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Debussy, Bartok, and the Golden Section

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DEBUSSY, BARTOK, AND THE GOLDEN SECTION

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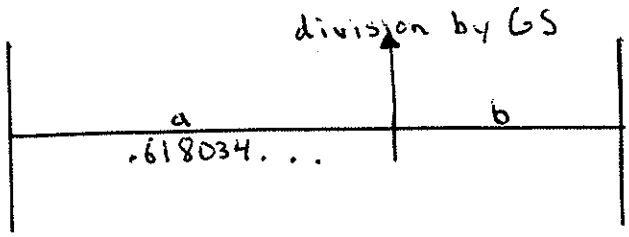
Throughout my life I have been fascinated by symmetry and balance in nature, architecture, and other areas in the physical world. As my love for science broadened, my attention was turned to the microscopic world. The exact symmetry of many microscopic materials in the organic and inorganic spheres is evidence that something beyond our simple selves is in control. My explorations into the world of music opened my eyes to a world of symmetry that previously I was oblivious to. I looked at sonatas, for instance, and was enthralled by the delicate balance between sections in a sonata rondo movement, or the strong relationship between the exposition and recapitulation of a sonata-allegro movement.

However, it was my increasing interest in 20th century music that served as the impetus for this project. I became interested in the new sounds and orchestrations that were being experimented with. The landmark pieces I became interested with included Strauss's *Salome* and Stravinsky's *Rite of Spring* and other masterpieces. Then last spring I became familiar with Bartok's *Music for Strings, Percussion, and Celeste*; it was in my analysis of this piece that the idea for this paper was born. Then my thesis advisor, Fr. Jerome Coller, gave me a book on how Debussy uses the Golden Section, or Golden Ratio in both his piano and orchestral music. In order to combine the two composers into a coherent paper, a relationship between the two had to be found. I then found a book by Erno Lendvai that also talked about the Golden Section, but with regard to Bartok's music. The stage was then set for my analysis of how 1. Debussy and Bartok incorporate the Golden Ratio into their music and 2. That these two composers were conscious of their decision to use these methods. What follows is a look at how each of these masters integrates this divine proportion into their music.

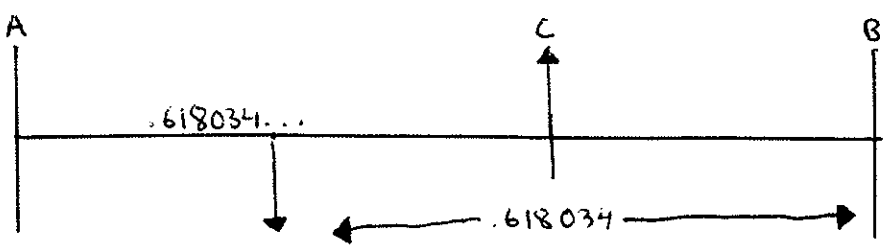
Before delving right into the works of Debussy and Bartok and how they relate to the Golden Section (this will be abbreviated GS from now on), it must first be established what exactly the Golden Ratio is. First, draw a line. Then draw a bisecting line through the first line in such a way that if you labeled the sections "a" and "b" the ratio would be b/a = a/a+b. The ratio's exact value is irrational, but as the substitution numbers increase, it approaches asymptotically to .618034 . . . (a little under two-thirds) (Howat 2). Figure 1 shows what this line would look like.

Fig. 1



In the next drawing another special characteristic of the GS is, henceforth, found. C divides the line AB by the GS. D is then drawn to divide AC by the GS; however, in doing this D divided the entire length AB by GS in the other direction. Only the Golden Ratio has this property (Howat 2). Figure 2 proves this relationship.

Fig. 2

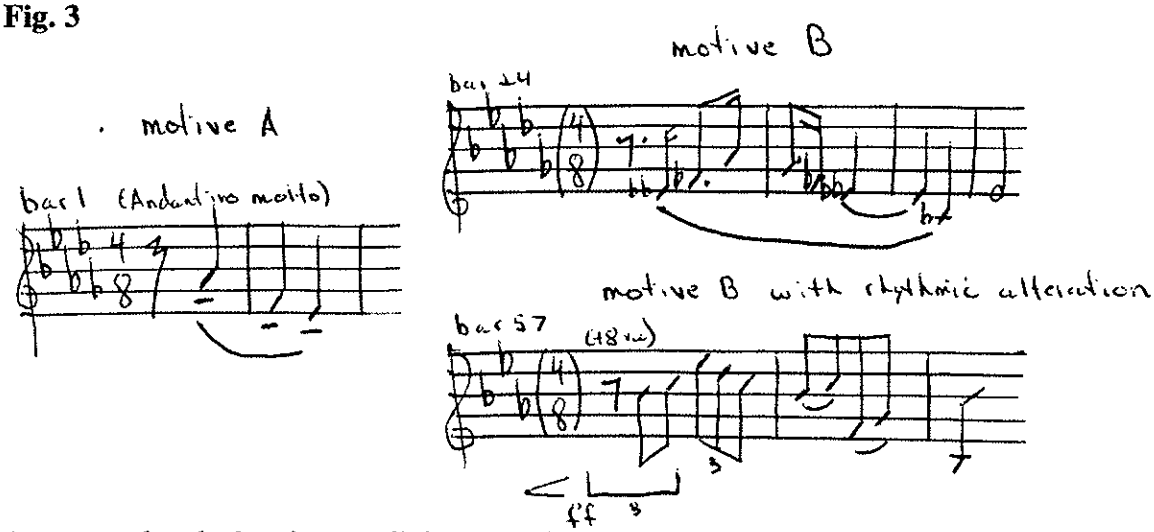


Thankfully, the irrational value of the GS can be expressed in a more proficient manner. As was mentioned before, the irrational number of .618034 . . . is approached asymptotically which means the proportion of b/a = a/a+b will approach .618034 . . . but will never reach it exactly. When we substitute in Fibonacci numbers for the equation, the larger the number, the closer one gets to the desired number. The Fibonacci series is as follows: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233 . . . Each number in this series is the sum of its previous two terms, as well as the fact that each number gives the nearest whole number to the GS of its two neighboring numbers. For example, if one takes 34 x .618034 the resulting answer is 21.013 . . . ; 34/.618034 the result is 55.013 . . . (Howat 2). These numbers show up quite frequently in well-defined places in these composers' music. These are unusual numbers musically speaking, but intelligible in terms of the Fibonacci series. There are 55 bars in the introduction to *La Mer*, 21 bars of introduction in 'Rondes de Printemps', and the 55 bars to the beginning of the climax in 'Reflets dans l'eau' (Howat 3). Some quick examples in Bartok are: There is 443 bars *Sonata for Two Pianos and Percussion* the recapitulation begins at bar 274 -- 443 x .618034 = 274. Movement I of *Divertimento* consists of 563 triplet units; when one takes 563 x .618034, the result is 348 -- again the exact bar where the recapitulation begins (Lendvai 18).

