairy, and servants' quarters have a full southern exposure. (Slides 5, 6) Even the stables and wash house along the north side have a handsome quota of light, air and view. (Slide 7)

The plan of Monticello has certain obvious similarities with those of Mt. Vernon, Shirley, Stratford and other great houses of the area, where the service areas are symmetrically organized into low wings flanking the great house. All of these, of course, stem from the Renaissance, most specifically from Palladio. Thus Jefferson is not the inventor of the plan, any more than Wright is the inventor of radiant heating or plate glass. Jefferson is rather the innovator who takes an existing prototype and carries it to its highest possible stage of development.

In the process, he introduces many innovations of great importance. We have already seen one of them--the device of submerging the whole service level below the <u>piano</u> <u>nobile</u>. Another complimentary device is his solution of vertical communication. It seems incredible that Jefferson should have been criticized for "forgetting" the central stairway at Monticello. As an architect he may have had his deficiencies: but forgetfulness was never one of them. We can assume, therefore, that he had very definite reasons for omitting the grand stairway. And very convincing they turn out to be.

As a frequent visitor to the palaces of Europe, Jefferson could not have missed what others less observant had commented upon: the conflict between the ceremonial and the functional use of stairways. In the evening at Versailles, for example, the stairs would display glittering cascades of elaborately dressed courtiers: the morning after, they would carry a more sordid traffic of milch goats and slop jars. Even in the great houses of Virginia, stair traffic would have been offensive to one of Jefferson's taste. Twice a day, servants would have to run up and down with fire wood, ashes, cold water for drinking, hot water for shaving, warm water for bathing; with bed warmers, night jars, candles and lamps; with clean and soiled linen. And the standard Palladian plan with its grand stair and central halls, would direct all this traffic through the heart of the living area.

Today, most if not all of this service traffic is mechanized. It moves silently and invisibly through ducts, tubes and wires embedded in the walls. Lacking such technical resources, Jefferson unlocked this paradox in a very direct and sensible way. He abandoned the central stair altogether and replaced it with two service cores, consisting of stairs, halls and cupboards, which penetrate Monticello vertically from basement to attic. (Slide 4 <u>again</u>) These cores serve every room in the house and create two quite separate circulation patterns--one for the family and its guests, one for the servants. And Jefferson thus comes as close to modern standards of service as his times permit.

For such crassly functional reasons alone, Jefferson would have been justified in this ingenious plan. But there were other reasons, also. As a thorough-going republican, he had nothing but contempt for toward the northwest to [illegible] sequestered valleys. The guest room and [illegible] are [illegible] well-lighted [illegible]. [illegible] (Plates 7, 8). [illegible] of [illegible] and [illegible]. (Plate 9.)

The plan of [illegible] has [illegible] similarities with those of Mt. Vernon, [illegible], and other [illegible] houses of the area, where the [illegible]. [illegible] the [illegible] of the [illegible] of development.

In the [illegible], the [illegible] of [illegible] the [illegible] level [illegible] the [illegible] of [illegible] of Virginia [illegible] the gable chimney. [illegible]

In a [illegible] of the [illegible] of [illegible] of Virginia [illegible] through the [illegible] of the [illegible].

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the pomp and pretension of European nobility. Under such circumstances, the grand stairway had symbolic aspects distasteful to him. His way of life did not include great balls or great ladies, either, to sweep up and down stairs displaying their hoopskirts and decolletage. Actually, for all its elegance and refinement, Monticello is not a pretentious house. (Slide 8) It is not very big--many a comfortable farm house even then was larger--and Jefferson went to great lengths to maintain its small scale. It is basically a single-story affair: (Slide 9) and when the pressure of guests forced him to add more bedrooms above, he resorted to all sorts of ingenious devices to conceal or minimize its increased size: framing the main floor and low attic windows together on the East facade, so that they read as one; concealing those on the West behind a balustrade, etc.

