

Nature to nurture¹

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The theoretical basis for, and description of, an introductory semester 1 first year design fundamentals studio.

Introduction

Spatial ordering systems in contemporary architecture and interior architecture based on any form of meaningful geometry are rare. The geometric ordering principles taken for granted in the great architecture of history are no longer understood, are ignored or derided as being stultifying and formulaic. That without exception these principles were based firmly on the numbers, patterns and geometries to be found in the natural world counts for very little. Our understanding of, and connection with, nature has deteriorated to such an extent that we are virtual foreigners in our land. That such a relationship between the great architecture of the past and its context was understood to be of fundamental importance, reflecting a healthy relationship between the building and the natural world, is of no importance in an age when the personal aesthetic sensitivities, predilections and tastes of the artist/designer, no matter how ill informed, are held to be the ultimate determinant of the configuration and nature of the built fabric. The gulf that has opened between humankind and the natural environment, so blindingly obvious in the ever-increasing environmental degradation wrought by human hands, cannot be argued to be unrelated to this ignorance.

We draw distinctions between the 'natural world' and our world as though they were in some way different, as though the world we inhabit is 'un-natural'. 'Nature' is seen as being 'out there', not 'here'. We act as though we are aliens in our world, unaware of or disinterested in the implications of our destructive impact on our world. As long as 'nature' remains 'other', we will go on seeing ourselves as somehow not a part of the ecosystems we inhabit, imagining that we will be able to escape the consequences of our destructive impact on this fragile planet. This is absurd of course. We are a part of this world having a common destiny with the plants, the animals, the earth and the air we see as 'other'.

We are makers and we modify our world by constantly making things. It is possible to be makers working in harmony with the world of which we are an integral part. We are not pre-destined to be in opposition to the 'natural' order, rather, our 'nature' (from the Latin, *natus* – 'born') and our 'natural' way of being is to be in harmony with it. Every great work of humankind bears testimony to this reality having not only a resonance with its place and time but with its total context, the 'natural' order of the world. If we are going to work in such a way we need to have some understanding of this order.

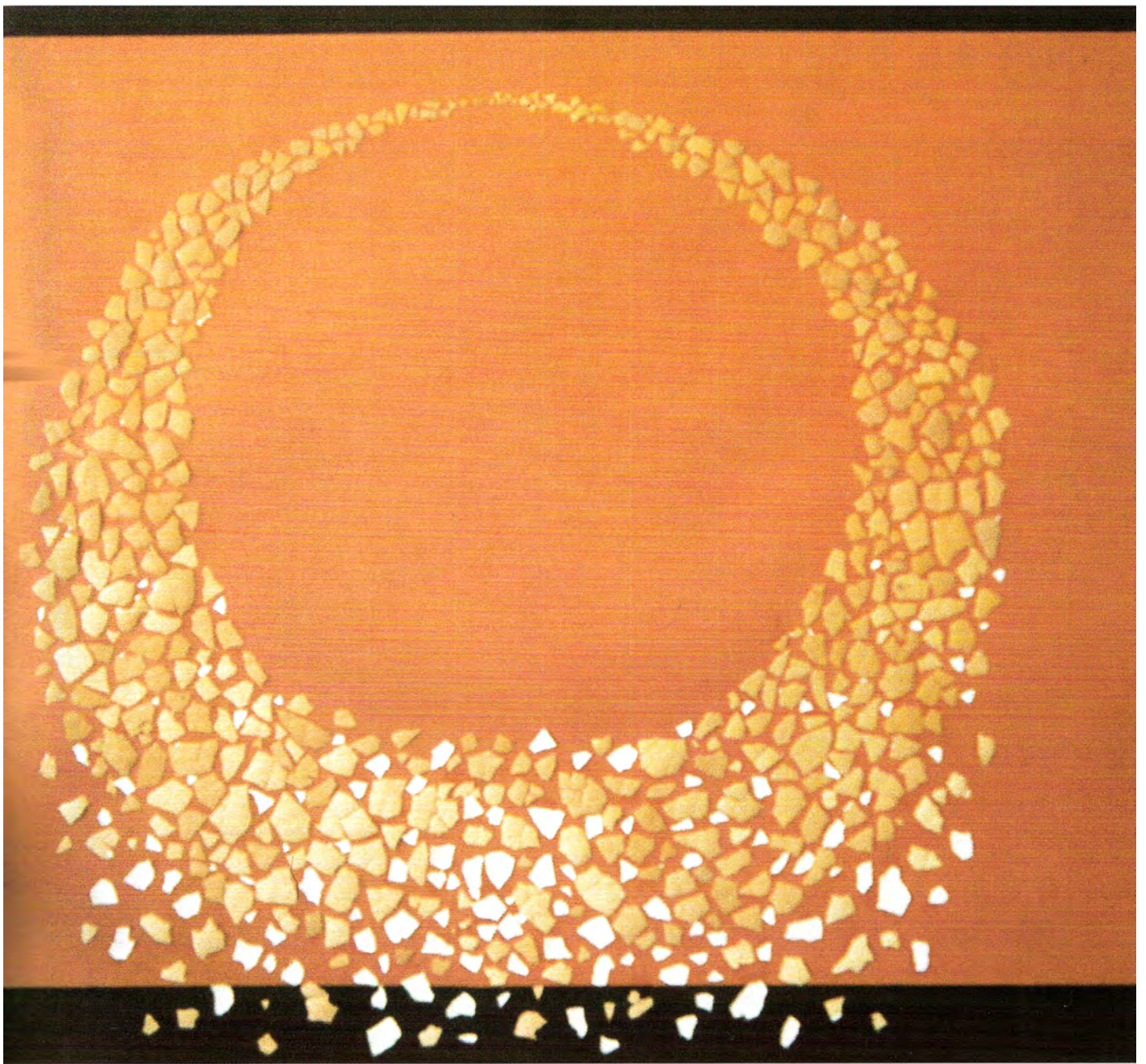
What follows is elaborated from notes given to first year students undertaking an introductory Design Fundamentals studio. The studio projects were based on these notes, on lecture material delivered at the time and on a series of related briefs written to provide opportunities to explore and test the potential of 'natural' ordering systems to inform spatial design.

