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The early relationship of Le Corbusier to the 'golden number'

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Abstract. That Le Corbusier used the 'golden number' in *Le Modulor* is well known. This paper examines his earlier attitude toward the 'golden number' as a system of proportion.

When trying to decide what system of proportion an architect or painter used or if indeed he did use a well-defined system of proportion, one is usually faced by a lack of documentary evidence (see, for example, Fischler, 1979). Thus the case of Le Corbusier (or Jeanneret as he will be referred to when he himself used his original name—as in all his pre-1928 paintings) is particularly interesting for several reasons. Not only do we have articles and books from the appropriate period, as well as later articles and autobiographical material, but we also have the unique case of a painter trying to analyze geometrically his own paintings over twenty-five years later.

In his *Le Modulor* (1948, page 29), Le Corbusier informs us:

> "Quand bien des années après son article de *L'Esprit Nouveau*: 'Les tracés régulateurs' (1921), apparaissent les livres de Matila Ghyka sur les proportions dans la nature et dans l'art et sur le nombre d'or, il n'était pas préparé pour pouvoir y suivre pratiquement la démonstration mathématique (l'algèbre des formules); par contre, les figures qui, en fait, sont l'objet considéré, lui sont instantanément saisissables."

There are in fact two of Le Corbusier's personal copies of Ghyka's 1927 *Esthétique des Proportions* in the Fondation Le Corbusier Library in Paris (catalogue numbers A5 and A6). There are several marginal notes, sketches, and coloured-in drawings in the early edition that confirm his study of the golden number at that time. Furthermore inserted in it is a copy of a foreword—never published—that Le Corbusier had written for a new edition of the book.

Von Moos (1974, page 294) has previously dated, without reasons, "Le Corbusier's serious occupation with the golden section" as beginning with his acquisition of Ghyka's *Le Nombre d'Or*. This book, however, was published in 1931 and in fact contains relatively little on the golden number. The confusion is probably due to the many editions of *Esthétique des Proportions*.

This information is also in accord with Le Corbusier's own analysis [figure 1(b)] of one of his 1929 paintings (Le Corbusier, 1948, page 213, figure 92, number 2). The analysis is based on reference points that he had 'prudently' placed on the drawing. The construction involves a logarithmic spiral (Coxeter, 1969, pages 110, 121, 125) based on the golden rectangle. To be precise it should be said that, even though some of Ghyka's logarithmic spirals (for example, Ghyka, 1927, page 180) are not based on the golden rectangle, it seems that Le Corbusier, with his limited mathematical background, did not realize, a mistake that is often made, that there was a difference between the special case and the general class.

Later architectural examples which should be compared with this are the sketches for the *Musée à Croissance Illimitée* (see, for example, von Moos, 1966, page 14).

Incidentally, after having considered Le Corbusier's analysis one might turn to the footnote on page 217 where we learn that all the graphic analyses are printed backward! Also of interest is the 'tracé régulateur' copied from the back of a 1931 painting, given on pages 216 and 217.

The question then is not if Jeanneret used the golden number in his paintings but when he started using it and in particular if he used it in his early period with Ozenfant.

If we consider Ozenfant and Jeanneret's first joint work, and in fact Jeanneret's first theoretical writings on art, namely their 1918 *Après le Cubisme*, we find only vague statements such as the following from the section on proportions:

> "Tout peut se représenter par des nombres; les proportions sont les rapports des nombres constituant un tableau. Un tableau est une équation. Plus les éléments sont justes entre eux, plus le coefficient de beauté tend à augmenter" (Ozenfant and Jeanneret, 1918, page 55).

We also read:

> "Celui [l'instrument] du peintre est son oeil qui agit vraiment comme un instrument de contrôle, de vérification et de pénétration" (Ozenfant and Jeanneret, 1918, page 43).