When it comes to creature comforts, no house on either side of the Atlantic displayed more attention to detail. To begin with sanitation. Monticello had rainwater for washing, well water for drinking, a special pond for storing fish alive, an ice house for refrigerating other foods. In addition to outdoor privvies for fair weather use, Monticello is served by indoor privvies on each floor. They are served by vertical zinc-lined shafts which lead down to a subterranean tunnel. Here on tracks, were parked zinc-lined carts which were rolled out of the tunnel and emptied each morning. The shafts were independently vented directly through the roof to the out-doors. (Slide 10) All in all, this was as far as domestic sanitation could be carried until the mechanical pump made running water and the water closet conceivable.

It hardly needs repeating that, both as architect and decorator, Jefferson was a thorough-going modernist. There was no antique furniture at Monticello in his day. All of it was modern, much of it his own design: adjustable reading stands, revolving tables, drawing boards and desks. He used the recessed French bed for cold weather snugness. But in his own bed, at least, he also provided for warm weather comfort by providing through ventilation. (Slide 11) His triple-hung sash provided for flexible ventilation. He used what was probably the first storm sash in history on the northwest exposure, as well as our earliest sun porch. His storage facilities are phenomenal for the time. The central service core on each floor is flanked with closets and cupboards--a facility completely lacking in most of the great plantation houses.

In terms of site development and landscaping, Monticello is astonishingly modern. Even his contemporaries noticed that he did not follow the usual plantation procedure of locating the great house in a valley, near the fields, highways and waterways. Instead he chose a mountain top whose only asset was its beauty. For this he paid a heavy price in terms of roadways and utilities but he paid it gladly. Obviously, he wished to place his family and friends in a setting of real nobility from which every vestige of the grimy, everyday world of work had been removed. (Slide 12)

In developing this mountain top, again, he is very close to us modern Americans. The entire entourage of Monticello is a unit with the house itself and involved literally remaking the mountain top. (Slide 13) To achieve those lovely vistas which are an integral part

of each room, he moved thousands of yards of soil, built hundreds of feet of walks, drives and walls. He had complete planting schemes for the garden and they were completely executed long before the house was complete.

We have already seen how adroitly he utilized a change in grades to submerge his service areas. But it is necessary to add that in terms of orientation to sun, wind and view, Monticello could scarcely be improved upon. Only two of the eleven groundfloor rooms face north: all the most-used face south or west. The kitchen and its auxiliaries have a direct southern exposure while ice house and carriage house and stables face north. All the food storage areas for roots, grain, wine, beer and the like are underground for low, even temperatures the year around.

"Under the most imposing exterior," Jefferson said, the courts of Europe conceal "the weakest and worst parts of Mankind." Yet it was precisely royalty which had hitherto monopolized the world's beauty and comfort. It was Jefferson's lifelong determination to make available to the people of the American republic this beauty and comfort: to sift the wheat of true culture from the chaff of feudalism, to cleanse and democratize culture. Monticello is, on the architectural plane, a clear and imposing record of this determination.

Jefferson is not popular with many younger architects today because, architecturally, he spoke the idiom of Classic antiquity. But this is tantamount to criticizing Shakespeare for using Elizabethan English or Homer for writing in archaic Greek. The real problem of criticism, of course, is not what language a man speaks but what he has to say in it. The simple fact is that, in Jefferson's day, the classic idiom was the absolutely universal language of the West. And, as I have pointed out elsewhere, the Classic styles were still a perfectly adequate system of expression. (Slide 14) Neither social needs nor building techniques differed substantially from those of the ancient world. The post-and-lintel, the load-bearing wall, the masonry arch and vault were as appropriate for Jefferson as for Vitruvius. The world of Frank Lloyd Wright--with its new demands and its new materials --were still three quarters of a century away from Jefferson at his death.