Theoretical basis of studio

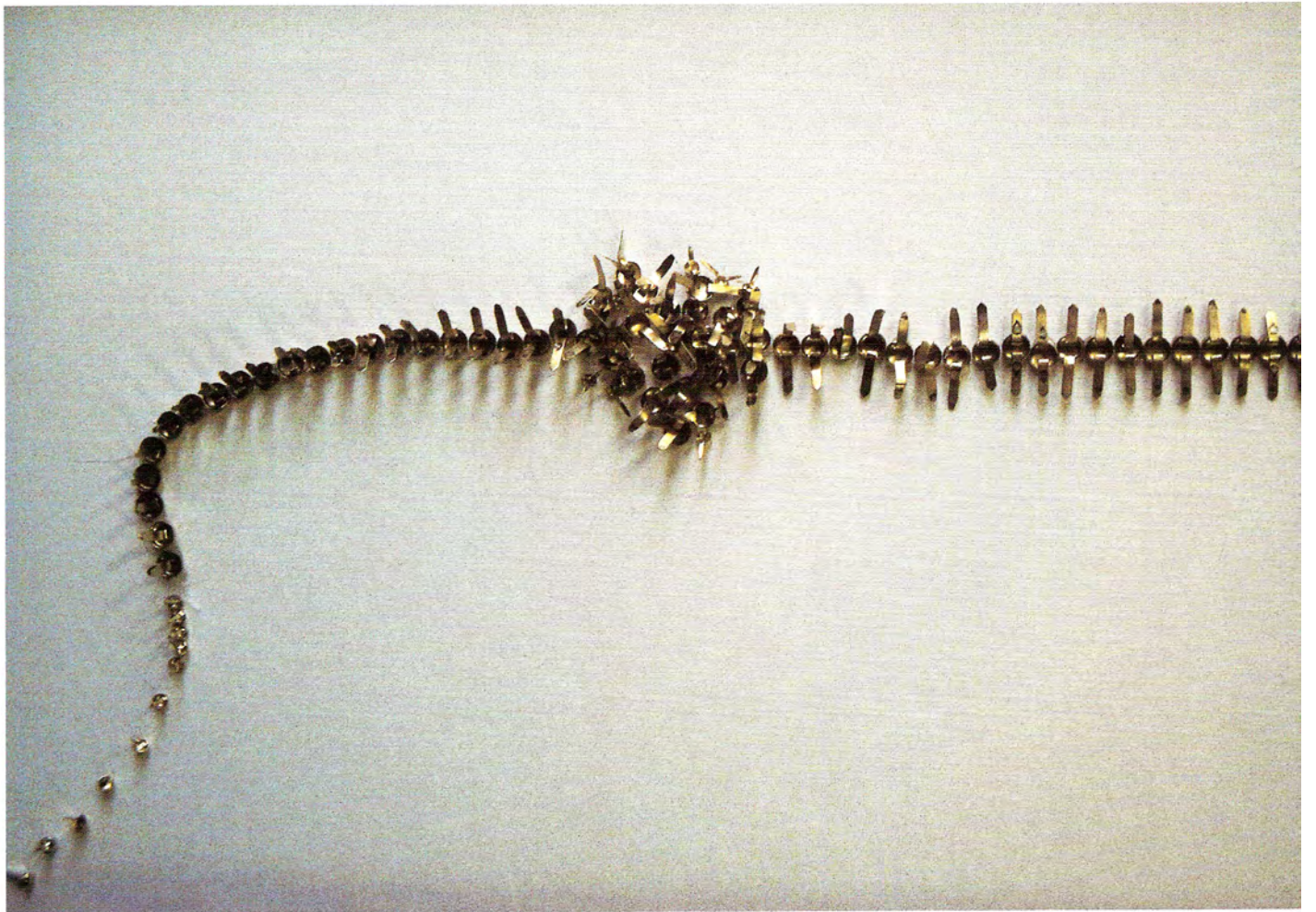
The order of space

Space is the sine qua non of architecture. Far from being the inert, amorphous, indefinitely extended, undifferentiated mere backdrop to our art that it seems too often to be understood to be, it is and always has been absolutely dependent upon a fundamental ordering system that may be approached by means of number, extension and direction – in short, by geometry. The quest for an understanding of the 'order of space' lies at the root of most investigations into the nature of the world we inhabit. From the explorations of the furthest reaches of the universe to the greatest depths of the sub-atomic world, we are only able to comprehend what we find by means of geometry. Indeed, at the forefront of the new physics, physicists are finding it far more informative to speak of existence as consisting of geometric arrangements or patterns of electromagnetic waves than to speak in any other terms. The 'order of space' ought to be of just as much importance to spatial designers as it is to the physicist – possibly even of more importance as the consequences of their actions will usually have a more immediate and possibly longer lasting impact on the lives and culture of those it serves.

