Richard Padovan

Proportion: Science, Philosophy, Architecture

(London: E & F N Spon (USA and Canada: Routledge) 1999).

Reviewed by John Sharp

Is it possible to get Proportion in Proportion?

Richard Padovan's book *Proportion* has the subtitle, "Science, Philosophy, Architecture". I did not realise this was the case when I first heard of the book and was looking forward to finding some new directions and ideas to develop, and some answers. Expectation is always a problem when someone else writes a book on a topic you are passionate about in a different way than you would approach it. As I got into the book I was struggling to find my way in a strange environment which I found to be philosophy. I can philosophise like everyone else, but I am essentially a pragmatic geometer. So as I began reading I wondered would I find something of benefit? Since I soon realised I was more in the realm of philosophy than science or architecture, I also wondered if I would find the answer to the question that I would expect a philosopher who is an architect to ask: "Is there really any connection with architecture and proportion or is it all done by intuition anyway, and does it really have a place?" I am perhaps being philosophical in asking what is the purpose of such a book. It is a book that does not seem on the face of it to raise controversy, but from my point of view it does.

Padovan's book has a range of titles for chapters (16 in all covering nearly four hundred pages) that are roughly as expected. They appear to fall broadly into three groups as follows:

- The titles in the first half, which range from "Unit and Multiplier", though "The proportions of the Parthenon" to "Euclid: the golden section and the five regular solids," show a firm historical background in perhaps mathematical theory.
- The middle portion covering "Vitruvius", "Gothic Proportions" through to "The golden section and the golden module" with the additional help that the subtitles to each section within the chapters, cover practicalities from the Romans to Le Corbusier.

- The final chapter "The house as frame for living and a discipline for thought" with subtitles to sections dealing with "The search for a starting point" and "What system of proportion do we need?" seem to be reaching a conclusion and asking pertinent questions, if not answering them.

The table of contents is followed by three pages showing the list of approximately 150 figures. This is perhaps slightly less than might be expected and on flicking through the book it is apparent that there are fewer than ought to be there, since many are quite basic or tables of numbers. A book on proportion cries out for communication in visual terms more than words; and so to me it seems that the proportion of the two is wrong, but then this is a book about philosophy as much as about proportion and there are many other themes which permeate the work as well. For example, there is one which Padovan calls "empathy and abstraction"; then there is the cosmological links to architecture and also his championing of the Hans Van der Laan and his plastic number. These and other minor ones are threaded through the text, surfacing obviously or poking their head above the surface when least expected. However, it is not always easy to manoeuvre through the book to follow these threads (if, for example, you have a particular interest in them) without reading through the whole text, since they are so tightly bound in; for example, the word cosmology does not appear in the index. I have to confess at this stage that it has taken me a year to read this book. This was partly because of the braiding of the multiple themes, but also because I found I had to concentrate to work through the mathematics for the following reasons.

My interest in proportion is in the geometry and how and why it is used in architecture. I am also more pragmatic than philosophical, so the latter approach has made the book harder to read. I was also put off by the first paragraph, in the preface, which I think is worth quoting since it may explain why I found reading the book such a challenge:

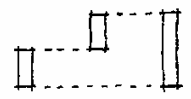
> *In my schooldays, mathematics was for me a nightmare. What made this worse was that from an early age I wanted to be an architect, and my elders warned me that mathematics was essential for architecture. It seemed that my inveterate inability to get a sum right would forever bar me from my chosen profession* [Padovan 1999: xi].

He also found out that his fellows, when he did become an architecture student, were no better at mathematics than he was. Padovan goes on to say that he had to discover for himself that numbers and geometrical constructions are beautiful in themselves. I will return to this topic later. However, I think it explains why I believe this book could have been written two hundred years ago, apart from the work of two architects that stand out. Le Corbusier and Hans van der Laan feature in recent history and obviously could not have been written about then since they were not born, but in principle, the impression is one that either mathematics is not required or architects are still dwelling in the past. This is not the case, as seen by some of the papers in the Nexus books and the *NNJ*. I would be interested to know how much of this view of the world is prevalent in

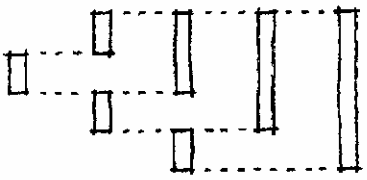
general. Unfortunately, it is not just this sense of the past that comes over, but that proportion is a Western exclusive privilege.

