184

Analysis Symposium

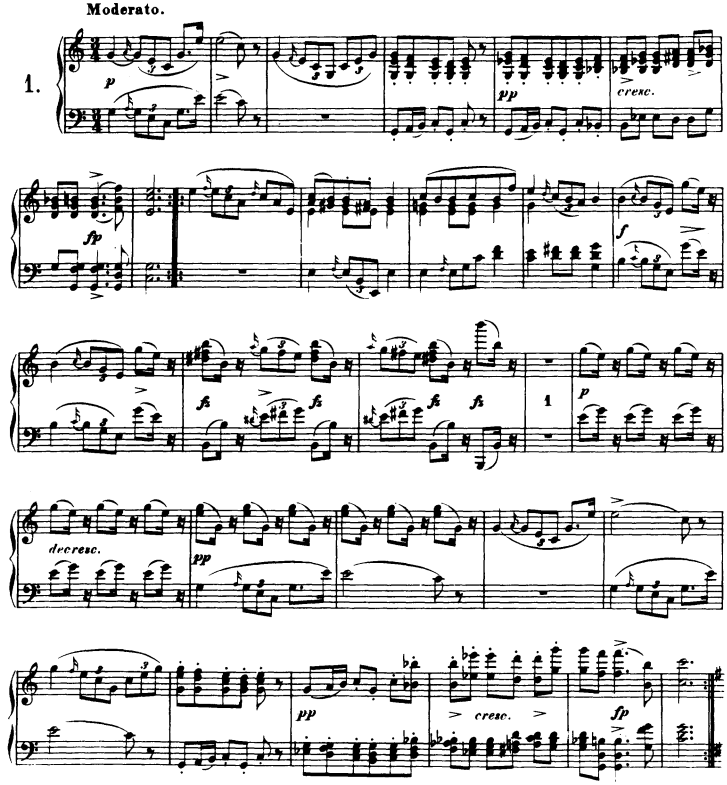
MATT HUGHES

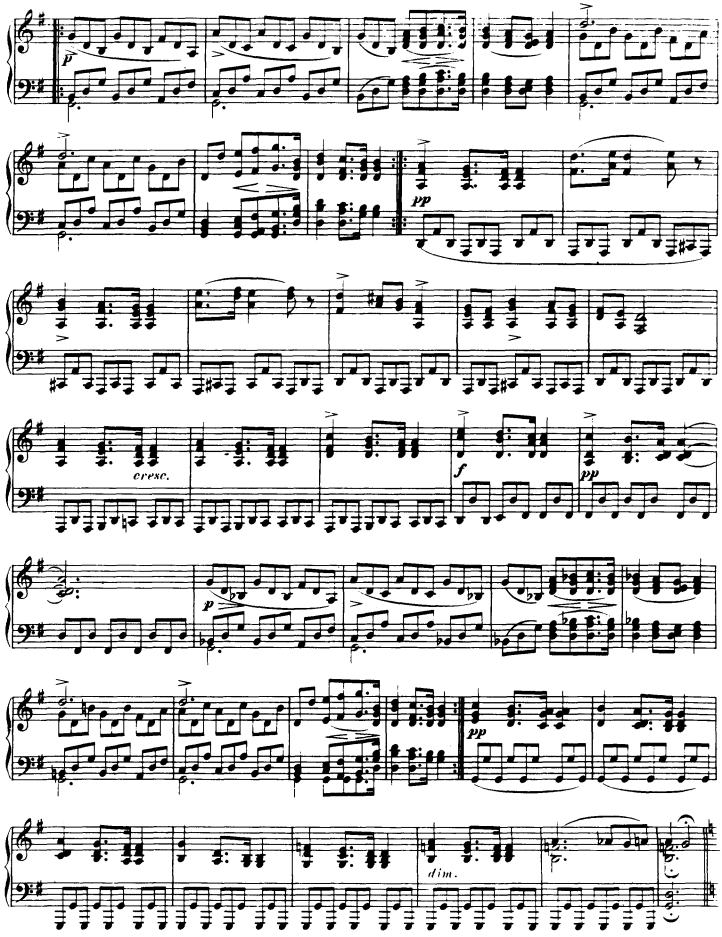
LAWRENCE MOSS

CARL SCHACHTER

MOMENTS MUSICALS, Op. 94.

FRANZ SCHUBERT

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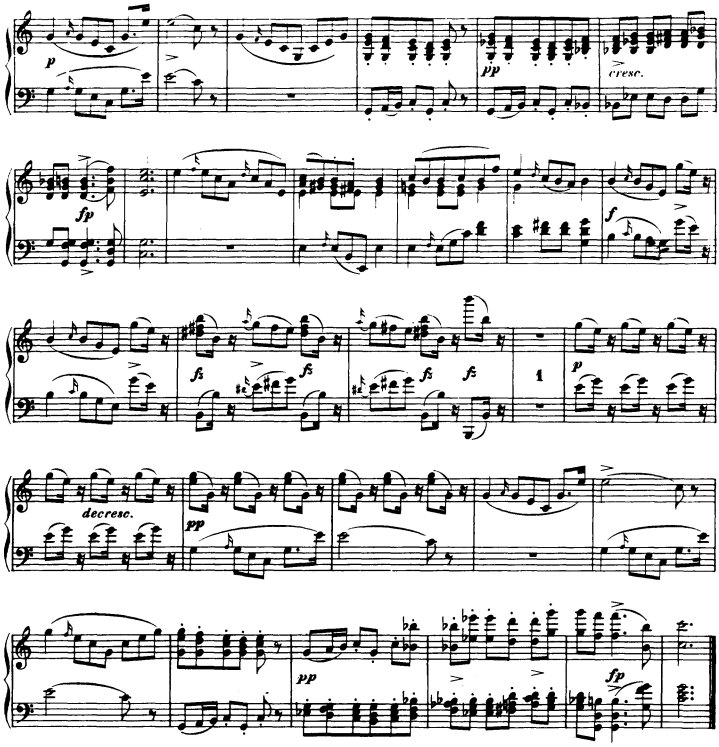
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Analysis Symposium

MATT HUGHES

A QUANTITATIVE ANALYSIS†

Through the creative thoughts of various musicians and mathematicians, the quantitative approach in analysis has cultivated the premise to an area in musicological thought which has yet to be either exposed or expressed in its entirety. Since the inception into this area of "quantitative musicology", the wise researcher is one who recognizes its many limitations in some respects, and, at the same time, realizes its almost boundless possibilities in other respects. As the technique is conceived

† The author wishes to express his gratitude to Hans Heinz Draeger, Professor in the Music Department of the University of Texas at Austin, for the encouragement and many helpful suggestions in the preparation of this article.

in mathematics, an area often frightening to musicians, many reactions are to label it as being beyond the comprehension or interest of a musicologist and to discard the technique and results as uninformative. This procedure was ameliorated for the benefit of the musician; and, therefore, it foregoes the complexities of mathematics to find its foundation in simple mathematics. Because the nature of this type of analysis appears to be perplexing to many musicians, a necessary portion of this paper will have to be devoted to the analytical procedure, in addition to discussing the results of this technique.

