PROPORTIONAL FORM

FURTHER STUDIES IN THE SCIENCE OF BEAUTY, BEING SUPPLEMENTAL TO THOSE SET FORTH IN "NATURE'S HARMONIC UNITY"

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THE TEXT AND MATHEMATICS ARE BY CAPT. COAN

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[1] These chapters are taken from *The Great Modules*, C. A. Coan, 1914.

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PROPORTIONAL FORM

CHAPTER I

HEAVEN'S FIRST LAW

IN the study of Nature, man has, from time immemorial, frittered away valuable hours and years in an endeavour to visualise some almost inconceivably complex system of laws which, he took it, were necessary to explain her intricate results. Cycles and epicycles innumerable were constructed in his effort to explain astronomical phenomena, even up to the very date when at last the one basic law of gravitation was developed and he realised that it was the application and not the law itself which was complex. No science has been free from such abracadabra, and research has been correspondingly slow. Gradually and bit by bit it has been found that the mysteries of Nature yield to rules very simple when compared with the results which, in combination, they produce. Science, aided by mathematics, has step by step displaced the metaphysical guesswork of our forefathers, and the process, far from being finished,

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might almost be said just to have begun. The further such investigation is carried, the more clearly it appears that a few fundamental and major rules work in concert for the government of the whole scheme, and upon the universality of such a harmony and its ancient use and future value in developing beauty, was based the former treatise called *Nature's Harmonic Unity*.[1]

When years have been given to the intimate consideration of any subject, it is easily possible for the searcher to lay too much stress upon its importance, but Nature sometimes furnishes a barometer which records her wishes and needs, and calls her cohorts into action at the proper moment. She has a way of telephoning mankind a message to the effect that she feels it time he should develop a better knowledge along certain lines. Forthwith a manderin in Chinese robes, and wearing a peacock's feather, or a Thibetan priest burning incense in some walled and forbidden city, will fall into a brown study. Bent he will be on de-coding Nature's telegram, and all unaware that perhaps studious Mahometans nodding in some far-off Sahn el-Gamia and lonesome astronomers on the peaks of the Andes, explorers in the heart of Africa, anæmic students in rooms too hot, and sturdy, practical scientists in tents too cold, separated by a whole world of land and water, may have all been unconsciously impelled to take up the same questions at the self-

[1] *Nature's Harmonic Unity*, same authors (Putnam, 1912).

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same time. Telepathically perhaps they will transfer to each other their agreements and disagreements preparatory to disclosing a series of inventions, discoveries, and theories which will seem in the final analysis to have come straight out of the blue. Thus, when Nature's chicks are ready to hatch, they merely peck the shell and step boldly out. In all this, you will observe that Nature has simply set the stage, rung up the curtain, spoken the prologue, and dispatched Iris as her messenger and call-girl to warn the actors of their impending cues.

A similar analogy is not lacking in the study of those laws by which Nature regulates the proportions of her works, and which it seems but logical that man should use as his guide in his own creations in art and architecture. The publication of *Nature's Harmonic Unity*, in which many of these things were treated, came after a period of long quiescence in the production of writings of this kind; yet it was scarcely in press before it was found to be surrounded by others as in a cloud. Writings came out of the east and out of the west and across the seas, all bearing on questions of the same kind, and many of these works will be found referred to in the following pages. Meanwhile, the authors of *Nature's Harmonic Unity*, continuing their original researches, have been brought to a double decision: first, that, in view of the many recent publications touching on questions of proportion in Nature, the conclusions reached in

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our previous work and which have happily met no inconsiderable favour, should be extended through the presentation of additional matter, and, second, as an incident, that in the new work the means of reaching those conclusions could and should be simplified in their demonstration. Hence the present book is before the public. And since the desire to simplify the labour of the reader would at once be negatived by requiring him constantly to refer to the former publication, necessity demands that while the present work is, in essence, a sequel to *Nature's Harmonic Unity*, it should nevertheless, as now presented, be in fact a complete whole, even at the expense of the repetition of certain fundamental demonstrations and principles set forth at large in the pages of the earlier writing.

Let us start then with the knowledge that, however difficult it is in any given instance to follow through the intricate mazes of any one of Nature's daily combinations, yet we may rest assured that the various rules are themselves austerely simple and each applied with religious severity. It is only the resultant combination which taxes our attention, like some confection, some marvellous creation into which we see the products of the farm, the market and the dairy poured and stirred, to be finally transmuted by a chef's magic into castles and camels and cakes, fruits and fairies and frosting.

