Foreword

by the author

This book, entitled *"Geometry of the Golden Section"* might just as well have been entitled *"Discovery of the Treasures of Geometry"*, *"Lines Drawn by Ruler and Compass"*, *"The Dynamics of Number 5"* or also *"The Art of Lines".*

Treasures, because we use the Golden Section that is the canon of Beauty and Harmony.

The knotted cord*, the stakes, the builders' cane and the plumbline have, among other devices, allowed our ancestors to draw circles, straight lines and perpendiculars...all of them being the basic elements in the building of monuments that we admire to this day.

In this book, we use a ruler and a pair of compasses to make such geometrical figures.

Indeed, our purpose is to study the aesthetic properties of geometry according to the golden section determined not by calculation but only by drawing.

About one hundred geometric figures, **many of them quite novel**, are proposed to help the reader acquire the art of line drawing.

That technique, specifically based on the division of a line according to the Golden Section, was that of the Romanesque builders and their Egyptian, Chaldean and Greek predecessors (in those days decimal numbers, trigonometry and even the signs for addition, multiplication and division were unknown).

* see page 35

It is a well known fact that it was only during the Italian Renaissance, in the 14th and 15th centuries, that the use of Arabic numerals, among which "zero", became common.

This study will help young people, who use computers and calculators more and more, to sharpen their intuition and develop their taste for research.

It will also give senior citizens a way to keep their minds young and enrich their retirement years.

Let everyone discover, by the art of geometric figures, in particular those of line drawing, the treasures inspired by the Golden Section.

Is not geometric drawing an activity that requires all one's knowledge and stimulates one's imagination and reflection?

Each of us will therefore be able to verify by his own experience that mathematical knowledge is not necessary to build geometric figures .

One can draw many figures that are beautiful and attractive by means of ruler and compass alone.

I have written a little book entirely dedicated to the creation of such drawings: "Nombre d'Or et Créativité" Chalagam edition 2001.

Pascal said: *"We can see by experience that given equal minds and all things similar, he who has a geometrical mind gets the upper hand and acquires a new strength."*

ACKNOWLEDGMENTS

I wish to thank all my friends who have helped me in many ways.
This is indeed a team work book.

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Notes :

— We remind readers that this book is a handbook of geometrical figures which can be useful for everyone's personal enrichment and prove, if need be, that our ancestors were able to build the harmonious monuments we continue to admire, using only ruler and compass (knotted cord, stakes, builders' cane…).

— When drawing a figure, follow the explanation and the drawing simultaneously.

— Each figure is given without any mathematical proof but we can supply it to those who are nterested.

It is up to the curious reader to have the pleasure of making the demonstration with the help of a few basic mathematical notions.

Such figures can also be the object of interesting problems.

— We have not represented the drawings related to hearts, spades, clubs, etc. nor the writing of capital letters as mentionned in PACIOLI's book.
They would have been superfluous in this book.

— When a point is defined by the intersection of two objects there may be a confusion if the two objects have several points of intersection: in such a case, the drawing is there to make things clear.

— By pedagogical desire, we have deliberately re-used the same geometrical figures in different drawings (thus enabling the reader to become familiar with the use of ruler and compass).

— Most figures use simple constructions resulting from the basic figures of chapter 1.

— When we speak of a length that is equal to 1 or 2 we give the chosen unit.

— The figures are, for the most part, the result of approximate methods. However, being hand-drawn, this result is acceptable

By simple mathematical calculation, using trigonometry in particular, one can determine the degree of approximation.