We are now ready to look at how Debussy uses the Golden Ratio to express his musical ideas. I have chosen pieces exclusively from Debussy's piano works. They are 'Reflets dans l'eau', and *Suite Bergamesque* (specifically 'Clair de lune'). The first piece, 'Reflets dans l'eau,' is from Debussy's *Images*, bk I. This set of pieces was

completed in the summer of 1905. Debussy died in 1918; the relevance of this fact will be seen in the next section. 'Reflets dans l'eau' opens the *Images*, bk I despite the fact that it was last in order of composition (written in August of 1905). This set of pieces is much like *La Mer* (composed in the spring of 1905) in that they are similar in "breadth of architecture." Compositionally the work is like an altered rondo. The rondo is built on two repeated motives *A* and *B* (Howat 23). The motives occur as shown in Figure 3:

Fig. 3



A starts and ends the piece outlining a rondo with major returns at bars 35 and 71. *B* is more melodic as opposed to *A*, and begins with *A* in retrograde. When *B* appears, it creates a contrasting episode-like section to the *A* section. *B* has major entrances at measures 24, 50, and 78 -- one entrance in each of the rondo returns prior to the coda (Howat 23-24).

We therefore have a form of *ABABABA* in 'Reflets dans l'eau'. However, while it is not the motivic order which is obscure, what clouds this sequence is the fact that the tonal and dynamic schemes follow a much different course than that of the thematic sequence. These separate musical "turning points" have important entrances at 43, 48,

56, and 69. This is one reason why the term "altered" rondo is used instead of a rondo in the strict, academic sense: The dynamics and tonal schemes outline the piece more aptly than do just an *A* section and a *B* section (Howat 24).

These entrances (entrances of dynamic and tonal importance) come about, quite noticeably, by wave-like tendencies. The first such wave-like section builds up to its climax at bars 30-31. The second, larger wave section builds up and culminates between bars 56-61. It is noteworthy that in both cases similar events shape the formation of the "wave" effect. In the first example, the tonal center modulates, after being mainly tonic throughout. This modulation prepares for the entrance of motive *B* at bar 24, which then leads to the aforementioned climax at measure 30. Similarly, in the next section the tonic modulates at bar 43 leading to the entrance of the *B* motive at bar 50 (Howat 24).

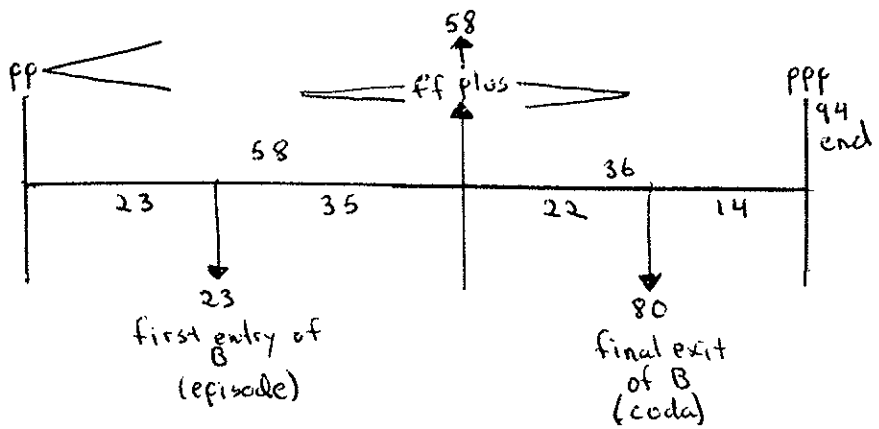
If the first two sections were a building up of waves, then the final section after the second climax is a calming of the waters. Debussy here delays the return of the tonic as long as possible. The original tonality returns at measure 69 with the return of the five flats and a dominant ninth chord. We then expect the tonic return at 73, but find that it drops out when a descending run in the tonality of bars 67-70 appears. Our ears are finally content at bar 77 when the tonic is held; even now it is still adorned with additional sevenths and ninths (Howat 24).

Apparently the piece's scheme is crucial in defining and giving the fullest impact to the structural surge. Evidence of this lies in the *pianissimo* beginning and the triple-*piano* ending.

Interestingly enough the piece has 94 measures total and the dynamic climax comes at bar 58 -- This is 58/94 of the way through, which cancels out to 29/47. The importance of this is that 29 and 47 are consecutive numbers in what is known as the Lucas series. This series is much like the Fibonacci series in that each number is the sum of the previous two. The series is as follows: 0, 1, 3, 4, 7, 11, 18, **29**, **47** . . . Ergo, the work's dynamic peak occurs to the nearest bar with its GS (Howat 24).

Motive *B* is the predominant motive of this climactic section -- its first appearance being at measure 23 and its disappearance follows measure 80. This is plotted in Figure 4 below. The first episode (bar 23) and the coda (bar 80) are two secondary GS points between the beginning and climax and the climax and ending, respectively. There is, however a slight error in calculation: the entrance at 23 is one bar later than the theoretical GS point of 22 --the reasoning behind this will appear in the next paragraph (Howat 25).

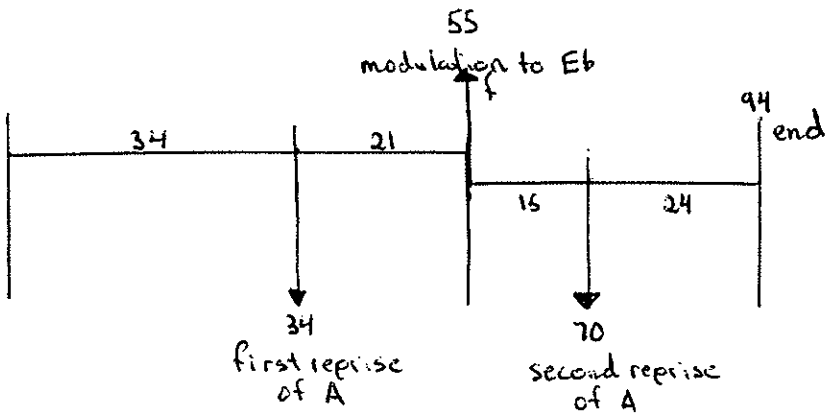
Fig. 4



The rondo entrances can also be diagramed in a fashion similar to that of Figure 4.

As we have already seen the first return of the rondo is seen at measure 35; this signals the GS between the beginning of the piece and the start of the climactic passage (at bar 56). Similarly, the other rondo return comes in at bar 71 and divides the climax with the end in a GS ratio of 15:24. This scheme is plotted out in Figure 5:

Fig. 5

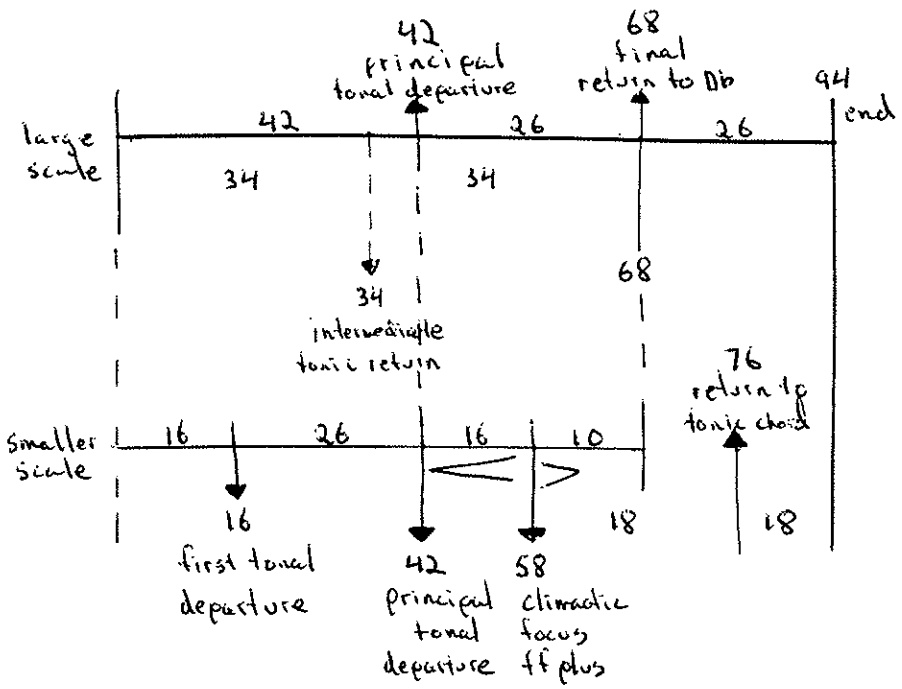


Notice that this somewhat staggered, almost "contrapuntal" section offers a solution to the inaccuracy mentioned earlier. Adding the extra bar in Figure 4 keeps the two sections staggered. If the theoretical "22" had been used, the two sections of 21 bars would overlap. The addition of the one bar avoids the confusion of two overlapping sections (Howat 25-26).

After calculation one finds that measure 56 is not the piece's overall GS. This can be explained by the fact that the first two events in Figure 5 (measures 34 and 56) are important tonal areas, unlike measure 70. These two more significant tonal centers are part of a more extensive proportional design -- this is shown in the top part of Figure 6. This (the new proportional scheme) divides the total 94 bars into another major

proportional sequence. The major tonal departure, at bar 42, is the GS on the way to the return of the original tonality at measure 68. The latter point creates a symmetrical division of 26:26 bars between bars 68 and 94. This completed succession of divisions (42:26:26) when reduced to lowest terms (21:13:13) should look rather familiar. The numbers in the ratios are members of the Fibonacci series. **These new points of symmetry introduce an idea that is prevalent in the analyzed works of Debussy -- points that mark the GS are usually analogous to tension, whereas points of exact symmetry are associated with balance.** To illustrate this point further in Figure 6 we see that the first tonic return occurs at measure 34. The final return to the tonic tonality occurs exactly 34 bars later at measure 68 (Howat 26).

Fig. 6

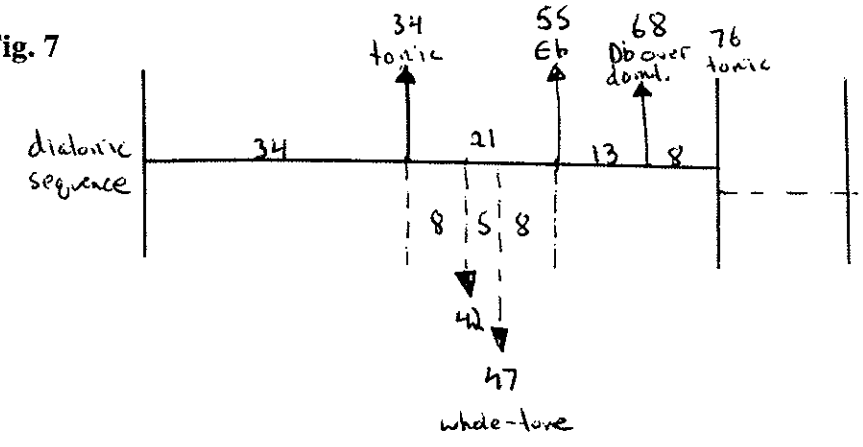


When the "climactic focus" at 59 is added, the dramatic focus of the larger scale

tonal sequence is made clear. The first departure from the original tonality (plotted in the lower half of Figure 6) creates a secondary GS in preparing for the primary modulation. This then creates a ratio of 16:26 (reduced to lowest terms we get 8:13, again members of the Fibonacci series). Accordingly, the main tonal modulation at 42 marks the primary GS between the first tonal departure and the dramatic focus after 58. Within this proportion the climactic focus creates a corresponding GS of 16:10 between the main modulation at 42 and the final return to the original tonality at 68. This smaller scale diagram produces a series, when reduced, of 8:13:8:5. It can clearly be seen how the dramatic aspect is an important function of the overall tonal scheme (Howat 26-27).

The only remaining tonal return is the reappearance of the tonic at 76. We see here again the feeling of balance as the tonic return is at the halfway point between the climactic focus and the end of the piece (18:18). This point, however, has another important tonal function. The plagal passages in the coda are just embellishments on the tonic, therefore, measure 76 is the final tonic resolution. This is the fourth major tonal center of the piece as well -- the tonic at 35, the supertonic at 56, the dominant at 69, and the tonic again at 76. This series (I-I-II-V7-I) creates a Fibonacci series of 34:21:13:8. This new proportional design is diagramed in Figure 7 (Howat 27).

Fig. 7



To complete the diagram in Figure 7another harmonic transition must be added; at 47 we experience a shift to whole-tone harmony. So in the 21 bars between the tonic and supertonic we see a symmetric ratio of 8:5:8 -- the first 8 measures from the tonic to the principal modulation, the 5 measures from the principal modulation to the whole-tone passage, and the last 8 measures from the whole-tone harmony to the entrance of the supertonic. Between bars 35 and 68 we have a "network" of Fibonacci ratios of 5:8:13:21 going into and crossing over the climax, "so that the dynamic quality of this passage is emphasized by Fibonacci ratios in its internal bar-groupings" (Howat 27).

As was said earlier, the opening section of this piece had wave-like characteristics. The crests of these waves give each wave a GS shape (5 eighth notes out of 8). The *A* motive is also introduced in these opening sections forming a similar sequence of 3:2 semitones, so that "the geometric characteristics of the entire form" should be easily heard by the listener from the onset of the piece (Howat 28).

Could these geometric wave patterns have something to do with the title of the piece? Indeed, many of the aforementioned sequences are seemingly reflected around a central musical idea, coupled with the fact that the "reflected portions (or images) tend to be compressed in size, giving an effect of refraction -- another aspect of reflection in the water." The fine pianist Marguerite Long, who studied this very piece with Debussy recalled that Debussy "likened the A motive to a pebble dropping in water -- after which one's view of it would be refracted" (Howat 28).

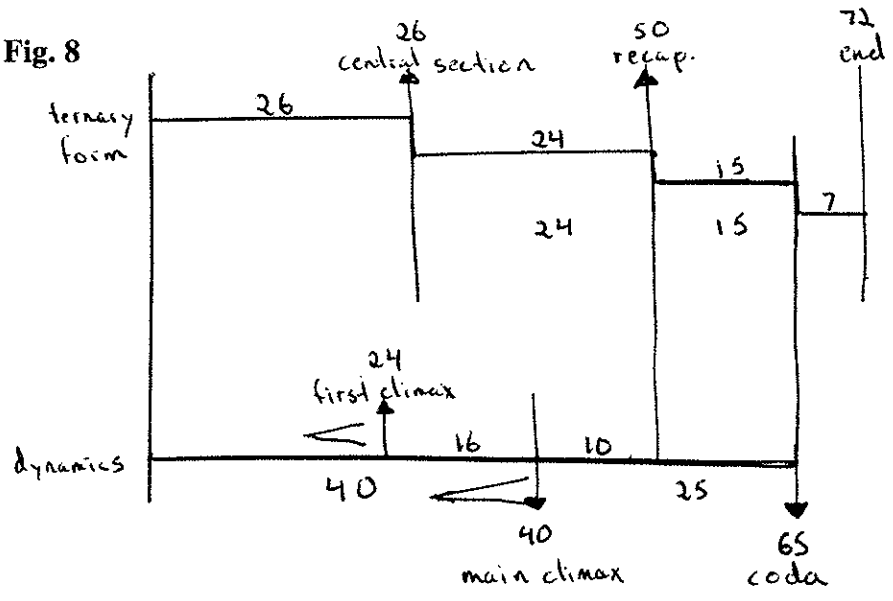
The next piece to be analyzed is the *Suite Bergamesque* in particular *Clair de lune*

also composed in 1905. The fact that both of these works were composed later in Debussy's life show that he probably worked on using the Golden Section in his compositions until he perfected the method the best he could -- as seen in these works. The 'Prelude,' 'Menuet,' and 'Passepied' are not nearly as dramatic and also they do not have the exquisite proportional construction previously seen in 'Reflets dans l'eau'.