Proportion and rule are everywhere present in Nature, and it is as hopeless to visualise her without precision as it is to imagine

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beauty dependent on chance, and without that order which is Heaven's first law. For, as every natural creation and phenomenon is supported and measured, guided and terminated by order and proportion, so, prone as we are to suppose that beauty is an erratic production superior to all regulation and uninfluenced by laws, yet is every form of beauty found, upon careful analysis, to be subject to the controlling power of these universal rules. One does not think of the plentiful noises of a boiler shop as music, nor does an overturned paint cart spell art; a mad and whirling brain is indeed a sad, but in no sense a beautiful thing to contemplate; and anarchy ever produces ruins and abundant chaos rather than churches, pictures, towers, and monuments. Consciously or unconsciously, beauty must have reason behind it. If this be not so, why then have we no evidence that the ape and the elephant, the horse and the faithful dog are affected by beauty equally with ourselves. Nature is founded upon laws and rules and man alone appreciates them.

"For the world was built in order
And the atoms march in tune."

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CHAPTER III

THE TRIGON IN VISIBLE NATURE

AS gravity and polar force are such vast and universal powers and constantly exercising their influence over whatever possesses physical attributes, there would be perhaps some academic advantage in placing next in order a chapter setting forth the evidence to prove that these forces are governed by rules coming under the tetragon and trigon group. Efforts however to catch the attention relative to mere invisible force are of extreme difficulty, and in order first to introduce to the reader some of the visible beauties upon which this series of rules is brought to bear the tangible has been given precedence over the intangible in the hope that thus, fixing interest first on the visible demonstrations, the unseen and more abstruse matters of force may safely be left for a succeeding chapter after the general working of the plan is more clearly illustrated.

Recognising then that as all members of this tetragon group have been found to support certain features in common, and that as shown in the preceding chapter, once it be satisfactorily demonstrated that an object is proportioned on the square, we can instantly

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feel assured that the equilateral triangle and the hexagon will, at their appointed places assume their wonted responsibilities, it will be interesting to see how these things work out in practice and whether these points develop in fact as well as they do in theory.

Perhaps in all created things no more beautiful example of the workings of the laws of polar force, or more perfect hexagonal design could be found than in one of the whirling snow flakes formed and reformed while making its one terrestrial journey from the dull, grey, wintry cloud that conceived it, through a few short seconds to the drift where it joins its storm-born mates. Bear in mind that, though a lifetime were spent in the search, no two of these spectacular beauties would ever be found exactly alike, none of them last more than a few seconds, none of them have been more than a fraction of a minute in their formation; they are engraved and etched and beaded and carved beyond the power of the microscope to investigate them; they have been falling from the heavens since man came on earth and will continue to fall so long as temperatures vary. Yet never one in all of these milliards of millions that varied from the form of a hexagon or showed a pattern which was not a six-cornered exemplar of the Tetragon Family.

Suppose we look carefully at a number of examples of snow crystals taken from the wonderful collection of photographs made by W. A. Bently of Vermont. It is hardly necessary to indulge in very

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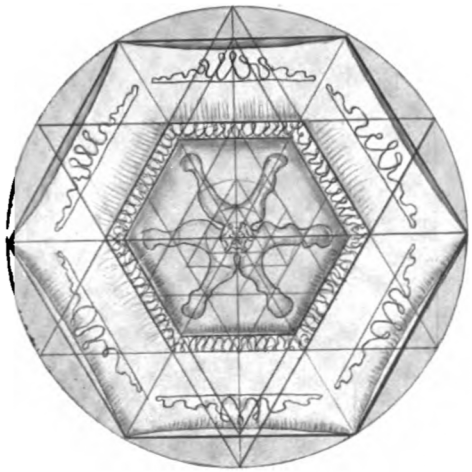