The order underlying the natural world may be investigated in many ways, however it is particularly accessible in the 'regular' solids². Our spatial domain, this universe, allows for the existence of only five regular solids. This has been known for thousands of years³ by many cultures. Following Plato's exposition of their qualities⁴, the regular solids are sometimes called the 'Platonic solids'. Critchlow (1969) illustrated how space may be understood to 'unfold' in an orderly fashion from point, line and plane to produce these five solids, the tetrahedron, hexahedron, octahedron, icosahedron and dodecahedron and that they embody the numbers and geometrical relationships that nature employs in endless variation to 'create' our world. Any inquiry into the order of space that is concerned with the regular or Platonic solids is well placed to reveal the numbers, ratios and proportions to be found in the natural world. However, in Platonic thought, number, ratio and proportion are merely the tools employed by nature to configure or give shape to manifestation in accord with the formative principles, 'pure forms' or archetypes which may be more thoroughly comprehended through a study of Form.⁵



*Figure 1: 'Continuity and Alternation': 'Form' study by Eileen Carter using egg shell.
Photography: Author.*



*Figure 2: 'Continuity and Alternation': 'Form' study by Sally Rhys-Jones using paper fasteners.
Photography: Author.*

Form

Any well-designed entity will exhibit 'wholeness', a balance or a harmonious relationship of its parts within and to the whole. It will seek to 'hang together', to demonstrate an internal consistency. In fact any organism or entity that is in a healthy state (the word 'health' being related to wholeness through its Germanic origins) is seen to be well balanced, to exhibit a distinct harmony of constituent parts. Our greatest teacher in such matters is the natural world that always operates according to principles that may be approached through a study of the principles of Form.

The word Form is used here in a precise if somewhat unfamiliar way. It refers to the 'formative principles' of things, principles which lie beyond the physical world but which determine the configurations to be found in that world. We have introduced the concept of 'harmony' above. It is no accident that perhaps the most common usage of the word 'harmony' is in the art of music where, in the west, at least until the middle of the last century, it was seen as the primary means of unifying a composition. Far from being a simple thing to achieve and in truth itself being philosophically illusive of accurate definition, harmony nevertheless remains a principle we intuitively seek in art as in life.

Harmony implies a balanced relationship of parts. It is no friend of that which gives over-emphasis to one part, characteristic or quality of an entity at the expense of the others or of the whole. Whilst we recognise that 'unity' is a desirable principle in any entity, we just as quickly must affirm that unless it is in harmonious relationship with its antinomy, 'multiplicity', then it is in fact counter-productive as a harmonising principle. Any whole will have parts, every whole is a part of a greater whole and a moment's reflection will confirm for us that 'wholeness' involves the existence of both unity and multiplicity – the one and the many – at the same time, in balanced opposition.

'Unity' and 'multiplicity' may be seen as a primal duad whose contrapuntal relationship is as fundamental to our earthly existence as day and night, male and female, good and evil. They are antinomical qualities of Form. There are many other such antinomical qualities, indeed they are innumerable. Here we will mention just three more pairs – **continuity/alternation**, **authority/dependence** and **completeness/transformation**.

We have deliberately used the musical term 'contrapuntal' above. This refers to the musical concept of 'counterpoint' which derives from the expression punctus contra punctum, 'point against point' and refers to the ability of a musical composition to say two things at once. In the field of art and design we too are concerned with composition and these pairs

of antinomical qualities of Form exist in our compositions in a way not dissimilar from counterpoint in music. They may also be seen as contrapuntal in that they say two things at once about the composition of which they are qualities.

The terms are fairly self-explanatory. 'Continuity' refers to the fact that the entity under consideration is not disjointed, fractured or in pieces but that it is whole, that one can clearly see that it 'hangs together', that one can trace a continuous path through it so to speak. Its antinomy is 'alternation'. Note that we do not use the word 'discontinuity' for this implies a negation of 'continuity'. 'Alternation' on the other hand recognizes the rhythmic patterns of the parts within the whole. If you were to study a fractal pattern, say a Mandelbrot set, you would see a powerful 'continuity' throughout but at the same time wonderful 'alternation' with the many parts being variations on a continuous theme.