The objectives of this first procedure may be stated quite simply: (1) After counting the notes with its duration, some notes prove to be more significant than others. When viewing these important tone elements in terms of the circle of fifths, the wider the distance in steps of the circle of fifths and the greater the number of statistically important notes, the more complex is the tonal orientation of the composition. What is advantageous is that tonality may be expressed in terms other than functional; this mathematical precision can be invaluable.*1; (2) The other result is called tonal orientation, a term adopted to differentiate between it and tonal organization. Analysis of organization is an analysis of chords, progressions, measures, and periods in their mutual relationships. Orientation is at no time a chord-by-chord analysis but is a result of the total occurrence of each note and its durational value. This phenomenon is expressed in the statistically important notes discussed in the first result and is understood to be the over-all tonality or tonal orientation of a composition. This condensation of important notes or tonal orientation could reveal that a composition in C major, for example, was in reality tonally oriented toward G major, a consequence of semantic salience.*2

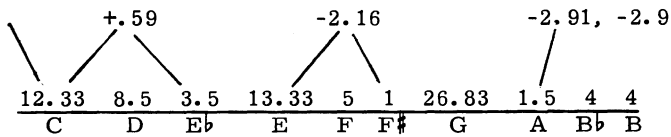
This technique is no more than a tool for the researcher. At no time is it meant to be a substitute for critical intellectualization. Rather, it is a tool for organizing data so that one may more discernibly view tendencies and interassociations. Analysing the piano preludes of Skriabin, this tool proved to be successful.*3

Turning to the music, Schubert has divided this composition into five parts (Measures 1-8; 9-29; 30-37; 38-58; and 59-65). The tempo of the composition is marked Moderato and the meter signature is $\frac{3}{4}$. The division of the beat is basically simple but Schubert chooses to enhance the playful character of the melody in the first two sections of the composition by the utilization of a triplet figure. Adding to this character, the triplet figure is

juxtaposed with the simple beat and developed upon with relative frequency. The texture in these two sections is either basically melody heard alone or doubled, or is harmonized in a pianistic fashion in which the chords and a melody line reverse hands at the end of the second section. It is important in this analysis to note that the first two sections (which are repeated after the last three sections) are given the key signature of C major. In the last three sections, the key signature is changed to G major. Here, the texture remains basically the same as in the first twenty-nine measures although the beat becomes primarily compound. In the fourth section, simple-beat chords are placed above an ostinato-like triplet figure. Also in this section, this rhythmic activity is continued, whereas the ostinato becomes a pedal-point on G. Although the parts are not equally divided, a sectional analysis by this tool is easily accessible.

Measures 1 - 8 (Bits = 79.99)

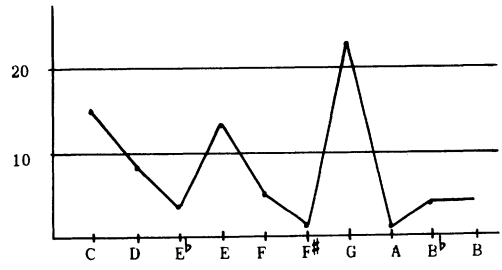
Step 1a: Closely related to the Fucks approach, the first step is to count every note of the composition according to its duration value. *4 Counting duration can not be over-emphasized as every note would be of equal value if duration were ignored. Alike note-name frequencies are then added together forming a scale pattern of an octave span. Step 1a, in itself, does not give a complete answer and hasty interpretations should be warned against. This, then, would establish that occurrence does not necessarily determine the tonality of the composition. Although the results are not available, it is to be expected that, for example, in Bach's "Praeludium I" in Das Wohltemperierte Klavier, Vol. I, the tonal orientation would be identical with the tonality of the piece; however, it might be questionable with regard to Bach's Chromatic Fantasia and Fugue in D minor. *5 Thus, the series which contains all notes with duration used in this composition is:



This may also be shown in the form of a graph (see Figure 1). Above the series of numbers another row of digits is listed. This additional row is the result of an analization of the complexity of the peaks. The digits are preceded by a plus (+) or

FIGURE

1



minus (-) sign, indicating the peak's relationship to its theoretical extreme, 100% information or 100% redundancy. This complexity of the peak is seen graphically when the peak affects either a convex or concave shape. The minor sign or concave shape indicates a tendency towards 100% information; and the tendency toward its opposite extreme, 100% redundancy, is represented by the plus sign or convex shape. This result is derived from the series by a sequence of three steps or more in either an increasing or decreasing direction. The two numbers at the poles of the complexity are then added together and the arithmetic mean is found. Then the number between the poles is subtracted from the mean. If this number is smaller, the result is closer to 100% information; thus, a minus sign is placed before the result. If the number is larger than the mean, the result is given a plus sign to indicate its tendency towards 100% redundancy.

Step 1b: In this, the second part of Step 1, the arithmetic mean is found and the letters are sorted as they compare – above or below the line.

7.99 =	C	D		E	(F)		G	(A)	(B♭)	(B)
			E♭		F	F♯		A	B♭	B

It should be noted that all letter names are listed; hence, F, B♭, B, and A are found in parentheses to indicate that their actual value is below the mean.

Step 2a: Here, the letters are arranged as to their order of importance.

1	2	3	4	5	6	7	8
G	E	C	D	(F)	(B♭)	(B)	(A)

Step 2b (C major tonal orientation): Step 2b is designed as an attempt to perceive a tonal orientation. In this instance, the notes form a C major scale, B♭ excepting. In other compositions, a comparison with different types of scales, patterns, tone rows, or chords is valuable.

Step 3a: Barring the correct computation of notes, the following steps in this series of consequential events are perhaps the most important. First, the notes above the arithmetic mean are given their corresponding numbers in the circle of fifths. *6 This approach is achieved by a numbering of the letters in the circle of fifths from d♭♭ to b♯. The notes are counted in the following manner:

d♭♭	a♭♭	e♭♭	b♭♭	f♭	c♭	g♭	d♭	a♭	e♭	b♭	f	c
1	2	3	4	5	6	7	8	9	10	11	12	13

g	d	a	e	b	f♯	c♯	g♯	d♯	a♯	e♯	b♯
14	15	16	17	18	19	20	21	22	23	24	25

Perhaps, one will think it unusual that the circle of fifths is used at all for further analysis and that the connection between it and the important peaks appears remote. Because one is dealing entirely with underlying tonal orientation and having the problem of reducing it to as simple a structure as possible, it is quite logical to contend that further insight might be achieved when given an equally simple structure. The circle of fifths, as a basic tool, fulfills this essential requirement for simplicity and this procedure offers a possible solution. Therefore, in Op. 94, No. 1, the notes and numbers are:

G	E	C	D	F	B♭	B	A
14	17	13	15	12	11	18	16

Step 3b: Immediately, the numbers are arranged in an ascending consecutive order if possible. From Measures 1-8, one discovers a conjunct series of eight numbers with no interruption in the consecutive arrangement: 11, 12, 13, 14, 15, 16, 17, 18.

Step 3c: In this portion of Step 3, one is counting numerical distances between 11 and 18. Breaking the preceding example into more detail, there are: seven 1-distance relationships (11-12, 12-13, 13-14, 14-15, 15-16, 16-17, 17-18); six 2-distance relationships (11-13, 12-14, 13-15, 14-16, 15-17, 16-18); five 3-distance relationships (11-14, 12-15, 13-16, 14-17, 15-18); four 4-distance relationships (11-15, 12-16, 13-17, 14-18); three 5-distance relationships (11-16, 12-17, 13-18); two 6-distance relationships (11-17, 12-18); and one 7-distance relationship (11-18). This situation is unchangeably true in every case offering a consecutive series. There are no exceptions and it does not matter what size the numbers are. The reason for forming this arrangement is that it facilitates counting all possible relationships with regard to the circle of fifths. In other words, by counting numerical distance between the numbers, one is also counting distance relationships in the circle of fifths. The following trend is seen.

Distance Relationships	1	2	3	4	5	6	7	=	28	=	1
Occurrence	7	6	5	4	3	2	1	=	28		

The distance relationships are then added separately as are the number of distances. Both equal 28 in this case as in all other identical situations. The distance relationships are then divided by the number of distances. Again in this composition, as in all exact situations, the quotient is 1. Thus, the underlying orientation is reduced to its simplest base, also giving the means for determining the degree of tonality. From the preceding, the following formula may be stated:

$$\sum \frac{a}{b} = x$$

Hence, the sum of the distance relationships (a) is divided by the sum of the number of distances (b) and equals the degree of tonal complexity (x). In every case in which the pattern is not consecutive, the result varies. Non-consecutive arrangement may then be understood to mean a more complex tonal orientation.

Step 4: The note numbers are added together and the arithmetic average is found: 11 + 12 + 13 + 14 + 15 + 16 + 17 + 18 = 116 ÷ 8 = 14.5. This last number (14.5), when referred back to the numerical circle of fifths, pinpoints the location of this composition as shown by the circle.