When we came to Frank Lloyd Wright, we cross the threshold into another world. Science, technology and industry had, by their advance, thrown into solution all the old verities of Jefferson's republic. A new world was waiting to be born; and with it, a new architecture. To its creation, Wright has contributed as much as any man alive. He has been called the inventor of the modern American home. Certainly, during a long and fruitful life, he has brought to the suburban home a level of comfort and amenity which, before him, could have been found only at Newport or Fifth Avenue and a kind of domestic beauty which was entirely new. His houses have made available to the ordinary middle-class American family an environment of spacious ease and luminous urbanity, such as only the very rich could have enjoyed before.

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Like Jefferson, though in a quite different context and at a higher level, he took the burgeoning material accomplishments of his world and put them to work for the emotional enrichment of our people generally.

When Wright began his architectural practice in Chicago, in the early 1890's, a basic change had already occurred in American life. The old, self-sufficient family of Jefferson's Republic which produced most of the food it ate, the clothes it wore, the furniture it lived with, the very house that sheltered it--this family and this way of life were already on their way out. In its place was appearing a new kind of family of consumers which, instead of producing what it ate and wore, bought it with earned wages from the stores.

Today, beset with contemporary problems, we may tend to regret this change. We look back to this pre-industrial way of life with a rosy nostalgia not very firmly bedded in fact. Today, the words "home-made" and "hand-made" are terms of praise, trade-marks of chic. We forget that, fifty or seventy-five years ago, these same words were terms of disparagement, of reproach and contempt. Now, there were doubtless real merits to home-baked bread, home-cured meats, hand-woven cloth: but the hard and often noisome labor connected with their preparation was not one of them. Here we must take the word of our own grandmothers, who had to do this work and only too gladly gave it up. To our grandmothers, housework meant the stupifying heat of the kitchen on a July day, the squalid labor of the wash tub, the stench and flies from the pig pen. The fact was that most homes were little factories and most wives were slaves to a sweatshop schedule. Under such conditions, most houses were uncomfortable to live in, unbeautiful to look at.

Here again we must take the testimony of the women. Why do you suppose they labored so hard to create front yards, front doors, front rooms if not to conceal the ugliness of the rear? Why this effort to create little islands of peace and beauty if not for occasional escape from the grinding routine of pre-industrial housekeeping? For those women, cleanliness meant a constant struggle: comfort they sometimes won, beauty almost never. No wonder, then that they were turning with much enthusiasm to the labor-saving comfort-making devices which American factories were turning out in the decade Frank Lloyd Wright began to work.

Consider what the "store-bought" products of American factories accomplished for the American home in the decades between the Civil War and 1900:

Sanitary conditions were revolutionized. Municipal water banished the well and cistern. Sewers and septic tanks eliminated the privvy. Plumbing brought hot and cold running water into the kitchen and bath. Washing machines, first hand-operated, then electrically-powered, cut the drudgery of the family wash to a fraction and eliminated washpots, tubs and benches from the back yard. (The clothesline hung on for a few more decades, awaiting the dryer.) And, of course, the commercial laundry was removing the family wash from many a housewife's troubled dreams forever.

Central heating appeared: stoves and fireplaces, with their daily clutter of kindling, fuel and ashes disappeared. The unsightly wood pile in the yard gave way to basement coal bin or buried oil tank: and the mechanical stoker and thermostat soon took over all the responsibility for keeping the fires going.

First gas, then electricity, entered the kitchen range. Quick, clean, relatively cool cooking was possible for the first time in history; ashes, coal scuttle, wood box and soot were all banished.

Municipal garbage collection eliminated trash pile and garbage pit.

Butcher shop and dairy replaced domestic animals and with them the heavy labor of milking, churning, butchering, lard-rendering, etc. And with the cow, pig and poultry went some of the most unattractive features of the domestic landscape--cow barn, pig pen, chicken run--with their flies and odors.

The food industry, first with canning, then refrigeration, took the processing of fruits and vegetables out of the kitchen. Another constellation of utilities disappeared: root cellar, ice house, pantry and vegetable garden.

The automobile replaced the horse and buggy: and gone with Dobbin were stalls, pasture, haybarn and manure pile.