— Use of knotted cord:

the knotted cord measures length in "cubits"* i.e. the distance between two knots. in French the cubit is a «coudée», Both terms are found in this book

Thus to determine :

- the value of $\Phi = 1.618...$ » 8/5, we use a cord of 8 + 5 = 13 "cubits" (2-13 page 20)
- the triangle 3-4-5, we use a cord of 3 + 4 + 5 = 12 "cubits" (1-10 page 20)
- the golden rectangle, we use either one

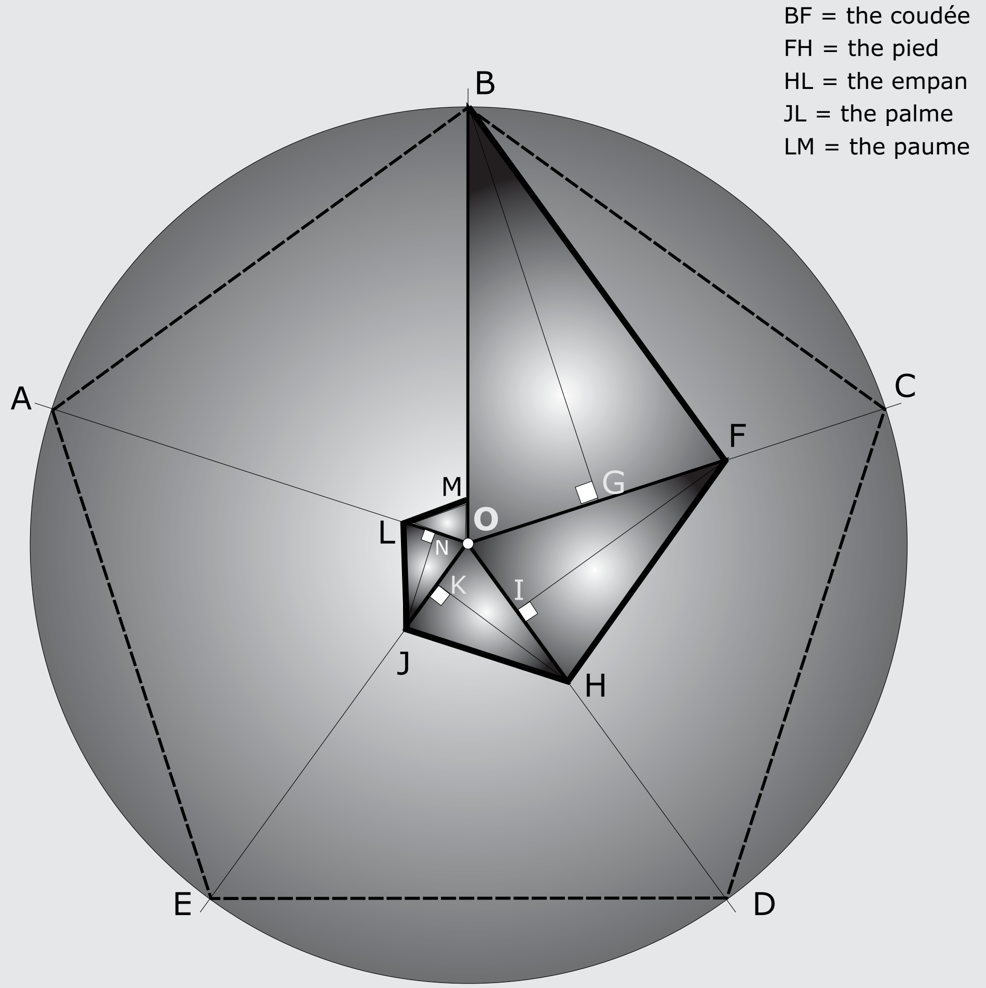
— In the first part of this book when an arc cuts a line at an extension of that line, we mention the extension.
Subsequently the reader will be expected to assume the extension.

— Anglo-Saxon builders used different dimensions and positions of the hand for measurement. For this reason we have retained the French names of the divisions of the "quine".

You will notice that in the very dimensions of this book we have taken Φ into account: indeed, when open, the book is a golden rectangle: 42 cm long and 26 cm large, that is to say the Φ ratio.
(42 / 26 = 1.615) and each page has a ratio of approximately 26 / 21 = 1.272 = $\sqrt{\Phi}$.

* – (See page 32)

Fig. 3-11 ~ the regular pentagon and the "quine"



Consider a regular pentagon ABCDE and its five equal radii starting from O,
the center of the circumscribed circle.

From B, drop the perpendicular onto OC (point G).
On OC, determine OF = 2 OG.

From F draw the same figure, then from H, from J and from L.