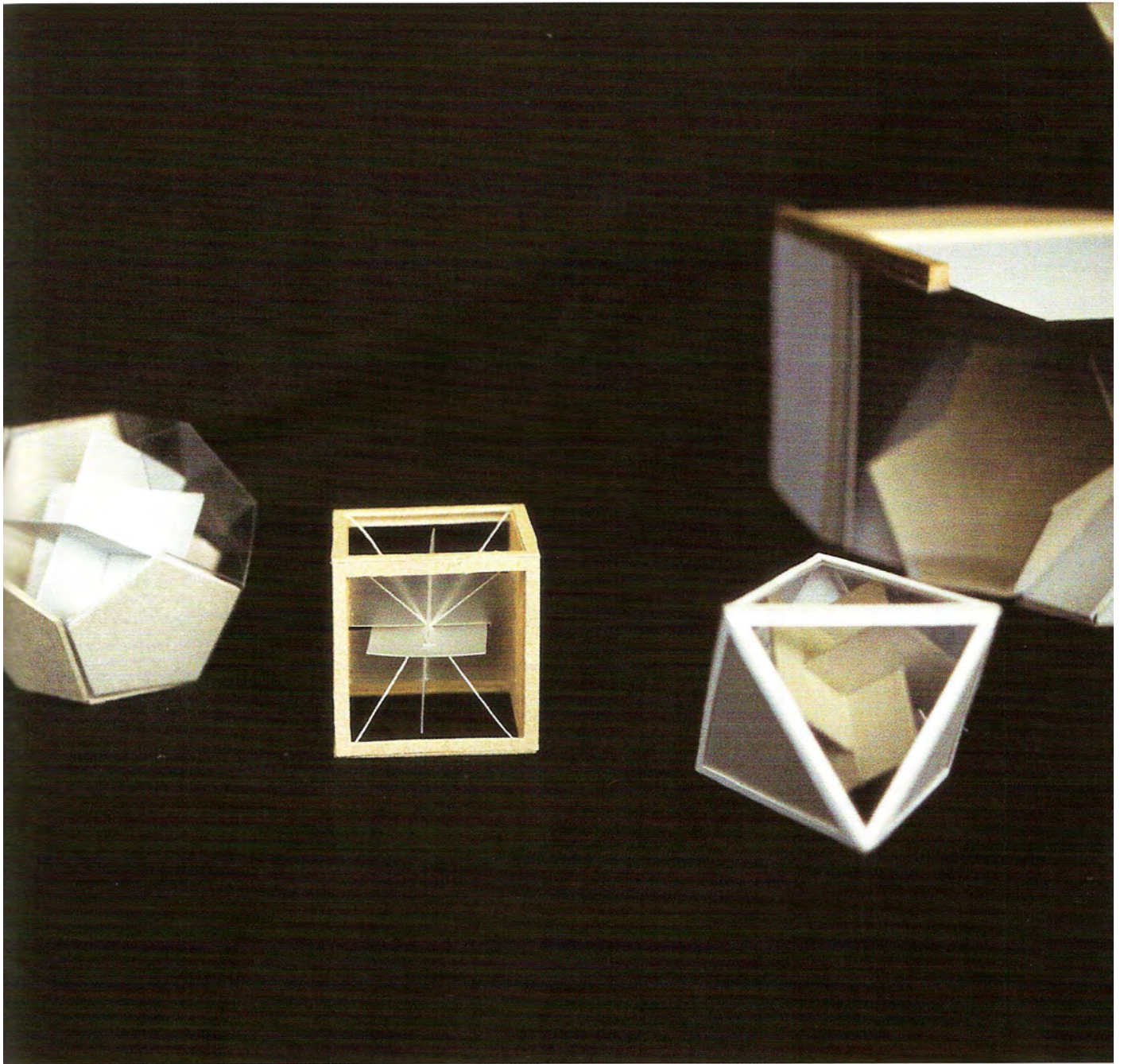
'Authority' refers to that quality of an entity that enables it to express its singularity, its uniqueness. But nothing in existence is without 'dependence' of some kind. The great pyramid of Cheops at Giza has fantastic 'authority' in the landscape but this authority is 'dependent' upon the many parts that have come together to make it, the physical, mental and spiritual context in which it was constructed.

'Completeness' refers to that state of an entity that suggests it is whole and not lacking in anything. 'Completeness' however, is not static. No healthy organism in nature ever reaches a state of absolute stasis. Rather everything is in a state of becoming, of becoming something else, of 'transforming' itself. But beautifully and mysteriously, at every stage of this 'transformation', the organism is 'complete'. Great works of art, architecture and music exhibit such qualities.