Step 5: Another type of interpretive question is raised by the meaning of the peaks. The peak is singled out as the most important factor in this analysis. All other notes falling around the peaks are of environmental importance, and therefore, are of secondary value in matters of interpretation. In this step, the peaks and only the peaks are listed, and the note's number according to the circle of fifths is added. This step differs from Step 3 in that peaks are used exclusively. Step 3 used both peaks and other statistically important notes above or below the median. Because Step 5 is more restrictive than Step 3, the result of Step 5 might be considered less comprehensive, but not less conclusive. In fact both steps are necessary to gain the final result.

Before understanding this result, several points should be made clear: First, because of its less restrictive character, Step 3 is more detailed than Step 5; and therefore, Step 3 shows a more complex picture than Step 5. And second, if Step 5, which is less comprehensive than Step 3, is larger than Step 3, the tonality is more complex. In Step 5, which is restricted to peaks only, the smallest and largest distance relationships are usually the same as Step 3, but the occurrence of all possible

distance relationships is usually smaller. Therefore, when the number of occurrences (abbreviated Occ.) is divided into the number of distance relationships (abbreviated D.R.), the result is larger than Step 3.

C	E	G	B♭	B
13	17	14	11	18

11, 13, 14, 17, 18

D.R.	1	2	3	4	5	6	7	=	28	=	2.8
Occ.	2	1	2	2	1	1	1	=	10		

Step 6: The final step in this procedure shows the difference between the resulting number of Step 3 and Step 5. First, in order to gain a correct basis for comparison, the result of Step 3 is multiplied by the largest distance relationship in that step. Then the same is applied to Step 5, after which Step 3 is subtracted from Step 5.

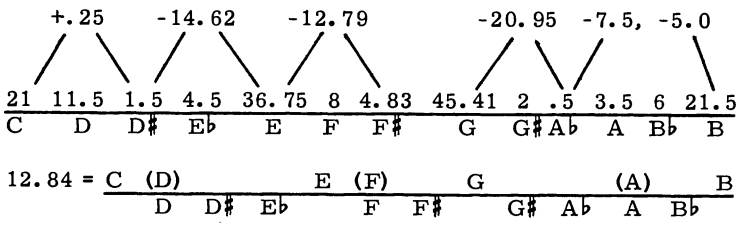
$$(2.8 \times 7) - (1 \times 6) = +13.6$$

If the result of Step 3 is larger than Step 5, a minus sign is placed before the final conclusions. A plus sign, on the other hand, is placed before the final conclusion if Step 5 is larger than Step 3. The greater the distance from the 0 axis in either direction, the more complex is the tonality.

This analytical tool is best utilized when viewing groups of compositions or sections of a composition rather than a single work. With this in mind, the results of the other sections are given as well as the results of an analysis of the composition as a whole.

Measures 9 - 29 (Bits = 166.99)

Step 1: See figure 2 for the corresponding graph.



Step 2: C major tonal orientation

1	2	3	4	5	6	7
G	E	B	C	(D)	(F)	(A)

Step 3:

G	E	B	C	D	F	A
14	17	18	13	15	12	16

12, 13, 14, 15, 16, 17, 18

D.R.	1	2	3	4	5	6	=	21	=	1
Occ.	6	5	4	3	2	1	=	21		

Step 4: Total steps in the circle of fifths = 105
Arithmetic mean of total steps = 15

Step 5:

C	E	G	B
13	17	14	18

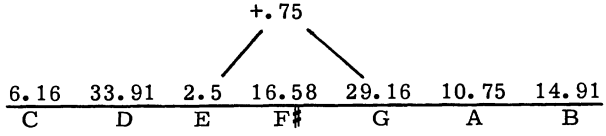
13, 14, 17, 18

D.R.	1	2	3	4	5	=	15	=	2.5
Occ.	2	0	1	2	1	=	6		

Step 6: (2.5 X 5) - (1 X 6) = +6.5

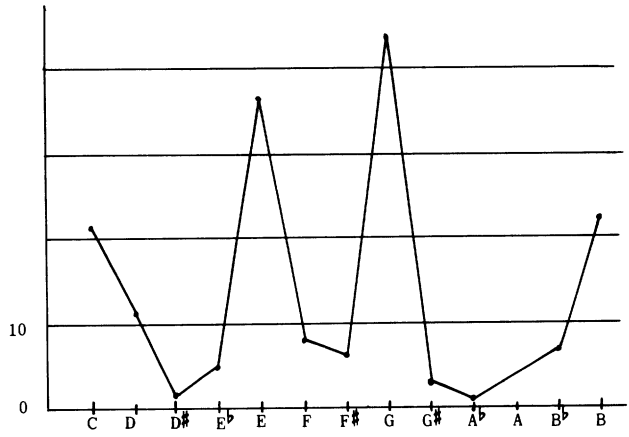
Measures 30 - 37 (Bits = 113.97)

Step 1: This short section is interesting for two reasons. First, this is the section in which Schubert changes to another key signature. It should be noted that the tonal orientation shifts to G major as well. Second, this is the only section of the composition that is entirely diatonic. For this reason, all tone elements are considered statistically important; therefore, Step 5 is regarded as redundant and the results of Step 3 are repeated in its place. Compare the following with figure 3.



FIGURE

2



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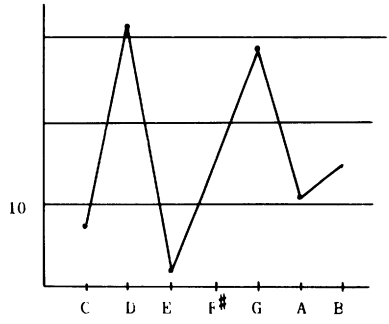


16.28 = (C) D (E) F♯ G (A) (B)
C E A B

Step 2: G major tonal orientation

1	2	3	4	5	6	7
D	G	F♯	(B)	(A)	(C)	(E)

Step 3:

D	G	F♯	B	A	C	E
15	14	19	18	16	13	17

13, 14, 15, 16, 17, 18, 19

D.R.	1	2	3	4	5	6	=	21	=	1
Occ.	6	5	4	3	2	1	=	21		

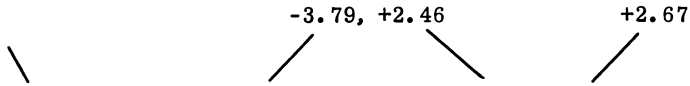
Step 4: Total steps in the circle of fifths = 112
Arithmetic mean of total steps = 14.58

Step 5: See Step 3.

Step 6: (1 × 6) - (1 × 6) = 0

Measures 38 - 58 (Bits = 246.31)

Step 1: See figure 4 for the corresponding graph.



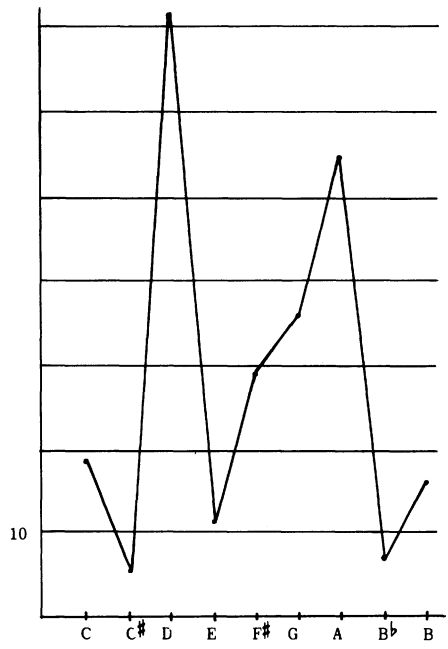
27.36 = (C) D (E) F♯ G A (B)
C C♯ E B♭ B

Step 2: G major tonal orientation

1	2	3	4	5	6	7
D	A	G	F♯	(C)	(B)	(E)

FIGURE

4



Step 3:

D	A	G	F♯	C	B	E
15	16	14	19	13	18	17

13, 14, 15, 16, 17, 18, 19

D.R.	1	2	3	4	5	6	=	21	=	1
Occ.	6	5	4	3	2	1	=	21		

Step 4: Total steps in the circle of fifths = 112
Arithmetic mean of total steps = 14.58

Step 5:

C	D	A	B
13	15	16	18

D.R.	1	2	3	4	5	=	15	=	2.5
Occ.	1	2	2	0	1	=	6		

Step 6: (2.5 × 5) - (1 × 6) = +6.5

Measures 59 - 65 (Bits = 94.75)

Step 1: See figure 5 for the corresponding graph.