'Clair de lune,' however is unique when proportionally compared to the other pieces of the *Suite Bergamesque*. Even the poetic sounding title is different from the dance-like movements implied in the titles of the other three pieces. One only needs to look at the ternary forms of the 'Prelude' and 'Clair de lune' to see how daring Debussy has become. In the 'Prelude,' the form is emphasized by the changes in key and dynamics; conversely in 'Clair de lune' the latter masks the former which forces the listener to focus on the two part wave shape -- much like that found in 'Reflets dans l'eau'. The handling of transitions and harmonic tension create a better dramatic element even with a smaller range of dynamics. (Howat 41).

In Figure 8 the primary proportional scheme of 'Clair de lune' is plotted out. The two main divisions of the ternary form are found at bars 27 and 51.

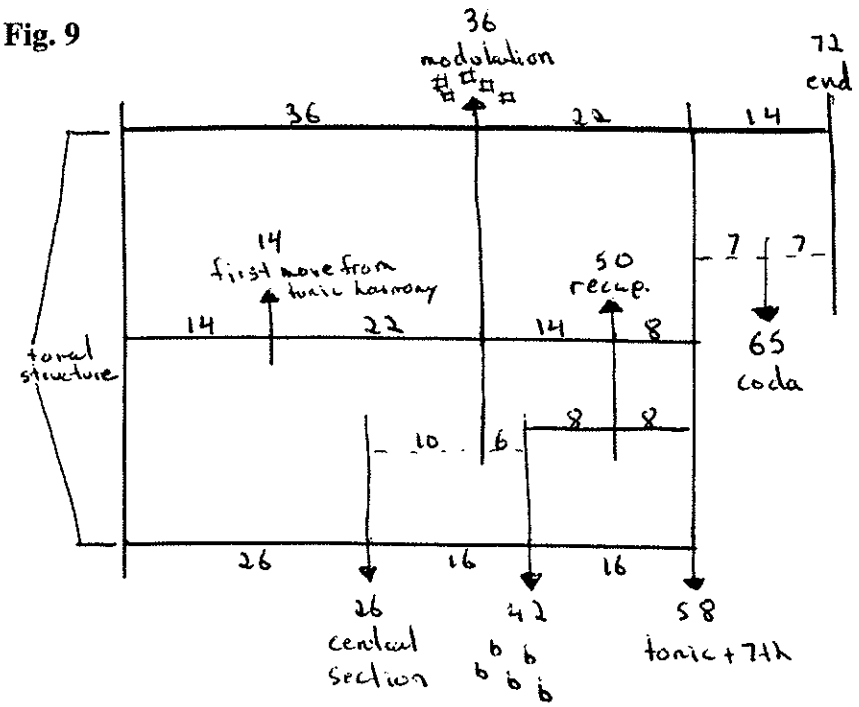
Fig. 8



These three divisions create a descending ratio of 26:24:22 measures. The last set of measures is further divided into a ratio of 15:7 by the coda at 66. As for the dynamic scheme, the first dynamic peak is at bar 24 -- a measure within the GS of the major climax at bar 40. This climax at measure 40 creates a GS of 40:25 between the beginning of the piece and the start of the coda and a ratio of 16:10 between the first climax at 24 and the recapitulation at measure 50. This recapitulation at 50 in turn forms a GS between the onset of the "central section" and the start of the coda (Howat 41-42).

As opposed to the rest of *Suite Bergamesque*, 'Clair de lune's tonal design is a study in subtlety. For instance at measure 15, Debussy moves away from the tonic but does not completely modulate; this modulation is saved for measure 37 so there is only one modulation throughout the entire piece. The ease with which Debussy changes tonality in such a small setting (72 measures) is displayed in the following transition areas. The first of such points is at measure 43 where the original tonality comes back over a dominant bass figure. Tricking our ears and avoiding the anticipated tonic chord, he begins the recapitulation on the mediant chord and ultimately achieves the tonic seventh chord at bar 59 which leads to the complete tonic resolution at the onset of the coda at measure 66 (Howat 42). The schematics of these points are plotted below in Figure 9:

Fig. 9

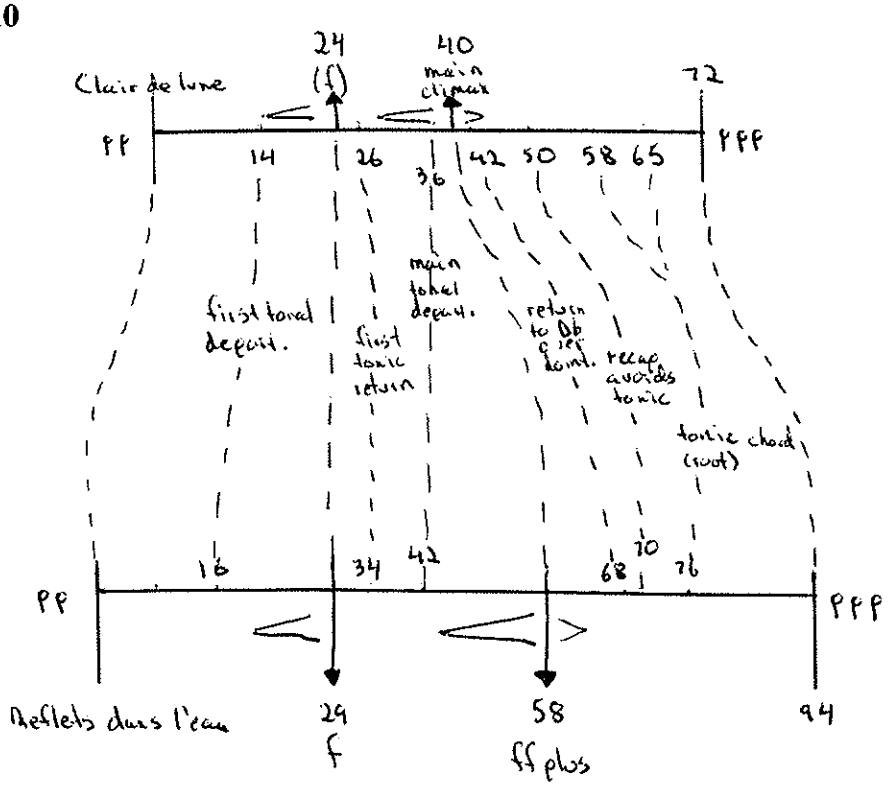


The major focus of development is at the exact halfway mark of the piece at measure 36. This point also happens to be the GS between the beginning of the piece and the return of the tonic at bar 58; this in turn forms a GS pattern of 36:22:14 from the beginning to the end of the piece. There are also secondary points of GS the first of which comes at the first move away from the original tonality at bar 14 and the next point comes at the recapitulation immediately following bar 50. This creates a GS ratio of 14:22:14:8 from the start of the piece to the return of the tonic in measure 59. Underlying the GS patterns in the aforementioned 58 measures, a ratio of 26:16:16 (13:8:8) is formed from the 26 bars before the central section (Figure 9), 16 measures before the return to the original tonal structure, and 16 measures before the reappearance of the tonic at bar 59. Because of the coming together of the two GS sequences, they must naturally correspond: The modulation at bar 37 creates a GS of 10:6 between the