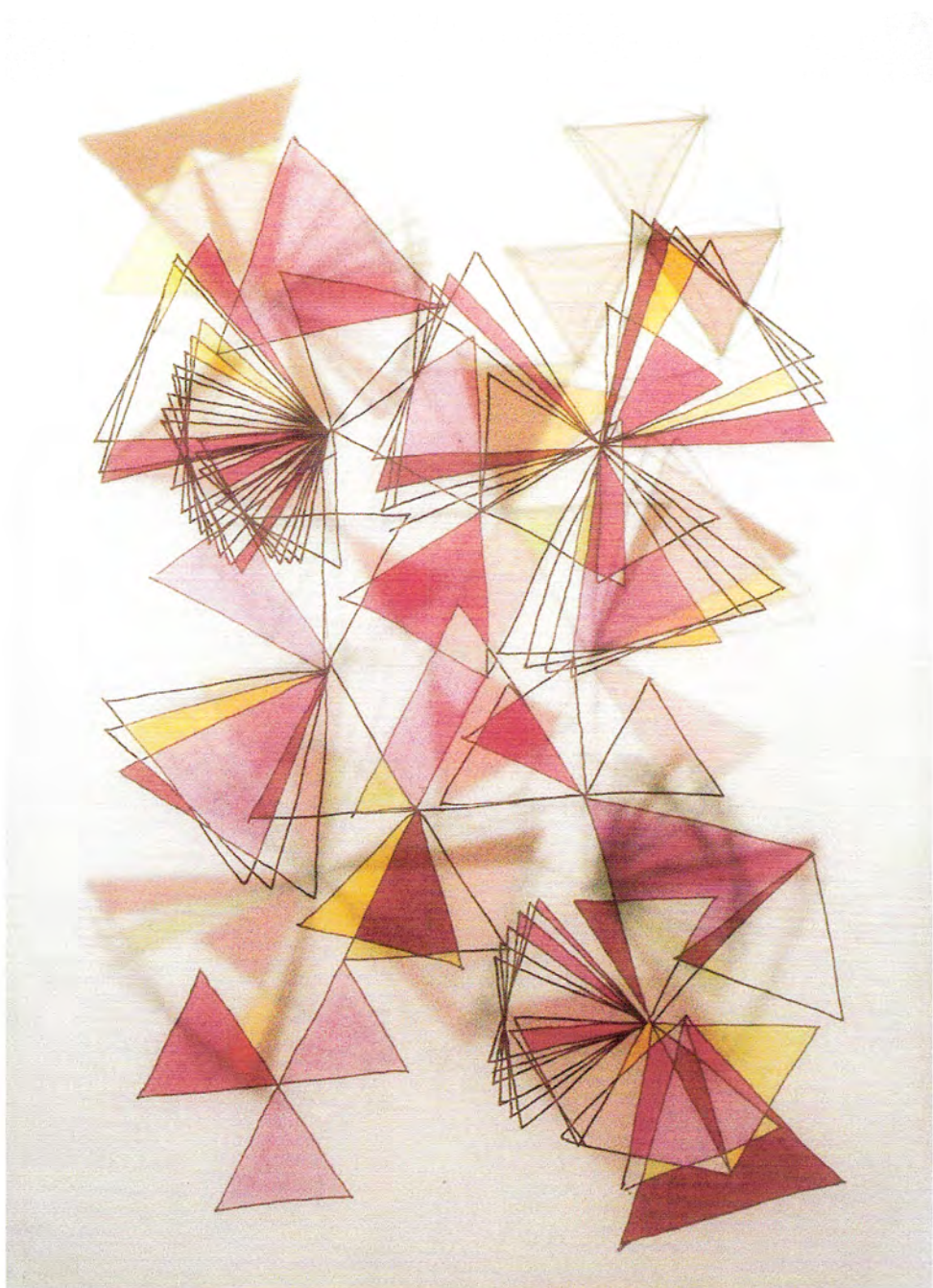
Pattern

The word 'pattern' has been considerably trivialized in general usage to the extent that it conjures up images of repetitive and mostly 'merely decorative' motifs, usually having little or no meaning. However it can and does have a far richer meaning for us as designers.

'Pattern, from the French "patron" and the Latin pater signifies a paternal, that is a "fatherly" principle operating, shaping, directing its "son", that is, its filiated image. This imagery acts not by translating exactly the characteristics of one thing to another, like a scribe may copy text, but acts as a principle of generation causing its image in another mode, alike, but in no way identical to itself.¹⁶ That is to say that the word carries ideas of the pattern being something that speaks more of the formative principle or essence of a thing rather than its appearance, its shape or configuration.



*Figure 3: Regular solids from case designed as an offering to Alvar Aalto by Minna Malen.
Photography: Lisa Coleman.*



*Figure 4: Pattern generated from study of flowering plant by Felicity Houghton.
Photography: Lisa Coleman.*

Every thing in existence is a unique entity with no other exactly like it. No two snowflakes, flowers or grains of sand will be identical just as no two people or animals will be identical. All things are unique variations on their theme or 'pattern'. Whilst two things may be similar and thereby reflect the principle of 'sameness', they will nevertheless be distinct and separate and reflect the principle of 'otherness' at the same time. I am the 'same' as you in that we are both human but I am 'other' than you in that I am me and not you! The shape or configuration of a thing is a consequence of that thing obeying the principles of its 'pattern' or pure Form.

Ratio and proportion

There are many ratios that are employed in the natural world. It is profoundly instructional for any spatial designer to explore them and the regular solids are a rich source from which to begin. A study of ratios however is not as potentially revealing or as fertile a source of inspiration as is an understanding of proportion. Ratio is at the basis of our very thinking in that we seek to use our rational mind to make the comparisons we need to make in order to negotiate our way through the world. Proportion is of a higher order consisting of a relationship of equivalency between two ratios. It represents a level of intelligence more subtle and profound than the direct response to a simple difference, which is ratio, and it was known in Greek thought as analogy.⁷ One of the most common proportions and at the same time one of the most profoundly important in the quest for 'wholeness' in our work has been historically referred to as the 'Golden Proportion'. It is of value to consider this unique proportion in a little detail here but with the obvious rider that whilst it has absolutely unique characteristics in the universe of proportional systems, it is but one.

The Golden Proportion is a unique relationship between two ratios that is to be found in countless examples throughout the natural world. The proportion is:

$$1: \frac{1+\sqrt{5}}{2}$$

The extraordinary quality that this proportion has is that when the number on the right hand side is squared the product is that number plus 1! That is:

$$\left(\frac{1+\sqrt{5}}{2}\right)^2 = 1 + \frac{1+\sqrt{5}}{2}$$

This unique proportion then has within itself one of the characteristics of all growing things, a congruence between the whole and the part. It is no wonder that it is to be found so often in the plant and animal kingdoms. The Greeks as well as many others from the ancient world right through to today have employed this proportion in their work for various reasons this

