The Pentature of Gerard Caris

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The birth of the pentagon

From 1970 the work of Gerard Caris has been dominated by the regular pentagon. In that year, Caris produced a silk-screen print which shows a kind of lightning bolt which leaves behind a scorch mark in the form of a pentagon (figure 1). He named this work *The birth of the Pentagon*. His mission was born there and then. The pentagon, which apparently arose as a *creatio ex nihilo*, became the theme of his artistic drive. The work of Gerard Caris thus finds its place in the long tradition of Dutch artists who, in the course of their creational process, have based themselves upon fundamental geometric forms in one way or another. With the regular pentagon as *Leitmotiv* for his creations, Caris takes up a special position within this tradition. In the company of the *perfect* circle, the triangle and the square, the pentagon is the odd man out. It is a *difficult* figure, as one will notice the moment one tries to draw a regular pentagon roughly by hand. In the case of a regular triangle or square this will not pose any serious problems, but it will turn out to be a lot more difficult to draw a regular pentagon without special aids. Besides, it will appear impossible to fill a plane with regular pentagons alone, whereas with regular triangles, squares or hexagons this is easy to do.

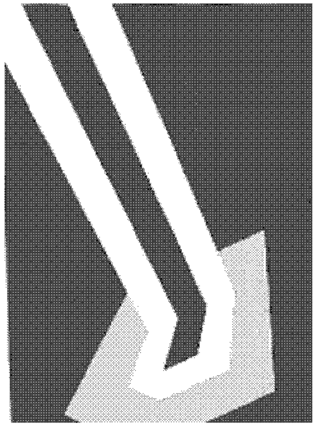


Figure 1. G.Caris, The birth of the pentagon (1970)

In the course of time, the dodecahedron, the regular polyhedron built up out of twelve pentagons, became a second subject of Caris' research. This, too, is a difficult figure, which does not comply with the laws of regular space filling and crystallography. The dodecahedron is one of the five Platonic bodies (regular polyhedrons, cf. figure 2). This structure takes up a special position among the regular polyhedrons. The four other Platonic bodies are all constructed from triangles or squares and were associated with the four elements in antiquity: fire, air, water and earth. Contrary to this, and going back to times immemorial, the dodecahedron symbolizes the cosmos as a whole.

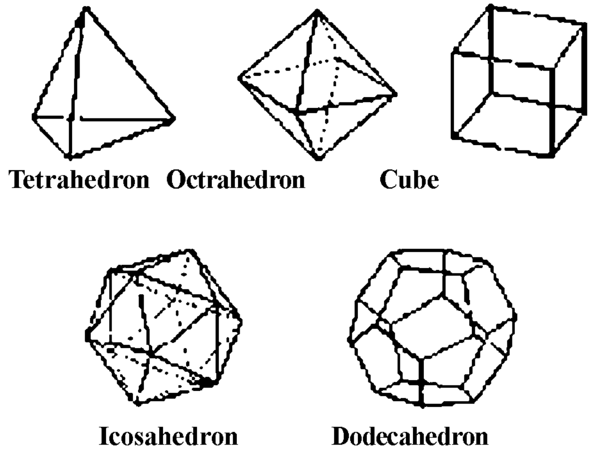
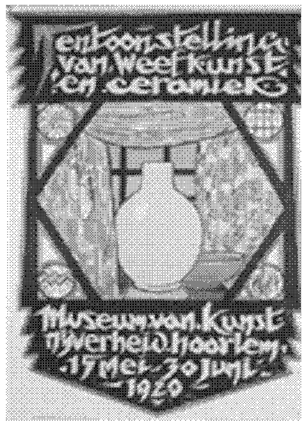


Figure 2. The Platonic bodies



Lithography by Otto van Tussenbroek (1882 - 1957) for the cover of *De Architect* (The Architect; 1905). The dodecahedron here symbolizes the cosmos.