Numbers and Geometry

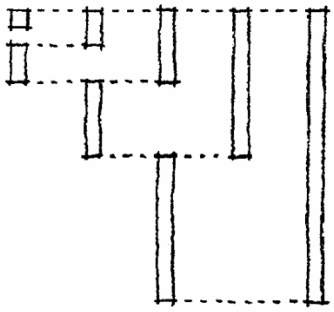
After establishing the philosophical sense of direction, the book moves into a chapter on "Unit and multiplier" and the question of whether geometry or number is at the heart of proportion. It is obvious that Padovan prefers number, and when number does not suffice, algebra. There is a beautiful example of this in the last chapter when he says "Van der Laan himself rejects algebraic expression, on the grounds that the architectonic reality of buildings and spaces consist of measurable quantities, and even of tangible units like bricks" [Padovan 1999, 367]; but then he goes on to summarise the rules of the plastic number, and he is forced to do so in algebra. This raises the question about the meaning of "measurable quantities"; proportion is the key to this, since the measure of the proportion is as important as an absolute measure. This idea of relative measure does not come across strongly. Maybe an architect has to think in units, of bricks and lengths of wood, and this clouds the issue.



The beginning of counting, 1+2



Arithmetic progression



Geometric progression

Padovan's focus on number, as a convenient unit, also seems to limit the extent to which three dimensional and geometric proportions are considered in the work. In working through the mathematics behind proportion, just as the Golden Section is reduced to the Fibonacci numbers, he reduces all other proportions to series and tables of numbers. I can sympathise with this, because one has to know and understand to get this far, but many people are more at home with the geometry, because they can feel and see it and relate to it with their bodies. The relationship between number and space is further complicated by representation. This can be illustrated by the figures which are meant to convey the notion of arithmetic and geometric progression, preceded here by the notion of counting.

Where is the multiplication in these figures? It is there, but it takes time to decode. Now an arithmetic progression is addition, and a geometric one is multiplication and, yes, multiplication is a sophisticated form of addition, but to push the visual explanation

of a geometric progression back to arithmetic is a step backwards from two dimensions to one. Arithmetic is one dimensional: addition on a line. Multiplication is two dimensional; concerned with area. You cannot deal with proportion in the spaces we live in if you reduce it to cardinal numbers, because that implies one dimension.

There is an issue which has not been addressed, even though I believe Van der Laan understood it. We do not have an equivalent to continue the series arithmetic = 1, multiplication = 2. What = 3 relates to volume? The reason there is none is because we live in a space of three dimensions and not outside it, but more than that, the geometric tools used were still two dimensional (and of degree two also) until very recently: the ones of the ancient Greeks. This meant that they were not able to duplicate the cube in the famous Delian problem. They did have other tools, but because the use of these tools was restricted, they effectively limited their use by architects. We do have the tools to construct in three dimensions, namely CAD programs in the computer. How soon will the 20 years or so we have had them allow us to break away from the 2000 years of ruler and compasses? More importantly, what was the special genius of architects like Palladio and Vitruvius which allowed them to build in space? I am not convinced it was number.

Right from the preface Padovan points out one of his themes (for which he borrows the terminology of Wilhelm Worringer) that he calls the quarrel between "empathy" and "abstraction". Padovan defines empathy as that "being ourselves part of nature, we have a natural affinity with it and an innate ability to know and understand it". Abstraction, on the other hand is "the contrary tendency to regard nature as elusive and perhaps ultimately unfathomable, and science and art as abstractions, artificial constructions that we hold up against nature in order in some sense to grasp it and command it."