There is just one precise mention of proportions, and this occurs in a discussion of "canons artistiques" and speaks only of "triangles égyptiens" and "rapports numériques" (Ozenfant and Jeanneret, 1918, page 47). It is not clear what triangle is being referred

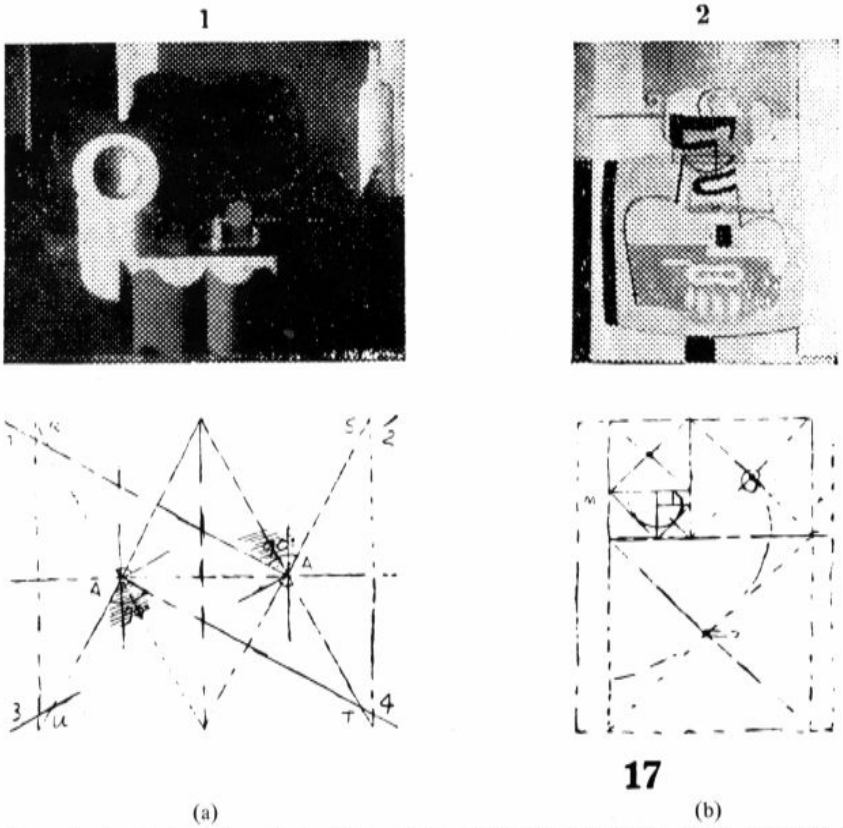


Figure 1. Le Corbusier's analysis of two of his paintings (Le Corbusier, 1948, page 213, figure 92).

to here since there are two triangles which go under the name 'égyptien'. Choisy (1899, page 53) uses the term for the 3-4-5 right triangle. Violet-le-Duc (1863, page 405; 1864, entry entitled "Proportion") on the other hand used this expression to designate the isosceles triangle whose altitude is $2\frac{1}{2}$ units and whose base is 4 units. This latter is shown by Choisy (1899, page 54) as the union of two right triangles each with legs of length 4 and 5 units. There it is simply stated as being derived from Choisy's Egyptian triangle. Further it is known (Turner, 1971) that Jeanneret obtained copies of the books by Choisy (1899) and Violet-le-Duc (1864) in 1913 and 1908 respectively. We shall have further occasion to speak of this triangle.

The earliest written mention of the golden number by Ozenfant and Jeanneret appears to have occurred in their article "Sur la plastique" in the first issue of *L'Esprit Nouveau* (Ozenfant and Jeanneret, 1920, page 46). There is a discussion of the use of the right angle by Michelangelo, followed by:

> "Même chose chez Cézanne, autre homme à tempérament.
>
> Lieu de l'angle droit, triangle équilatéral, triangle égyptien, section d'or etc., autant de modules régulateurs."

At first glance this last 'sentence' would seem to be linked to Cézanne, but that in fact this last 'sentence' is isolated and rather vague and general is shown by its forming a new paragraph and by its being followed by an analysis of a Cézanne painting where only the right angle is used.