						+.78		
5	14	2.5	9.25	1.25	37.5	.5	9	15.75
C	D	E	F	F♯	G	A♭	A	B

10.52 =	(C)	D	(E)	(F)		G		(A)	B
	C		E	F	F♯		A♭	A	

Step 2: G major tonal orientation

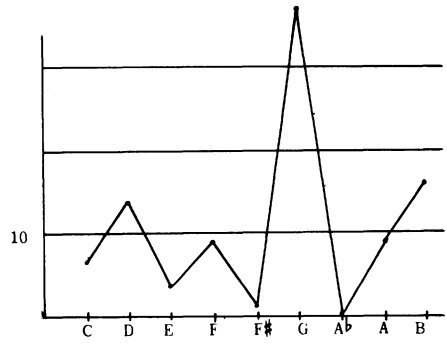
1	2	3	4	5	6	7
G	B	D	(F)	(A)	(C)	(E)

Step 3:

G	B	D	F	A	C	E
14	18	15	12	16	13	17

FIGURE

5



12, 13, 14, 15, 16, 17, 18

D.R.	1	2	3	4	5	6	=	21	=	1
Occ.	6	5	4	3	2	1	=	21		

Step 4: Total steps in the circle of fifths = 105
Arithmetic mean of total steps = 15

Step 5:

D	F	G	B
15	12	14	18

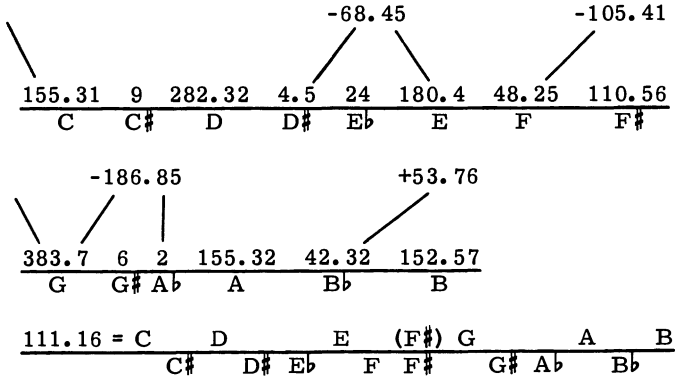
12, 14, 15, 18

D.R.	1	2	3	4	5	6	=	21	=	3.5
Occ.	1	1	2	1	0	1	=	6		

Step 6: (3.5 X 6) - (1 X 6) = 15.0

Moment musicale, Op. 94, No. 1 (Bits = 1556.25)

Step 1: See figure 6 for the corresponding graph.

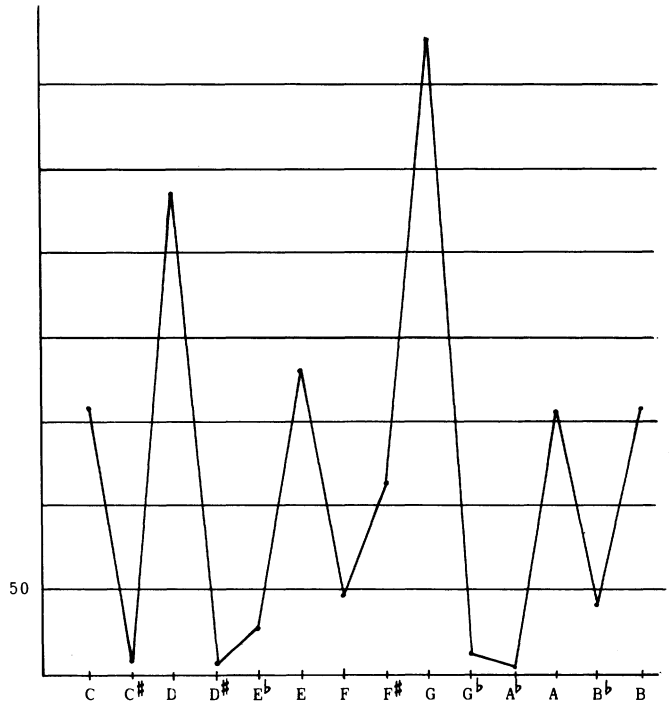


Step 2: G major tonal orientation

1	2	3	4	5	6	7
G	D	E	A	C	B	F#

FIGURE

6



Step 3:

G	D	E	A	C	B	F♯
14	15	17	16	13	18	19

13, 14, 15, 16, 17, 18, 19

D.R.	1	2	3	4	5	6	=	21	=	1
Occ.	6	5	4	3	2	1	=	21		

Step 4: Total steps in circle of fifths = 112
Arithmetic mean of total steps = 14.58

Step 5:

C	D	E	G	A	B
13	15	17	14	16	18

13, 14, 15, 16, 17, 18

D.R.	1	2	3	4	5	=	15	=	1
Occ.	5	4	3	2	1	=	15		

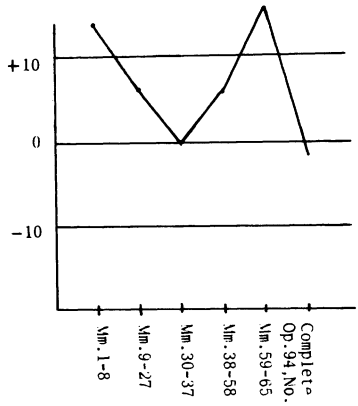
Step 6: $(1 \times 5) - (1 \times 6) = -1$

Since the 0 line is a result of a subtraction of Step 3 from Step 5, 0 indicates the axis of tonal orientation, above or below which every tonally notated composition could be placed. This graph shows the development of tonal orientation in this regard. It is important to note that Measures 30-37, an entirely diatonic section, is the only section placed on the 0 axis. Considered as a whole, the results of Moment musicale, Op. 94, No. 1, located very close to the 0 axis, indicate a rather simple tonal complexity much closer to the key of G major rather than the key of C major as presented by Schubert. This is shown in figure 7.

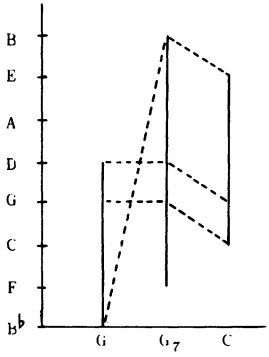
Utilizing an approach developed by Draeger, a discussion of the cadence at the end of each section is warranted. Using the numbering system for the circle of fifths previously given, the basic idea, as outlined in "An attempt towards a semantics of chordal progressions"*7, is that a chord is defined by the sum of its numbers. For example, G major is defined as 14 + 18 + 15 = 47. Also each step upwards in the circle of fifths is described as a tendency towards an open, non-final effect; likewise, each step downwards in the circle of fifths results in a tendency towards a close, final effect. In the case of a change

FIGURE

7


+10
0
-10
Mm.1-8
Mm.9-27
Mm.30-37
Mm.38-58
Mm.59-65
Complete Op.94,No.1

8


B
E
A
D
G
C
F
B♭
G
G7
C

from major to minor and vice versa, the following has to be considered:

1. Major – Minor in the circle down increases the final effect.
2. Major – Minor in the circle up decreases the non-final effect.
3. Minor – Major in the circle down decreases the final effect.
4. Minor – Major in the circle up increases the non-final effect.

The terminology remains a problem as the terms "final" and "non-final" are not to be confused with satisfying and unsatisfying musical endings. From a psychological point of view, a legitimate description seems to be "up" and "down". It is valid, therefore, to distinguish two attributes of melodic and chordal movement: an external direction, and an internal direction. Following Handschin *8, the external means the spatial distance between two tones, and the internal meaning is the tonal distance.