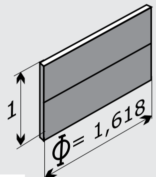
You will notice that the BOF, FOH, HOJ, ... triangles, are isosceles triangles
with angles of 72° at the base: they are acute golden triangles*.

The segments starting from O: OB, OF, OH, 0J, OL are the five elements of the "quine".
The same goes for segments BF, FH, HJ, JL and LM
which make up the false spiral BFHJLM.

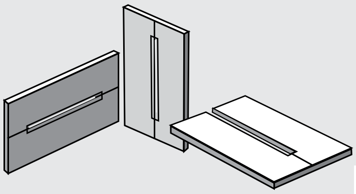
*an acute triangle is said to be a "golden" triangle when the sides and the base have a Φ ratio.

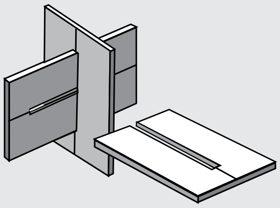
Fig. 5-06 ~ Icosahedron inscribed in a cube and a sphere

For each of these three rectangles: length / width = Φ.

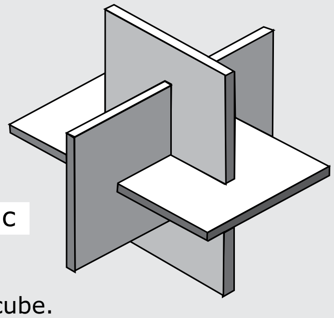


a



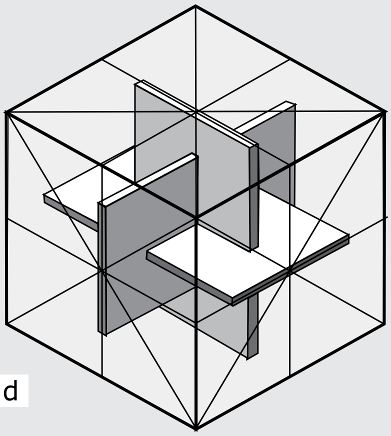


b

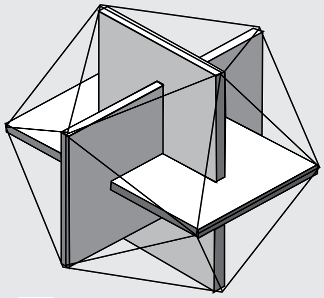


c

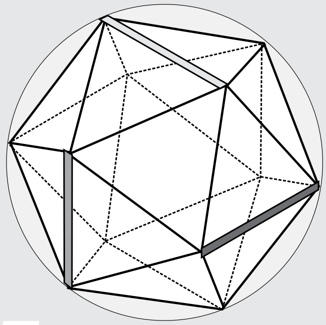
These three **golden rectangles** are inscribed in a cube.



d

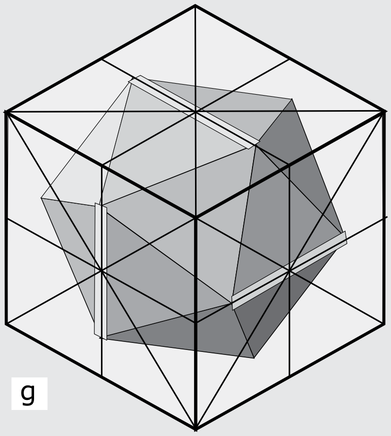


e



f

A thread joining the (3 x 4) vertexes of the golden rectangles e, brings into existence an **icosahedron** (12 vertexes, 20 faces and 30 edges =1) that bears a clear relationship to Φ**.**