Triangulature, quadrature, … pentature

For centuries artists have used designing systems to design or proportion their works of art. Often, these systems are not superimposed upon the design until afterwards and they serve to add order, harmony and the right proportions in the design. There are systems based on a grid of triangles, commonly called triangulature; there is also a system based on squares and circles, the so-called quadrature (figure 3). These designing systems have been used since antiquity; from the end of the nineteenth century onwards they became the vogue again among a group of innovative Dutch artists, commonly referred to as the *Negentigers* ("artists of the nineties"). They aspired to new forms of art and based themselves on what they called the fundamental geometric principles of art.

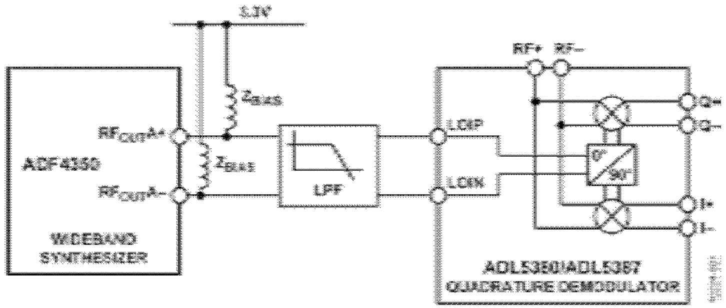


Figure 3 The basic figure of the quadrature

Caris goes one step further than his colleagues of the nineties: he does not merely found his work on geometry, his art is geometry, in essence. Geometry for him is not an aid to structure and order reality; he completely detaches himself from reality and defines the fundamental geometric principles themselves as art. "It was not until I started working solely according to abstract principles, thereby ending my dependence on real life, that a universe arose in which I found peace, a world which I experienced as a kind of liberation."[1] With each of his works Caris shows a detail of an infinite universe under the sign of fivefold symmetry. The work of the "Negentigers" marks the beginning of a movement towards abstraction, which appears to have found its ultimate goal in geometrically abstract art. This tradition encompasses the work of Caris. In that sense the *pentature* of Gerard Caris forms a logical sequel to triangulature and quadrature.

But in a different respect, too, the work of Caris is a logical next step from triangulature and quadrature, namely in the very choice of the pentagon. Caris himself justified this choice once, saying: "I felt that quadratic or rectangular shapes had long enough been around."[2] That would seem to be a rather simplistic explanation, but one that fits the time in which it was put forward. In order to understand this it is necessary to direct our view to science, which unquestionably forms a cardinal ingredient of the work of Caris. Consciously or subconsciously, Gerard Caris has always moved in the twilight zone between art and science. In his work, he is constantly searching for the

order and structure which conceal themselves behind reality and turns to science for answers. In his own words he put it like this: "I wanted art, but needed science to arrive at a creative language."[3] To Caris, research equals the creation of art. In the course of his searching he produces works of art, in which geometry is the language in which he expresses himself.

Relativity and systems thinking

"We have, in our minds, a tendency to accept symmetry as some kind of perfection. In fact it is like the old idea of the Greeks that circles were perfect, and it was rather horrible to believe that the planetary orbits were not circles, but only nearly circles. The difference between being a circle and being nearly a circle is not a small difference, it is a fundamental change so far as the mind is concerned. There is a sign of perfection and symmetry in a circle that is not there the moment the circle is slightly off – that is the end of it – it is no longer symmetrical. Then the question is why it is only *nearly* a circle – that is a much more difficult question … So our problem is to explain where symmetry comes from. Why is nature so nearly symmetrical? No one has any idea why."[4]

This quotation from physicist Richard P. Feynman (1918-1988) illustrates the turnaround in scientific perceptions at the end of the nineteenth and early twentieth century. It was discovered that nature did not comply with our idea of perfection, and slowly but surely we grew to realise that this *deviation*, however inexplicable, is conditional for its very existence. In order to understand this shift in perceptions better we need to go back to the nineteenth century. At the start of that epoch Europe was dominated by a strongly optimistic spirit. Confidence in the future was abundant, and likewise in *progress* - however it was conceived – and there was a rock solid conviction that the powerful growth of technology and science would render mankind better and happier. As a consequence, an upswing of rationalism and individualism could be seen, as an expression of trust in personal competence and independent thinking. There was a fairly wide-spread belief that it would not be long before an *all-encompassing theory* would be uncovered. By the end of the nineteenth century, and the start of the twentieth, a number of developments occurred which undermined this world view and which lead to a fundamental shift in scientific thinking.