There is a further mention of the golden section in their January 1921 article, "Le purisme". For purposes of discussion it will be necessary to refer not only to the paragraphs dealing directly with the golden number but also to several of those preceding them.

> "D'autre part, le peintre ne doit pas s'arrêter à des surfaces particulières déterminant nécessairement des sensations d'ordre accidentel. Une surface à peindre doit faire oublier ses limites, doit être *indifférente*.
>
> Pour nous, nous avons choisi les surfaces semblables à celle de la toile de 40 F, estimant que cette surface est d'ordre indifférent.
>
> De plus, cette surface contient des propriétés géométriques importantes; elle permet divers tracés qui déterminent des lieux géométriques de la plus haute valeur plastique. Ces tracés sont ceux du triangle équilatéral qui s'inscrit utilement dans la toile et déterminent sur les axes deux *lieux de l'angle droit* de la plus haute valeur constructive. La toile se trouve ainsi divisée en segments à angles semblables et contient des lignes qui conduisent l'oeil aux points les plus sensibles. Ces points sensibles constituent de véritables centres stratégiques, organiques, de la composition.
>
> Il y a là un fait capital au point de vue plastique car de tous temps et à toutes époques, les grandes oeuvres, autant d'architecture que de peinture, ont été composées sur des tracés régulateurs impératifs de cette nature.
>
> La composition, dès lors, au lieu de suivre les caprices d'une imagination effervescente, trouvera dans la division de la toile des directives généreuses qui détermineront des concordances, qui amplifieront les résonances, qui disciplineront le groupement des masses, qui situeront les points capitaux de la composition.
>
> Le choix de la surface pour ses lieux géométriques a préoccupé de tous temps. Le souvenir en reste dans le terme fameux de section d'or qui hante les ateliers, comme la hantise de la pierre philosophale. La section d'or n'est pas une section de surface. La section d'or est une section mathématique de ligne permettant de diviser une droite de telle sorte qu'un rapport harmonieux règne entre les deux segments.
>
> On a construit sur cette section d'or le triangle dit de *la section d'or* et ce triangle qu'on débite en carton dans les ateliers y est employé comme unificateur

d'angles; il a pu rendre quelques services, mais comme on se contente de le promener sans orientation cohérente avec le format, sur la superficie du tableau, on ne réalise pas cette condition plastique qui exige que les lignes directives d'un tableau procèdent des propriétés géométriques de la surface.

Les anciens ont bien utilisé la section d'or, comme d'ailleurs d'autres sections, la *section harmonique* par exemple pour moduler leurs oeuvres: mais ils les employaient en tant que divisions de lignes et non comme division de surface" (Ozenfant and Jeanneret, 1921a, pages 380–381).

Green has this to say about the last part:

"Ozenfant and Jeanneret demonstrate how the planes of the painting should be organized according to a coherent relationship between the Golden Section triangle and the picture format (a much simplified variation on Gris's 1912 methods)" (Green, 1970, page 49).

This interpretation of 'on a construit' as referring to Ozenfant and Jeanneret is impossible. First of all the only time 'on' is used in French to mean 'we' is in very informal French. When Ozenfant and Jeanneret refer to themselves, they use 'nous', as in the second paragraph quoted. Second the preceding paragraphs as well as the statements on the golden number indicate that a historical standpoint alone has been taken. Indeed the discussion of the use of the golden number is not very enthusiastic. We shall see the same thing again further on.

There is another assumption being made by Green that is completely conjectural and most probably incorrect. The term 'Golden Section triangle' refers to the triangle obtained by dividing a golden rectangle into two triangles by means of a diagonal. This had been previously used by Camfield (1965; see also Robertson, 1948) in an 'analysis', which in my view is completely without basis, of the works of Juan Gris. Another candidate is the isosceles triangle inscribed in a golden rectangle with the base on the long side of the rectangle and its apex at the centre of the opposite side. This triangle is virtually identical, as Jeanneret could have learned from Choisy's *Histoire* (Choisy, 1899, page 53), with Violet-le-Duc's 'triangle égyptien'. An argument against this interpretation is that, in the first *L'Esprit Nouveau* quotation given, 'triangle égyptien' and 'section d'or' are two separate entities. It is possible that still another triangle was meant; for example, the 72°, 72°, 36° triangle sometimes goes under this name.