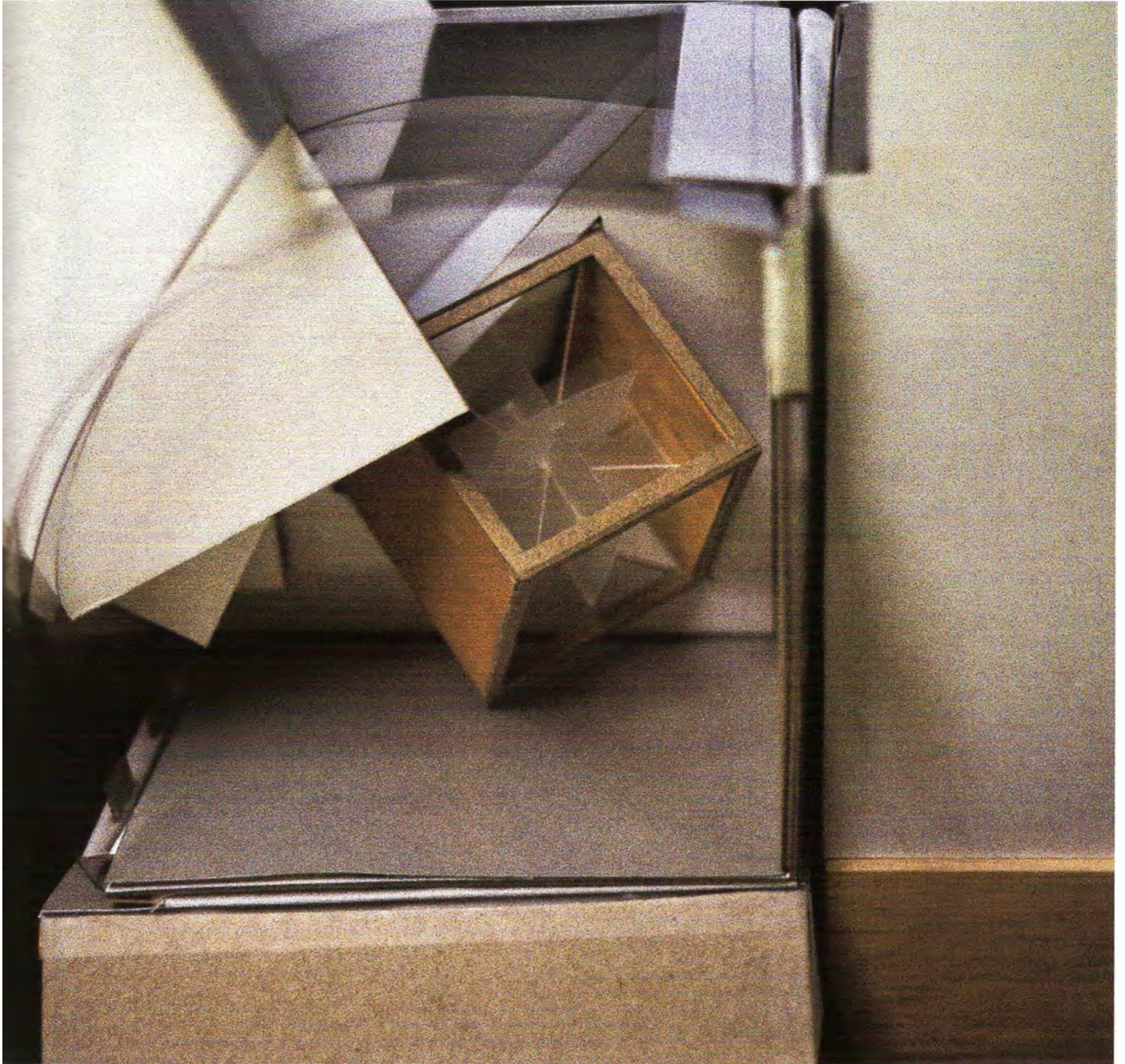
characteristic being possibly the major reason as it has the ability to give to the work a high degree of unity between whole and part, a fundamental aim of all good design.

It should be noted that the Golden Proportion is to be found in the common regular plane figure, the pentagon. The relationship of any diagonal of the pentagon with one of its sides is the Golden Proportion. This five-sided figure is often related to humankind in art and architecture and with good reason for it is to be found in our body parts (for instance the ratio between consecutive joints on the finger) and of course the number five is 'our' number in so far as we have five fingers and toes! There are many considerably more profound correspondences but these should suffice to illustrate the point.