In 1905, Albert Einstein (1879 – 1955) published a number of articles which put the world as it had so far been known – or better: conceived – upside down.[5] Where time and space had hitherto formed a fixed and unchangeable framework encompassing all and everything these concepts themselves turned into the subject of scrutiny. Time and space turned out not to be infinite and flat, as had been assumed up to then, but came to be seen as intimately entwined. Whether two events take place before or after each other, turned out to depend of the position and speed of the observer. Objectivity was an illusion and everything suddenly became relative.

Another important scientific development was the rise of systems thinking. Scientists had been wrestling for very long with questions like: "What is the organizing principle behind an organism consisting of millions of cells, like the human being?" It was discovered that an organism must be seen as a system, an integrated entity of which the defining characteristics stem from the specific relationships between the parts, resulting in self-organization. A system cannot be understood by dissecting the whole into its parts, the whole being more than the sum of the parts. Systems therefore can only be understood in their context. The tendency to form structures which consist of multiple layers or levels, or systems which in their turn again consist of systems is a property of all life. Each of those systems forms a whole or unity in relation to its constituent parts and is part of a greater unity at the same time. Thus, cells form tissues, tissues combine into organs, organs make up organisms and organisms together form social systems and ecosystems. The whole world consists of systems, embedded in systems, *ad infinitum*. Linear, Euclidean mathematics soon proved to be insufficient to describe such a self-regulating and self-organizing network pattern. A new type of mathematics was discovered, non-linear in nature, which was given the name complexity mathematics. This new scientific language is qualitative rather than quantitative in nature, deals with relations and patterns, cannot often give exact predictions and is characterized by iteration, a process in which an equation will constantly process itself by auto-feedback. Complexity maths laid the foundation for a development which, decades later, was to result in fractal geometry.

Chaos theory

The most important scientific discovery of the past century has possibly been that reality is too complex to be fully grasped by scientists. The rational approach to nature, arisen in the age of Enlightenment, was based on linearity, periodicity and progress. It presupposed that nature is purposive, centripetal, and thus finite. This perception of nature was undermined by Einstein's discoveries and was to crumble even further during the twentieth century. It became increasingly clear that reality is infinitely complex. Nature turns out to be regulated by non-linearity, non-periodicity and auto-feedback. Nature is centrifugal and every observation resembles a cut-out from an ever changing continuum without beginning or end. These discoveries became known as chaos theory, but that is in fact a confusing title. Firstly so, because chaos theory is not a uniform theory. Secondly, because the term chaos implies lack of order, and arbitrariness, whereas the truth is that seemingly irregular, unstable processes in nature turn out to be governed by rules, too. But by their complexity these processes contain and generate so much *information* that their outcome may definitely be unpredictable, but not at all arbitrary. Nature is a self-organizing, dynamic process, in which feedback of information forms an infinite web of auto-identical branchings and concentrations. Without a doubt, there is structure to this web, but the overwhelming amount of information makes it impossible to make predictions about next stages of the process. The smallest fluctuations and turbulences may ultimately decide how processes develop.

A new reality

Because of these developments it became urgent that a reassessment of the concept of reality would take place. After all, if reality is infinitely complex and our perception can only - and by necessity – reveal a limited part of this complexity, then

the assumption of an objective reality is impossible. The distinction between reality and illusion will fade and multiple realities may simultaneously exist alongside each other. Naturally, these developments did not leave art unmoved. To an important degree, the multitude of artistic movements and trends in the twentieth century echoes the search for a new world view. The rise of abstract art, the abandonment of reality – which had proved to be an illusionary reality – the abandonment of *the dependence on life* as Caris called it[6], was ultimately an inevitable step.