PLATE 13
SNOW CRYSTAL

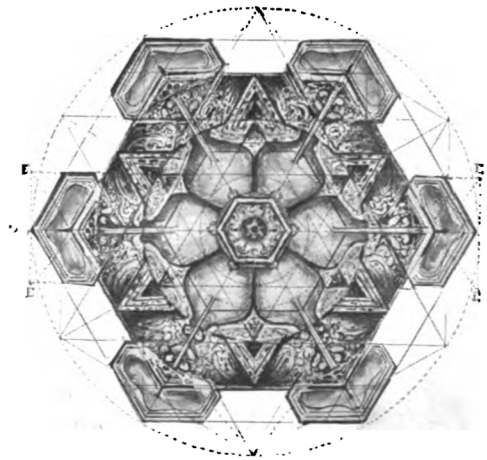

PLATE 14
SNOW CRYSTAL

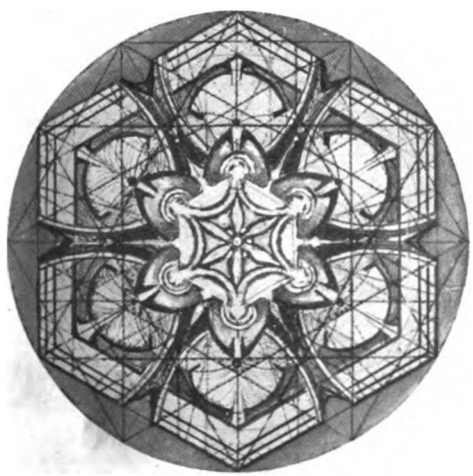

PLATE 15
SNOW CRYSTAL

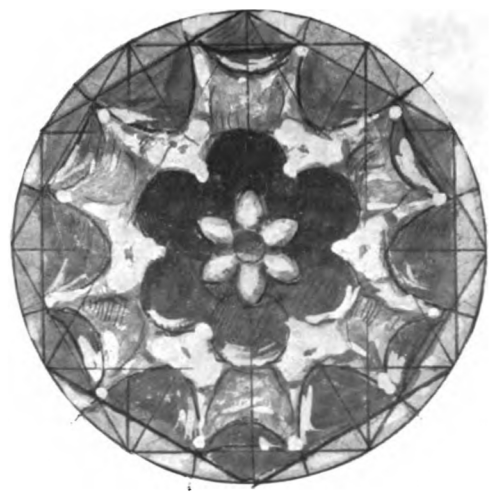

PLATE 16
SNOW CRYSTAL

The above illustrations are taken from *Nature's Harmonic Unity.*

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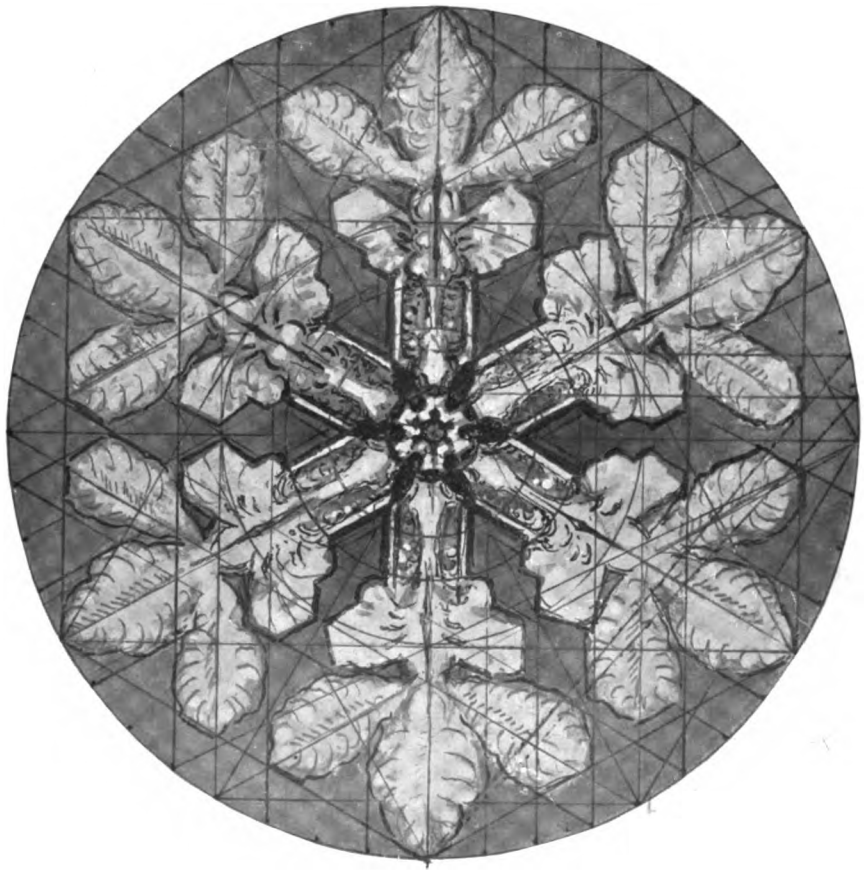

PLATE 17

SNOW CRYSTAL

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extended comment as the illustrations themselves proclaim their origin and family in every line.

