To my dear friend
Fritz Trautmann
Claude Bragdon –

March 9
1932

"Let us build altars to the Beautiful Necessity"
— Emerson

BOOKS BY CLAUDE BRAGDON

"That boldest of all adventurers in the region of the fourth dimension." — JAMES HUNEKER

THE BEAUTIFUL NECESSITY

FOUR DIMENSIONAL VISTAS

A PRIMER OF HIGHER SPACE

PROJECTIVE ORNAMENT

ARCHITECTURE AND DEMOCRACY

ORACLE

OLD LAMPS FOR NEW

THE NEW IMAGE

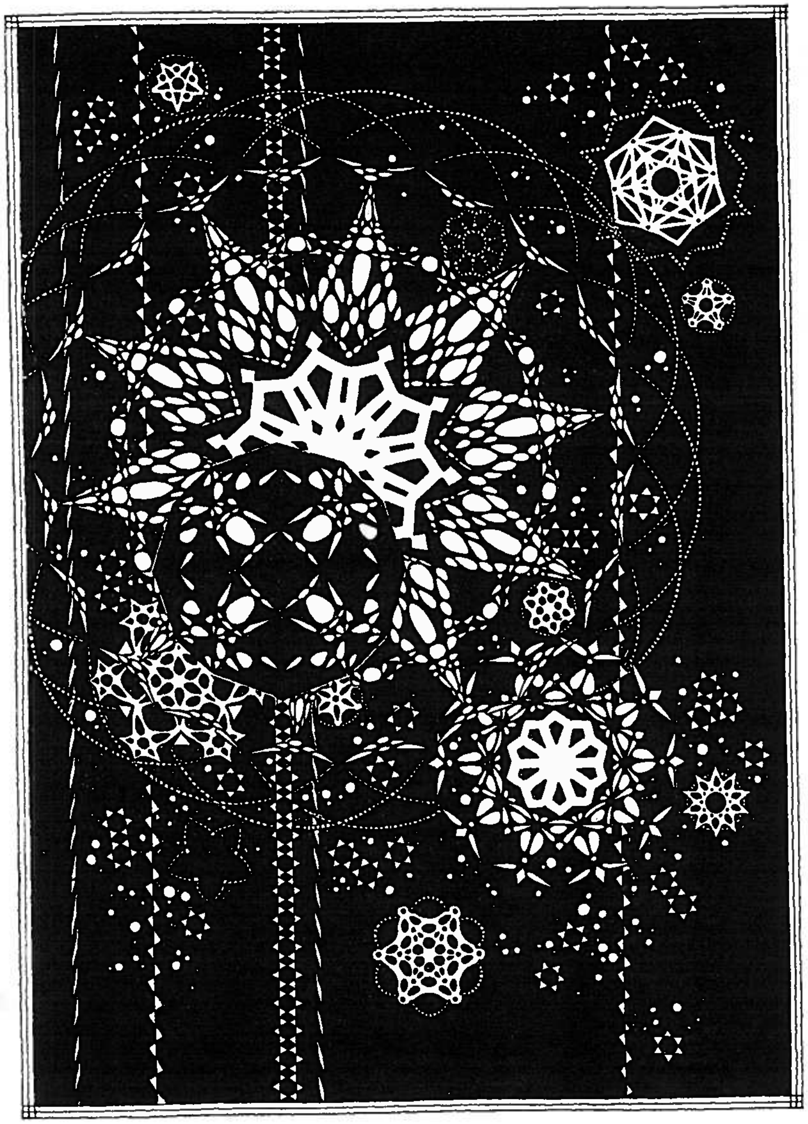
MERELY PLAYERS

THE ETERNAL POLES

THE FROZEN FOUNTAIN

These are Borzoi Books
Published by Alfred A. Knopf

THE FROZEN FOUNTAIN

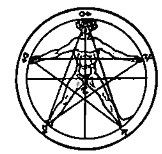


The FROZEN FOUNTAIN

Being Essays on ARCHITECTURE *and the* ART of DESIGN in SPACE

by

CLAUDE BRAGDON



New York, 1932, Alfred A Knopf

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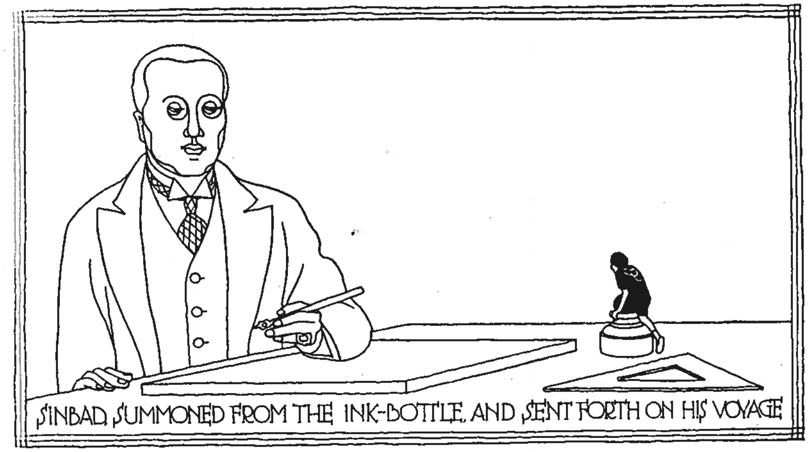


INTRODUCTION

THIS book is addressed to everyone interested in the fine arts, to designers in all fields, and particularly to architects, architectural students, and draughtsmen. It constitutes the final distillation of many years of thought and experimentation along unusual lines. Naturally, I am desirous that it shall be read and pondered, but according to the habit of the day there are many who will only skim it and look at the pictures. Realizing this, I have tried to cram these as full of meaning and interest as possible, making them self-explanatory and provocative. To this end I have had recourse to a most ancient device, one used by Dürer and Hogarth. It consists in many different presentations of the same symbolical character in situations and surroundings which are themselves symbolical — as in *The Dance of Death,* and *The Rake's Progress.*

To my fictional protagonist I have given the name of Sinbad, not alone for the reason that this Arabian voyager had many strange adventures in strange lands, and might have unchronicled others, but the name itself seemed appropriate because — well, aren't we all? I mean, of course, bad sinners. It is a synonym for Everyman, which is what I wanted — the reader, the author, the candlestick-maker: that is, more specifically, the artist. This is a sort of *Pilgrim's Progress.* John Bunyan's masterpiece is a serious book, but so entertaining that my mother used to read it aloud to me when I was a child. *This* is a serious book, but with Sinbad's help I have tried to make it amusing. The American Spirit, as Kipling says, is "stirred, like a child, by little things," and I have sought to honor this truth by a due observance.

The book deals largely with matters about which I have already written, and sometimes it even repeats, in a different form of words, for the benefit of the uninitiated reader, things which I have said elsewhere; but for this I offer no apology. Every author, however wide his interests or various his gifts, can write but one book — the book of *himself;* and because life perpetually unfolds, he writes it in installments. Now a serial should be accompanied by a synopsis of the antecedent chapters to make it comprehensible to the reader who comes upon the story for the first time. This is the only extenuation I have to offer for the echoes from my other books which may be found herein. Aimed to relieve the reader of the necessity of referring to those other books, these repetitions perform the office of the sandwich which saves one, on a journey, the trouble of going back to the inn.

I desire here to make acknowledgment of my indebtedness to the following books and authors:

Dynamic Symmetry: The Greek Vase, by Jay Hambidge (Yale University Press, New Haven, Conn.; 1902).

Proportional Form, by Samuel Colman and C. Arthur Coan (G. P. Putnam's Sons, New York and London; 1920).

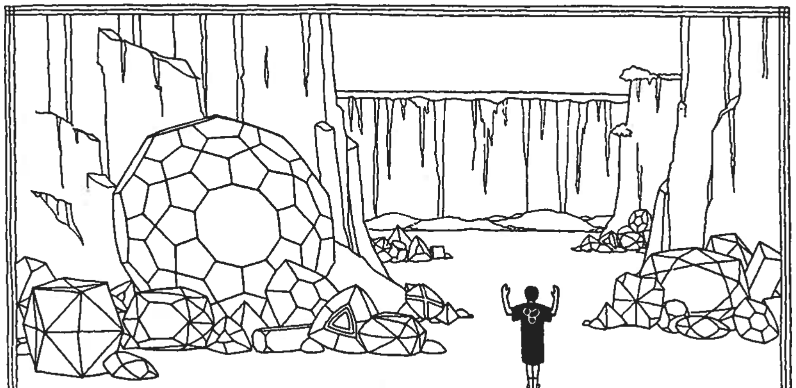
Magic Squares and Cubes, by W. S. Andrews (The Open Court Publishing Company, Chicago; 1908).

Geometry of Four Dimensions, by Henry Parker Manning (The Macmillan Company, New York; 1914).

Traité élémentaire de géométrie à quatre dimensions, by E. Jouffret

(Librairie du Bureau des Longitudes, de l'École Polytechnique, Paris, France).

Le Nombre d'or: Les Rhythmes, by Matila C. Ghyka (Librairie Gallimard, 43 Rue de Beaune, Paris, France).



SINBAD [THE ARTIST] IN THE VALLEY OF DIAMONDS [GEOMETRY]

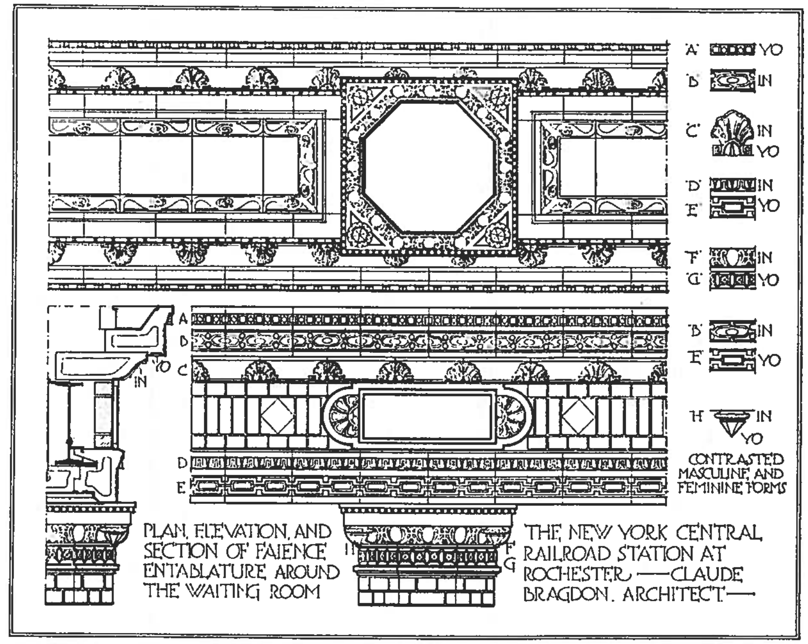
VII
ORNAMENT

ECONOMIC and structural necessity are at last driving us toward the development of an architecture the forms of which will be determined by their functions, as in the case of a machine. And because it is the machine ideal which avowedly, according to its own high priests, inspires this architecture, everything not directly contributory to some kind of *usefulness* is — theoretically at least — tabu. For this reason an outstanding characteristic of the best of the new architecture is the general absence of ornament, for ornament serves no useful practical purpose other than to delight the eye, and a science which has electrocuted Santa Claus concerns itself with other things than delight.

The machine ideal applied to architecture, save in its most utilitarian aspects, is, however, a false one, or at least it needs to be supplemented by something else to make it true. *Man cannot live by bread alone!* He requires also that wine of life which is beauty — a beauty be-

yond mere "structural expressiveness." Our age requires, no less than antecedent ages, *an ornamental mode.*

Ornament springs from an impulse no less natural and primitive than singing and dancing. It may even be the same impulse, for is not or-



PLAN, ELEVATION, AND SECTION OF FAIENCE ENTABLATURE AROUND THE WAITING ROOM

THE NEW YORK CENTRAL RAILROAD STATION AT ROCHESTER — CLAUDE BRAGDON, ARCHITECT —

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nament an arrested song, a frozen dance? At any rate the desire for decoration is as primitive and deep-seated, arising from a psychological rather than from a physical necessity — and this is the reason why ornament has ever been and must ever be a mirror of the individual and racial consciousness. The ornament in use today, whether derived or invented, reveals that consciousness to be afflicted by æsthetic sterility — so in its untruth there is truth. There is need of an ornamental mode which shall be eloquent of our *uniqueness*, drawn from the same source from which our power is drawn and in which our interest is centered.