With *his* pentagon Caris, in all consciousness, renounces the geometrical forms which determined our image of the perfection of nature for centuries. For a long time, the triangle, the square and the circle responded to our feeling for symmetry and beauty and thus modelled the deterministic world view of mankind. But the discovery that *the structure* of life is not static, but dynamic instead, and that its continuation is determined by movement and change and not by rigid (natural) laws and ever unchangeable patterns forced us to look for different models. In this respect, Caris is a child of his age, he started this quest on his own initiative nothing but the regular pentagon as his tool. His work reflects a new vision of reality. He creates structures with regularity in them, but without repetition, as cut-outs from an ever changing continuum without beginning or end. In his work one is constantly surprised by the simultaneity of transparency and complexity. Caris does not create after nature, but just as nature; while scrutinizing his work one is struck by a combination of beauty and inevitable regularity. One recognizes order, but does not understand it.

The universe of Gerard Caris

For over thirty years now Caris has been creating his own universe, a universe in which he has shown an endless variety of possibilities within the rigid restrictions of fivefold symmetry. This universe has gradually evolved and was mapped in its historical development by Caris himself. After the discovery of the pentagon, his first spatial works soon followed in the shape of Polyhedral net structures (figure 4), thanks to which Caris discovered local fivefold symmetry. Years later, this finding was to become of sudden interest with the discovery of the so-called quasi-crystal[7]. With his pentagrids Caris creates a two-dimensional pentagonal universe. By extending the lines of a pentagram and the enveloping pentagon in all directions a grid of lines arises, resembling squared paper, but with varying distances between parallel lines and without straight angles. In his Structure study 5 of 1973. Caris shows the wealth of forms he is able to produce on the basis of this grid and with the aid of a just few colours.

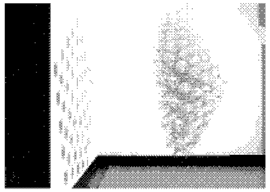


Figure 4 Gerard Caris, Polyhedral net Structure 3, 1973

More than twenty years later Caris still used his pentagrids to make his Pentagon complexes (figure 8) and Eutactic star series. The pentagrid, in effect, is a designing system comparable to triangulature and quadrature; Caris, however, does not use it to portray reality, but to show the infinite wealth of forms enclosed in the system itself. In his work PC 24 (figure 5) one can see how the rhombic centre of the pentagrid is brought to life by the colouring of each element in either white or black. An enormously rich variety of forms results. Every time the obeserver looks at this work he will find new details; never will he get the feeling that he has seen all, let alone understood all that he is seeing. Caris here shows that the whole is more than the sum of the parts.

Looking closely one can see how five white or black triangles together form a pentagon, but also that the same small triangles, with nine others of their kind, form a pentagon of greater size, of which the smaller pentagon is a part. What we see here is the emergence of structures which form a unity in relation to their parts, but which in turn are part of a greater unity, a process which can be repeated *ad infinitum* and would seem to be a visual image of the fundamental ideas in systems thinking described above. At the same time a comparison with fractal geometry – the mathematical language of systems theory - forces itself on the viewer. Fractals[1] are the graphic rendition of complex mathematical formulae and are characterized by auto-similarity, meaning that their form is built up out of smaller versions of itself, a process which can be carried out up to infinity in both directions (reduction and amplification). In Pentagrid of 1994 (figure 9) such a fractal can be found. The centre of a pentagram is a pentagon. By connecting all angles of this pentagon by straight lines a new pentagram is created, of which the centre again forms a pentagon; this process can be repeated endlessly in both directions.

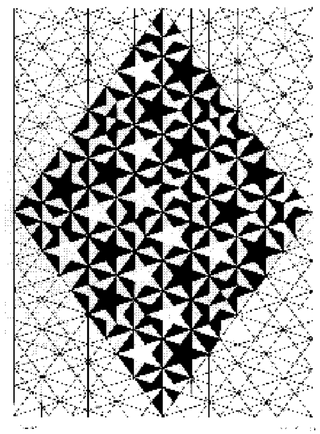


Figure 5 gerard Caris, PC 24, 1995.

In the Structure C series Caris succeeds in creating a suggestion of depth by his use of colours, which already seems to point forward to his next works, his configurations of polyhedrons and his reliefs (figures 6 and 7. These three-dimensional works are less mysterious than the Pentagon complexes, in the sense that their structure is a lot clearer. But in his reliefs Caris does show ever new and surprising patterns by using colour and the incidence of light.