What all this amounted to, in plain English, was that <u>for the first time in history the squalid, never-ending drudgery of housekeeping had been lifted from the housewife's shoulders</u>. The most degrading and stultifying processes of family sustenance had been mechanized, either in the factory or at home. She was able, suddenly, to join the human race, to enjoy that comfort, leisure and self-respect which has hitherto been the prerogative of rich, slave-or servant-attended women.

But there was another--and for architects even more important--side to this coin. The same process which had removed from the house the causes of hard labor, inconvenience and discomfort had also removed the causes of most of its ugliness. <u>For the first time in history, the home of the average family could be a thing of beauty</u>. Not just the parlor or the front yard but all of it, inside and out, could be an object of pleasure and delight.

We can say, without fear of contradiction, that Wright was the first American architect fully to comprehend this new fact, fully to exploit its exciting possibilities.

It would be nonsense, of course, to claim that Wright, in those early days of the new American house, was the only or even the first architect to use central heating, plumbing, electricity and the like. His contemporaries used all these new things enthusiastically, but they tried to graft them onto the old, conventional designs. They used steam radiators but masked them behind Renaissance grilles; steel columns and beams, but sheathed them to look like wood or marble; modern plumbing fixtures, but panelled them to look like bishop's chairs.

No, Wright's role was of quite another order. He saw that all these developments, taken together, demanded nothing less than a totally new system of architectural expression. The old traditional forms simply could not contain the new reality: a new kind of beauty was called for. The same science and technology which had wrought such changes in the family life had also given the architect a whole new palette of building materials: structural steel, reinforced concrete, olywood, huge sheets of rolled plate glass. And Frank Lloyd Wright--almost alone it was Wright, in those early days after the retirement of his lieber Meister, Louis Sullivan--argued that these should be employed boldly, honestly, in new forms, and not tortured into traditional ones.

As a result of this independent approach, Wright was able to make very important architectural contributions to design, many of which have become standard elements in the modern house. Let us enumerate a few:

Central Heating and the Open Plan

By 1900, everybody who could afford it demanded central heating --either hot air furnaces or steam heat. All architects were quick to include it in their new houses, but only Mr. Wright saw its ultimate implications. It made obsolete the old honey-comb plan of boxy, air-tight rooms strung like beads on a necklace. This had been logical in cold climates so long as fireplaces and stoves were the only way of heating each room. But Wright was quick to see that, if all rooms could be kept equally comfortable with almost invisible heat sources, rooms could flow freely into one another. Doors and whole walls could be eliminated, rooms could dissolve into one another. The open plan was the instrument which enabled Wright to create those splendid interior vistas for which his houses are justly famous.

Glass and the indoor-outdoor relationship

By 1900, everyone was aware of the therapeutic value of sunshine and demanded more of it in houses. Plate and rolled glass made possible windows of unprecedented size. But while other architects used more glass, they used it in conventional patterns--cutting up their sash into little Colonial rectangles, Elizabethan diamonds or leaded Medieval bull's-eyes. Only Mr. Wright saw the dramatic possibilities of these huge transparent sheets and he used them to destroy the iron boundary between indoors and out. Here was another instrument of great power and beauty at his disposal; with it he could extend the living area to include not merely the enclosed area, but the terraces, porches and gardens beyond. He thereby brought his interior space into a new and exciting proximity with nature.

Electricity and the new illumination

By 1900, everyone was demanding electric lighting in their houses. Its advantages over oil lamps and gas were obvious and immense. But electricity was not merely a substitute for kerosene or coal gas: it made possible a totally new concept of illumination. Instead of the niggardly pinpoints of historic light sources, electricity made it possible to flood whole areas with light. Spaces could be modeled, forms

dramatized, textures enhanced. Who besides Wright, in those early days, understood this? While the rest of the profession continued to mask their Mazda bulbs in fixtures of conventional form--candelabra, chandelier and sconce--Wright went boldly ahead building the unadorned bulb into the very fabric of his house. Light itself--and not just the fixture--became a source of pleasure and delight.