start of the central section (bar 26) and the return to the original tonality (bar 42). Likewise, the recapitulation at measure 50 forms a symmetrical division of 8:8 between the return of the home tonality and the restoration of the tonic chord. Lastly, the beginning of the coda forms another symmetrical division of 7:7 between the tonic return at measure 58 and the end of the piece (Howat 43).

After analyzing these two pieces, 'Reflets dans l'eau' and 'Clair de lune,' some rather interesting parallels can be made concerning the structure of the two pieces. There are several; leaving out the obvious same key relationship: the larger dynamic wave came before the smaller one; the main move away from tonic was preceded by the related smaller harmonic departure; the deliberately, symmetrically placed return of tonic over a dominant bass and its reluctance to move directly into the tonic. More of these parallels are diagramed in Figure 10 (Howat 43).

Fig. 10



A final note on 'Clair de lune' is the interesting fact that it lies at the GS of the *Suite Bergamesque*. This is important only in the sense that it is so different from the dance-like pieces in the rest of the suite, making it the "lyrical climax of the suite." In this respect, its swell in structure is somewhat anticipated by the smaller proportional design found in the Menuet. If this was Debussy experimenting with GS and other non-GS symmetries, he truly used these two methods to the fullest extent in the massive design of *Suite Bergamesque* (Howat 44-45).

With our analysis of the selected works of Debussy, one must keep in mind that these are just representative of his works for the piano and what is seen here is a small sample of those works. Some of his orchestral works, *La Mer* in particular, use these same proportions. Now we will look at how Bela Bartok uses the Golden Ratio and Fibonacci series to work his wonders in the compositional world.

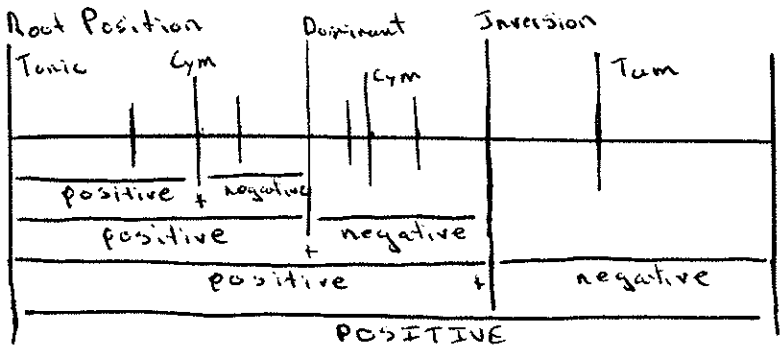
When analyzing Bartok's music it is easier to analyze the methods he used, rather than his works, as was done with Debussy. Bartok uses his major methods in so many pieces that it would not be reasonable to cover all the works, but rather a single work and technique. Thus, one piece is selected for analysis in terms of the Golden section and/or Fibonacci series.

As was said, the only work that will be analyzed is concerned with the Golden Section; this work is *Sonata for Two Pianos and Percussion* (composed in 1937) particularly the 1st and 3rd movements. Again we see that Bartok composed this in his later life, much like Debussy. Beginning with bars 2-17, the "organic life of the work

begins." The first part, measures 2-5, of this larger section is concerned with the tonic, the second subsection (bars 8-9) relates to the dominant, and the final subsection is concerned with the subdominant. We will consider time in 3 eighth-note units. The whole section consists of 46 units. The GS, therefore of this passage, is 28; this point marks the inversion of the theme to form the subdominant (Lendvai 19-20).

Subdividing the section up to the entrance of the inverted theme (the first 28 units), when we take 28 by its GS and come up with 17.3 units -- this is where the tonic ends and the dominant takes over. When talking about Bartok the terms will be positive GS and negative GS, respectively. A positive GS is one in which the larger section comes first and when talking about the negative section, vice versa (See Figure 11).

Fig. 11



There is an interesting twofold relationship between the tonic and dominant parts, in particular where the cymbal enters in each case. The cymbal strokes mark the GS in both sections, but in the tonic it is divided in a positive section and in the dominant passage it is divided to make a negative section. These two sections seem to mirror one another, yet their meeting point designates a positive GS in itself. Therefore, the mixing together of the positive and negative nodes creates a "longitudinal undulation" the crests

ultimately leading to a positive section. The corresponding negative is marked by the tam-tam so that the root position and inversion sections are joined symmetrically once again (Lendvai 21).

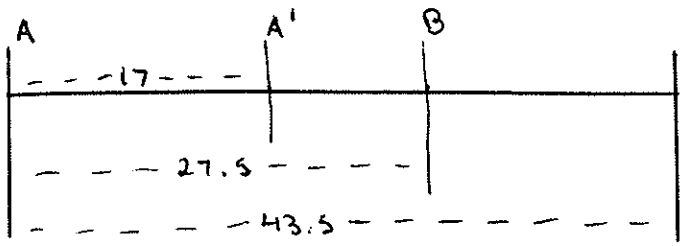
The same is true on even a minute scale. For example, in the dominant passage before the cymbal comes in, there are 11 eighth-notes. The positive GS creates a division of 7+4 and in turn makes for the stress experienced by the lengthened E-flat note. Likewise the tonic section up until the entrance of the cymbal is marked by the most crucial point; when we count in eighths there are 33 and 33 x GS = 20. It is at the 21st eighth-note that the "thematic condensation" begins (Lendvai 21).

In summary, the smaller and larger formal aspects are made up of a symmetric network of positive and negative sections. From these linked sections comes a single "potential" form. Thus from this and other studies we can see that a positive section is characterized by build-ups of intensity and drama, while negative sections contain passages that seem to fall or recede (Lendvai 22).

We are now ready to move on to a more detailed look at the 3rd Movement of *Sonata for Two Pianos and Percussion.* The form shows how tightly knit the proportions of the exposition are. The opening theme balances the closing theme in that the former has a positive section and the latter a negative section and the secondary theme is symmetrically placed between. The main theme in the 3rd movement of *Sonata for Two pianos and Percussion*, which is 43.5 measures long, is divided into three sections: A, A', and B. Point B marks the positive GS (43.5 x .618 = 27.5) whereas A and A' are divided at bar 17 in another positive GS (See Figure 12 for a

diagram of A, A' and B).