One potential problem with Padovan's "empathy and abstraction" is that to discuss them in terms of proportion, however much he may support his argument, is fraught with problems. I believe we impose conceptual ideas (namely mathematics) on the world because it is easy to do and because they are a language which enables us to speak to our fellow human beings. It is surprisingly easier to understand something if it is symmetrical and ordered. Now nature may use symmetry, but it may be that we see it as a form of simplification and not see the full picture. In trying to piece together the world in our consciousness our brains do fantastic "computations" and rely both on past experience and guesswork about which we are not aware. I believe good architects are intuitive because they use this sense and compromise with abstract explanations (rather than abstraction) afterwards both to physically create and to communicate the ideas to others. For example, Le Corbusier is said to have drawn up plans and then superimposed Modulor measurements on them [Evans 1995]. Secondly, the Greeks knew about perceptual illusions and made columns taper towards the top in order that their buildings look "correct". So to talk about the proportions of a Greek temple is either over simplifying or massaging the data. Now there is a difference between the intuition example of Le Corbusier and Padovan's empathy. Padovan describes Le Corbusier's system, but not his method. Is he trapped by empathy? I find it difficult to have faith in any discussion of the "proportions" of the Parthenon in his description taken in

isolation. It is like our struggling to make sense of the world through science and art and a pointless "abstraction". What is important is to find evidence from working papers because that is the only way we can know method and intent. All the diagrams in the book are redrawn as far as I can tell since they are all in the same style. Having been trained as a scientist, this leads me to be deeply suspicious on two counts. I know for the most part there is no documentary evidence available, and if there is, it is very easy to adjust the data to meet the point you are trying to make.

The problem with trying to come to terms with the problem of empathy (simplified in Padovan's words as projection into nature) and abstraction (projection from nature) is that it is too black and white, too simplistic. We are complex animals and behave in ways we do not understand, as our perception of the world changes in fractions of a second. Moreover, we often do not have to think, because some things are hard wired in our biology, physics and chemistry, and not just in our genes.

The Historical Section

This section is quite detailed, and contains the major landmarks, Vitruvius, Palladio, Gothic Cathedrals, Alberti, Serlio and so on with much more. I am sure many readers will find this the most useful part of the book in many ways because it is quite a comprehensive collection and distillation. It is perhaps the least philosophical part, but it does work from Aristotle both as an initial inspiration and as a point of return when the history has been put into perspective.

The historical aspects and the links to cosmology seem well covered in perhaps a fairly standard way. I would praise the scholarly and not the "sacred geometry" point of view, but I am hesitant to be too drawn to this. Surprisingly, there is no mention of decoration in this book until a brief note towards the end in a comparison of Ruskin's Victorian ideas of decoration, contrasted with Le Corbusier's. Padovan infers that Ruskin's decoration is vulgar ("a sort of tattooing or make up applied to the surface of the building"), but I am not sure what to make of Le Corbusier's approach of "a mask covering it up". This is a great omission since decoration plays a great part in some types of architecture and defines proportion in other ways than he considers; one only has to think of Greek columns to start the flow.

Padovan's philosophical approach is an armchair one, though, as I said above, I veer towards the pragmatic end of the spectrum. I think that the question of *why* something might be done is not as important as *how*, because if you try to do something it is often more apparent why it was done that way. For example, I do not think that the masons building the Gothic Cathedrals were trying to play at being God. They took the geometry they knew and worked with it and because they did that, it came together: their intuition guided them, not any logic or mysticism. That was superimposed later. If you are familiar with quite a small amount of geometry, it is surprising what you can do. I also think that synthesis in these matters works better than analysis. The problem is that to start to understand a Gothic Cathedral one really does need to build it, but we can't do it because we are too sophisticated; we have lost the innocence required.

Although the book has the sub-title "Science Philosophy Architecture", I can find no science in it. There is quite a bit of mathematics, but mathematics is not an applied science. Mathematics starts from a set of premises, or axioms, and deduces something from there. Philosophically, there is also the question as to whether mathematics is discovered or is the invention of the human mind. I do not recall this being discussed in what is a very philosophical book. But it is vital to any discussion on proportion.

Moreover, the science of proportion is also vitally important. It is no good building a model of paper and then scaling it up in stone without knowing that the science and engineering properties of the materials. Without this knowledge, disaster can strike. Buildings have fallen down before the practical science was understood.