These are just three examples of Wright's electrifying touch, of his ability to transmute simple technological developments into new esthetic experiences. And if we turn to the more prosaic aspects of his houses, we see the same great talent at work. Take, as an instance, his kitchens. A whole series of developments had revolutionized this area and he was by no means the only man to see this. New ranges, sinks, dishwashers, refrigerators, cupboards and counter-spaces were being used more and more.

But the same forces which had removed the ugly chores from the kitchen had also removed the servants. The cook, who had formerly canned peaches in the kitchen was now canning them, at higher wages and shorter hours, in the factory. This meant that more housewives than ever would have to work in the kitchen. And this implied, in turn, that the kitchen must not only be labor-saving and convenient, it must also be as pleasant esthetically as the living-room.

Moreover, if the wife was to spend a good part of her working day there she could not be isolated, exiled, from the rest of the family. Wright grasped this fact decades before his colleagues: and the steps he took to destroy the separation, psychic as well as physical, of the kitchen from the house have had a profound and benign effect upon the new American house.

In the catalogue for his Exhibition house, Wright says wryly that he would be accused of arrogance if he claimed that his early houses were "the first truly democratic expression of our democracy." Yet a distinguished mark of his houses had, from the start, been their <u>modesty</u>. Even large and expensive ones, like the Coonley house or the Kaufmann houses lack that brow-beating pretentiousness which was always the trademark of the great house, at least until the Depression.

Big or small, Wright's houses have the grace and urbanity of the mansion. Yet this is never the result of just shrinking the mansion down to cottage size, as the Amazon headhunter does his trophies. Many of his contemporaries tried that, but not Wright. Even his own house at Talieson East, actually one of the largest country houses in America, is so demurely fitted into its terrain that its real size is never apparent--is, on the contrary, deliberately concealed. There <u>are</u> impressive, even majestic, vistas in these houses, but they are designed to delight the inhabitants, not to overawe the passerby.

All elements of a house were, to Wright, equally important and hence equally beautiful. It had no "front" and consequently could have no "back"--and thereby he dealt a mortal blow to the hypocrisy of the Victorian house with its "Queen Anne front and Mary Anne back."

[illegible] a source of pleasure and delight.

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[illegible]

Moreover, [illegible]

In the [illegible]

[illegible]

All [illegible]

Wright's houses were also democratic from the start in the sense of materials. Cost or rarity of a material has never been for him, an argument either for or against it. He could create interiors of magnificent warmth, of skin-stroking luxury, with the simplest materials--wood, brick, plaster--while his contemporaries were using imported marbles, cut velvets and gold leaf with much less effect. How can one explain this? Wright says it was because they had no real feeling for the nature of their materials. They cut, carved, chiselled, clipped, painted and plastered and stencilled. He, on the contrary, let each material speak clearly for itself. The result was a sense of repose, of blessed ease and calm space, quite unprecedented in American architecture.

All this is history now. Whole generations of Americans have matured under Frank Lloyd Wright's influence without ever realizing it. This is why his houses seem, today, so strangely familiar. But that does not explain why they strike us as still modern, contemporary, up-to-date--even, in some circles, still controversial. How can forms already over a half-century old still have this power to excite us? One might as well ask the same question of Cezanne or Van Gogh. They too created half-a-century or more ago, yet they too strike us as marvels of contemporaneity. The answer can only be that, like all great artists, Wright has created the vision of his times.

Jefferson and Wright are linked, then, by this common quality--a vision of the splendid potentials of culture, a determination to use it for the enrichment of the lives of their country-men. They chose to do this, not at the level of university or museum, but at the level where the people lived--their homes. We are all the richer for it, whether we realize it or not. And what contribution more admirable can we demand today of an American?

The architectural work of Paul Rudolph, Paul Thiry, and James Hunter was presented on Thursday morning, October 20. Due to the fact that these presentations were heavily illustrated by slides showing the architects' professional accomplishments, it was not considered practical to include their remarks in these Proceedings.