The realization of this need dawned on me first some twenty years ago, when I was called upon to design a railway station for my native city of Rochester, New York. Though I had never been averse to dipping into the dust-bin of *Meyer's Handbook of Ornament*, in this case it seemed imperative that no ornament should be employed which antedated steam transportation. There was none: therefore I was confronted with the necessity of eliminating ornament altogether or of inventing it.

The first seemed too stark an alternative, and the second too difficult for a talent atrophied by that order of parasitism practiced by me in the past. What I did, therefore, was to deal with some of the canonical ornamental motifs with a free hand — much as a jazz-band leader might syncopate or otherwise distort the masterpieces of Beethoven or Bach (Illustration 40).

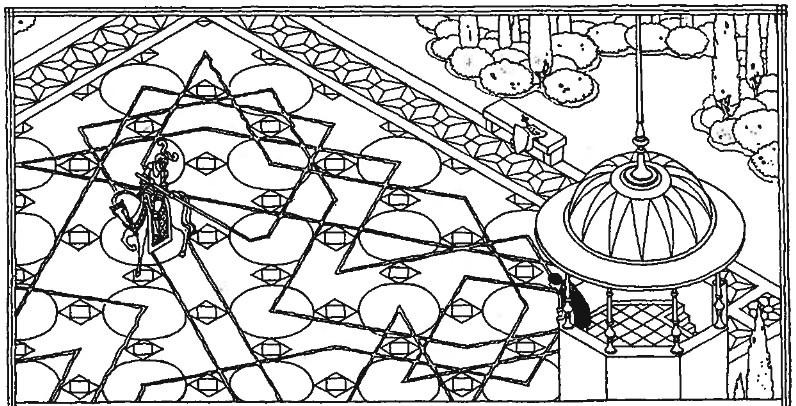
This compromise, though moderately successful, was so far from satisfying that I thereafter undertook a searching inquiry into the whole subject. One of the first things which impressed me was that all good ornament readily submits itself to a simple geometrical synopsis; that much of it, indeed — like Gothic tracery and Moorish decoration — consists solely of the combination, repetition, or symmetrical assemblage of the most elementary geometrical forms, and that all floral and free-spreading ornament has a mathematical substructure — the rock can exist without the lichen, but the lichen cannot exist without the rock.

In mathematics, then, I seemed to have found the source of all ornament whatsoever, and it was there that I decided to plant my metaphysical spade. Moreover, it is the thing most native to the modern temper: ours is pre-eminently the age of mathematics; it is the one subject that is universally taught; it has given us our control of natural forces; it is the magician's wand without which our workers of magic, be they bankers, engineers, physicists, inventors, could not perform their tricks. Of course this is nothing new: mathematics has long been made to serve man's uses, but never so universally or so successfully as now, threatening to swallow all other knowledges as fast as they assume organized form. Moreover, since the advent of non-Euclidian geometry the field of mathematics has been enlarged, enriched, and, by reason of the theory of relativity, popularized: space-time, curved space, the fourth dimension having become

catchwords. In brief, the modern mind is as definitely centered on invention and discovery, of which mathematics is the guiding light, as ever the mediæval mind was centered on Christ, the Virgin, the disciples, and the saints; and just as the cathedrals were decorated with their images, by a parity of reasoning mathematics should be made to furnish forth an ornamental mode for the modern world.

Such was my conclusion, shared, I found afterwards, by Ruskin, who said: " I believe the only manner of rich ornament that is open to us is in geometrical color mosaic, and that much might result from taking up that mode of design." But my position was not unlike that of Watts, who, having noted that the expansive force of steam was sufficient to blow the iron cover off a tea-kettle, had not yet devised a way whereby it could be made to run an engine. My idea was sufficiently sound, but how could it be developed practically?

Keats' dictum, " Beauty is Truth; Truth, Beauty," gave me the clue. Because mathematical truth is absolute within its own limits I had only to discover some method of translation of this *truth-to-the-mind* into *beauty-to-the-eye*. In the course of time I discovered several. These I have described in *Projective Ornament* and, as new possibilities unfolded, in certain essays in *Architecture and Democracy* and *The New Image*. But I now feel that my explanations were unclear and my illustrations not sufficiently convincing, and that the whole matter should be formulated anew. I hope that the already initiated reader will bear with me, therefore, if I repeat myself, on the assurance that " from this time forth I never will speak word."



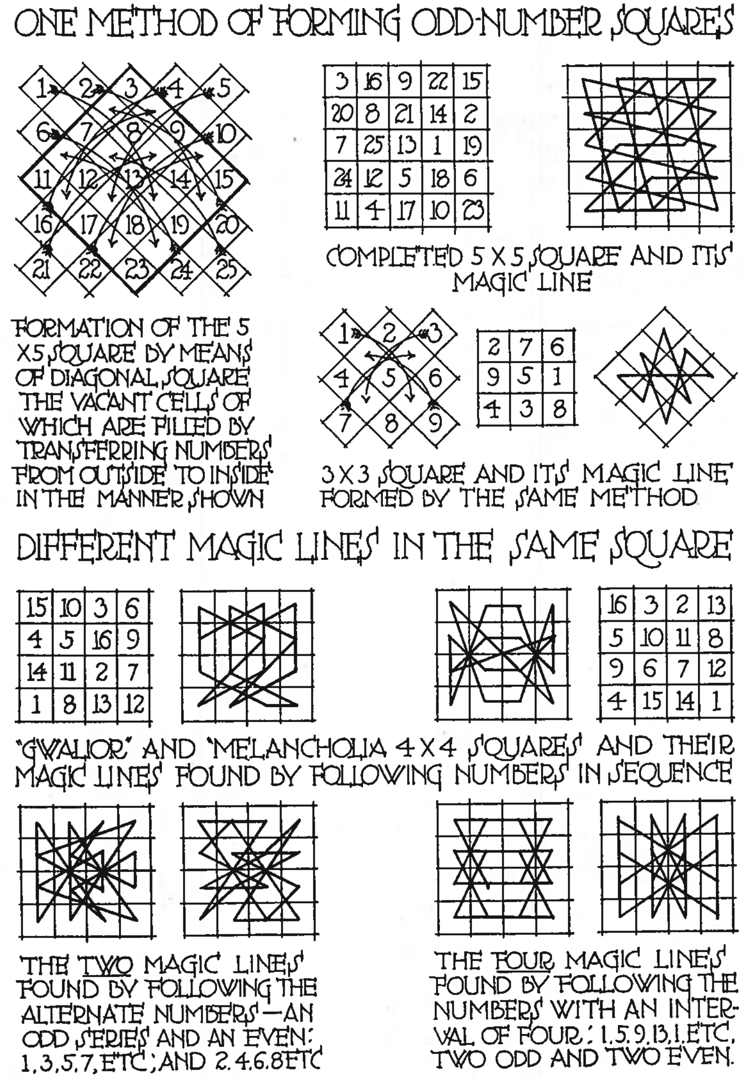
SINBAD WATCHING INSOMNIUS THE WHITE KNIGHT, TRACE THE KNIGHT'S TOUR IN CHESS

MAGIC LINES IN MAGIC SQUARES

The three mathematical sources from which I was able to derive ornament were magic paths in magic squares, the Platonic solids, and the diagrammatic representations of the regular hypersolids of four-dimensional space. My first experiments were with magic squares because they constitute such a conspicuous instance of the intrinsic harmony of number — of mathematical truth.

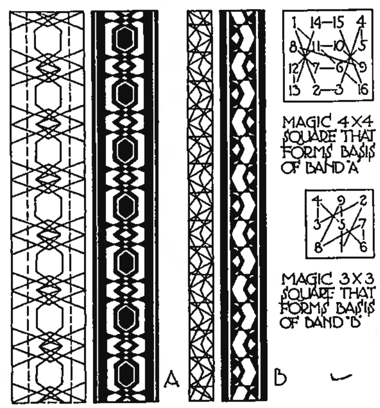
A magic square is a numerical acrostic; a progression of numbers (usually arithmetical) arranged in square form in such a manner that those in each band, whether horizontal, vertical or diagonal shall always form the same sum. Every magic square contains a magic path, discoverable by tracing the numbers in their original and natural sequence from cell to cell and back again to the initial number. This is called *the magic line*. Such a line makes, of necessity, a pattern, interesting always and sometimes beautiful as well. Here is the raw material of ornament: in this way the chasm between mathematical truth and visible beauty may be bridged. It remains only to intensify and utilize this beauty — to deal with the magic line in such a way as to subserve æsthetic ends.

I began with the simplest of all magic squares, that of 3 x 3, consist-



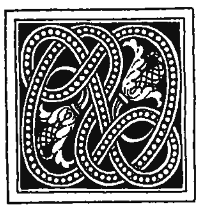
ing of the first nine digits, three in each row, with a magic sum of 15. It is constructed according to the following method, applicable to all odd-number squares:

The numbers are first written in their natural order, in three rows of three each, so that the whole forms a square. Parallel diagonal lines are then drawn between the numbers with the effect of forming rectangular cells, every alternate cell being a blank. In the diagonal square of the same number of cells as there are numbers, of which five cells are already filled and the remaining four empty, these latter are filled, and the magic square formed, by transferring the four numbers remaining on the *outside* of this square to the corresponding position *inside and opposite* — as though rotated in the third dimension. The process is clearly shown in Illustration 41, and the resultant magic line obtained by following the numbers in their natural order.



ORNAMENTAL BANDS DEVELOPED FROM THE MAGIC LINES OF 3X3 & 4X4 SQUARES

42

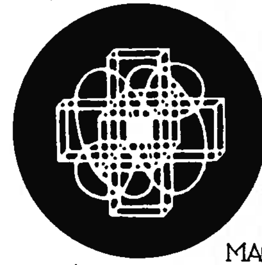


DESIGN FOR A VENTILATING REGISTER DERIVED FROM THE MAGIC LINE OF THE MAGIC SQUARE OF 3

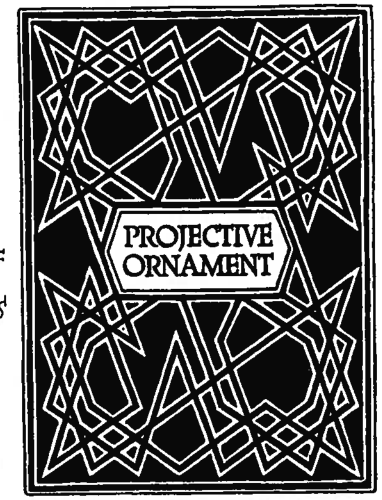
43

The ornamental band in Illustration 42 is directly derived from this line. Four of them, arranged about a common center, yield the pavement pattern shown in the headpiece to the next succeeding chapter. I made this magic line of 3 x 3, translated into a free-hand curve as shown in Illustration 8 and given the form of a Celtic interlace, do service as a ventilating grille in the ceiling of the Rochester Chamber of Commerce (Illustration 43), and I was much amused by the comment of a visiting eclectic architect: " Where did you get that design? I don't remember it in *Meyer's Handbook of Orna-*

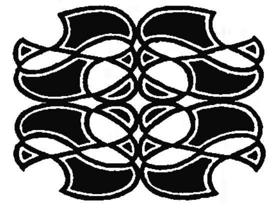
ORNAMENT FROM MAGIC LINES IN MAGIC SQUARES

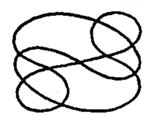


MAGIC LINE OF 3X3 SQUARE COMBINED WITH CUBES



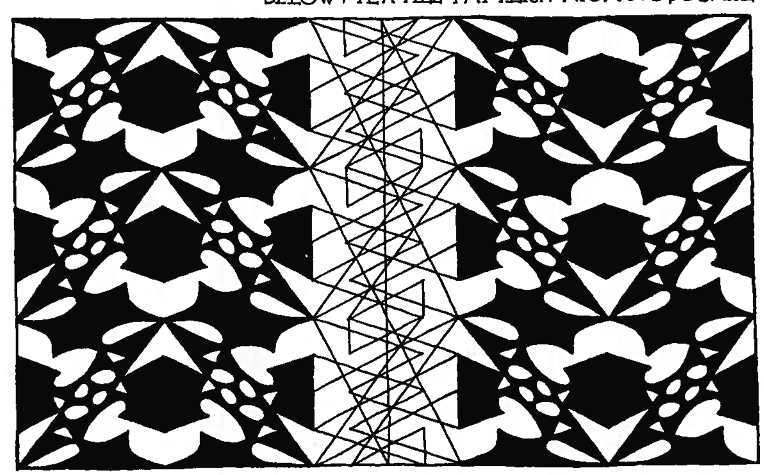
BOOK COVER DESIGN FROM MAGIC LINE IN 8 X 8 KNIGHT'S TOUR MAGIC SQUARE