The identification of 'le triangle dit de la section d'or' remains then an open but tantalizing question, as does the meaning of 'sans orientation cohérente' and 'employé comme unificateur d'angles'. Who indeed was using it? Whoever it may have been, the quotation from *L'Esprit Nouveau* demonstrates that Ozenfant and Jeanneret were not among them.

There is further evidence that not only did Ozenfant and Jeanneret not use the golden number in the early twenties but were in fact hostile to it.

In their 1921 article "Les tracés régulateurs" there is mention of right angles, 3–4–5 triangles, circles, and squares but not a word about the golden number. Strictly speaking this article deals only with architecture, but in Jeanneret–Le Corbusier's spirit, painting and architecture were linked (see, for example, Le Corbusier, 1948, page 34).

Furthermore in the book *La Peinture Moderne* published in 1925, the section "Idées Personnelles" has one chapter on "Angle Droit" ("l'orthogonal marque le pas énorme que vient de franchir la peinture ...") and one on "Purisme", but again the golden number is not even mentioned (Ozenfant and Jeanneret, 1925, pages 149–158, 163–172). Indeed there is a reference (page 170) to the German psychologist

Fechner's experiments dealing with the right angle, but nothing at all about the well-known ones dealing with the golden rectangle!

On the other hand Ozenfant's 1921 review (Fayet, 1921; the identification of Fayet as Ozenfant is made by Stuart, 1972, page 98) of Severini's *Du Compas au Classicisme* (Severini, 1921) has statements such as: "... votes au plaisir sur une telle ou telle division de la ligne (Fechner et co)!" and "Faisons de la géométrie une culture de l'esprit correcteur des écarts de la sensibilité excessive, mais ne remplaçons pas le mysticisme de la sensibilité par celui de la section d'or ou du triangle".

Also of interest is Ozenfant's (1968, page 572) description of Sérusier's visit to him in September 1921 just after the latter's publication of his *ABC de la Peinture* (Sérusier, 1921). Although Ozenfant speaks of having "believed in the miracle", he does not list himself among those who he claims did use the golden number. Incidentally pages 570–576 of the *Mémoires* contain an often bitter discussion of the golden number. There is for example a mention of "discreet helping hands, thickening of lines ... in order to adjust to the 'numbers' of the golden section or its modern version the Modulor".

What is sure is that neither Ozenfant and Jeanneret nor anybody else has ever learned how to use the golden number in painting from Sérusier's book. On page 17 we are told in five lines that the golden section or 'golden cut' is also called mean and extreme proportion and is equal to ... (ten decimal places!). On page 19 only the ratio definition is given. There is not even the geometrical construction. This last statement also is true of Severini's (1921) book. The golden section is discussed on pages 27–31, but these pages deal mainly with the 'historical' aspects and again there is nothing on how to use it. In fact on page 48 we are told that simple numbers are better.

I should mention that neither the book by Sérusier, nor that of Severini, nor any other book on proportion entered Jeanneret's library before 1927. Aside from the books by Choisy and Violet-le-Duc, the only other architecture book is de Baudot's *L'Architecture, le Passé, le Présent* (1916; see Turner, 1971).

In his article "Du canon", Ozenfant (1932) again is quite vague when speaking about artists who sought canons, in particular those involving the golden numbers. No names are mentioned but the impression is that he is not referring to the recent past.

We now consider *Le Modulor* once again and see what Le Corbusier thought over a quarter of a century after his debut in painting.