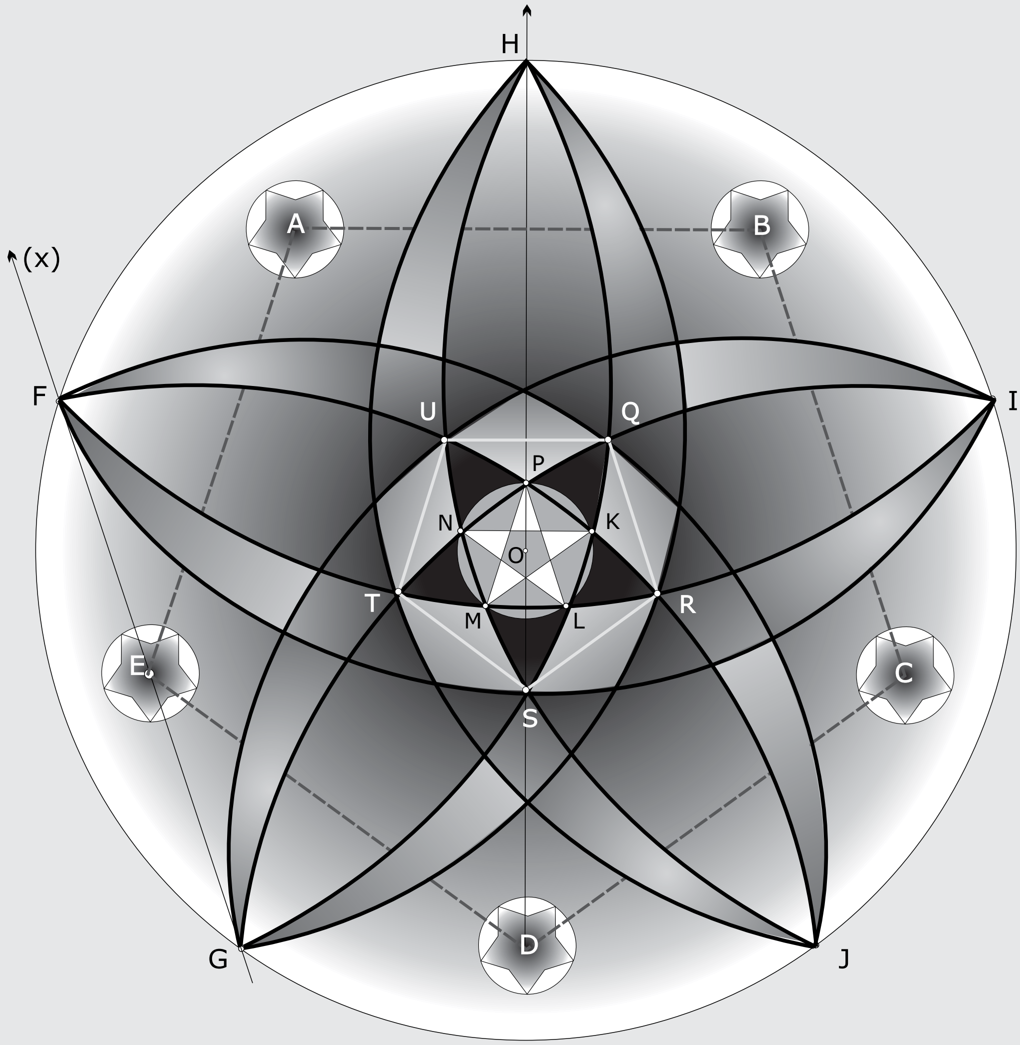


g

The **icosahedron** is inscribed in cube g
with side a = Φ
and in sphere f
whose diameter = the length of the golden rectangle.

These three solids are concentric.

FIG. 7-22 ~ PENTAGONAL STAR-SHAPED ROSACE



Consider the regular pentagon ABCDE and O the center of the circumscribed circle.

From E, draw the straight line Ex parallel to BC
intersecting straight line CO at F and straight line BO at G.
In a similar way, you obtain points H, I and J.

Draw a circle with O as center and with an undetermined radius
intersecting EI at K, AJ at L, BG at M, CF at N, and DH at P.
You obtain pentagram KLMNP.

Draw arc HG that passes by points K and L (the center being at the intersection the vertical bisector of HK and GL) and that intersects BG at Q, then draw the arc passing by points L and M and intersecting FC at R. Continue similarly with points S, T, and U.

Thus, you will determine pentagon QRSTU and the star-shaped pentagonal rosace.