ORNAMENT FROM MAGIC LINE OF 3X3

BELOW: TEXTILE PATTERN FROM 5X5 SQUARE



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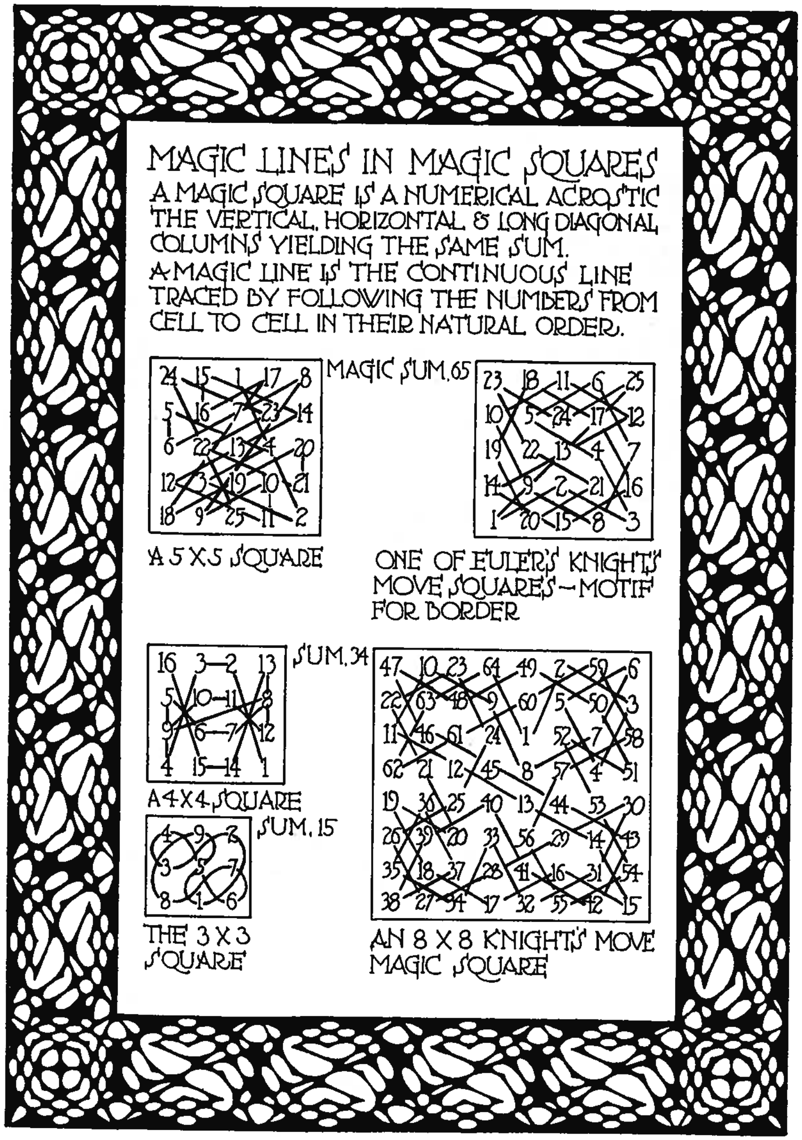
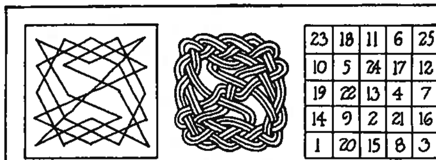


45

ment. He appeared to feel that I had cheated because I had *not* used a crib. Two other decorative uses of this line are shown in Illustration 44.

There is another method of magic-square formation productive of what are known as knight's-move squares, so called because their magic path conforms to the knight's move on a chess-board — two squares forward and one to right or left. Examples of these knight's-move squares are shown in Illustration 45, one of 5 x 5, the magic line of which supplies the motif for the enclosing border, and the other of 8 x 8, whose line is developed into the book cover design shown in Illustration 44. The 5 x 5 magic line as a Celtic interlace is shown in Illustration 46. Other knight's-move squares account for the border of the title page of this volume, the elevator door in Illustration 47, and the cabinet doors in Illustration 48.



A 5X5 KNIGHT'S MOVE SQUARE & DERIVED ORNAMENT IN THE FORM OF AN INTERLACE

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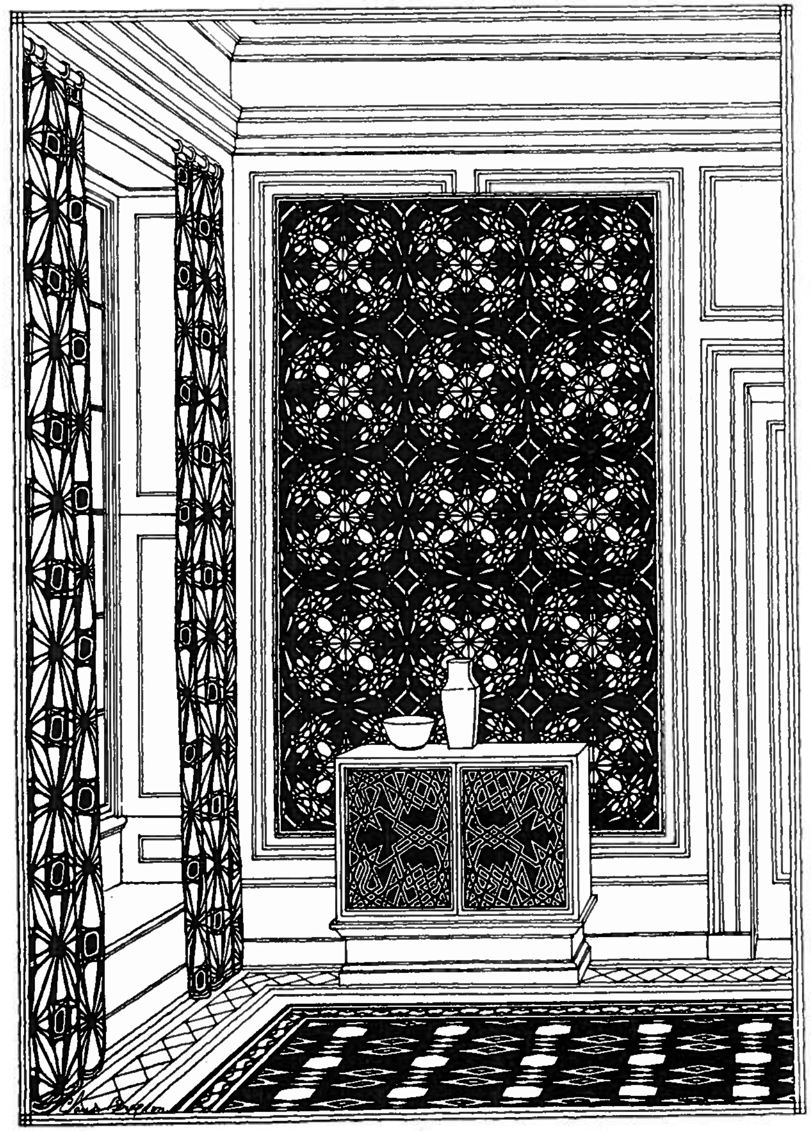
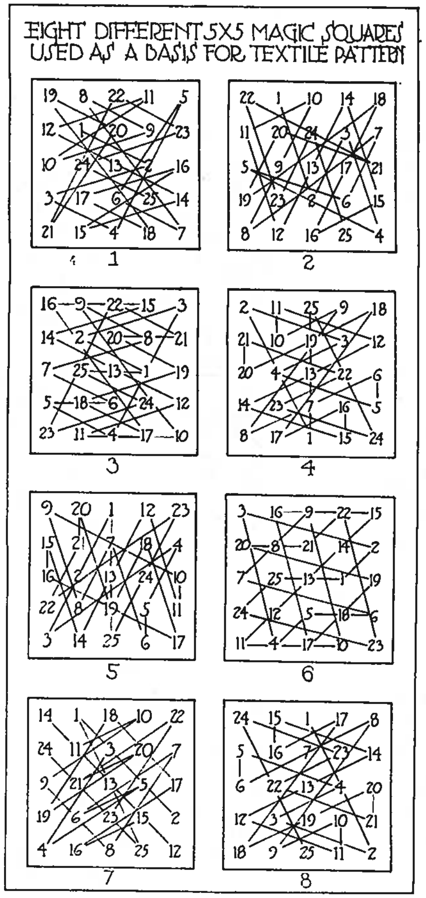
There is an altogether different way of using magic lines for the development of ornament — one which gives the æsthetic intuition freer play. This consists in repeating and reversing any given magic line, and these, in chess-board formation, yield a network which may be used as a warp for a great variety of patterns. The creative faculty has free play, yet by these means is subject to a control and direction which, because it is mathematical, makes for a beauty which is necessitous rather than fortuitous. Illustration 49 shows a number of 5 x 5 squares whose magic lines may be used in this way, and Illustrations 50 and 51 show textile patterns developed therefrom. Different designs may be thus derived from the same mathematical web. With the number of lines at one's disposal the possibilities of this variety of pattern-making are inexhaustible.

The number of different magic lines at the disposal of the designer is indeed without limit. To the mind uninitiated to the wonder-world of mathematics it might seem remarkable that there is even *one* arrangement of the first sixteen numbers in square form in which the vertical, horizontal, and diagonal columns will yield the same sum, 34, but it has


Claude Bragdon '31


Claude Bragdon

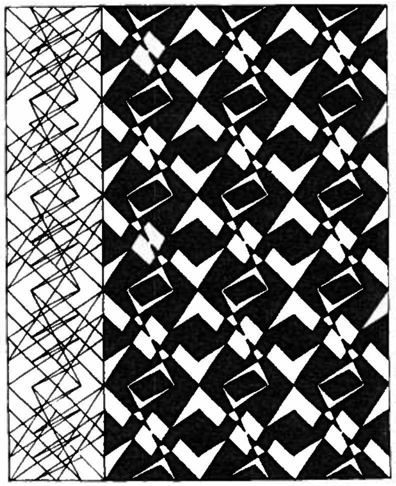
been estimated that there are no less than 384 such arrangements, each one having, of course, a different magic line. Furthermore, from every one of such squares *more than one magic line can be developed.* For in addition to the line resulting from following the numbers in their natural order — 1, 2, 3, etc. — two other lines result from following from cell to cell the odd numbers and the even — 1, 3, 5, etc., and 2, 4, 6, etc. Nor is this all: four more lines reveal themselves by using an interval of four — 1, 5, 9, 13; 2, 6, 10, 14, etc. Such lines, being reciprocally related, sometimes make more interesting patterns than the magic line of the ordinary sort. Take, for example, the " Melancholia " 4 x 4 square (so called because represented in Dürer's etching by that name) represented in Illustration 41. Its magic line is not without interest, but the *two* lines made by following alternate numbers make a far more pleasing pattern; while the *four* lines made by using an interval of four yield truly symmetrical figures and are the most promising decorative material of all. Exactly the same thing is true of the " Gwalior " square (so called because inscribed on the lintel of the gate of the fort at Gwalior, India) , also shown in Illustration 41. The leaded glass design in Illustration 52 and the rug pattern in Illustration 48 are derived from lines from these two squares.



49

In general, magical arrangements of numbers result from transpositions and rotations whereby a kind of balance or polarization is established, making a magic square as different from any other similar arrangement of numbers as a horseshoe magnet is different from a horse's shoe. This polarity is indicated by the magic line in a manner analogous to the way magnetism in a magnet is revealed by the shape assumed by iron filings laid within its field of attraction. Magic lines are a legitimate and useful aid to the designer of ornament, but care should be taken not to use them slavishly. One's personal and intuitive feeling for rhythm and beauty should be the final arbiter.