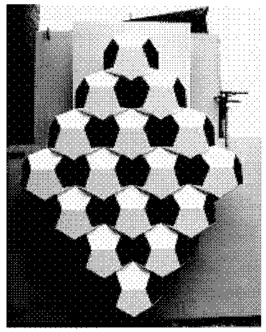


Figure 6 Gerard Caris, Relief structure 1S-1, 1 993

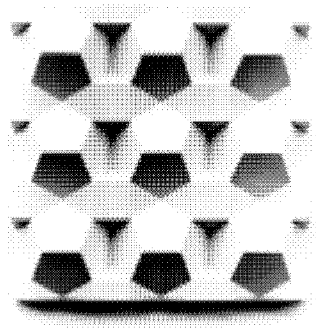


Figure 7 Gerard Caris, Relief structure 1T-1, 1993

Building with polyhedrons

At the end of the seventies and early eighties Caris sought out ways to express his pentagonal form language in design and architecture. What strikes at once is that Caris forces his form language onto his designs directly and without concessions. Whether it concerns a house, a teapot, a doorknob, a lamp or a chair (figure 8), the form of his subjects is completely determined by the pentagon or the dodecahedron. Triangulature and quadrature were used as aids in the designing and proportioning process. The basic forms of these systems could generally not be found again in the final design. Caris' pentature is not an aid, but a basic form defining principle.

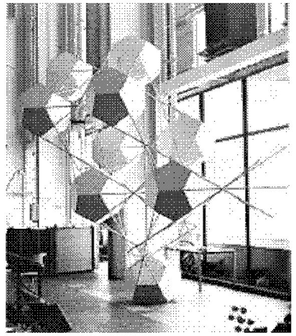


Figure 8 Gerard Caris, Chairs, 1978

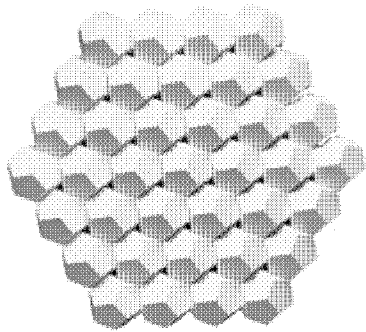


Figure 9 Gerard Caris, E house scale model, 1983

The reason why Caris started to involve himself with design and architecture lay in his desire to give an impulse to a mentality change, hoping that it might lead to a change in society. The fact that modern design and architecture were largely determined by right angles, horizontals and verticals, often chosen solely on the basis of efficiency and economic motives, to Caris was like a thorn in his flesh. According to him, the influence of the living environment on the behaviour and happiness of people was not sufficiently taken into account. With his design of Model D and Model E houses (figure 9) Caris tried to turn the tide. In this context he pointed out the economic and structural advantages of *roundish* house design more than once: the fact that the spheric form, and so the dodecahedron to a lesser degree, combines the greatest content with the smallest surface and guarantees optimal structural strength by the thinnest gauge of the building materials. Another motive for his roundish house designs was found in the feeling of security they would offer, which can be traced back to our first living environment, the womb.

In the mid-eighties Caris returned to abstraction, leading to a completely new chapter of form vocabulary emerging from the mid-nineties, namely rhombohedrons or polyhedrons of rhombuses. To understand how these figures fit in the pentagonal universe of Gerard Caris it is necessary to explore the concept of fivefold symmetry a little further.

Fivefold symmetry

Caris has always said that he does not create after nature, but just as nature.[1] In 1984 it was confirmed that nature, too, uses pentagons and dodecahedrons. In a rapidly cooled alloy of aluminium and manganese a crystalline structure with fivefold symmetry was clearly formed. A number of the planes of the crystal were regular pentagons. This discovery defied all the laws of crystallography, which dictated that crystalline grids must be periodical: it is always possible to find a repeating unity in the grid, called the unity cell. Fivefold symmetry was simply forbidden in crystallography. The forbidden crystal was therefore termed quasi-crystal. It turned out that the crystalline structure of the quasi-crystal showed great resemblance to the structures Caris had created in his Polyhedral net structures in the early seventies (figure 6). "Science and art are of the same value when it comes to gaining knowledge".[2] Caris once stated in an interview and this was confirmed in 1984. Caris realizes that not everything can be reasoned out or calculated, but that there are other ways which may lead to knowledge.