It can hardly be without great additional interest to note that plate 16 is an extremely magnified photograph of the interior concentric portion of the decoration on the same snow crystal shown more completely, though on smaller scale, in plate 17 nor has any photographic apparatus yet been devised which discloses the slightest waning in the exactness and beauty of these concentric diagrams.

While the rock crystals and crystals of various salts and chemical combinations furnish an endless array of interesting subjects, they are nevertheless difficult of examination from a mere drawing, being many-sided solids which at best present but a confused mass of lines to the eye in an illustration. It is possible, however, in some of the simpler forms to show clearly how crystals, whatever be their nature, conform to the great rules laid down by polar force and gravity and this can scarcely be better illustrated than by showing the two plates 18 and 19 wherein are given end views of crystals of cuprus uranite and dolomite.

As we progress upwards in the scale to animate life we rise first from the inanimate crystals to the lower orders, wherein must be classed the *algeæ*. Among the monocellulars are many forms of vegetable life formerly considered to be minute animals, developing with a marvellous rapidity, an incredible number finding ample space in a

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teaspoonful of water. They have been given the name of diatoms (Diatomaceæ) from their habit of propagation by a simple division, thus creating two atoms where only one was before. These beautiful

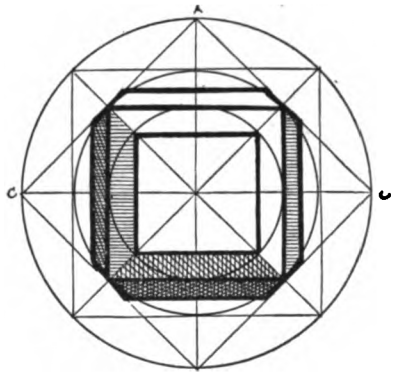

PLATE 18—CUPRUS URANITE

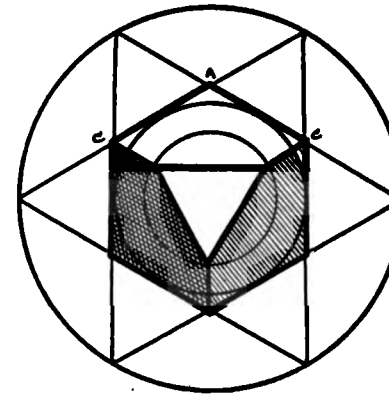

PLATE 19—DOLOMITE

Bacillariaceæ are engraved and etched with the same care as the snow crystals, and instances are not lacking where the lines of engraving in the decoration have been microscopically traced and counted to the number of 125,000 to the inch. We may say that our knowledge of these decorations is limited as in other cases only by the possibility of the instrument to make them visible by magnification. These beautiful things take the forms of all of the polyhedra but in the majority of cases the patterns are limited to triangular and hexagonal ones as shown in the illustrations in plates 20, 21, 22, and 23. Occasionally one is seen which shows the direct tendencies of the square

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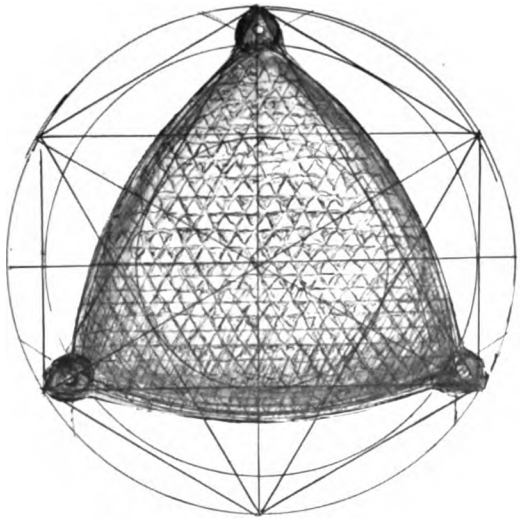