Concerning the open and closed effects, the cadence shown in figure 8 (Measures 7-8 and 28-29) illustrates both. Shown in a chart, the vertical lines represent the chord. The dotted lines depict the open and closed effects by connecting roots with roots, thirds with thirds, and fifths with fifths. From G minor to G_7 major, a change from minor to major upwards in the circle, increases the non-final effects. And G_7 major to C major, the result is a tendency towards a final effect. This is also true in Measures 36-37, 57-58, and 64-65. However, the cadence in Measures 64-65 is much more static than the others. Mathematically, measures 7-8 and 28-29 may be represented as:

	f	
d	d	g
b♭	b	e
g	g	c

40 + 59 + 44 = 143 ÷ 3 = 47.66

Finding the arithmetic mean, the final number indicates how well balanced this cadence is when referred to the circle of fifths. A balanced cadence, such as

g	c	d	g
e	a	b	e
c	f	g	c

44 + 41 + 47 + 44 = 176 ÷ 4 = 44

would equal its final chord. The following tabulation pinpoints the result.

A♭	E♭	B♭	F	C	G	D	A	E	B	F♯	etc.
32	35	38	41	44	47	50	53	56	59	62	
f	c	g	d	a	e	b	f♯	c♯	g♯	d♯	etc.
34	37	40	43	46	49	52	55	58	61	64	
a♭	e♭	b♭	f	c	g	d	a	e	b	f♯	etc.
25	28	31	34	37	40	43	46	49	52	55	

Measures 36 - 37 and 57 - 58:

				c	
d	g	g	d	a	d
b	e	a	b	f♯	b
g	c	f♯	g	d	g

47 + 44 + 49 + 47 + 63 + 47 = 297 ÷ 6 = 49.5

Measures 64 - 65:

a	a♭	a	f
f	f	f	d
b	b	b	b
g	g	g	g

60 + 53 + 60 + 59 = 232 ÷ 4 = 58

The result of Measures 7-8 and 28-29 reveal an almost perfectly balanced cadence. This is not true of Measures 36-37 and 57-58 and even less true of the result of Measures 64-65.

The definition of a chord by number may often be misleading. The number 47 can portray either a G major triad (g – b – d) or the notes g + a + e. Because of this, the individual voices must be considered. The remaining examples are of the last two measures of each section; however, in order to be brief, only the results of the last two chords will be given or discussed. The tonal structure in Measures 7-8 and 28-29 is the

same although the voices are rearranged. Basically it consists of a cadence from G_7 to C major. Comparison proves the cadence in Measures 28-29 to be the more balanced.

Measures 7 - 8 (See figure 9): This cadence is characterized by the downward tonal movement. Although the balance of the downward tonal movement toward the final chord is good, a slight imbalance is indicated by the numerical definition of chordal movement. Also the tonal orientation (+13.5) is slightly more complex than is indicated by the final result. In terms of the circle of fifths, the first voice ascends 5 steps; the second voice descends 5, the third voice ascends, the fourth voice remains the same, the fifth voice disappears, and the sixth voice descends 1 step.

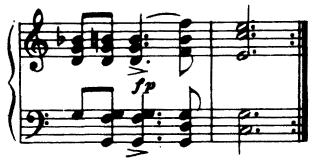
Measures 28 - 29 (See figure 10): Chordally and mathematically the characterization of this cadence is identical with that of Measures 7-8. What is different is the tonal orientation and the rearrangement of chord tones. By analysis of tonal orientation, the results signify a simpler orientation much closer statistically to diatonicism. As illustrated by the diagram, the arrangement of the voices allows tonic to be more strongly emphasized. Both of these qualities increases the balance and stability of the cadence to a point that intensifies the effectiveness of this cadence when compared to Measures 7-8. Again, in terms of the circle of fifths, the first and second voices descend 5 steps, the third voice remains constant, the fourth voice ascends 5 steps, and the sixth voice descends one.

Measures 36 - 37 and 57 - 58 (See figure 11): More active rhythmically, the cadence in Measures 36-37 and Measures 57-58 is based upon D_7 major to G major. In this instance, the depiction at both points is exact. Significantly, the tonal orientation of Measures 30-37 denote a section diatonically oriented to G major. Measures 38-58 are slightly more complex; however, this cadence does not result in as balanced a construction as the cadence in Measures 28-29. A characterization of this cadence compares favorably with that of Measures 7-8. Anew in terms of the circle of fifths, the first and fourth voices ascend 5 steps, the second voice descends 5 steps while the third voice remains static, and the fifth voice descends 1 step.

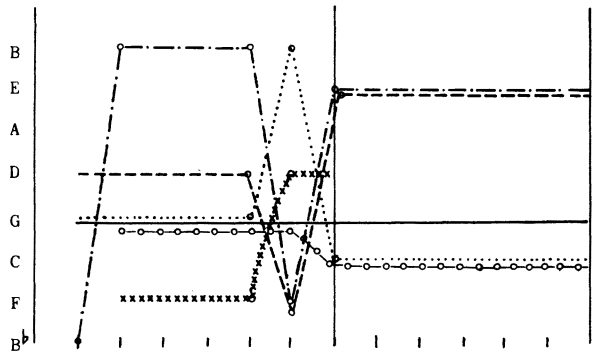
Measures 64 - 65 (See figure 12): The cadence with the simplest melodic construction and least rhythmical activity, is most vividly described by its static nature.

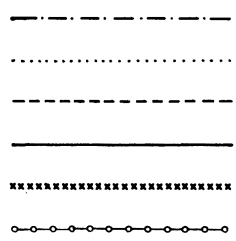
FIGURE

9a



b



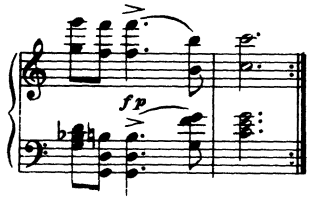


The vertical dashes represent the duration of one eighth note.

210

FIGURE

10 a



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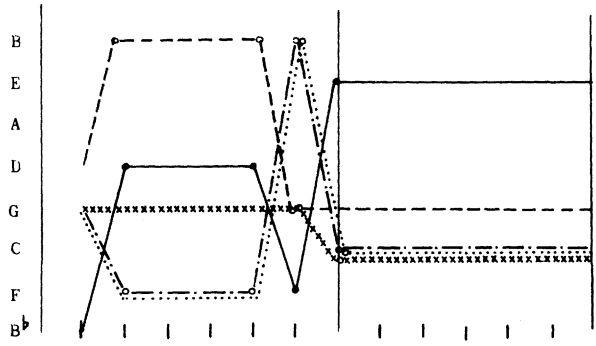
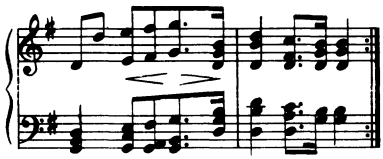
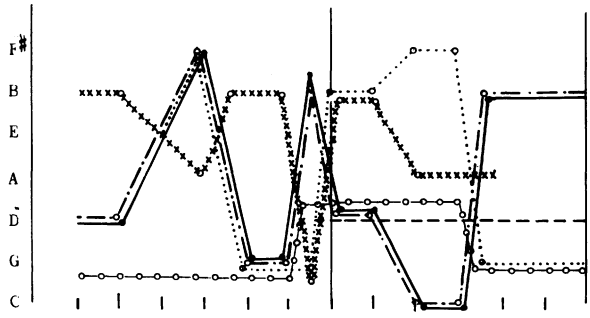


11a

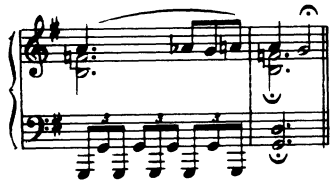


b



FIGURE

12 a



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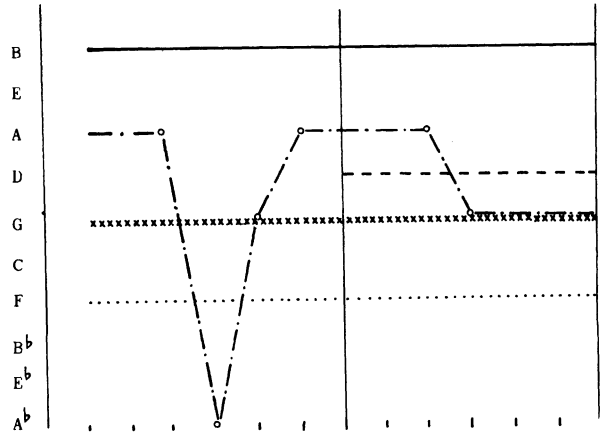

One might think of mathematics and music as having engaged in a rather sporadic conversation. Once in a while, a mathematician asks a question which the musician is able to answer or to reshape; or an idea in mathematics strikes the musician as relevant to his field. Hopefully this paper represents a contribution in that direction.