> "Le troisième, en 1919, cherche à occuper la toile d'une façon ordonnée. Le résultat est presque bon. Mais voici le quatrième tableau qui reproduit le troisième rectifié cette fois-ci, calé, cadré, structuré par un tracé catégorique. Le résultat est indiscutable. Voici les tableaux suivants, en kyrielle, 1920 (Exposition Galerie Druet, 1921): ils sont soutenus par une ferme géométrie. Deux ressources mathématiques y sont exploitées: *le lieu de l'angle droit, la section d'or*" (Le Corbusier, 1948, page 27).

Thus Le Corbusier himself said in 1948 that he had used the golden number in his 1920 paintings. Later on, however, he actually gives an analysis of perhaps his best known painting, the double-versioned *Nature Morte à la Pile d'Assiettes* [figure 1(a)] (Le Corbusier, 1948, page 213, figure 92, number 1; reproduced in Golding and Green, 1970; Rosenblum, 1966). The golden section is not mentioned: "... tracé ... fournit en A, la solution dite 'du lieu de l'angle droit' qui servit spontanément d'incitateur aux recherches du 'Modulor' en 1942, vingt-deux ans plus tard" (page 213).

That the "lieu de l'angle droit" without the golden number was dominating Le Corbusier's mind, thus ruling out the possibility of reading 'golden numbers' into the quote, is supported by both *Le Modulor* and *Modulor II* (1955). Note for

example his presentation of the problem to Hanning (Le Corbusier, 1948, page 37) and his obvious joy when (Le Corbusier, 1955a, pages 43–44) two of his architects managed—after all the errors of *Le Modulor* (for example, page 235)—to rigorously link the golden number, which alone defines the 'Modulor' system via its powers, and the right angle, which is completely irrelevant to the set of 'Modulor' dimensions. Further indication is given by his *Poème de l'Angle Droit* (Le Corbusier, 1955b).

Now notice the following about the analysis of *Nature Morte à la Pile d'Assiettes*: the regulating lines do not start from the edges of the canvas. This phenomenon is also evident in the other analysis on the same page where the border is shown [figure 1(b)]. It might be argued, however, that for the painting *Nature Morte à la Pile d'Assiettes*, no border is shown and that one could not be sure if the apparent smaller size of the analysis, as compared with the painting, was not perhaps due to a printing error.

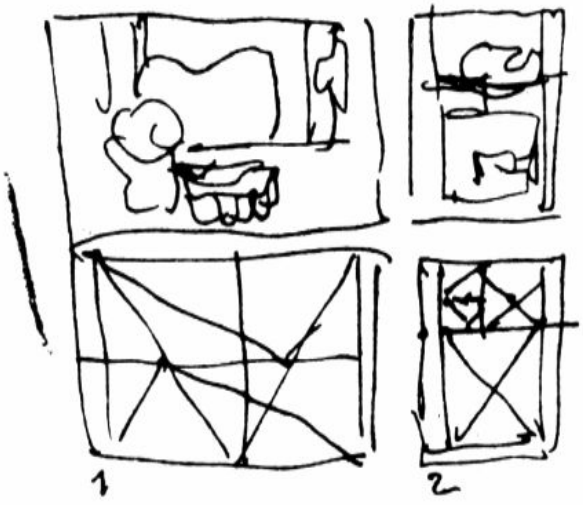
To answer this possible objection I have examined the manuscript of *Le Modulor* in the Fondation Le Corbusier Library, Paris (file OL.2 BI 15; file OL.3 BI 11 also contains material used in the preparation of the manuscript—the correspondence with Manning is particularly interesting). Figure 2(a) shows that it was indeed Le Corbusier's intention that the regulating lines be shown as starting from within the boundary.

Furthermore Le Corbusier has this to say on the very next page (page 214) of *Le Modulor*: "L'exégète non-averti pourra s'évertuer sans succès à reconnaître en ces oeuvres des tracés partis des quatre coins de la toile; il n'y arrivera pas ou il tombera dans l'arbitraire".

All of this is in perfect agreement with the statement in the earlier quote from the January 1921 article "Le purisme":"une surface à peindre doit faire oublier ses limites, doit être indifférente" (page 380).