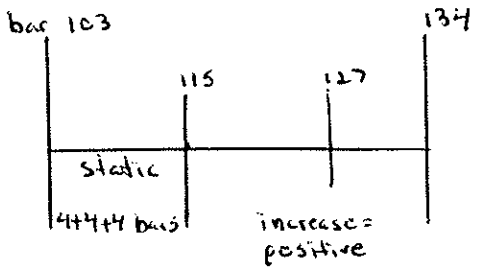
Fig. 12



The division of the secondary theme is perfectly symmetrical in relation to the GS divisions of the first theme. From bars 44-102 the ratio of bars is 12:17.5:17.5:12; the center of this section at bar 72 goes along with the "tonal construction of the theme also" (Lendvai 22-23).

We now come to the closing section which is a negative one marked by measure 115. Within this overall negative section there is a positive section marked by measure 127 between bars 115 and 134 (See Figure 13). The static 4+4+4 unit in the negative section provides a good foundation for the dynamic ascent in the positive section (Lendvai 23).

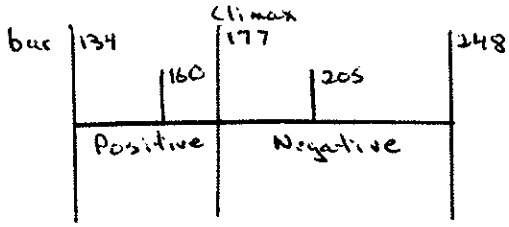
Fig. 13



The development section is symmetrical in construction as well (measures 134-247). The negative main section of the development is marked by the climax point at

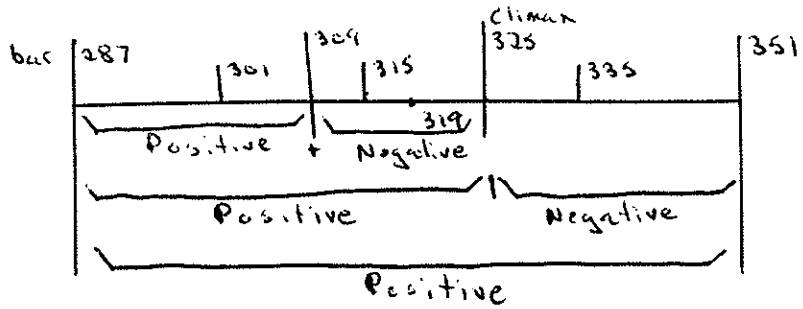
measure 177. The positive GS before 177 and the negative GS afterwards mark the two most crucial points of change in the development: at bar 160 we find the fugato of the main theme and at bar 205 the reappearance of the first development theme comes in with the xylophone (Figure 14) (Lendvai 23).

Fig. 14



In the recapitulation (bars 248-350) a negative main section is formed with the peak of thematic material at measure 287. Following the peak (See Figure 15) the measures make up a single wave which is similar to the opening section of Movement I analyzed earlier.

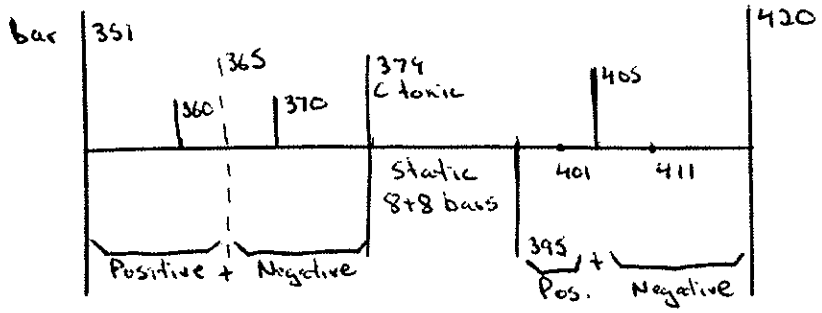
Fig. 15



The coda is, like the previous section, a negative section determined by the return to the tonic C at measure 379. This section corresponds to the "thematic center of gravity of the whole coda." As seen in Figure 13 with regards to the negative section we saw a 4+4+4 static section; a similar section of 8+8 is seen from bars 379-394 in Figure 16

(Lendvai 24-25).

Fig. 16



Bars 351-378 of the coda combine symmetry and GS; two sections, positive and negative, form 9+5 and 5+9 units respectively. Likewise measures 379-420 have a positive section (bar 405) and a negative section (bar 395). And finally within bars 395-420, we have a positive section (bar 401) between bars 395 and 404 and a negative section (bar 411) within bars 405-420 which are all symmetrically connected to each other. On a final note, to show once again Bartok's conscious knowledge of the Golden Section we turn to the overall structure of the entire work whose movements go slow+fast, slow+fast. One might expect that the GS would appear at the second slow movement -- this is very true, the piece contains 6432 eighth-notes and the second slow movement begins on the 3975th eighth-note, the exact GS of all the notes (Lendvai 25-26).

Now we are ready to look at the techniques that Bartok uses in his works that result from the Golden Section. In this section we will look at how Bartok bases his chords

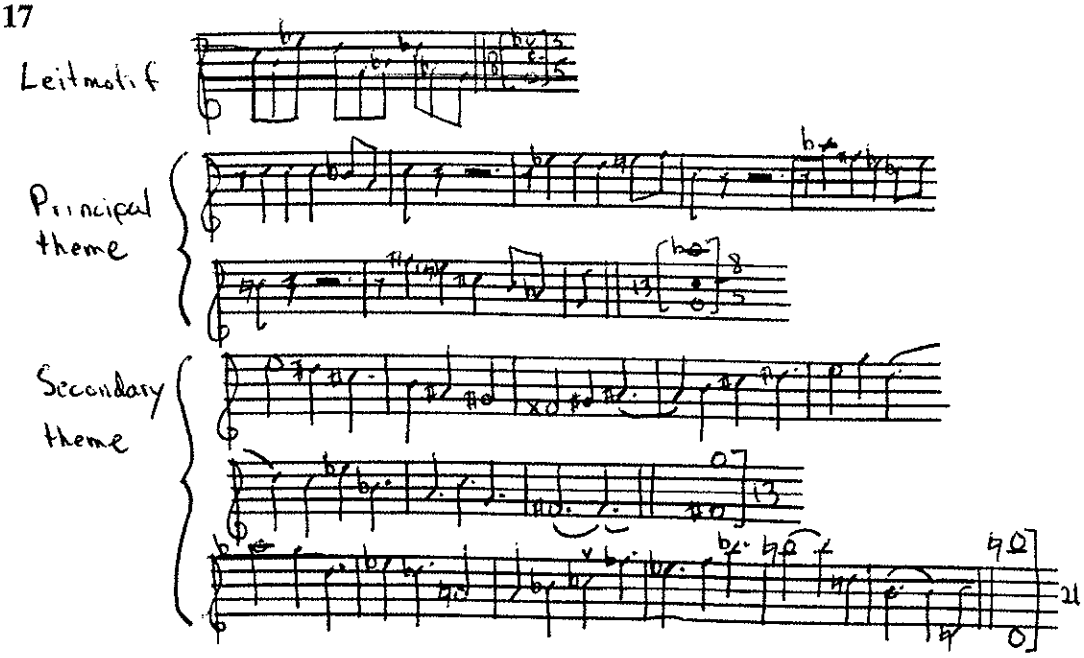
and intervals on the GS and in particular the Fibonacci series. If we use half-steps to count between intervals we come up with the following:

2 stands for a major second
3 " " minor third
5 " " perfect fifth
8 " " minor sixth
13 " " an augmented octave, etc.

Therefore, the intervals and chords can be constructed by using groupings of 2, 3, 5, 8, and 13 in accordance with the above table. Consequently, 8 can only be divided into 5+3, or vice versa (proportionally, these are the only practicable divisions) (Lendvai 35).

