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ON THE APPLICATION OF THE GOLDEN RATIO IN THE VISUAL ARTS

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The *Golden Ratio* or *Section* or *Mean* for a line divided into a shorter length a and a longer length b is determined by $a/b = b/(a + b)$. The value of the Ratio is the *irrational number* $(\sqrt{5}-1)/2 = 0.618\ldots$. A *Golden Rectangle* is one in which the Ratio applies to its sides of length a and b. The ratios of the successive Fibonacci series 1, 1, 2, 3, 5, 8, 13, 21, 34, ... oscillate rapidly to the limiting value 0.618, the Golden Ratio [1].

There are two aspects of the Golden Ratio that are of interest to contemporary artists: (1) whether it should be used as a theoretical basis for their own works of art and (2) whether works from another era were designed with the Golden Ratio taken as a theoretical basis. In this Note I examine these two aspects and give some examples.

In his *Entretiens sur l'architecture* (1863), Violet-le-Duc explained why a visual artist or a design architect might divide a line in the ratio 5/8 or 0.625, which is a rational number and which is close to the Golden Ratio [2]. Despite his book being well-known in the Occident, a '5/8-ratio' school has not developed among either visual artists or design architects.

In 1921, R. Carpenter [3] compared two analyses of the proportions of an ancient Greek lecythus vase. One analysis involved J. Hambidge's 'dynamic symmetry' system [4], which includes, as a special case, the Golden Ratio (and, therefore, the irrational-number division of a line). The other analysis was 'static', that is, it involved rational-number divisions of a line. Carpenter concluded that 'practically speaking, this lecythus ["based on a static system"] would be indistinguishable from that constructed dynamically ... and if it were drawn on paper and subjected to the same analysis of squares and diagonals, all the geometry would be the same' [3, p. 33].

In 1921, E. Monod-Herzen pointed out that the ratio $2/\pi = 0.637\ldots$, an irrational number, is also close to the Golden Ratio and that furthermore π is used, for example, in mathematical analyses of wave motion [5]. Still, a '$2/\pi$ - ratio' school has not appeared among visual artists and design architects.

At least eight different hypotheses have been proposed to explain the form of the Great Pyramid of Cheops in Egypt [6]. Two of these involve the Golden Ratio irrational number. One of the two gives an excellent agreement with actual measurements, but it is based on a quotation that does not exist [7]. There is, however, a simple hypothesis based on rational numbers that gives just as good an agreement and, furthermore, this hypothesis is supported by archeological and textual evidence [6, 7].

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It is often stated that Paccioli in his *Divine Proportione* (1509) advocated the use of the Golden Ratio. In fact, while in the *Divina Proportione* proper, he praised highly the mathematical properties of the Golden Ratio, in the accompanying *Architectura,* which deals with design and proportions, he advocated a classical Vitruvian system, that is a system based on simple proportions [8].

On the basis of measurements, it has been stated that Seurat used Golden Ratio divisions as a basis for his paintings. However, a detailed analysis of his writings, sketches and paintings shows that this was not the case [9].

An analysis was made of the works of the cubist Juan Gris using the diagonal of a Golden Rectangle and the fit seemed to be rather close. However, there is still in existence a letter written by Gris in which he categorically states that he did not use the Golden Ratio to proportion his paintings [10].

Le Corbusier used the Golden Ratio in his Modulor system and several authors have stated that he had used it in paintings in his early 'Purist' period [11]. But, Le Corbusier's (or rather Jeanneret, as he was known at that time) own writings and preliminary sketches of the period show that the theoretical basis of his paintings was really the equilateral triangle [12].

One often sees a reference to the works of Fechner accompanied by a statement that Fechner's experiments showed that the Golden Rectangle was the most favoured from an aesthetic viewpoint. What Fechner really showed was that there was a spread of rectangle ratios, including the Golden Rectangle, that could be considered to form a 'favourite range'. Since Fechner's time much work has been done concerning the question of which are the most aesthetic rectangles; this has been summarized by Zusne [13]. The literature on the subject shows that preference varies from group to group and under differing testing procedures and that there is a spread of data even within a given group. One may conclude that it is erroneous to try to establish one particular preferred rectangle on the basis either of data on an individual or of those averaged for a group.

There are several conclusions that I believe can be drawn from the above examples: (1) It is not possible to conclude by means of measurements that an artist used the Golden Ratio as the theoretical basis of his work; documentary evidence is required. (2) It is easy to confuse the use of simple proportions, for example the ratio 5/8, with the use of the Golden Ratio, for which the numerical values are close to one another. (3) There is nothing significant about the Golden Ratio from an aesthetic viewpoint. (4) Practising visual artists might as well abandon complex proportions, such as the Golden Ratio, in favour of simple ratios, which are easier to work with.

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