The fivefold symmetry in the quasi-crystal and the Polyhedral net structures by Caris can be compared to the fivefold symmetry in the so-called Penrose patterns[3]. The difference is that the Penrose patterns are two-dimensional and the quasi-crystals and Polyhedral net structures three-dimensional. Penrose patterns (figures 10 and 11) are plane filling patterns, constructed wholly from two rhombuses with equal sides but different angles, viz. a sharp angle of 35° by 144° and an obtuse one of 108° by 72°. The special features of these patterns is that they fill the plane without showing regularity, i.e. they produce a filled plane without a self-repeating pattern. In fact, Penrose patterns appear to contain no repetitive unity cell. They are what one might call quasi-periodical. Indeed, there is symmetry in the Penrose patterns, but completely non-comparable with the symmetry we know of in regular plane filling patterns. The latter do contain a unity cell, stacked according to a fixed, self-repeating pattern.

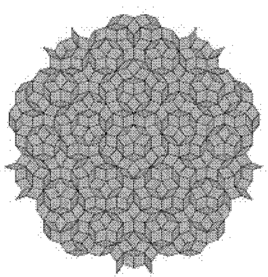


Figure 10 Penrose pattern

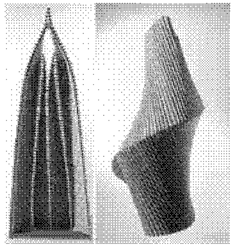


Figure 11 Penrose pattern

The key to quasi-periodicity is fivefold symmetry. The angles of the two rhombuses are multiples of 36°, just like the angles of the pentagram and the pentagon. If we colour all rhombuses in the Penrose pattern of which two sides have the same orientation by the same colour, it turns out that these rhombuses together form a capricious line. In figure 11 these lines have been averaged out, resulting in straight lines. This type of symmetry is sometimes called translational symmetry. What it comes down to is that a particular rhombus determines both the position and the orientation of another rhombus further afield. When we analyse the Penrose patterns a little further still, we can see that they have been built up out of decagons, consisting of five sharp and five obtuse rhombuses. The rhombuses of which such a decagon is construed have one of five different orientations (cf. the numbers in figure 10), again proof of fivefold symmetry. The Penrose patterns are therefore quasi-periodical, but there is symmetry in these patterns nonetheless.

Quasi-periodical patterns are, however, periodical in hyperspace (a space with more dimensions than ours). For instance, Penrose patterns can be defined as periodical patterns in a five-dimensional space. On many occasions, Caris has declared that he views his work as the visualization of higher dimensions, "of which we are certain that they exist in nature, but which could only be described in mathematical terms as three-dimensional projections of higher levels of order."[4] At one time, Marcel Duchamp stated that: "a three-dimensional object casts no more than a two-dimensional shadow", from which he concluded "that a three-dimensional object must in turn be the shadow cast by an object of four dimensions."[5] One could say that the periodicity in the Penrose patterns has been lost because they are only a representation at a lower dimensional level of an original at a higher level, just as depth is lost in the two-dimensional shadow of a three-dimensional object.

Penrose patterns can be compared to the homologous structures created by Caris (figure 8). In contrast to homogeneous structures, homologous structures cannot be formed of just one basic form. As is the case in the Penrose patterns, at least two different geometric forms are needed to build these structures.

Roger Penrose published his now famous patterns in 1979, five years before the quasi –crystals were discovered. In response to this publication, scientists wondered if spatial Penrose patterns might exist. This indeed turned out to be true. As Penrose

patterns can be built up out of two different types of rhombuses, so the spatial versions of the Penrose patterns can be constructed from different rhombic polyhedrons or rhombohedrons. Caris discovery of these rhombic hexahedrons was prompted by an error in a drawing accompanying an article in Scientific American, by Martin Gardner. By drawing a dodecahedron and an icosahedron (a regular construct with twenty planes) as duals inside each other he arrived at the acute-angled and obtuse-angled rhombohedrons which make quasi-periodical spatial filling possible. The forms of the rhombohedrons are determined by angles of 63°26' and 116°34'. In effect, these rhombic hexahedrons are a type of cubes gone askew. As the cube is the spatial version of the square, so the rhombic hexahedron is the spatial version of the rhombus, consisting of six rhombus-shaped sides. What we find here is that, just as a simple plane, only two bodies are needed in three-dimensional space for quasi-periodical space-filling. Since their discovery by Caris, the rhombohedrons have been the building blocks for a new universe in the making (cf. figure 12).