Indeed the key to the understanding of Le Corbusier's analysis is also given in this portion of "Le Purisme". For Ozenfant and Jeanneret speak of an equilateral triangle, inscribed in a useful manner inside the canvas, which in turn determines two "lieux de l'angle droit".

The accompanying text of *Le Modulor* does not mention the triangle, and the "Le purisme" article does not specifically say that Ozenfant and Jeanneret used it, but fortunately Jeanneret left the 'regulating lines' on several of his drawings from



(a) (b)

Figure 2. Le Corbusier's original manuscript sketch of figure 1.

the period. The one on which the 'regulating lines' are clearest in his 1920 *Fontarabie* (figure 3), where two equilateral triangles but not the "lieux de l'angle droit" are shown. (This figure is taken from Wohl, 1971, page 16—read Fontarabie for Fontacabie. The similar looking painting on page 35 of *Le Modulor* is actually *Nature Morte au Violon sur Fond Clair*.) The equilateral triangles together with the right angles also appear in the 1920 *Étude pour le Tableau Guitare, Pile d'Assiettes et Lanterne* (Jardot, 1955, plate II) and in the 1920 *Violon et Boîte à Violon* (Sotheby's, 1969, page 12). Note that, in *Le Modulor* and in these last two examples the line from the "lieux de l'angle droit" does not end up where it should, mathematically speaking, namely at the vertex of the equilateral triangle.

There is an ironic touch to the whole question. The earlier quote from the "Le purisme" article in *L'Esprit Nouveau* describes how Ozenfant and Jeanneret chose "les surfaces semblables à celle de la toile de 40 F estimant que cette surface est d'ordre indifférent". Their preferred size was in fact 81 × 100 cm, which is the dimension of *Nature Morte à la Pile d'Assiettes*, *Fontarabie*, *Étude pour Guitare*,

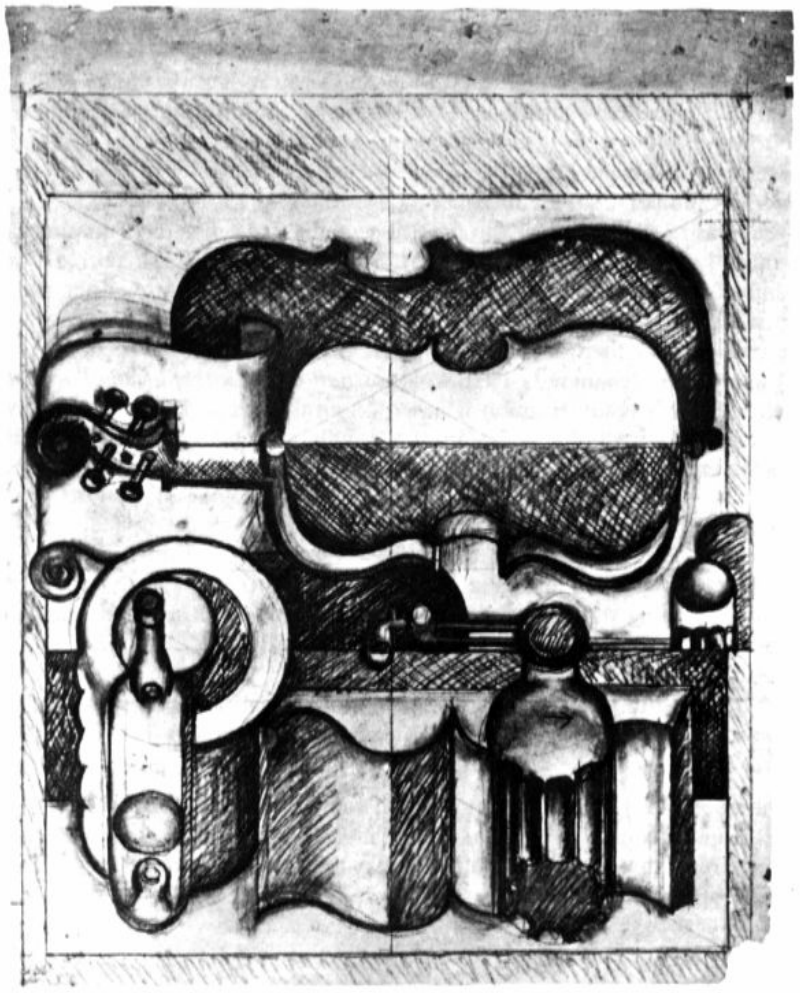


Figure 3. Le Corbusier's *Fontarabie* (Wohl, 1971, page 16).