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2 Kuhnau must have been aware of this significance in his discussion of the tonal orientation of the gigue in the suite "La Medica", in the introduction to his Biblical Sonatas.

3 Hughes, M.C. Tonal Orientation in Skriabin's Preludes: An Analysis on the basis of Information Theory. Unpublished Master's Thesis, The University of Texas at Austin, 1965.

4 Winkel, F. "Die informationstheoretische Analyse musikalicher Strukturen", Die Musikforschung, 17(Januar/März, 1964). Heft 1, pp.1-14.

5 Here the difference between tonal orientation and tonal organization should be absolutely clear.

6 Draeger, H.H. "An Attempt Towards a Semantics of Chordal Progressions", in Kongressbericht Salzburg 1964, Kassel, 1966, pp.261-268.

7 Ibid.

8 Handschin, J. Der Toncharakter. Zürich, 1948.

Analysis Symposium

LAWRENCE MOSS

A COMPOSER'S ANALYSIS

At first sight, Schubert's Moments Musicaux No. 1 seems one of his least interesting pieces. Perhaps at second sight as well. However, viewed with a bit of compositional hindsight, certain details emerge which show how artfully Schubert has managed an essentially simple scheme.

The "simplicity" of the piece is shown, first of all, in its overall symmetricality. (A), the opening section, is the same length as the Trio (I am excluding the last eight measures which serve as a retransition to the Da Capo). Not only this, but the internal subdivision of each is exactly the same: eight measures to the double-bar, thirteen for the middle section immediately

following (one could cavil at this for the opening section, but more on that later), and finally eight measures to complete each section, or twenty-nine in all.

Further, this formal symmetry is matched by an extremely clear overall harmonic scheme. The tonic chord obviously generates the opening idea and is continuously reinforced as the section unfolds. The Trio moves to the dominant, and after the double bar to its dominant (m. 38). M. 45 begins the leisurely return to the opening, with D major finally resolving to G (the minor key at m. 51 is a temporary delay), and G in the last eight measures becoming the dominant of C. It is interesting to note that the new tonics in this harmonic ascent (G and then D) are each introduced without preparation (i.e., without being preceded by their dominants). They are simply stated and become "tonicized" (to use Sessions' term) through repetition. On the way down however, to continue the metaphor, these tonics are carefully transformed into dominants through the addition of sevenths (mm. 45 and 63), thus giving a firm – if somewhat overly direct – push back to the home key of C major.

Turning now to the opening eight measures, let us concentrate on some of those artful details mentioned above. First of all, the theme is an articulated tonic chord: each beat in mm. 1-4 reiterates this chord. At first there is almost no dilution of this sound; the appoggiatura in m. 1 is simply the added sixth. Gradually the dominant is brought in to create tension, first through the appoggiatura in m. 3, then on the off-beat chords in m. 4 (note the accompanying V-I motive in the left hand). A chromatic change E♮ - E♭ in m. 5 gives us the favorite Schubertian shift from major to minor, and serves to throw us briefly to the flat side of things. In rapid order, c minor leads to E♭ major, which then leads as VI to g minor in mm. 6-7. Here an answering chromatic shift B♭ - B♮ rights matters, leading to the climactic F - E in mm. 7-8 which returns us to the opening motive's high point. The first arch I to I has been completed. Note how the ascending fourth motive in the left hand furthers the drive to the cadence by outlining V (G - g in mm. 4-7) and how this build-up finally spills over to the right hand with the tritone of m. 7 resolving finally to the climactic fourth B - E. Of course dynamic indications help this, beginning with the dramatic "pp" of m. 5, which makes the following crescendo more telling. But Schubert seems afraid of overdoing things; the dynamic climax is staggered with the melodic climax, as the cautionary "p" in the last beat of m. 7 indicates. Here is a case where Schubert's dynamics and phrasing are revealing. The transfer of the left hand ascending fourths to

the right hand in m. 7 comes out clearly in the original phrasing as shown in Example 1a. (I am assuming Gieseking's version *1 to be correct; the MS has been lost. *2). Later "edited" versions, an example of which is shown in Example 1b, obscure this.

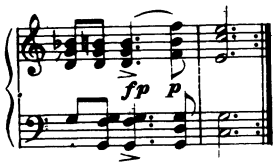
Speaking of Schubert's intentions vis-à-vis those of later editors, it is interesting to compare the first two measures as well in this respect (see Example 2). Probably no great harm is done by the added crescendo (Example 2b). It is simply unnecessary, the necessary impetus to the downbeat of m. 2 having already been supplied by Schubert's increase in rhythmic tension during the course of m. 1. Over-emphasis of this through an added crescendo would possibly obscure the later much more important crescendo to the cadence. Like Mozart, Schubert knew better than his later editors when to quit.

Turning now to the measures following the double bar, we find an obvious reference in mm. 9-10 to the events of mm. 1-4; the opening E heard as appoggiatured fifth of the chord A - C - E recalls m. 1, while the rhythm of the right hand of course repeats m. 4. Then comes a surprising cancellation of G♯ in m. 11, bringing us up again on a tonic chord, and incidentally recalling previous chromatic shifts. As if to reinforce this allusion, m. 13 moves (after the brief I-V interruption of mm. 11-12) to the minor dominant of A minor, in a move analogous to mm. 7-8. From here on the developmental character of this section is emphasized by progressively shorter phrases. Repeated two-beat phrases in mm. 15-16 are followed by one-beat phrases in m. 16, with the last of these reinforced by a simultaneous extension of register in both hands – the first so far.

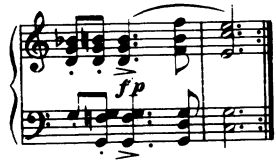
Note how the harmonies of this section (mm. 9-16) have mirrored in the small the overall harmonic scheme sketched out in the opening paragraphs. Assuming that vi is our "tonic" in m. 9, we move first to the related dominant key – e minor – in m. 15, and then to its dominant a measure later. A measure's rest dramatically follows, and then what appears to be its resolution. The one-beat "fz" phrases in m. 16 have become a "p" ostinato pulsing on the beat in mm. 18-20. But the missing B of this e minor triad never materializes, and we are given instead our opening motive in the left hand in m. 20, completing the chord with an almost Haydnesque wit. Ex. 3 shows how our C major chord has been exploited so far for its potential as a pivot chord. Circled notes are the common tones held over. It is important to remember that these pivot-chord modulations articulate the three major subdivisions of the opening

EXAMPLE

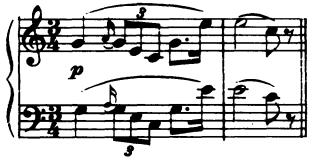
1a



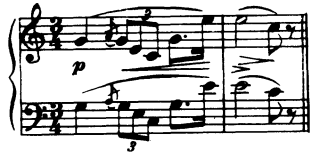
b



2a



b



section. The symmetries emphasized by this example thus further the clarity of the overall design.

One other point, before proceeding to the Trio. While the entrance of the theme in the left hand in m. 20 would seem to begin the expected return to the opening, it does begin in fact two measures later (though this point could be debated). For me the matter of texture is crucial. Mm. 20-21 continue the previous little ostinato as accompaniment, creating the expectation that the entire recapitulation of mm. 1-8 will be so embroidered. This in fact does not happen. Instead, we shift to a new solo texture in m. 22 which then is elaborated in a consistently canonical manner and spun out to the requisite eight measures of the opening. Mm. 20-21 can thus in retrospect be likened to a false recapitulation – something like a brief echo of the famous big bang in the recapitulation of the first movement of the Eroica.