A WINDOW OPENING INTO THE WORLD OF THE WONDROUS



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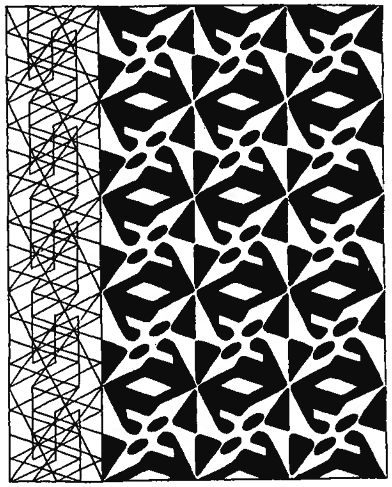

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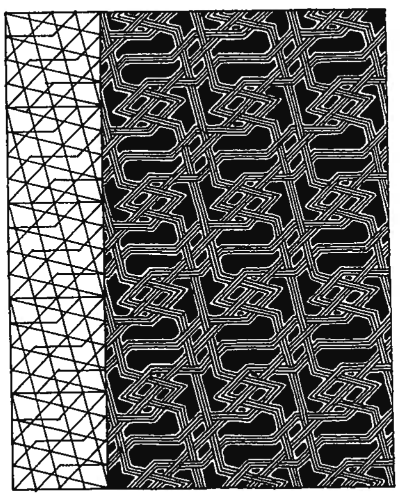

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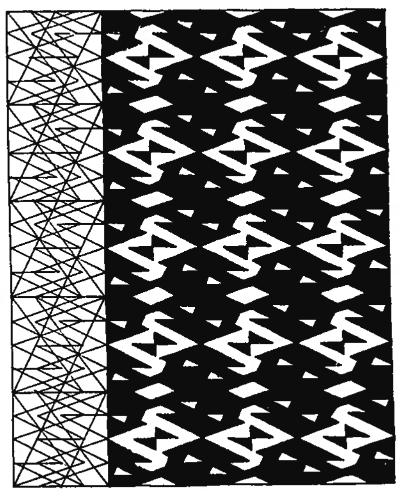

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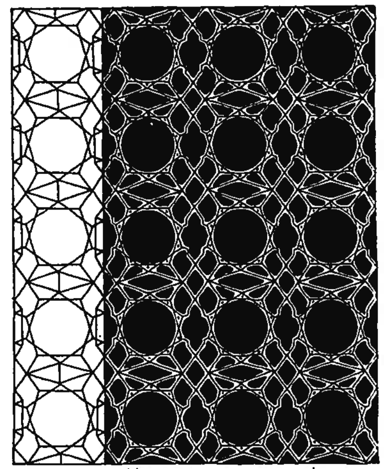
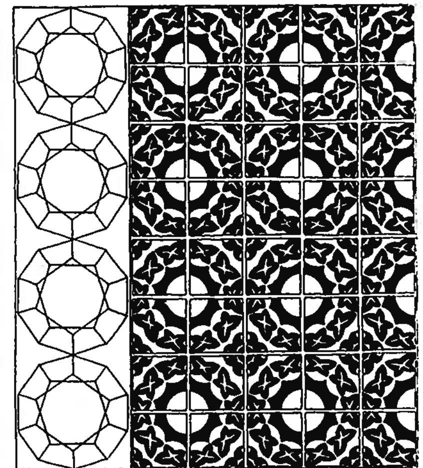
THE NUMBERS REFER TO SQUARES SHOWN IN THE TEXT ILLUSTRATION

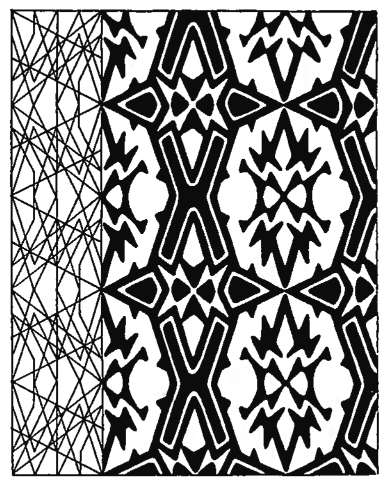
TEXTILE PATTERNS DERIVED FROM MAGIC LINES IN 5X5 SQUARES



LEADED GLASS—MOTIF: THE DODECAHEDRON IN PLANE PROJECTION. UNITS LINKED TOGETHER



ENCAUSTIC TILE—MOTIF THE DODECAHEDRON



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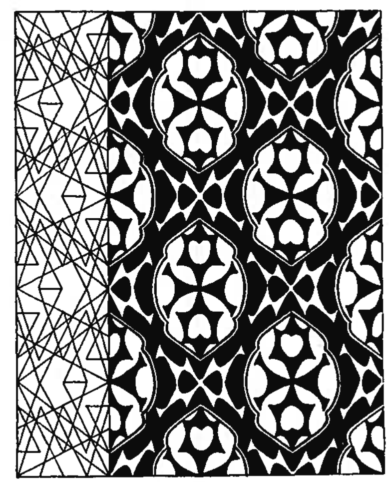

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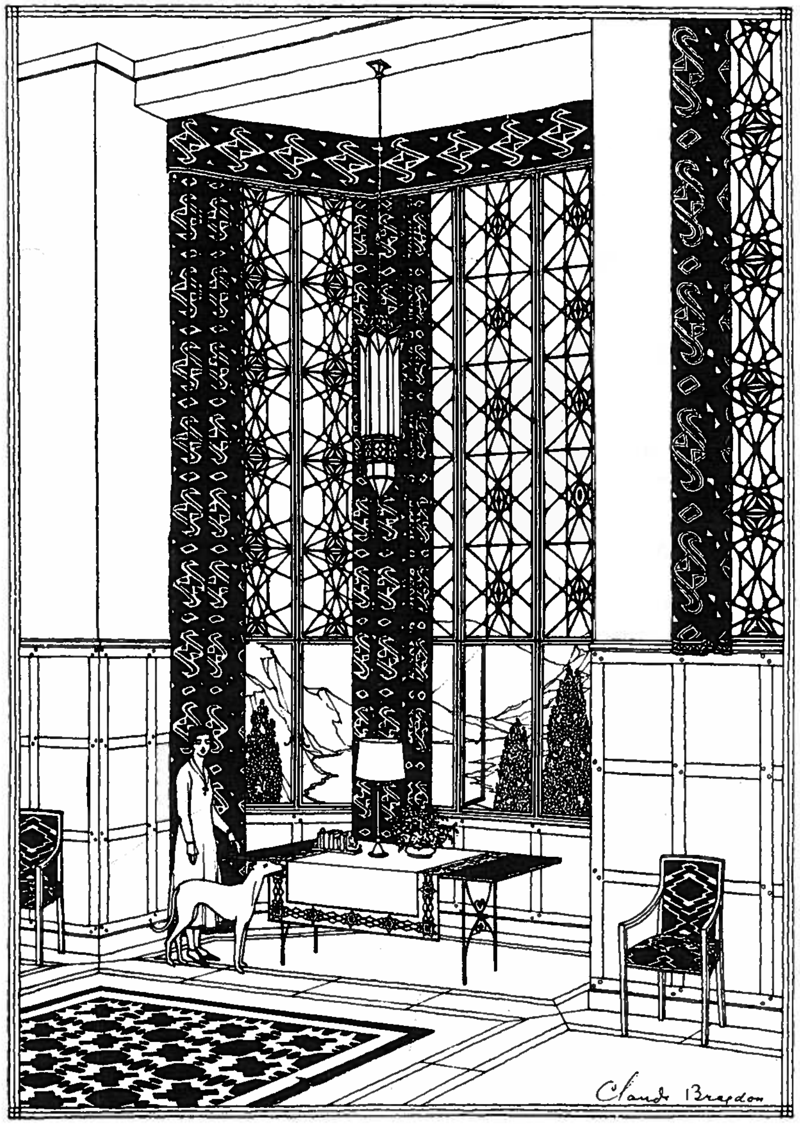
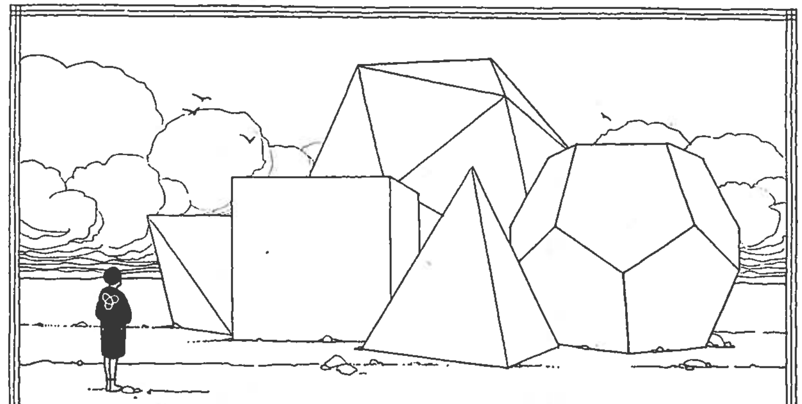
DESIGNS DERIVED FROM THE PLANE PROJECTION OF ONE OF THE PLATONIC SOLIDS AND FROM MAGIC LINES IN MAGIC 5X5 SQUARES





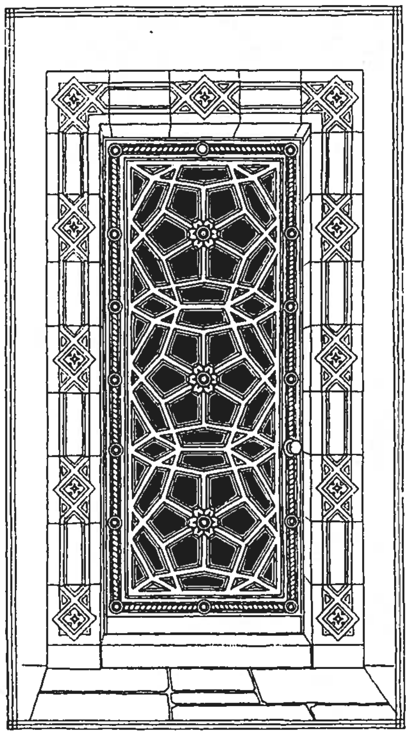
SINBAD, LOST IN THE DESERT, DISCOVERS THE FIVE PLATONIC SOLIDS

THE PLATONIC SOLIDS

A second profitable source of ornament I found in the so-called Platonic solids. The unique, the archetypal character of these regular polyhedrons of three-dimensional space has been recognized from the most ancient times. Among the playthings of the infant Bacchus were " dice " in the form of the five Platonic solids, the implication being that upon these patterns all things in the universe are built. Plato assigns four of them to the four elements, earth, fire, air, and water, and the vessel which contains them all he conceived to be the sphere, which he identified with the dodecahedron because of its approximation to the spherical form. The Platonic solids are the only regular polyhedrons which, assembled together each after its own kind, would fill three-dimensional space — or any portion of it — without a remainder.

Here, then, is mathematical truth; here is significant form; how may the Platonic solids be made to yield the thing we seek? Nature herself gives the needed hint, having seemingly pre-empted these very shapes for her own pattern-making, along with the ovoid and the logarithmic spiral, as the study of flowers and crystals makes plain. We have only to follow nature's method — not slavishly following her patterns, but creating, with the same data, new patterns of our own.