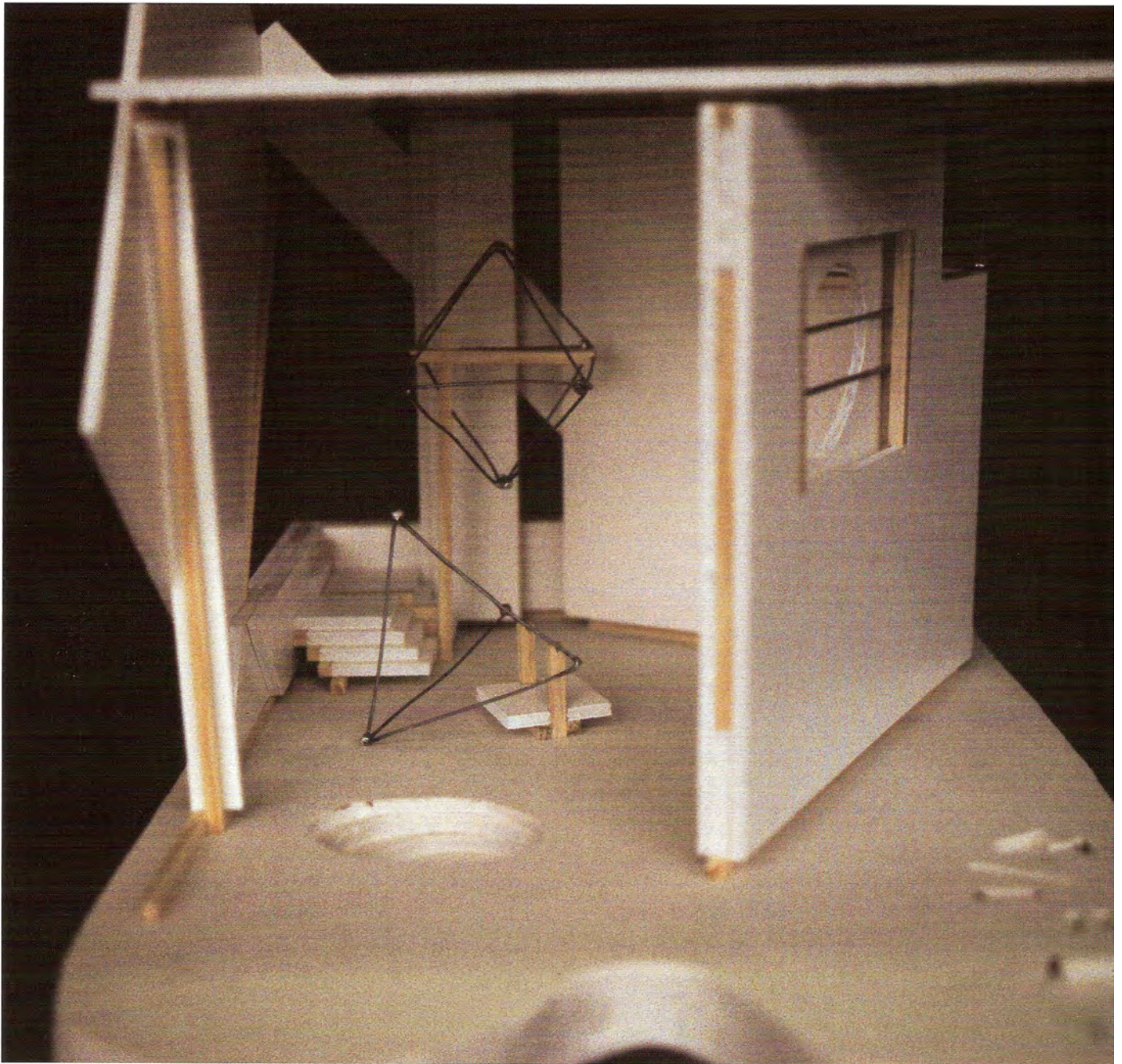
The studio

Beginning with a careful study of a flowering plant and concluding with the design and making of a 'geometrical offering to a designer', this introductory (foundation) studio attempted to illustrate the liberating creativity to be found in the study of natural spatial ordering systems. The following is a compilation of the essential aspects of the briefs issued in the studio. There were three significant projects carried out in the fourteen week, one-day-a-week studio. Each dealt with a different aspect of the overall theme of designing with natural ordering systems. There were five studio groups of approximately fifteen students in each group and each group worked with a different tutor. The studio day commenced each week with all attending a one-hour theoretical lecture dealing with the principles of design delivered by the course lecturer (author). For the rest of the day the groups worked with their five tutors in a common large studio space where interaction between the groups was encouraged and where from time to time the whole class could be assembled to participate in forum discussions, to critique the work in progress or to be given supplementary lectures.

The rhythm of the studio learning process may be seen to be a carefully controlled alternating series of experiences from careful, tight and rigorous observation and meticulous demanding work with precision tools, through to the use of more immediately expressive and bold media, all the while backed up by an ever-present and open educational framework of academic inquiry within a carefully prescribed context. The rhythm might be seen very crudely as 'tight-loose-tight-loose-tight' so that the students are paced through the process at a challenging but achievable rate.



*Figure 5: Regular solids from case – an offering to Alvar Aalto by Minna Malen.
Photography: Lisa Coleman.*



*Figure 6: Regular solids case for Carlo Scarpa by John Molloy.
Photography: Lisa Coleman.*

Project 1: Patterns from nature

Preamble

This project was intended as an opportunity for the students to make a small incursion into the order of a part of the 'natural' world that is readily accessible but which is not generally investigated in this way except by the specialist. They were asked to 'select a plant that you find attractive for some reason or other'. They were encouraged to look at plants having fairly obvious flowers and fruit (with a preference for dicotyledonous angiosperms as they have a generally more readily accessible geometry).

It was not suggested that this would be doing anything profoundly significant or that 'new discoveries' would be made about the subjects of the inquiry but the students were invited to look with the eyes of the 'engaged amateur' at a field of inquiry that has been a source of inspiration to designers in all cultures and times – order within the plant kingdom.

As the element of personal choice entered the equation at this moment, the students were invited to reflect on the nature of personal preferences and to consider the possible affinity or resonance between them and their chosen plant.

The 'order' of the plant

The task was then to systematically study the plant in whole and in part to reveal its order, its numbering system, and its geometry. Numbers of petals in the flower; number of stamen; the spacing of the leaves on the stem; the ratio between these spaces; the geometry of the fruit, internally and externally; any spiral growth evident; the ratio of the unfolding of any spiral growth etc.

The findings of this inquiry were illustrated in a series of annotated analytical drawings and photographs. (Development of skills in careful observation, drawing and presentation played a large part in the educational objectives and outcomes here).

This analysis was then used to produce a design response to the plant whereby the students were invited to make a graphic composition based on the pattern they found to be ordering the plant, the composition being a 're-presentation' of the essence of the plant; a variation on the same theme; an evocation of the plant in line, number, geometry and colour, not a re-presentation of the appearance of the plant but intelligently and discerningly using the numbers, the geometry and the colours of the plant as the 'building blocks' of the composition.