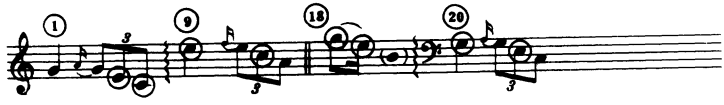
Now, to the Trio; if anything it is even simpler than the opening. The relatively dynamic form of the piece's first eight measures gives way in mm. 30-37 to a simple period marked by continuous reference to the new "tonic", G major. Ex. 4 gives the Trio up to the first double bar and also shows relationships with the opening. The circled G - A - G in mm. 30-31 recall the opening three notes of m. 1. The notes under the first bracket are an augmentation of the left hand in m. 4. Those under a slur are a rhythmically distorted recall of the right hand in that measure. Note that although the left hand motive in m. 4 came to be developed in a progressively more dynamic fashion up to m. 7, the basic confines of that progression – G to G – are preserved in the octave skip g^1 to g^2 in mm. 32-36. The second bracket in m. 36 emphasizes Schubert's division of this octave into skips of the ascending fourth – again, a reference to the opening.

M. 38 moves abruptly to a new key, analogously to m. 9. The regularity of the previous eight measures is preserved, though there is an increase in pacing with 4+4 measures being replaced by 2+2 (mm. 38-41). Mm. 42-43 bring an interesting rhythmic shift through accents, giving us in fact a 3/2 measure followed by one in 3/4. The hemiola effect thus produced has been heard before (cf. mm. 15-16, first three "fz"). Just one more reason, perhaps, for Brahms' well-known admiration of Schubert.

The dotted rhythm of the Trio (borrowed of course from m. 1) becomes progressively more pronounced as we prepare for its return in mm. 45-51. Here comes the first "surprise" of the Trio – g minor instead of the expected G major. The linkup

EXAMPLE

3



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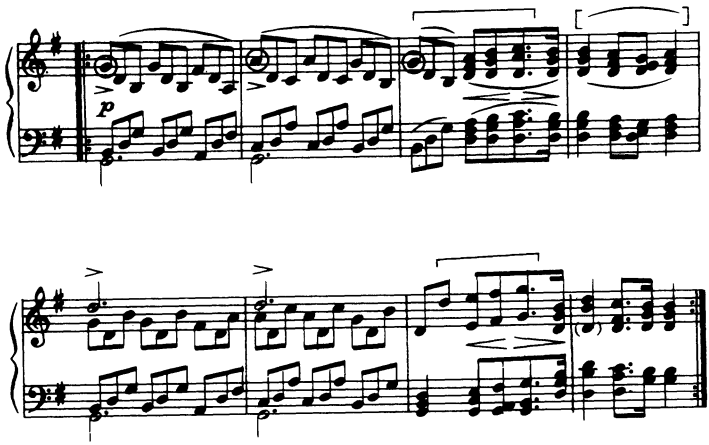

with mm. 4-5 is obvious. After four measures of this Schubert goes on blithely to the Trio's consequent phrase, and in so doing reinforces his switch of mode with a cross-relation (B♭ - B♮ in mm. 54-55) recalling the analogous spot in the first section (mm. 25-26).

The retransition to the Da Capo (mm. 59-66) is fairly routine, de-tonicizing (if one may use such a word) G major, just as was done with D major previously. In fact, these eight measures are so much less interesting than the others, one is tempted to picture Schubert already thinking of the next piece. That would explain the mechanical recapitulation of the opening section which follows.

Concluding, I would like to go back to the symmetrical arrangement of subsections mentioned earlier. The following diagram brings this out:

	(A)	‖: 8 meas. :‖:	13 meas.,	8 meas. :‖	
Trio	(B)	‖: 8 meas. :‖:	13 meas.,	8 meas. :‖	(retransition 8 meas.)
		(a)	(b)	(a′)	

Of course, one could think of the second section of (A) as being divided eleven and ten measures. However, as I tried to show, compositional as well as notational details reinforce the above interpretation. Schubert could have used a fermata in place of the one measure rest in m. 17, or even a rest plus fermata, as he does in Moments Musicaux No. 4, right before the Trio. That he didn't makes me wonder whether in fact he was aware not only of the symmetries in the overall structure but even of the relative proportions of the subsections. The reader will have noticed by now, of course, that I am referring to the Fibonacci series, each of whose numbers is the sum of the preceding two. This is evidenced not only by the eight and thirteen measure durations, but by the overall length of twenty-one measures for each second section (b + a′). One feature of the Fibonacci series is that adjacent numbers approximate the famous Golden Mean of medieval and Renaissance art:

$$\frac{21}{13} \approx \frac{13}{8}$$

A means of assuring visual proportion can thus be transferred to music, and in fact has been done so by leading twentieth century composers, among them Bela Bártok and Luigi Nono. If Schubert's precedence in this were known, he might be studied

more assiduously by today's composers. Who knows, it might even lead to a revival of the Moments Musicaux at Darmstadt along with that other nineteenth century relic, Parsifal. But for this of course the title *3 would have to be appropriately altered. I leave that to the reader's imagination.

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2 Deutsch, O. E., ed. Schubert Thematic Catalogue. London: Dent, 1951, pp. 360-61.

3 Deutsch says that the title was "probably. . . an invention of the publishers". Ibid., p. 361.

Analysis Symposium

CARL SCHACHTER

Schubert's Opus 94 No. 1 is so unpretentious and apparently simple that a collection of analyses of it might seem to be a kind of musical "Pooh Perplex". Actually the piece contains a number of unusual and irregular features and is rather more elusive than it appears to be at first. The difficulties it presents result neither from complexity nor from obscurity; they are due, rather, to the wayward, unpredictable character from which the piece – or at least the A part *1 – derives so much of its charm.

THE A PART

Measures 1 - 8

The unison statement of the opening measures sounds like a motto; we expect its elements, presented in such clear focus,

to recur significantly. Which are the most important of these elements? The first thing we hear is the neighboring figure g^1-a^1-g^1 caused by the grace note; the significance of this fleeting idea will become evident only later in the piece. We are more forcibly struck by the broken triad g^1-e^1-c^1; the evolutions of this pattern begin at once. The leap of a sixth from g^1 to e^2 in the second broken triad is the first and most important of these evolutions (see Example 1). The juxtaposition of g and e – both tones occuring in various registers – is to pervade much of the A part. In addition e^2 functions as the initial tone of the embracing melodic progression $\hat{3}\ \hat{2}\ \hat{1}$.

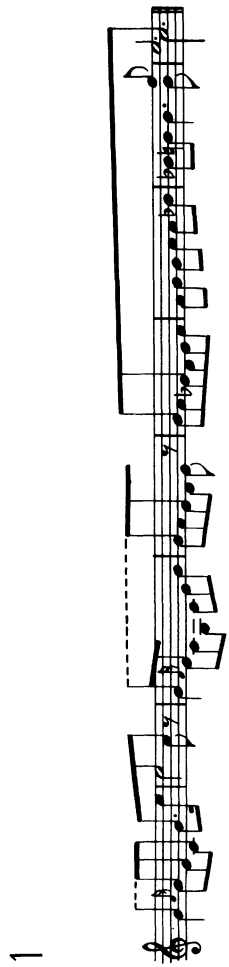
As example 1 indicates, the development of the broken triad continues in the right-hand part of mm. 3-8. Mm. 3-4 "reinvert" the ascending sixth to a descending third, g^1-e^1. This third is filled in; the grace-note of m. 3 hints at the more explicit passing tone of the next measure. (The passing-tone progression g^1-f^1-e^1 finds its simplest rhythmic embodiment in binary division, as in second-species counterpoint. The broken-chord pattern of m. 1, on the other hand, fits most naturally into a triplet division. Thus melodic elements give rise to the rhythmic figures whose alternation and combination permeate the design of the piece.) In m. 5 the change of mode brings about the inflection of e^1 to $e\flat^1$. As Example 1 shows, the filled in third g^1-f^1-$e\flat^1$ is followed by a stepwise ascent to c^2 producing another transformation of the broken-chord figure.