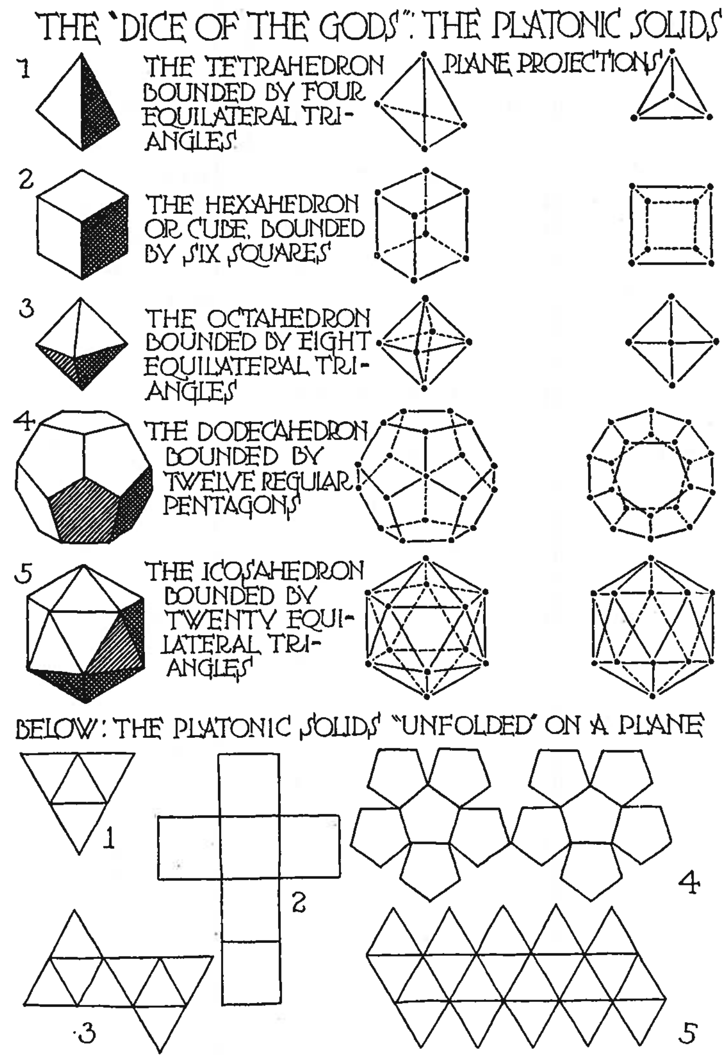
The first thing to do is to become thoroughly familiar with these five forms. By name they are the tetrahedron, the hexahedron (or cube), the octahedron, the dodecahedron, and the icosahedron, having respectively four, six, eight, twelve, and twenty polygonal faces, as shown in Illustration 54. A good way to get to know these forms is to make paper models of them according to the familiar kindergarten method of cutting, folding, and pasting. The lower portion of the illustration shows them developed on a plane — in their unfolded form. Better than cardboard or clay models would be replicas of them made of glass, for then by looking *through* them, seeing the far side simultaneously with the near, the interrelationships of the lines formed by the joining of their bounding surfaces could be studied from the point of view of *pattern*. The same thing can be done almost equally well, however, by means of plane projections. A number of such projections are shown at the right of Illustration 54. For convenience of identification the far sides of the figures are shown in dotted lines and the near side in solid.



MOTIF: THE PROJECTED DODECAHEDRON

53

The translation of these unfolded and projected Platonic solids into ornament is possible because they too, like magic lines, are graphic representations of significant mathematical truths. Of such truths beauty is,



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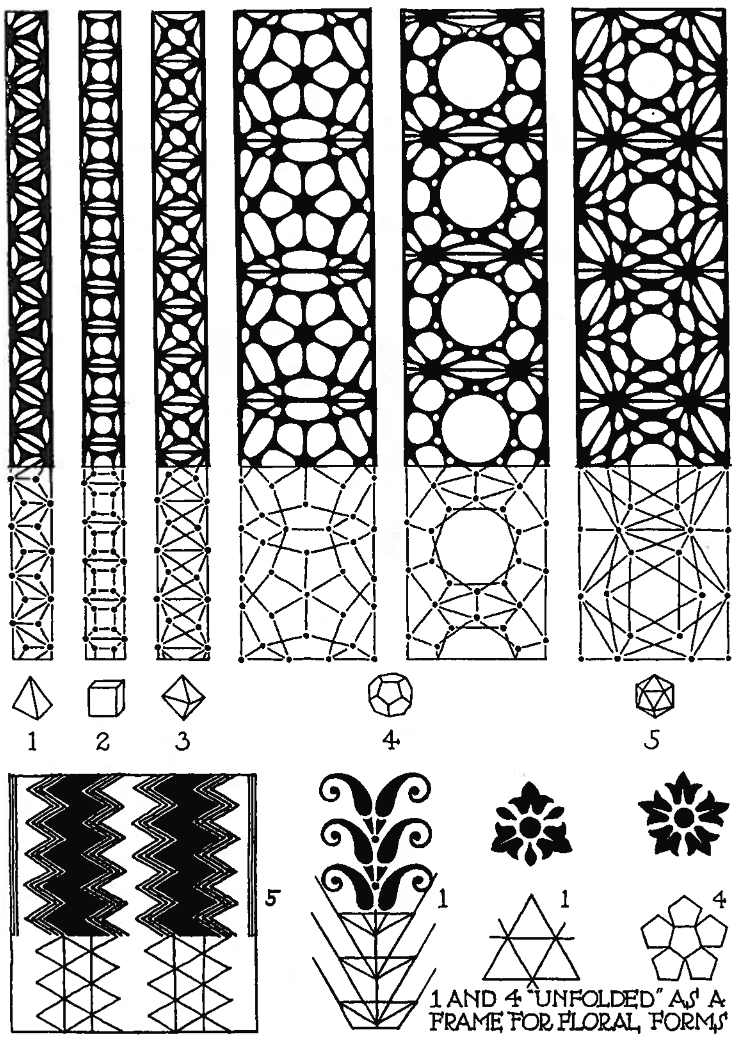
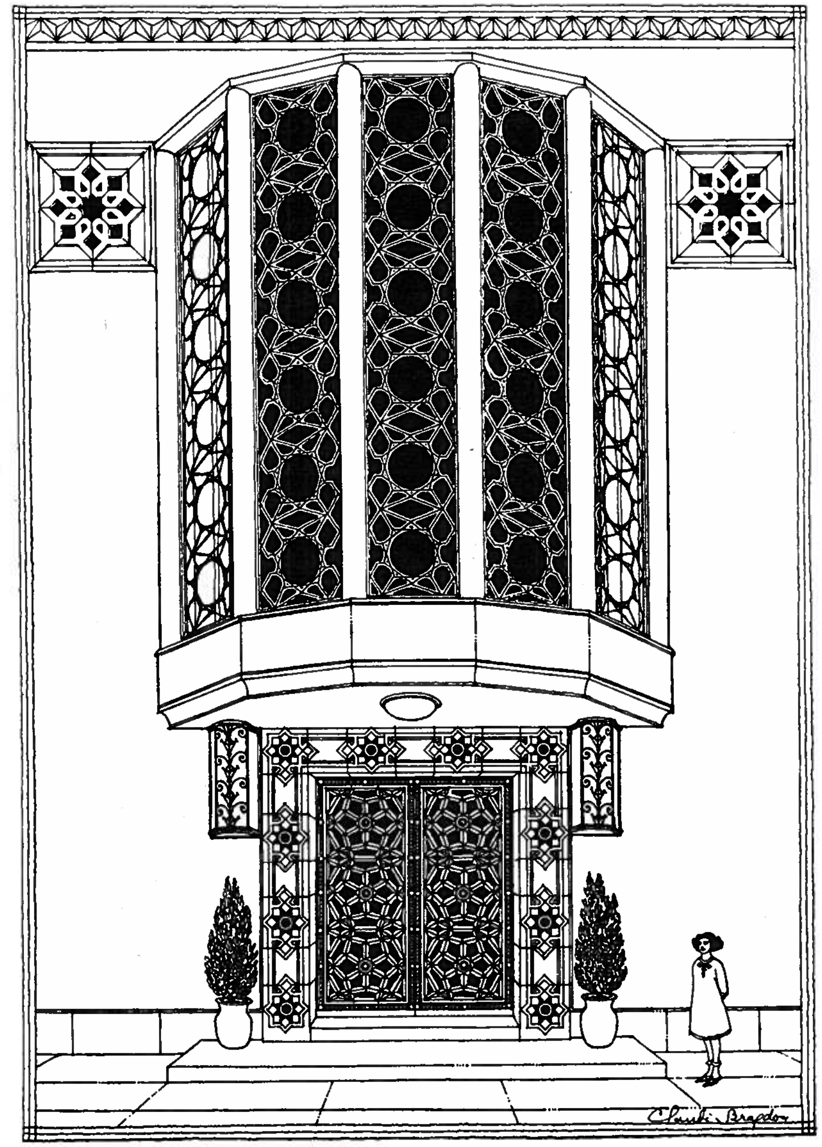
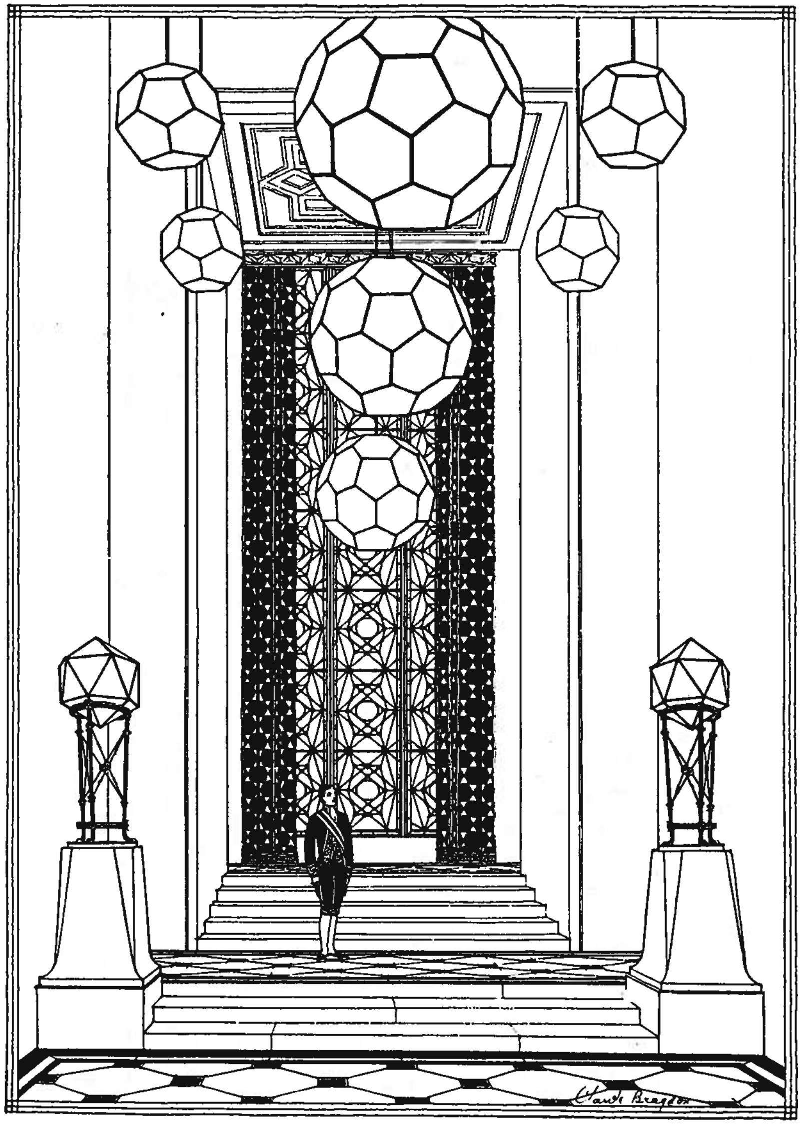
THE PLATONIC SOLIDS AS MOTIFS FOR ORNAMENT



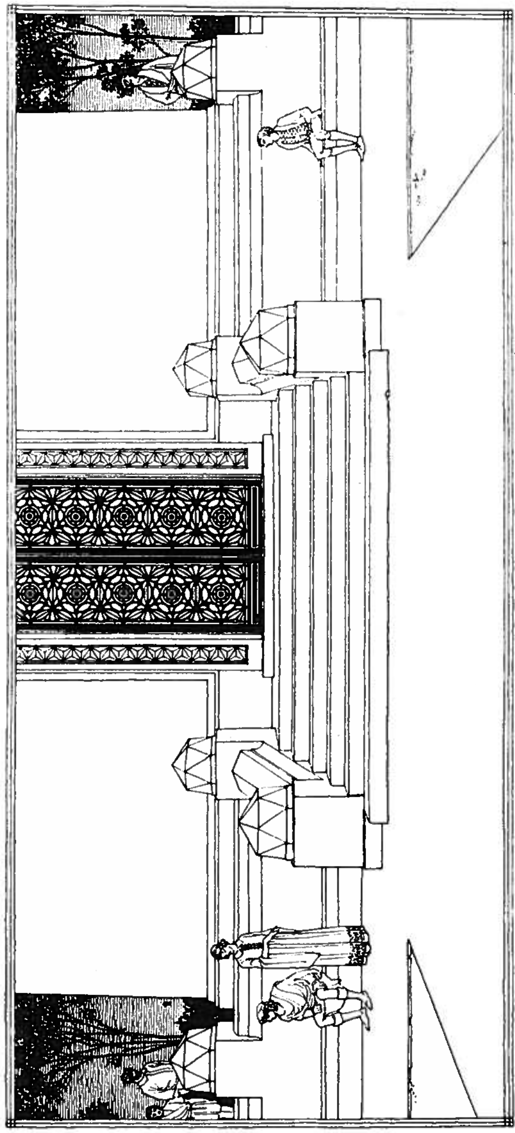




57

as it were, the *shadow,* a thing invisible until its shape and presence be revealed by something upon which it can be cast. The shadow of a magic square is its magic line, and the shadow of a Platonic solid is the network of lines made by its plane projection. Illustration 55 shows the direct translation of these into ornament, and Illustration 56 the same thing achieved with more subtlety and success. The design for the doors is derived from one plane projection of the dodecahedron, and that of the glass-work in the bay window above from another. Illustration 53 shows the same door design but to a larger scale. Illustration 57 shows a leaded glass pattern derived from a projection of the icosahedron not shown on the page of diagrams, but easily identifiable. The lighting fixtures which are so prominent a feature of this drawing are in the form of icosahedrons and dodecahedrons, the largest being a semi-regular polyhedron bounded by pentagons and hexagons. The ornamental motif used throughout Illustration 58 is the icosahedron, in its three-dimensional form in the terminals to the parapet, and two-dimensionally in the gates.