PLATE 20
TRIANGULAR DIATOM

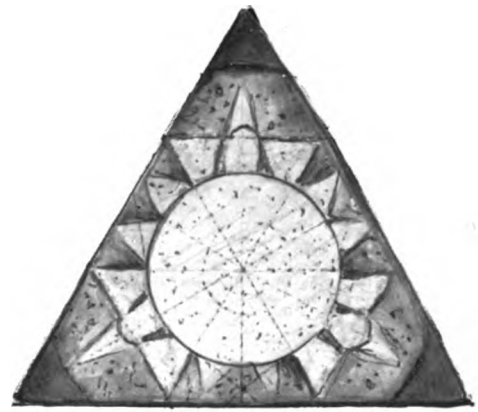

PLATE 21
TRIANGULAR DIATOM

PLATE 22
HEXAGONAL DIATOM

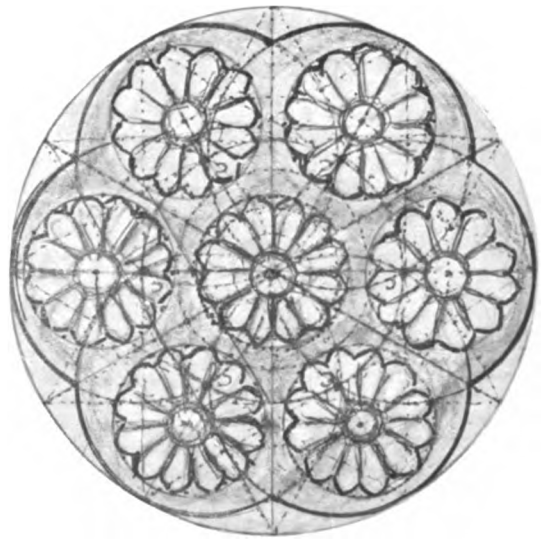

PLATE 23
HEXAGONAL DIATOM

Diatom Illustrations as taken from *Nature's Harmonic Unity.*

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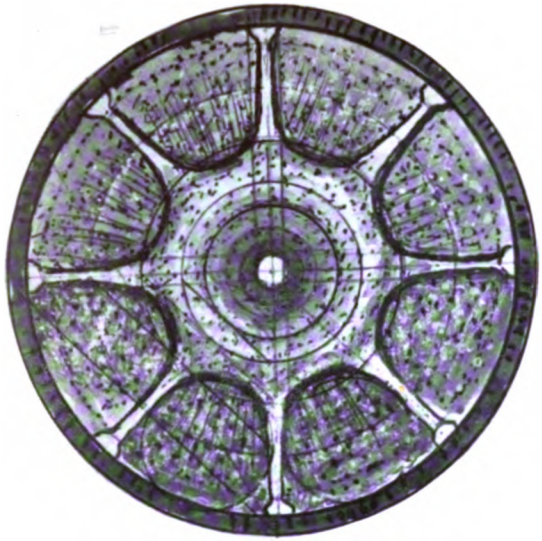