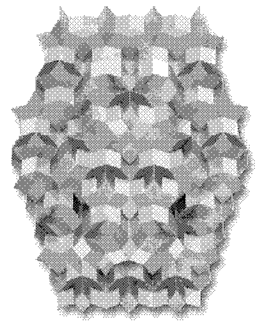


Figure 12 Gerard Caris, Reliefstructure 5 V-1, 2001

In conclusion

In a catalogue for the 1997 exhibition of drawings by Gerard Caris in the Amsterdam Stedelijk Museum Uli Bohnen made the following remarks: "It was said before that the extension of mathematics and geometry to the arithmetical and graphic manipulation of interdimensional and supra-dimensional functions has advanced at a forceful pace since the 17th century, but that the artists of the same period, with very few exceptions, have nevertheless remained caught in their conventional conception of plane and space. In this we can discover a deplorable detachment of the plastic arts vis-à-vis the problems discussed."[14]

Gerard Caris is one of those few exceptional artists who, using his creative work, is constantly trying to break through the conventional conception of plane and space. Not always a rewarding task, because the new views on plane and space, as they were formed under the influence of scientific discoveries over the past century, easily exceed our imaginative faculties. As it turns out, we become confused by higher dimensions, again and again. The art of Gerard Caris is also confusing: behind its apparent arbitrariness a complex harmony is concealed, which cannot be grasped or perceived in its entirety, but whose traces are visible to all who take a really close look.

Notes and References

1 E. van Uitert, "Passie en precisie, de kunst van Gerard Caris", (Passion and precision, the art of Gerard Caris) in W. Njio en M. Bertheux (red.), *Gerard Caris, Pentagonisme*, SMA Cahiers 23, Amsterdam 2001, p. 9.

2 As quoted in: E. van Uitert, "Passie en precisie, de kunst van Gerard Caris", (Passion and precision, the art of Gerard Caris) in W. Njio en M. Bertheux (red.), *Gerard Caris, Pentagonisme*, SMA Cahiers 23, Amsterdam 2001, p. 17.

3 D. van Delft, "Het pakkende pentagon. Gerard Caris verkent grensgebied tussen kunst en wetenschap." (The fascinating pentagon. Gerard Caris researches the border land between art and science), in *NRC Handelsblad*, 2 October 1992, Wetenschap en Onderwijs p. 3.

4 Quoted in J. Gielis, *Inventing the circle, the geometry of nature*, p. 7. (Original text in The Feynman Lectures on Physics, Commemorative Issue, Volume I, 1989.)

5 In 1905, Einstein published a collection of articles. One of these dealt with special relativity.

6 See footnote 1

7 See page

8 The term fractal derives from the French mathematician Benoit Mandelbrot, who first used it in his book *The fractal geometry of nature* of 1982.

9 Catharien Romijn, "Passie voor de vijfhoek" (Passion for the pentagon), *Limburgs Dagblad*, 13 October 2001

10 D. van Delft, "Het pakkende pentagon. Gerard Caris verkent grensgebied tussen kunst en wetenschap." (The fascinating pentagon. Gerard Caris researches the border land between art and science), in *NRC Handelsblad*, 2 October 1992, Wetenschap en Onderwijs p. 3.

11 After mathematician Roger Penrose, who discovered these patterns.

12 G. Caris, *Statement. Voorstelling en betekenis* (Representation and meaning), Maastricht, 15 November 2002

13 As cited in: U. Bohnen, "Inter dimensiones, spirit and nature in the creative work of Gerard Caris", in J. Poot, *Gerard Caris, tekeningen* (drawings), SMA Cahiers 8, Amsterdam, p. 25.

14 U. Bohnen, cf. note 13, p. 26.

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