Doubtless much more and much better ornament than any here shown can be derived, directly or indirectly, from the Platonic solids, but these examples sufficiently demonstrate that such significant and symmetrical forms can be used as ornamental motifs, and that by the skilful use of such material the designer is able to create beauty beyond his personal power of evocation. It cannot be too often insisted, however, that success depends less on a slavish adherence to the particular linear *web* selected than upon the æsthetic sensitivity which prompts departures from it and the free use of it only as a substructure. Mathematical aids to design, like the machine in industry, should ever be subservient to the human spirit, not an enslaver of it. Greek athletes are said to have rubbed their bodies with sand and oil: In this connection mathematics may be thought of as the sand and æsthetic intuition as the oil.



ENTRANCE TO A MAUSOLEUM—ORNAMENT DERIVED FROM THE PLATONIC SOLIDS, THE TETRAHEDRON AND ICOSAHEDRON

HYPERSOLIDS IN PLANE PROJECTION

The third source of ornament is an extension of the second (the plane projections of the Platonic solids), but an extension in a new direction — a direction at right angles to every known direction — into the fourth dimension, in point of fact.

Now although the fourth dimension may be only a fairy-tale of mathematics, it can be made use of by the designer of ornament, and this particular use constitutes, it seems to me, a contribution to his armory of no small interest and importance. Such also is the opinion of architect C. Howard Walker — himself the author of a book on ornament. In a review of *Projective Ornament* he says:

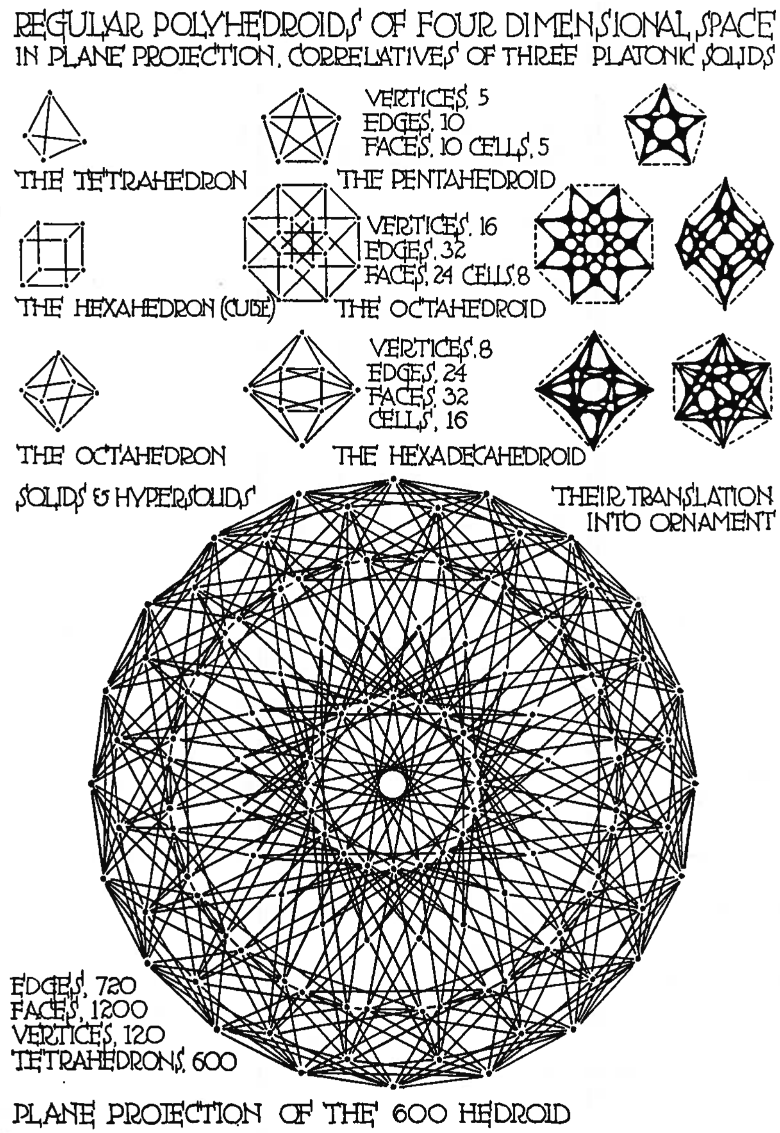
> Mr. Bragdon's knowledge of geometry has led him to an initial application which is practically a discovery of a hitherto unused method of enriching geometrical design. It is a very valuable addition to the *formulæ* of a designer. Among the chief faults in geometric design have been the paucity of detail and meagre modulations of varying scale. In order to obtain this, subdivisions of an unimaginative type or else mere filling patterns in geometric units have been adopted. The development in the fourth dimension has filled these needs without resorting to either subterfuge. It is a development which greatly enriches the geometric *foci* and creates its own detail. Modulation and variation of scale occur naturally in every case, and monotony is diminished.

Now the world of the fourth dimension is a paradoxical world, and its forms are in a literal sense fantastic, but they are *mathematically true* nevertheless, and this is the only kind of truth which need concern us in this connection. The regular hypersolids of four-dimensional space — analogous to the Platonic solids of three-dimensional space — are the "fantastic forms" which will prove most useful to the designer of ornament. The number and relative positions of the vertices, edges, plane sides, and bounding solids of these hypersolids can be as accurately known *to the mind* as the Platonic solids themselves. And although it is impossible to *visualize* them, by a process analogous to the perspective method (by means of which a three-dimensional object is represented in plane projection) they can be reduced to linear diagrams. Such representations, enormously more rich and various than the plane projections of the Platonic solids themselves, constitute this third source of ornament.

For a description of the method whereby these two-dimensional representations of four-dimensional forms is achieved the reader is referred to the following chapter; here I shall give only a concise record of the use I have made of them, with representations of a few of the achieved results.

Illustration 59 shows the pentahedroid, the octahedroid, and the hexadecahedroid in plane projection. These are the four-dimensional correlatives of the tetrahedron, the hexahedron, and the octahedron. That they are full of decorative possibilities is evident at a glance: they *are* ornament. The rug design in Illustration 47 was determined by two of them, and the rug in Illustration 60 was based upon four octahedroids represented as cubes within cubes with vertices joined, as shown in Illustration 61, which gives also the source of the sofa-covering — a hexacosihedroid. The wall-hanging in Illustration 48 was derived from a different projection of this same hypersolid — of six hundred sides. It is represented entire in the intricate diagram at the bottom of Illustration 59. It alone constitutes an exhaustless mine of beauty into which I have repeatedly delved. Practically every pattern in the frontispiece of this volume was derived, directly or remotely, from this 600-hedroid in one or another of its presentments, and the sunburst surrounding the clock in Illustration 62 is made up of certain of its constituent parts. Indeed, it might almost be said of this figure that it is itself the womb of a new ornamental mode. Illustration 63 represents a pair of doors the panels of which are decorated with patterns derived from projected hypersolids.

The so-called artistic temperament has an aversion, sometimes amounting to a subjective fear, to everything which savors of the mathematical, seeming to sense in it something inimical to the free play of the creative imagination. But this is an attitude born either of ignorance or of educational malpractice. There is nothing so liberating to the spirit and stimulating to the imagination as the intention of consciousness upon geometry and number. Approached in the right way, mathematics becomes not the ravisher but the lover, the bringer of light and of delight, the fecundator of new forms of beauty. And if the reader says, "All this is above my head," I can only answer, "No, it is close beside your hand!"