Pile d'Assiettes et Lanterne, and other 1920 works, as well as of paintings from 1925, 1926, and 1930. But this 'indifferent surface' with a ratio of 0·81 is almost exactly that of a rectangle made up of two golden rectangles: 1·618:2 = 0·809! [The only reference I have come across to the painting size is in a list of 'points' given by Havel (1974, page 33). Indeed the size 81 x 100 is number 40 in the 'figure' format. Havel, with a reference to Sérusier (1921), says the 'points' were not arbitrary. He then refers to the 'figure' format in general as "double Coupe d'Or", but this is certainly not in Sérusier and no indication is given of the source of the name: none of the other members of the class seem to approximate golden-number-related quantities.] But we can be sure that this 81 x 100 shape was not chosen because of its approximation to the double golden rectangle because (1) it is not mentioned in the "Le purisme" article, (2) Le Corbusier does not speak about it in *Le Modulor*, and (3) it is used for his 1919 *Nature Morte à l'Oeuf*. In other words Jeanneret unknowingly began with a surface almost precisely equal to one determined by the golden number and purposely changed the determining proportions, that is, literally destroyed this approximation to the double golden rectangle by using an equilateral triangle!

We have here another example of the invalidity of trying to reconstruct an architect's or artist's theory of proportion, if indeed he had one, solely on the basis of measurements [see Fischler (1978) for another artistic one]. For as we have just seen, anybody searching for the golden number in Le Corbusier's early works will 'find' it even though, as we have also seen, Le Corbusier was if anything anti-golden-number at the time. Furthermore the roughness of Le Corbusier's sketches combined with his imprecise mathematical knowledge—see the earlier discussion of the 'golden spiral' in figure 92, number 2 of *Le Modulor* (Le Corbusier, 1948, page 213) [figure 1(b)]—emphasize that it is not the precision of the artist that is of importance but rather his intention. There can be no such thing as the 'accidental occurrence' of the 'golden number'. It is a precise mathematically defined quantity; either an architect or artist had it in mind as his theoretical model or he did not.

An example of the aforementioned searching for the golden number occurs in Green's (1970) analysis of Jeanneret's 1920 *Composition à la Guitare et à la Lanterne*, also 81 x 100 cm. Green's reconstruction is based on an isosceles triangle formed by joining two vertices and a midpoint of a side of a double golden rectangle. Of course this triangle has its vertices in the corners and edge of the painting as opposed to what is stated or drawn in the "Le purisme" article, in the *Le Modulor* analysis, and in the quote about "l'exégète non-averti". No "lieux de l'angle droit" appears in Green's analysis, and a letter to me from Mr Hess, secretary of the Kunstmuseum Basle, confirms that no regulating lines are visible on the painting.

Another claim concerning the use of the golden number by Ozenfant and Jeanneret is given by Dorival (1957, page 73).

Perhaps just as Le Corbusier ended *Le Modulor* by saying "La parole est désormais aux usagers!", it is fitting to end this article with a quote from Le Corbusier which should be heeded by those who would indiscriminately use the golden number to analyze the works of Le Corbusier and others.

> "Bien que pratiquant les tracés régulateurs depuis plus de trente années, je déclare qu'une fois les années écoulées et la mémoire défaillie, il est très difficile de retrouver le véritable tracé régulateur dans une oeuvre remontant à dix ou trente années, à moins d'y avoir prudemment inscrit des points de repère ..." (Le Corbusier, 1948, page 214).

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