Project 2: Form

Every entity in existence may be seen to illustrate the 'antinomical qualities of Form' as discussed in the preamble above. This part of the studio work was intended to focus on this reality and to seek ways to give graphic expression to these qualities. The aim was to enable the students to appreciate that an understanding of these fundamental aspects of existence can imbue one's work with some of the most precious qualities of all – the same balance, wholeness and harmony we are able to observe in the 'natural' world. The observation was made for the students that 'if you were to study an animal, a plant, a shell, an eco-system or any other aspect of the natural world, you would see a powerful "*continuity*" throughout but at the same time wonderful "*alternation*" with the many parts being variations on a continuous theme. Great works of art, architecture and music have always embraced these notions accepting that the greatest teacher we have is the world around us' (from the authors' notes issued in class).

The task was approached firstly by asking that the students explore the potential of strong, bold charcoal, pastel or brush and ink linework to give expression to a theme selected from a short list supplied and to embody one pair of the antinomical qualities, *continuity/alternation*. The emphasis here was to 'release' the students from the rigour of the close and careful work undertaken in the first part of the studio, to enable them to explore in a more emotive way the expressive potential of the graphic field and strong media.

The bold composition was then required to be translated into another medium. Introduced with the following statement, this part of the studio project was gauged to be almost impossible for any student to do poorly as there is invariably a need at this stage of the session to bolster their self-confidence for the final task of the studio.

To produce a composition of many similar small components of a single class (seeds, match sticks, tooth picks, leaves, buttons etc.) that expresses the same theme you worked with above again making explicit the antinomical qualities of Form, continuity/alternation.

The resultant assemblages were remarkable for their variety and ingenuity.

Final (major) project

The final and major project for the studio was intended as a bringing together of all the essential aspects of the preceding coursework in a task that was introduced as 'to design and make a case for carrying and displaying three of the regular solids to be presented as a gift to a designer'. The stated aim was 'to explore the inexhaustible potential of the regular solids to inform significant and meaningful spatial design'.

The project commenced with research that culminated in the writing of an 800-1000 word illustrated essay exploring the 'use of number and/or geometry and/or pattern and/or other ordering devices that may have been used in the work of the designer'.

Each of the solids – tetrahedron, hexahedron, octahedron, icosahedron and dodecahedron – was then explored through accurate drawings and simple models. An in-house scholar of geometry (Alix Verge, tutor and author of one of the recommended texts) delivered a series of lectures on the inherent geometry of the regular solids at the beginning of this part of the project.

The task was then more closely defined as 'to design and make a case for carrying and displaying three of the regular solids. The case with its contained solids is to be designed as a gift, an offering to the chosen designer'. This was accompanied by a list of requirements designed to illicit a response that was: an intelligent encounter with the work of the chosen designer; a beautifully made object; a thoughtful composition based on an understanding of the inherent order within and between the selected regular solids; a fitting reference to the ordering systems found in the work of the chosen designer. The size of the object was limited such that it had to fit wholly within a 300mm cube. The solids were to be made from any material and both the solids and the case were required to be made with the utmost precision

Conclusion

The studio attempted to deal with a badly neglected issue of fundamental importance to designers in a manner that was accessible to the students at a range of levels. It was undertaken in a carefully paced manner that dealt with the material in a tightly controlled way providing however an extremely wide variety of experiences for the students in the process, developing fundamental writing, discussing, drawing, model making and presentation skills whilst at the same time encouraging the highest level of engagement with the theoretical basis for the work.

The results indicated that the general level of engagement with the issues was of a considerably high order given the relative youth and inexperience of the students. The material with which we were dealing is not new and indeed has been the basis of countless design studios in the past. Perhaps this is just one of the reasons it is rare to find rigorous investigations of this type being undertaken either in the universities or in practice. The particular approach taken here however was so carefully focused on the individual student and her/his engagement with the 'here and now' in the process that the perennial material came through as new, fresh and exciting.

It is to be hoped that the experience has left the students with a greater respect for the natural world than they had before and that in their future work they will seek a resonance with the total context within which they will be working.

For the author, the experience has been enlightening. Whilst I have spent many years trying to devise ways of engaging students with the kind of material presented here, until now I have never managed to maintain such a high level of focus by so many for so long on issues that are not easy to deal with but which are of such profound importance in an age when we are in quite desperate need of finding ways to live in harmony with ourselves and our endangered planet.

End notes

- ¹ The title of this paper is intended as a play on the notion that 'nature' may 'nurture' us and vice versa if we understand and respect our fundamental connectedness with our natural environment, a connectedness that may be expressed in number and geometry – and of course on the eternal clichéd question, how much is one formed by 'nature or nurture'.
- ² A 'regular solid' consists of edges that are all of the same dimension and faces that are identical plane figures.
- ³ Keith Critchlow (1979) has argued quite convincingly that they were known to the people living in the north of England at least three thousand years ago. He bases his argument on the existence of precisely carved small stone versions of the solids held in the Ashmolean Museum in Oxford that date from Neolithic times.
- ⁴ Plato *Timaeus and Critias* (53–58).
- ⁵ For a full and most scholarly account of Form see the monograph *Form* by L.P. Kollar, pub. by the author, Sydney, 1983.
- ⁶ Kollar (1987) p. 2
- ⁷ Lawlor (1982) p. 44

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