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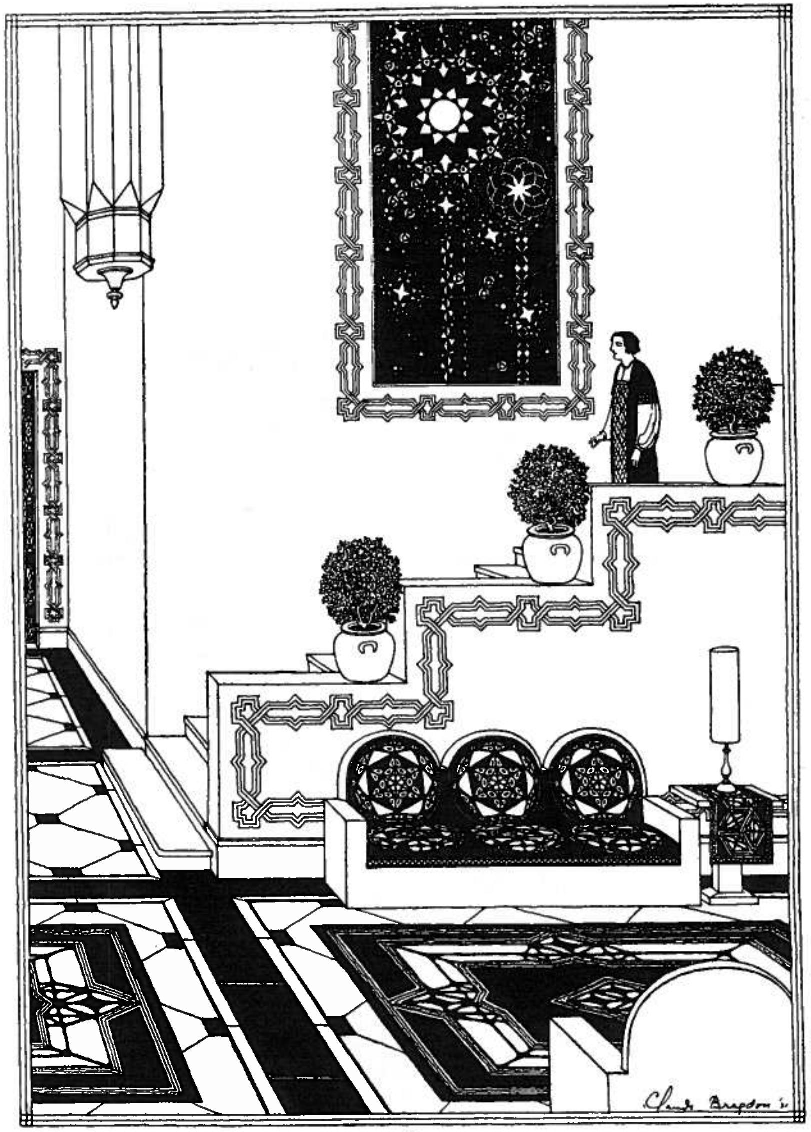
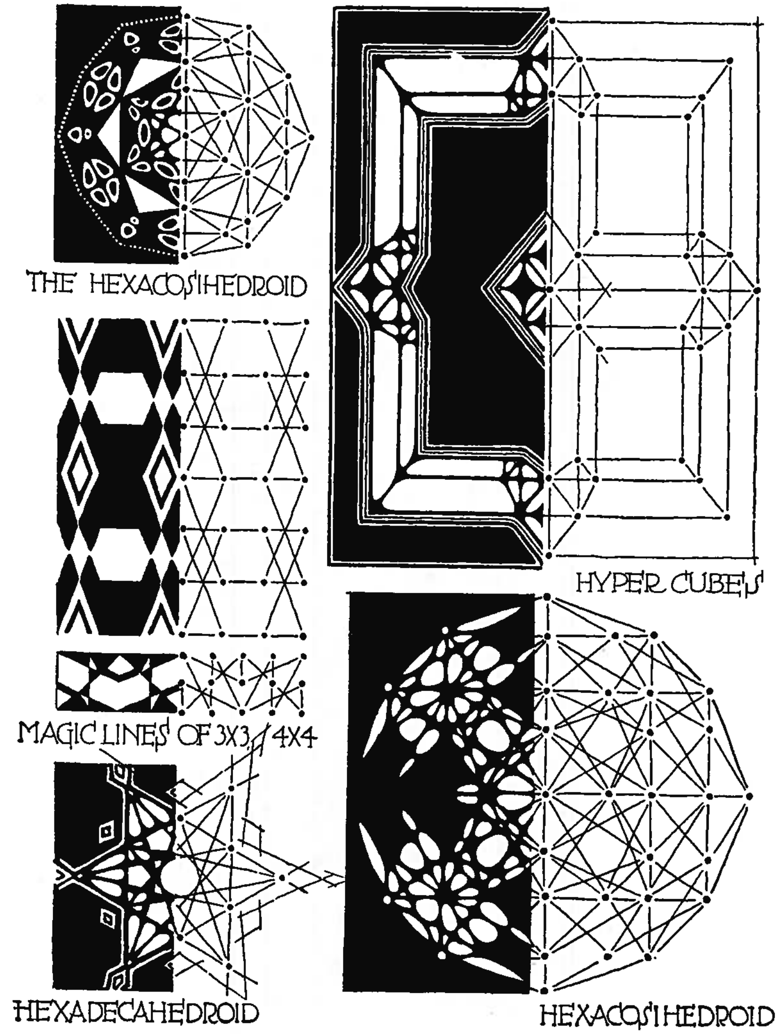
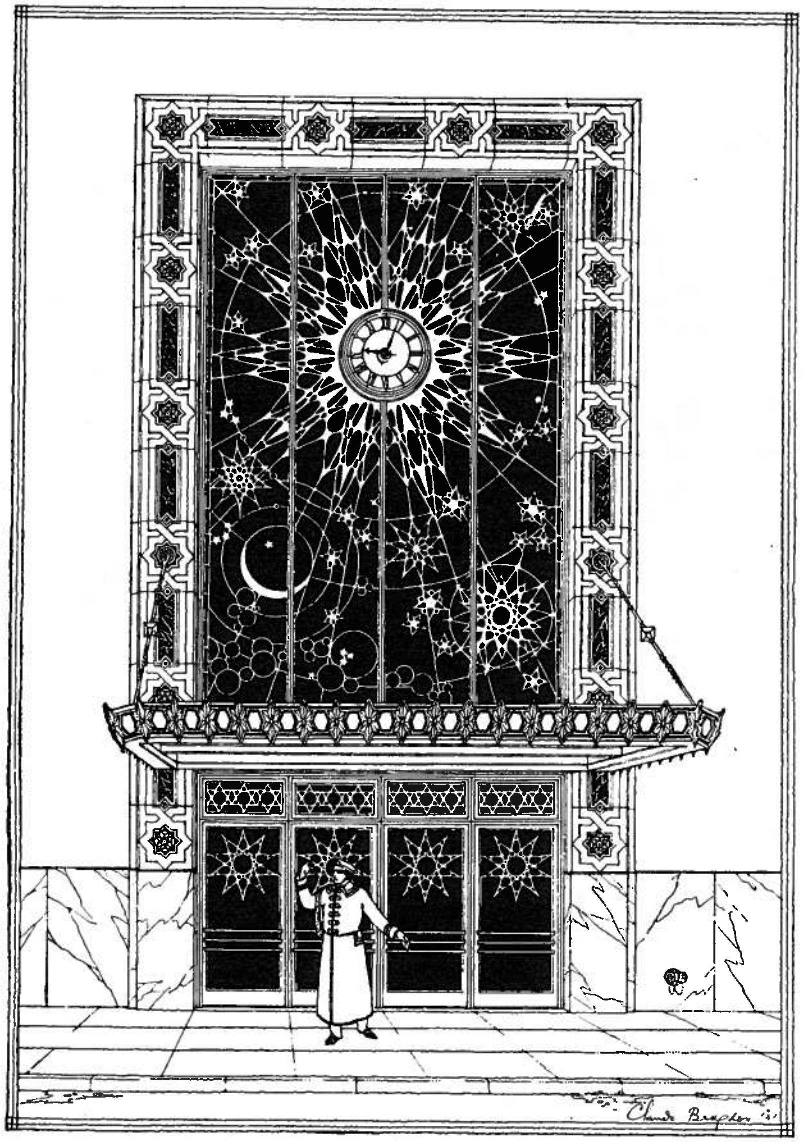
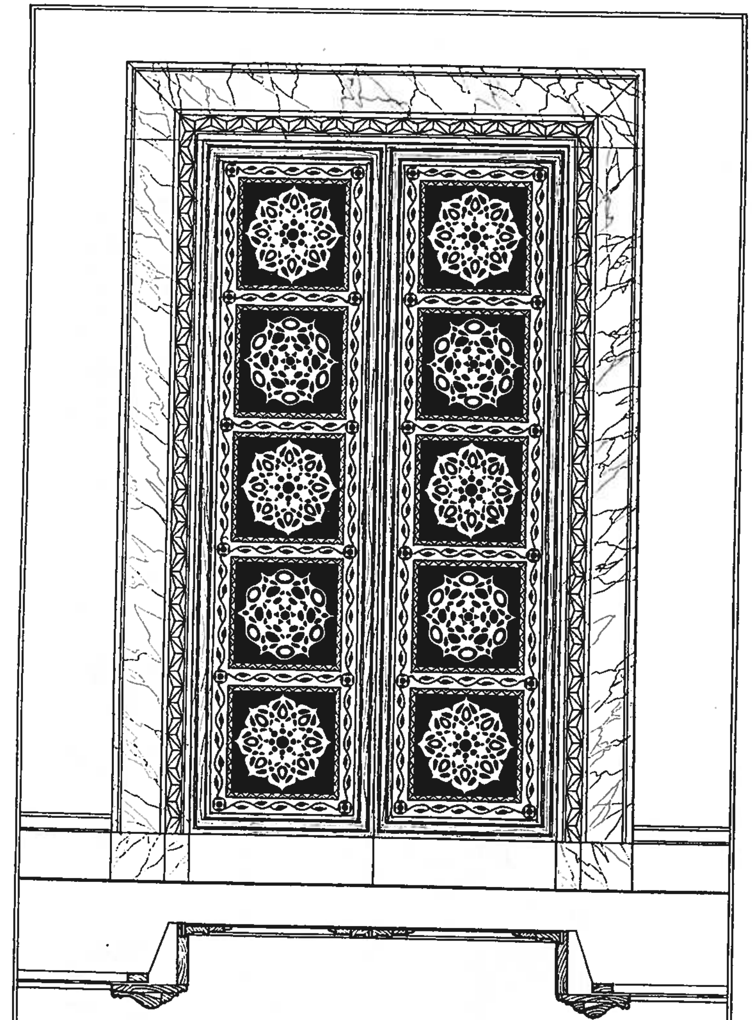


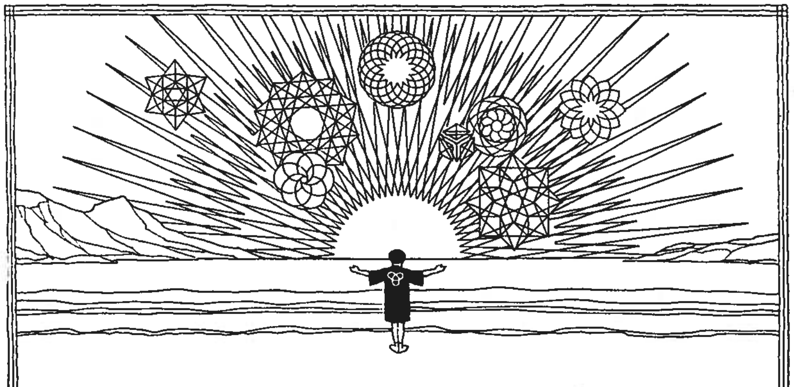
VARIOUS ORNAMENTAL PATTERNS: THEIR DERIVATION







ENTRANCE · DOORWAY
FOR · ORCHESTRA · SETTING



SINBAD DISCOVERS THE SPECTRAL COLORS LATENT IN THE LIGHT OF THE SUN

IX

COLOR

RUSKIN was right when he said that anyone could learn to draw — he was himself an admirable draughtsman — but only those who were to the manner born could become colorists. For the color sense, like the musical sense, appears to be a *gift,* and though amenable to training and development in everyone, it is so only within limits which the born colorist — like the born composer in the field of music — will easily overpass.

No book purporting to deal, like this one, with the elements of decorative design as applied particularly to architecture, can omit some discussion of color, for polychromy is entering into architecture more and more, but color cannot be *taught,* effectively — least of all from books. That is to say, no amount of instruction will make a person a *good* colorist; the most that it can do is to prevent him from being a bad one. All that I shall attempt to do, therefore, is to present a few fundamental facts and ideas which, like a knowledge of dynamic symmetry, should be part of

the equipment of every designer. Everything beyond this one must learn by actual experimentation — if one can and as one can.

The first thing is to become aware of the inevitable bisection of the color spectrum into cold colors and warm — electric and thermal. Roughly, the colors of higher vibration — from green to violet — belong to the first category, and those of lower vibration — from red to green — to the second. But any color, from either segment, may itself be warm or cold to the contrasted aspect of itself. That is to say, there can be a cold violet and a warm violet; a cold (greenish) yellow and a warm — there can even be a cold red relatively to another red. Some of the most satisfactory color combinations consist of the cold and warm of a single color, with just enough of the complementary to make them "live more abundantly."

The next thing is to become aware of complementaries. The complementary of a color may be compared to the reciprocal of a number; for just as in mathematics a reciprocal is a function or expression so related to another that their product is unity, the complementary of any given color is such another color from the opposite part of the spectrum that, when combined with it, cancels it, so to speak; yielding, in pigment, neutral grey; in light, white.

Because the secret of color harmony and color brilliance dwells in nothing so much as in the right application of the law of complementaries, the student should make it his first business to know what colors are complementary to each other. He finds this out most amusingly — as one finds out lovers — by bringing them together and observing how they act and react. For complementaries *are* lovers, longing for union, shining brightest when in juxtaposition, supplementing and completing each other. Complementary colors should be learned and committed to memory, just as a musician recognizes and remembers consonant musical tones. This can be done in several different ways; one is by the manipulation of pigments; another and a better, by experimenting with colored light. One learns by these means, for example, that the color of the shadow of an object — on white — will always be the complementary of the color of the light which casts the shadow. But lacking the necessary paraphernalia for this order of experimentation, there is another which is simplicity itself, already described by me in " Light as a Language " in *Old Lamps for New*:

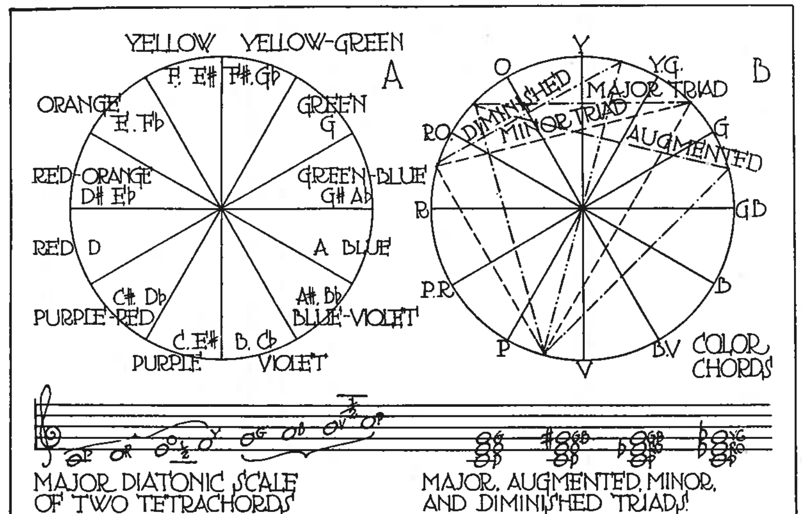
Assemble a number of brightly tinted squares of paper or silk of different colors — including the primaries — and in a strong natural light lay them, one after another, in the middle of a sheet of white paper, gazing at each one fixedly until the eye experiences retinal fatigue. After a time a fringe or nimbus of the complementary color will begin to appear around the edge of the colored bit, and if this then be removed quickly, the place it occupied will seem to be suffused by the complementary, which will slowly grow paler and finally disappear. The combinations discovered in this way should be noted and memorized, and the experiments repeated until one can tell beforehand, in any given case, what color will appear. The preconceived mental image and the perceived optical image should then be compared and the former corrected by the latter.