This brings us back to the practical understanding, and as an example I will take the very simple one of Roriczer's *Geometria Deutsch* (ca. 1486), which displayed the secrets of the masons and which Dürer used in his books. Padovan discusses the method for construction of a pentagon which is famously in Roriczer's book (and copied by Dürer). He notes it is an approximate method, which it is, although quite accurate. He seems to think that Roriczer and the masons would have used Euclid's method. What he fails to realise is the practical difficulties in which the two methods differ. Roriczer's method is a so-called "rusty compass" construction. Once you have set the side of the pentagon, the compass setting does not have to be altered. This is of tremendous importance in practice. Euclid's method is not simpler when you take practicality into account.

This practical aspect is important in other ways. Padovan mainly discusses systems which are Euclidean, that is constructible with the ruler and compasses and which can only lead to quadratic equations and not cubic or higher. This means that certain regular polygons such as heptagons and enneagons (9 sides) cannot be constructed with these tools, although there are quite accurate approximate methods, and the Greeks, particularly Archimedes, had ways of using other tools for accurate construction. When such items are seen by pure mathematicians they will puzzle over how "it cannot be done, but they did it" [Hancox 1997]. But we must be aware of the practical aspects, what was done rather than what is theoretically possible following a mathematically logical deduction. There is also a strong case for ignoring this artificial barrier and using modern tools like CAD programs to explore new proportions that were not easily possible in the past. (Peter Steinbach has done much to open up the properties of systems other than the Golden Section and their relationship to the geometry of polygons. See [Steinbach 1997].)

The Plastic Number and Conclusions

I first came across Padovan, Hans Van der Laan and the Plastic Number after reading Ian Stewart's column in the *Scientific American*, which was a successor to Martin Gardner's one [Stewart 1996]. I tried to gain some insight from Padovan's earlier book on Van der Laan's work [Padovan 1994]. Van der Laan found that he could not make the Golden Section work in three dimensions and worked from first principles on the mathematics to achieve the effect he wanted.

Padovan says that Van der Laan takes great pains to stress that there is no mysticism associated with the plastic number, but even so Padovan seems to be promoting it and Van der Laan as the successor to Le Corbusier and the Modulor. He makes the pertinent point that despite the "success" of the Modulor, it did not take off as an idea. We know it was just one aspect of the Golden Section movement which began with Fechner and perhaps reached its peak through Jay Hambidge. Surprisingly, I found no mention of the practical use Van der Laan made of the plastic number. Padovan goes through Van der Laan's pebble sorting hypothesis which smacks of Fechner and his Golden Section experiments. That is not to say I do not believe it has potential, I am more afraid of harm being done before it has been weaned properly. I would also say at this point that when I did look at Padovan's book on Van der Laan's work, small though it is in practice, I was not immediately drawn to the photographic results. I believe I would have a different view were I to see the buildings, but books are a poor way to experience architecture.

The title of the final chapter is, "The house as frame for living and a discipline for thought". However, far from being a comforting conclusion, Padovan's conclusions are slightly disconcerting. For example, he asks the question, "What system of proportion do we need?" Padovan keeps echoing that the whole must have a relation to the parts as if he is trying to convince himself. To me this is part of the definition of proportion, something which he brought out time and time again. It is also fundamental to the concept of fractals. Now this may just be the current fashion in geometry, but it can describe the geometry of a cloud or mountain and a plant in a way that the ancient geometry never will be able to get near. Perhaps he should be asking a different question: "What can different proportions do for me?" There is not one proportion, but each proportion has a use and a purpose. This would at least get away from the way of looking at the past as the golden age we cannot hope to reach again; it is like the summers of one's youth always being idyllic. If Vitruvius was a great architect, he is long dead; we are living 2000 years after his death and times have changed.

The architect Richard Rogers said recently that "the fear of beauty is destroying our urban environment" [Rogers 2001]. This was in reply to another piece by Sir Stuart Lipton, the chairman of the Commission for Architecture and the Built Environment, with a remit to improve the low standard of British Architecture. He had said that the improvements he was trying to seek "are not at the bottom about aesthetics". Richard Rogers replies that aesthetics is precisely what architecture is about. He berates British Architects for the acres of concrete blocks and glass boxes because they are building for "the quickest budget in the quickest time". Of course he blames the politicians, but my worry is that Richard Padovan may be typical of teachers our architects in the way he cannot reach a conclusion and give a lead after such an in depth study. If so, then we are in for a rough ride in the future.