PLATE 24
OCTAGONAL DIATOM

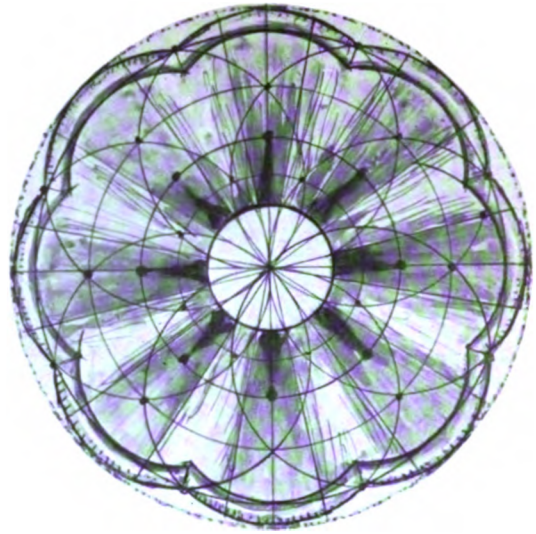

PLATE 25
OCTAGONAL DIATOM

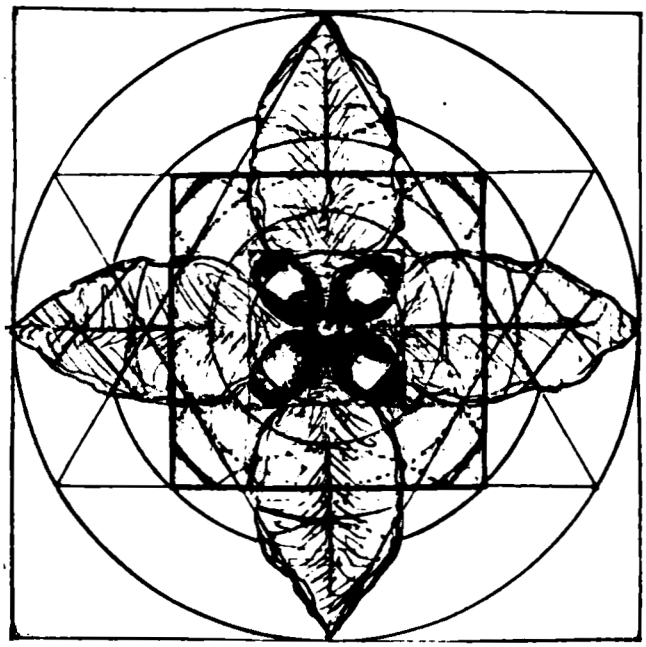

PLATE 26
SEPALS AND SEED VESSELS OF SYRINGA

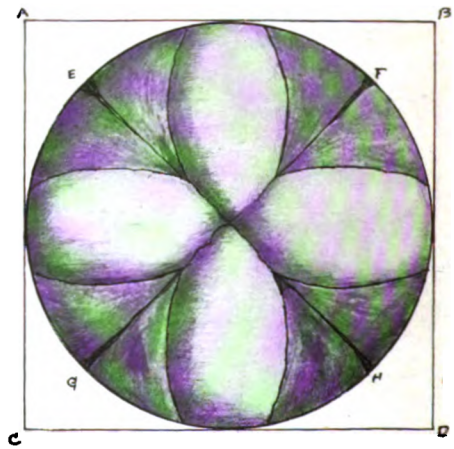

PLATE 28
COTTON

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and the octagon, as in plates 24 and 25, all of which will explain themselves immediately upon a comparison with the plates contained in Chapter I.

Rising now from these lower orders to the higher forms of plant life, we find the same tendency strong within flowers familiar to us all. Of these, attention is first invited to two in which the direct factor is evidently the tetragon or square. In plate 26 we see a drawing of the sepals and seed vessels of the syringa in which the four sepals are carried out by four seed vessels and these in proportion are governed by the fourth progression of the prime square. Again we turn to plate 27 showing Onagra Biennis, with its four leaves and a central circle coinciding with the fourth progression of the square, and again in the bursting cotton, as shown in plate 28, is seen a most definite instance of the same relationship to rectangular form.

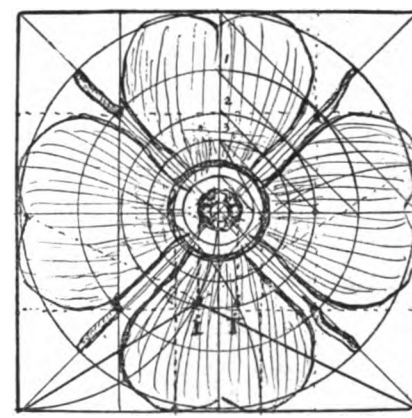

PLATE 27
ONAGRA BIENNIS

No examination of plant life under the influence of the laws of polar force and the tetragonal family would however be complete without some of the beautiful illustrations which constantly occur in

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the six-sided flowers such as the jonquil (plate 29) and the tiger lily (plate 30), to which might well be added Zygadenus Elegans and the Easter lily (plates 83 and 84), *Nature's Harmonic Unity*, in each of which the flower petals lie in the form of the equilateral triangle like a babe in its crib, while the inner markings are defined by the regular progressions of the hexagon as indicated in the plates.

There is, however, a stage in natural development which is high above that of plant and vegetation and this is the life of animate things, and these we must examine briefly. Look for a moment at the beautiful butterfly illustrated in plate 31 and then consider again the wonderful exactness of the equilateral triangle formed by his powdered wings.

And if these were not enough, inspect please, the work of the wasp in forming his remarkable nest (plate 32) and the marvellous comb of the common honey bee (plate 33) with its perfect building and ultimate utility and hexagonal economy.