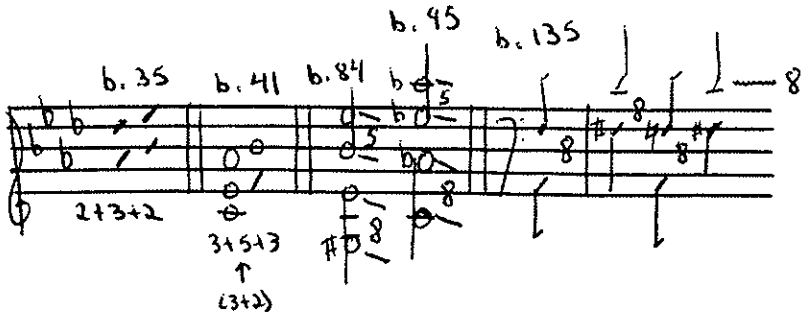
In Figure 17 we have a similar formation of Fibonacci intervals. This diagram refers to the 1st movement of *Sonata for Two Pianos and Percussion*. The 8 half-step range of the leitmotif is divided by the home note of C into a 5+3 division. Likewise, the main theme is a 13 half-step range divided once again by the fundamental C into a 5+8 grouping. The secondary theme's first section has a range of 13 semi-tones and the second section has an interval of 21 half-steps. As one can see from the previous examples they go in a GS order:

Fig. 17



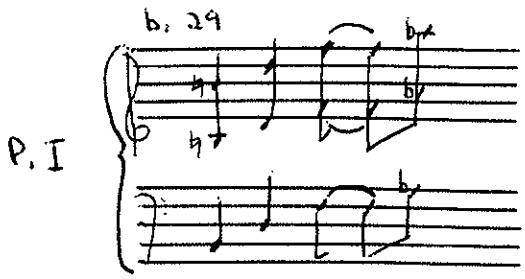
As far as the *harmonic* construction goes, the make-up is indeed systematic. The main theme obtains its "magical tone-color" from a *pentatonic* harmony. In Figure 18 The main theme is an ostinato constructed as 3+5+3, the fourth of E-flat to A-flat is further divided by an F-sharp into 3+2. The secondary theme contains fourths and minor sixths which are parallel also. Lastly the final theme is characterized by parallel minor sixths (Lendvai 38).

Fig. 18



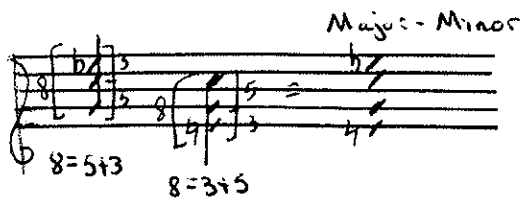
A question is probably forming at this point -- why aren't major thirds and major sixths used as well? The answer is, however, rather obvious: these intervals don't fall into the GS system of intervals. In that parallel fifths and octaves are forbidden in classical compositions, it is the opposite in Bartok's works. The major third, then, has no real melodic function; this role is reserved for the minor third as seen in the following example from *Sonata for Two Pianos and Percussion* (See Figure 19) (Lendvai 39).

Fig. 19



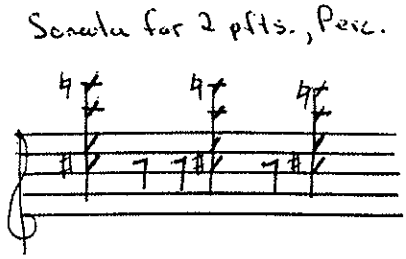
Out of this fact comes one of Bartok's most common compositional devices the major-minor, or Bartok chord. Whenever he used a triad in a *chromatic* movement, he put the minor third over the fundamental note and the major third underneath it. This created an internal proportion of 8:5:3 as shown below in Figure 20.

Fig. 20



The newly formed chord incorporated a minor third - perfect fourth - and a minor third coming up with a Fibonacci system of 3+5+3. This is usually seen with the seventh of the root note as seen in Figure 33. Some other examples of this creation of Bartok's are shown in Figure 21 (Lendvai 40).

Fig. 21



Now we are ready to move on to another group of GS chords that appear throughout Bartok's compositions. These chords are representative of intervals

constituting ratios of 1:5, 1:3, and 1:2. The GS relationship, then, forms a ratio of 5:3:2. Their construction is thus:

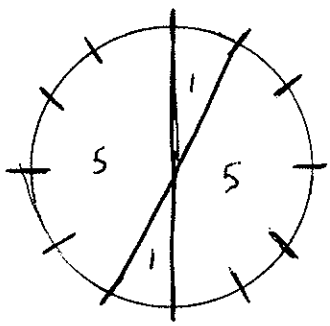
Model 1:5 alternating minor seconds and perfect fourths
i.e. C-C sharp- F sharp-G-C . . .

Model 1:3 alternating minor seconds and minor thirds
i.e. C-C sharp-E-F-G sharp-A-C . . .

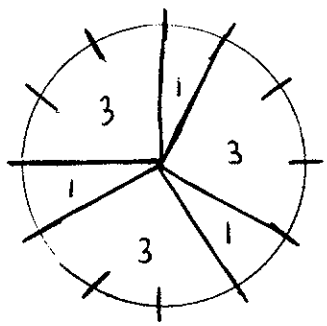
Model 1:2 alternating minor seconds and major seconds
i.e. C-C sharp-E flat-E-F sharp-G-A-B flat-C . . .

The visual models for these three systems and the 1:3 model found in *Sonata for Two Pianos and Percussion* are found below in Figure 22 (Lendvai 51-54):