Where Do We Go From Here?

It is becoming harder for anyone to be able to encompass more than a fraction of the knowledge in one's own discipline, never mind to go across many. There is definitely a place for philosophy and the study of aesthetics but I believe there is a requirement for

the specialists of architecture and mathematics to be talking to one another, and there needs to be such multidisciplinary modules in courses for architects. So I would like to return to Richard Padovan's quote at the beginning of the book, where he said he was bad at mathematics, and was not taught about the beauty in geometry and number. If he had been able to call on such help earlier rather than have to struggle, I feel he would have been able to get to grips with it much more, and we could have had some answers. The appreciation of aesthetics in science and mathematics, not just art, belongs in school.

The architect Jonathan Hale's book, *The Old Way of Seeing*, asks why someone hasn't written a complete survey of systems of proportion so that designers would have a definitive palette to work from. I hoped that Richard Padovan might have done this. Unfortunately, I do not feel that it even helps in this respect: philosophy is no substitute for action. P.H. Scholfield's *The Theory of Proportion in Architecture* is dated and so is Lionel March and Philip Steadman's *The Geometry of the Environment*, but both tackle the subject head on. Instead, Padovan has written a book of philosophising about proportion instead of creating a philosophy and understanding of proportion and architecture. He concludes with two quotes which at first appear to say the same thing but which illuminate this difference.

His last quote is from Hans Van der Laan and why he became an architect. Van der Laan tells a story about his first arithmetic meeting where the teacher put an apple on his desk then added more until there were five. The teacher then divided them into two groups of two and three apples and "we were supposed to conclude that these together made five apples. But in order then to teach us that these 2 + 3 = 5, even without any apples, the apples were sliced up and divided among the boys… But all my life I have been unwilling to forget those apples, and that is why I a became an architect and not a mathematician." I am not sure of the precise point Van der Laan was making, nor Padovan in ending the book that way. Was he saying that the mathematics was taught badly, or that there is a mystery which can't be solved by mathematics, or that he needed to get to the root of understanding another way or to be creative through architecture? Have I missed the point of the book, or perhaps it is a philosopher's tease?

I can counter it with another, by a quote from David Hilbert, one of the giants of mathematics at the turn of the twentieth century, who wrote a famous book called "Mathematics and the Imagination" with S Cohn-Vossen. He was in a group where someone said a mathematician they knew had become a novelist and there were exclamations of surprise as to how such a thing could happen. Hilbert said it was easy - the man lacked sufficient imagination to be a mathematician but had enough to be a novelist.

Padovan's penultimate quote is much more direct and is one of Le Corbusier saying that man becomes an abstraction when he closes his eyes, but that if he builds, it is with his eyes open and that architecture is judged by "what eyes see, by the head that turns and the legs that walk". Will someone write a book about proportion that does this by opening our eyes, moving our heads and taking us on a walk?

Richard Padovan has been brave to tackle such a subject and has made a balanced result in bringing a vast amount of detail together in one volume, and on that score alone it is worth having on your bookshelf. I don't think it is the last word on proportion by any means, since the questions that are not asked and those not answered leave much in the way of inspiration. But does it help me make sense of the role of proportion in the world? I don't think it does. I can't quite place what is missing, but it might just be that I have experienced the beauty of numbers and geometry which I would have liked to have been enriched by the experience of an architect. I need the walk that Le Corbusier recommends in the three dimensional world of architecture. I don't think a book can satisfy that need. It needs the dynamics of a video if the real life walk cannot be made. But it is a start that leaves me wanting that walk.

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About the reviewer

John Sharp has researched and taught Geometry and Art for over 20 years in Adult Education in and around London. He is the illustrator of David Wells' *Penguin Dictionary of Curious and Interesting Geometry* and has written his own book on modelling geometrical surfaces called *Sliceforms*, some of which are in the "Strange Surfaces" exhibit in the Science Museum in London.