In creating her remarkable wax storehouse, Mr. Bigelow, in his recent issue of *The Guide to Nature*, disowns the theory long upheld, that the bee really goes about this cell building with any plan to create a series of hexagonal cells. He says that "in making the comb the honey-bees never work in hexagons but always in circles. Then she keeps going into the cell like a gun swab and pushes out the sides, and it is this pressure on the sides, with not the slightest intent nor

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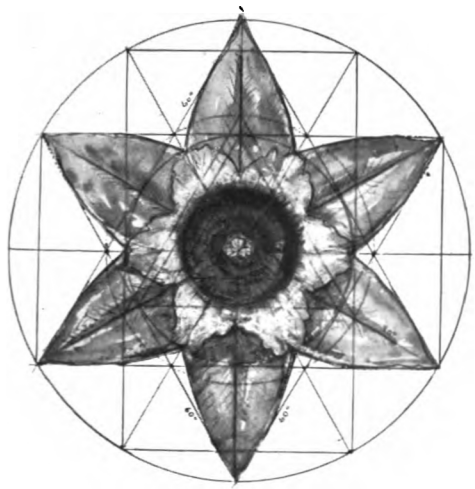

PLATE 29
JONQUIL

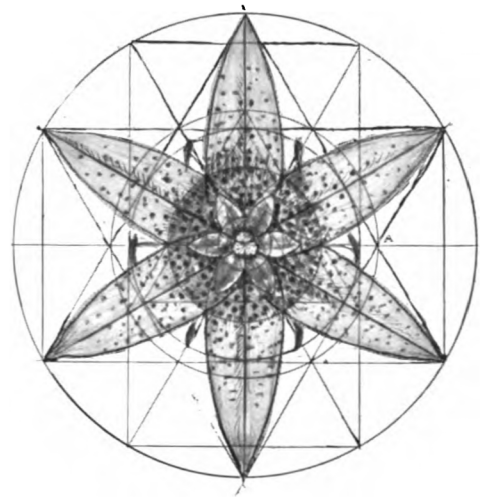

PLATE 30
TIGER LILY

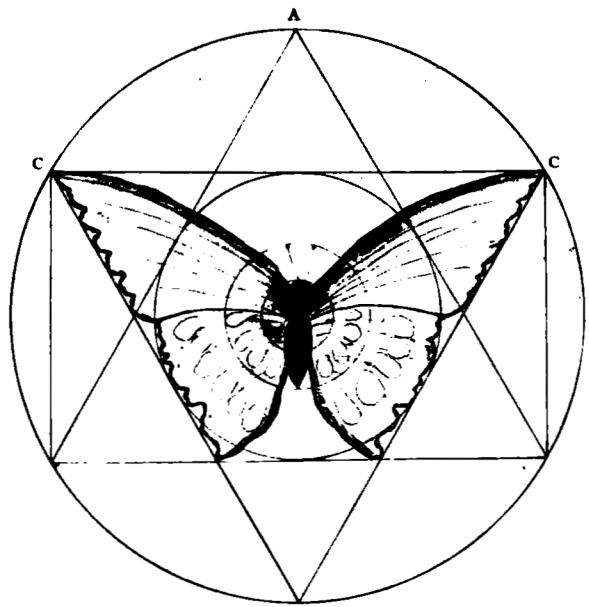

PLATE 31
BUTTERFLY AND THE TRIGON

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skill on the bee's part, but purely the effect of a mathematical law, that makes the hexagon." In these conclusions, as will be shown in the appendix, Mr. Bigelow has some supporters and many opponents; and for myself, while I am quite prepared to admit that from an

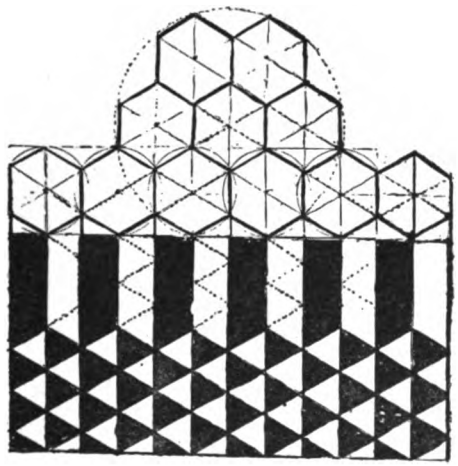

PLATE 32
WASP'S NEST

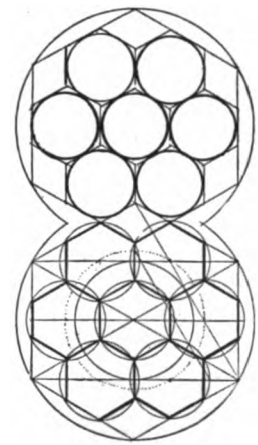

PLATE 33
HONEY COMB

architectural standpoint, it is highly likely that Mrs. Bee never thinks of her storehouse as a hexagon—or as a circle either for the matter of that; that she has neither ground plan nor elevation, blue print nor trowel, and that her "intentions" can only be guessed from the results produced; but if she can build circular cells and then change them into architecturally economic hexagons in the process of plunging back and forth to fill them, she is even a better economist

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than we had given her credit for. The result is one of the marvels of creation, and whether the bee or Mother Nature shall have the most of the credit is small matter. You can scarcely fail to read with interest, in view of this development, the account of the investigation made by the great Réaumur many years ago on the same subject.