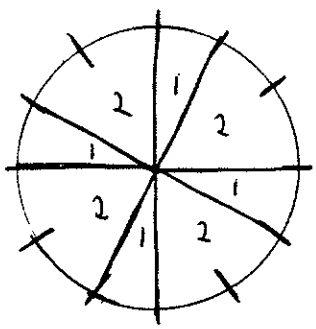
Fig. 22



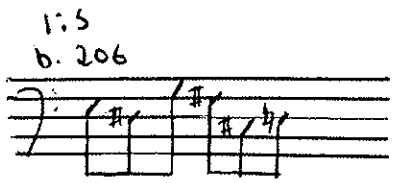
1:5 Model

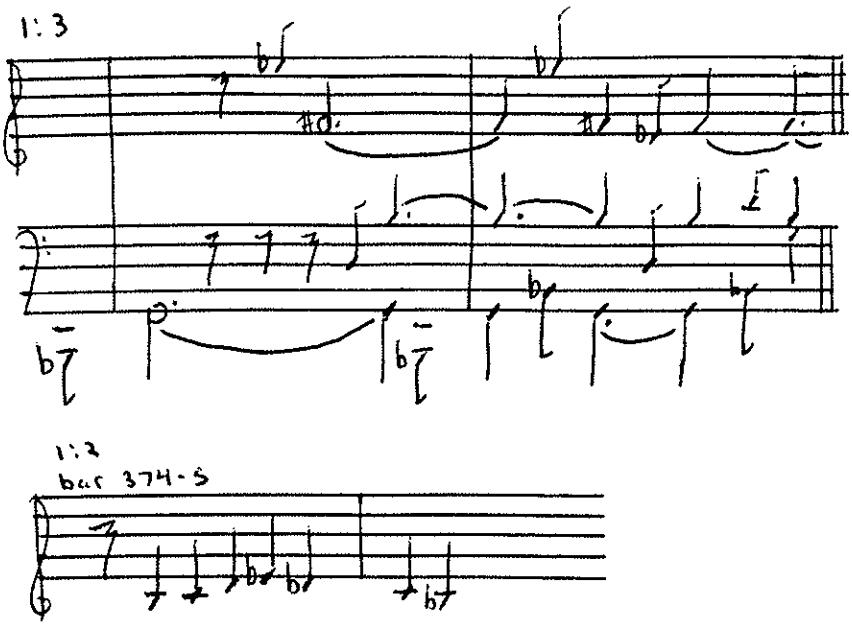


1:3 Model



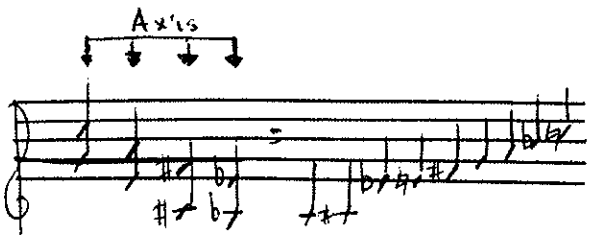
1:2 Model





The most important of these systems is model 1:2 because it, in scalar form, represents the axis in Figure 23. This scale is one that is one of Bartok's main standbys and is used to determine the tonality of his chromatic melodies and chords (Lendvai 55).

Fig 23



Out of this diagram comes an important revelation: there exists an important correlation between the above axis system, the *alpha*[1] chord, and Models 1:2 and 1:5. If

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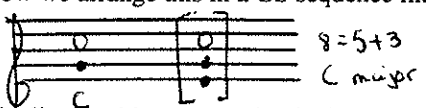
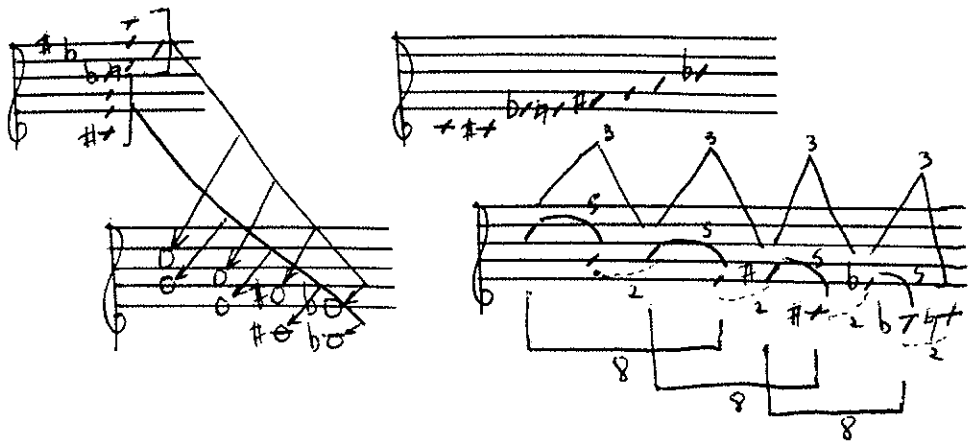
An alpha chord is created by taking a note, C for instance, and adding the fifth (G) and third (E). Now we arrange this in a GS sequence like so (Lendvai 43):



The only guideline on this construction is that the alpha should be composed of two "axes" comprised of the tonic and dominant.

the top C-A-F sharp-E flat and the bottom G-E-C sharp-B flat portions of the axis, this results in the *alpha* chord (Figure 24). If the "pole-counterpole" relation is separated, the 1:5 ratio is formed. If the notes of the axis are put in a scale form, a 1:2 correspondence is created. With regard to tonality, these possible outcomes are not capable of being separated. The function of the 1:2 model can only be helped by the alterations, i.e. major, minor, seventh, or alpha chords. This then explains why Bartok's axis melodies are totally dependent on the Golden Section.

Fig. 24



We have now seen, in some detail, how each of these composers uses the Golden Section and other symmetries to convey their musical ideas. Debussy's music, when listened to, reflects the wave-like and dynamic surges that the proportional structures indicate. In 'Reflets dans l'eau' the dynamic builds and other dramatic swells might

make one think about the sea and its power. Little do the listeners know that the dynamics he or she hears are the result of carefully planned out proportional balance between dynamics, thematic materials, and various tonal centers. 'Clair de lune' is a grand piece with a magnificent use of dynamics and other aspects. The placing of the major focus of development (the modulation from sharps to flats) at the exact halfway point of the piece indicates a mind as intricately woven together as the music it composed.

Likewise with Bartok's music we see a mind that is concerned not only with expression, but also with structure. As we have seen in *Sonata for Two Pianos and Percussion* the GS relationships are present down to the eighth-note. The intervals and chords that he used were based on the Fibonacci series. His use of these numbers indicated his fascination with the beauty of this proportion. In themes throughout his music the composition and order that the numbers are seen show that he knew exactly what he was doing. Finally, the versatility of the axis system and the 1:2 model prove to be the basis for numerous devices that Bartok used in his compositions.

All this proves to be overwhelming evidence to suggest that Debussy and Bartok not only used the Golden Section and Fibonacci numbers in their works, but they used this ratio consciously to achieve a desired effect. The effect that is achieved in each of the analyzed works as a direct result of the proportional scheme more than demonstrates that these composers were conscious of the fact that they were using such numbers. However for those who still are not convinced, I leave you with a passage from Debussy's own hand to his publisher Jacques Durand from page 7 of Roy Howat's

analysis of Debussy's music:

"You'll see on page 8 of 'Jardins sous la pluie' that there is a bar missing -- my mistake, besides, as it's not in the manuscript. However, it's necessary, as regards number; the divine number, as Plato and Mlle Liane de Pougy would say, each admittedly for different reasons."

WORKS CITED

Bartok, Bela. Sonata for Two Pianos and Percussion. London: Boosey and Hawkes, Ltd., 1942.

Howat, Roy. Debussy in Proportion: A Musical Analysis. Cambridge: Cambridge University Press, 1983.

Lendvai, Erno. Bela Bartok: An Analysis of His Music. London: Kahn & Averill, 1971.

WORKS CONSULTED

Ankoletz, Elliot. The Music of Bela Bartok: A Study of Tonality and Progression in 20th Century Music. Berkeley: University of California Press, 1989.

---, Bela Bartok: A Guide to R esearch. New York: Garland Press, 1988.

Bartok, Bela. Mikrokosmos. New York: Boosey Hawkins, 1940.

Briscoe, James R. Debussy: A Guide to Research. New York: Garland, 1990.

Crow, Todd. Bartok Studies. Detroit: Information Coordinators, 1976.

Gillies, Malcolm. Notation and Structure in Bartok's Later Works. New York: Garland, 1989.

Lockspeiser, Edward. Debussy: His Life and Mind. New York: Macmillan, 1962.

Parks, Richard S. The Music of Claude Debussy. New Haven: Yale University Press, 1989.

Suchoff, Benjamin. Bartok Essays. New York: St. Martin's Press, 1976.

Thompson, Oscar. Debussy: Man and Artist. New York: Dodd, Mead, and Co., 1937.

Wallace, Berry. Musical Structure and Performance. New Haven: Yale University Press, 1989.