Another exercise to the same end is the manipulation of colored gelatines or bits of stained glass against the light, superimposing one over another and noting the colors which result from these combinations. When that result is a perfectly neutral grey, the two colors which produced it are complementaries. Van Deering Perrine, the landscape-painter — a great colorist — used to amuse himself after this fashion with a toy of his own devising. It consisted of two cylindrical pasteboard containers, one within the other, in the sides of which he had cut round holes, similarly located and spaced. These holes, four in each cylinder, he had then covered with silk dyed red, blue, green, and yellow. Into the center of this contraption he dropped a small electric light, and by turning the outer container about he brought the different colors opposite one another, thus forming others. He used to sit for hours in the dark with this instrument in his hands, as charmed by the beauty of his color-music as a musician at the keyboard of an organ.

Having used the word " color-music," this is perhaps the place to say a little something on the much-discussed analogy between color and sound — the rainbow hues and the musical scale. Within limits clear and inescapable, this analogy is true only in a limited way and up to a certain point: if pressed too far it is full of pitfalls for the artist. It pro-

vides an excellent approach, however, to the study of color: of little use to the master, it is of service to the neophyte because by means of it he may learn about color in an orderly way.

The solar spectrum, proceeding by an infinite number of gradations from red at one end and violet at the other, may be compared to the



THE WILSON OPHTHALMIC COLOR SCALE & MUSICAL PARALLEL

70

sound of a siren which begins on one note and ascends to its octave. The color-band and this sound are equally capable of being artificially subdivided. The so-called chromatic scale in music represents a twelvefold subdivision of the sound-octave, and if the color-octave be similarly dealt with, it is clear that there would be a color to correspond with every note of the chromatic scale. In this splitting-up of the spectrum, however, an *equal* subdivision cannot be adhered to — the color-band must be more or less arbitrarily dealt with. By reason of this fact (among others) the various color-scales which have been suggested differ in detail from one another, though most of them make red correspond to the tonic, or middle C, and the deviations from one another of the other color " notes " do not as a rule amount to more than what in music would be a semitone.

Of these color scales — Rimington's, Taylor's, and others — the so-called " ophthalmic color scale " developed by Mr. Louis Wilson, is the most useful, since it embraces a greater range of purples, a color indispensable to the artist. Mr. Wilson makes " royal purple " — which is a deep sanguine, or blood-color, not a violet — the tonic of his scale (although of course, as in music, every color is the tonic of a scale of its own). He omits orange-yellow and violet-purple from his twelvefold subdivision, which makes his scale correspond more exactly with the major diatonic scale of two tetrachords, in which there is a difference of only a semitone between the next to the last note (E and F, and B and C, in the scale of C major). The scale has also the great merit that when its twelve colors are arranged in the form of a circle, the complementaries occupy positions exactly or very nearly opposite to each other as will be seen by reference to Illustation 70. Here follows Wilson's scale with its musical correlatives:

Purple	C, B#
Purple-red	C#, D♭
Red	D
Red-orange	D#, E♭
Orange	E, F♭
Yellow	F, E#
Yellow-green	F#, G♭
Green	G
Green-blue	G#, A♭
Blue	A
Blue-violet	A#, B♭
Violet	B, C♭

It is evident that by the use of this scale some sort of translation of musical chords — and indeed of entire compositions — into their color correlatives is rendered possible. The thing has been done — I have done it myself — and the results are interesting and instructive; they are also beautiful, for colored light is seldom unbeautiful, but not more so than could be arrived at by means more direct. For the beauty of any given

color combination depends almost entirely upon the right adjustment of relative *areas* and relative *values*, things unrelated to music, to the determination of which therefore the musical parallel can give no help. In color-translation musical consonances are often found to be less satisfactory than dissonances, and there are color combinations of extraordinary beauty of which a correlative musical expression gives no hint — like a passage from warm to cold of a given color together with its complementary (purple, purple-red, red, red-orange, orange, and green-blue, for example) ; in music all this would amount to would be a chromatic run of five notes and the fourth of the middle one of them.

As a matter of fact there are *no* ugly color combinations if they are dealt with in a manner which gives due regard to areas and values. Modern music appears to be built on the same assumption with regard to sound — that all is relative. Be that as it may, the law of complementaries is a better guide and safeguard (in so far as there *is* any guide and safeguard other than an intuitive color sense) than any labored translation of musical chords into color chords. Moreover, an intelligent application of the law of complementaries leads to much the same results but in a more direct way. For example, a color triad based on the law of complementaries would consist in " splitting " a given color and combining these two halves with its complementary (purple, orange, and green-blue, or yellow-green, blue-violet, and red). In our color-wheel these would define an equilateral triangle, and would correspond in music to an augmented triad. Major, minor, and diminished triads, picked out on the color-wheel in this way, also define triangles the vertices of which meet the " rim " never less than three " spokes " apart. Knowing this fact, should one choose to depend upon a mechanical method for obtaining harmonious color combinations, this system of triangulation is easier and more direct than the translation of musical chords into color chords by means of the musical analogy. Experimentation along these lines is helpful and educative, but it should always be remembered that the law of complementaries is the master-key to the color mystery in so far as there is any key at all. It is one, however, which gives access only to the anteroom of that enchanted castle, for with the three variables of hue, area, and intensity only the born colorist can successfully deal.

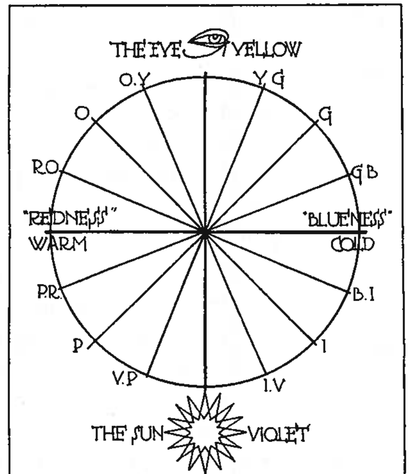
Mr. Fritz Trautmann, who starts from the vantage ground of being a born colorist, has for a number of years been studying and experimenting along original lines. The results of his researches he has not formulated as yet, but he has been gracious enough to permit me to transcribe part of a letter containing the core of his theory, from the application of which, in both painting and teaching, he has achieved remarkable results:

The most subtle and penetrating vibrations coming to us from the sun — the so-called ultra-violet ray — is the one that most definitely affects the skin, as is evidenced by sun-tan; and as the eye is the part of the skin most sensitively adapted or tuned to the sun's rays, it would seem that this most sensitive spot should make a natural — or normal — response to violet. We know that when any material is so constituted in its crystalline structure that it absorbs light of a given color, that material takes on an external aspect of all the rest of the light that is turned back — in other words, the complement. Now it is an interesting fact, and I think a significant one, that the physiologists have discovered that the pigmentation of that most sensitive spot on the retina is yellow, and they call it the yellow spot.

This is the underlying basis of my theory: The sun is the affector, the eye is the receptor. All phenomenal aspects occur between the two. It requires both affector and receptor for the conception of white light. So for us who live under the sun, the violet-yellow axis becomes the personal axis or beginning place for all color sensation. I have never had a group of students disagree about the location of these poles on the color-wheel or fail to isolate them from the other hues. Once they have made that judgment, the explanation of color action becomes simple: All the rest of it is a sort of emotional tremor imparted to the personal axis. I drive two tacks in a screen, one some distance above the other, and over these I stretch a rubber band. The top tack is yellow — the light of the eye: bright, luminous, revealing. The bottom tack is violet — helios, the sun — profound, deep, penetrating. If I grasp one half of the band — midway between the tacks or not — and stretch it out to the right, the personal axis is distorted or deflected, with the maximum of deflection occurring at the point where my finger happens to be. If I pull the band out to the left, the axis is again disturbed, but the extreme point of the disturbance is exactly opposite in nature and complementary to the one on the right. I ask the class to identify these extremes on the color wheel, and I give appropriate names to designate their emotional appeal. Here,

again, I have never had a group fail to agree on their location, even to a surprising degree of precision, and there is never any doubt about their feeling that one side is hot and the other cold. When it comes to color notation I find that there is usually some difference of opinion as to what these extreme places should be called. Almost everyone will agree on *red* as the name of the hot extreme, but *blue* is a name so long associated with a color containing a large dose of violet that many object to it as applied to the cold extreme. On the other hand, they also reject the term *blue-green* because the green part of the term implies a content of yellow, and they are quick to discern that the disturbance of the personal axis equally affects both poles and that no point can be considered extreme so long as it contains an element of either yellow or violet. Strange to say, however, the terms *redness* and *blueness* seem to satisfy the majority of any group, so I let it go at that and impress upon them that the name is really of little importance so long as they are sure of the quality.

This should be enough to give you the kernel of my whole idea. All of the intervening colors between these four critical points are considered as the two primary personal poles (yellow and violet), merely being cooled or warmed to succeeding degrees. White and black to me are neutrals, always secondary effects, the result of complementaries acting together — interacting. Dodge McKnight paints the whitest of snow with red and blue pigment. He could as well do it with yellow and violet or any other pair, depending on the time of day — the mood.



TRAUTMANN'S COLOR "CROSS" AND THE DERIVED COLOR SCALE

71

This seems to me a better approach to the subject of color than by way of the musical parallel, although the conclusions and results may prove to be identical. A graphic expression of Mr. Trautmann's idea would consist of a cross of which the vertical axis would have yellow at the top and violet at the bottom, and the horizontal axis "redness" at the left and "blueness" at the right (Illustration 70). Comparing this with the Wilson color-wheel, it will be seen that these colors occupy the same relative position, and that there is no essential contradiction between them. In Trautmann's cross the intermediate spaces between his four "primaries" may be bisected, yielding the "secondaries"* orange, green, indigo, and purple, a color scale of eight notes; or trisected, yielding a scale of twelve, in all essentials like the Wilson scale. If a more minute subdivision be required, the total may be increased to sixteen, in which case it would read as follows:

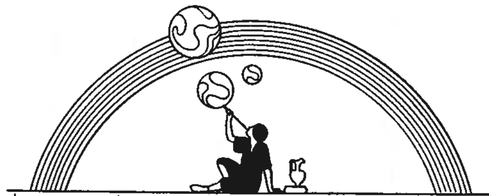
Violet
Violet-purple
Purple
Purple-red
Red
Red-orange
Orange
Orange-yellow
Yellow
Yellow-green
Green
Green-blue
Blue
Blue-indigo
Indigo
Indigo-violet

It would be well for the student of color to use this scale, which is both adequate and orderly; and to adopt also this terminology, abandoning the ridiculous practice of referring to colors by those arbitrary and meaningless names by which they are currently known. But in so doing one should keep clearly and constantly in mind what I have said about it, and particularly the "color cross"—as a mariner keeps in mind the cardinal points of the compass.

The color-world is *par excellence* a world of relativity: colors alter

* Trautmann says, "I don't like the term 'secondaries' as applied to any pure phase of the spectrum. You see, I have only one primary action—the personal axis and its extremes of amplitude. Secondaries seem to me to be the result of damping or interference.

their appearance in changed relations and proportions and under different conditions of atmosphere and illumination. A color may be made to appear warm or cold, to advance or to retreat, by an alteration of adjacent colors, and it in turn affects them. In this, more than in any other department of the fine arts, each must work out his own salvation with relatively little outside aid. Belonging as it does to the domain of feeling rather than of thinking, the intuition rather than the reason should be one's guide. Over and above what I have already said, perhaps the only further instruction which can be given is summarized in the words: *observe, reflect, feel, and experiment.*



SINBAD OBSERVING AND STUDYING COLOR AND LIGHT