"They have solved," says Réaumur, "a very difficult problem of geometry, for only a limited material or wax is at their disposal for the construction of their house, the rooms or cells of which must be of a determined capacity of the largest size, and with the strongest walls in proportion to the amount of matter to be employed. . . . The cylindrical form would seem to be the best adapted to the shape of the bee's body, but this would leave vacant or waste room between the contiguous cells; on the other hand, had the cells been square or triangular, they might have been constructed without so many unnecessary vacancies, still they would have required more material and then would not have fitted the body of the insect. . . . The six-sided form of the hexagon fulfils the problem in every particular; the base of each cell, instead of forming a plane, is composed of three diamond shaped pieces placed in such a manner as to produce a shallow pyramid, which structure imparts greater strength while giving a larger capacity with the smallest expenditure of time and material. The angles of these cells on the longest space measure 109° 28′ and

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on the smallest 70° and 32′." The angle as measured by Réaumur as nearly as might be in the bee's actual work varies only infinitesimally from the one which we are told produces the greatest strength for the least expenditure of materials in building, or perhaps, indeed, differs not at all. The above story of Réaumur has also been told in many versions, connecting it with the scientist Kŏnig and others. Réaumur, it is said, desiring to learn how exactly the work of the bee conformed to the requirements of abstract science, consulted the figures of Maraldi as to what the angles should be to give the greatest capacity for the least amount of comb and found, in answer, the figures 109° 26′ for the greater and 70° 34′ for the lesser. Puzzled by the slight difference between the actualities which had been observed and the theoretical perfection which the mathematical answer required, it is said that the academic question was later put to Kŏnig, upon whose reply, naturalists finally determined that the original figures and neither those of science nor the bee were at fault.[1] Whatever account of this episode be accepted, the fact remains that, somehow, the bee produces cell walls which comply in structural form with the last dictates of science, and it is wonderfully instructive to see how frequently it comes about that a bold statement to the effect that Nature is working at cross purposes or is less inspired than we thought

[1] For further details of this Nature-wonder and other hexagonal cell formations, *see* Appendix, Note XII.

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PLATE 34
JAPANESE IRIS
The Triangle (Korin)

her to have been, proves on investigation merely to be the means of disclosing carelessness in assembling evidence on the part of the critic himself.

The examination of the Tetragon Family in Nature cannot, perhaps, be brought to a focus more suitably than by the presenting of the four following illustrations, in the first of which (plate 34) we have an example of the orien-

PLATE 35
DANISH-CROSS POPPY
The Square

PLATE 36
ANEMONE CORONARIA
Hexagon

PLATE 37
SINGLE DAHLIA
Octagon

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tal iris after the drawings of the famous Japanese artist Ogata Korin, who saw this beautiful flower in all its obvious triangularity as long ago as 1675, when he led the art of Nippon and, disregarding the existing conventions, made for himself a name which has not yet faded, drawing those beautiful screen designs with which we are so familiar and which embody so many of these delightful blossoms. True to mythology, Iris bears a message from his day to our own.

In plate 35, a four-petalled Danish-Cross poppy, scarlet of bowl and silver-white of centre, presses its tetragonal significance not merely through the number of its petals but through its symbolic cross as well. Following this, in plate 36, are shown examples of the six-membered anemone coronaria, brilliant as red blood and renowned through the ages as being those lilies of the field of which we read that they toil not neither do they spin, yet that Solomon in all his glory was not arrayed like one of these.

Finally, in plate 37, we have the astonishingly regular and almost self-conventionalised blossoms of the single dahlia. Trained to assume many colours and many forms in many climes, yet in all its vicissitudes and wanderings and changes, we recognise one persistent characteristic in its determination always to be eight petalled when left to its own devices. Thus the dahlia, with its companions, round out the theme of floral symbols in which we see portrayed the equi-

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lateral triangle, the square, the hexagon, and the octagon, botanically typifying the chapter in its entirety, and fittingly concluding this portion of our subject.

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