Example 2 shows the context in which the motivic transformations described above take shape. It indicates that the initial phrase (it is best to hear it as a single eight-measure phrase) expresses a broadly unfolded tonic harmony supporting e^2 as top-voice tone. The right-hand part contains two linear continuities. The upper one centers on e^2 decorated by its upper neighbor f^2; the lower passes from g^1 to e^1 and $e\flat^1$ and thence up to c^2. The bass shows the imprint of the pervasive broken-chord figure, but in ascending direction and in minor. In mm. 5-7 the bass extends the tonic minor and leads to the cadential dominant by means of the arpeggiated progression c-e♭-g, each tone preceded by its own dominant. The filled-in fourths of mm. 4-5 prepare the disjunct ones of the following measure and become a motivic element of some importance.

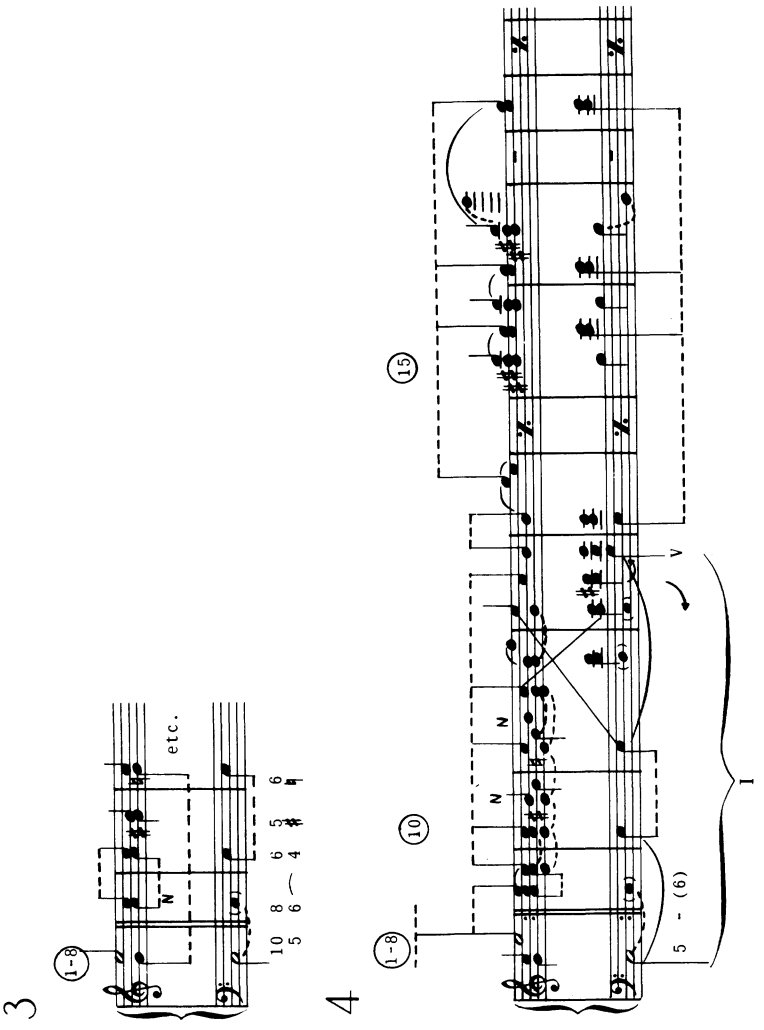
Measures 9 - 19

The eleven measures comprising the b section of the first part present some of the most challenging problems of the entire piece. Especially the first phrase (mm. 9-12), with its rapid

EXAMPLE



EXAMPLE

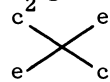


changes in tonal focus and vacillating top-voice line, requires careful study before it reveals its meaning.

The suggestion of a minor in mm. 9-10 is too brief and inconclusive to be considered a decisive departure from tonic harmony. In order to understand the contents of these measures we must remember that they follow the extensive tonic elaboration of mm. 1-8. Viewed in this context the a^1 of m. 9 reveals itself to be the upper neighbor of the persistent inner-voice tone g^1 of the opening phrase. The $g\sharp^1$ (in the foreground part of the V of a minor) functions as a chromatic passing tone leading again to g^1 in m. 11 (see Example 3). The origin of this inner-voice motion lies in the fleeting neighboring progression caused by the grace note of m. 1. This connection may seem forced, and it would be if this were the only instance of similarity. But the use of a^1 as neighbor to g^1 becomes a most significant motivic event in the B part and occurs both at the beginning (mm. 30-31) and retransition (mm. 64-66) to form a link with the A part.*2

We can now examine as a whole the phrase of mm. 9-12 (see Example 4, a graph of the entire b section). The bass, like that of mm. 5-6 grows out of the broken-chord figure of the opening measure. The c of m. 8 vibrates in our memory through m. 9. In m. 10 e enters, to be prolonged through the beginning of m. 12 (briefly displaced by c^1 through an interchange with the top voice). The arpeggiation finds its goal in the g of m. 12. In a more conventional piece this g might well function as a dominant of high structural order paving the way for the tonic of the a′ section. Here, however, the g constitutes a brief departure to the upper fifth, pointing back to the initial tonic but not fated to usher in the recapitulatory one.

The melody of mm. 9-10 begins with the structural top-voice tone e^2, the grace note echoing the f^2 of m. 7. However the change of chordal position at the third beat of m. 9 brings to the fore the inner-voice tone c^2. For the rest of the phrase the right-hand part exploits the inner voice region (note, however, the recollection of e^2 in m. 12, preceded by the diminished fifth b^1-f^2 as in the cadence of mm. 7-8). The melody wavers between c^2 and b^1 as if uncertain about the course it should take. In so doing it resembles somewhat the shifting figure-ground patterns of the psychology textbooks; which is the main tone and which is neighbor? The problem for the analyst is greatest in m. 11 where the playful alternation makes it difficult to judge whether the underlying chord is a C^6 or an E^5_3.

Only reference to a broader context provides us with an anchorage by means of which we can stabilize and order our perceptions. Heard in context rather than as a succession of autonomous chords the measure takes on a definite C-major physiognomy. Analysis of the first two beats as an E-chord would require us to disregard the C arpeggio of the left-hand part, the interchange 

, and the framing tonic before and after (mm. 1-8 and m. 12).

In mm. 9-12 the competition between b^1 and c^2 has mainly favored the c^2; only at the end of m. 12 does b^1 begin to prevail (as top-voice tone of the G-chord). At the E minor of mm. 13 ff (with c^2 reduced to a neighboring grace note) b^1 comes into its own, asserting itself ever more strongly until after the dynamic and registral climax of m. 16. However assertive, b^2 and its registral variants represent a manipulated inner-voice tone. The top-voice region comes into play again with the g^2 of m. 13. (The events of m. 13, incidentally, compress into a single bar the essential contents of mm. 1-2; even the sixteenth rest derives from the eighth rest of m. 2.)

After b exhausts itself in the climax of mm. 15-16 only e and g are left to represent the E-chord. As the memory of b – already weakened by the rest of m. 17 – grows fainter, the implication of E minor becomes attenuated; e and g as third and fifth of tonic harmony provide a bridge into the a′ section. Example 5, which presents a synoptic view of the entire b section in relation to context, should now be consulted in connection with the more detailed graph of Example 4. The symbol EM, originated by Felix Salzer, indicates a non-stepwise decoration; here the embellishing E-minor chord allows a further development of the pervasive relationship between the tones e and g. Note that the melodic outline of mm. 12-23, as shown in Example 5b, constitutes an expansion of the idea of mm. 1-2.

Measures 20 - 29

Almost every tone in the a′ section (mm. 20-29) can be traced back to the first eight measures and functions as a direct repetition, registral variant, or contrapuntal inversion of its "original". However the structural meaning of the a′ section differs greatly from that of the opening one. For here the melody, instead of centering on the third step of the scale, progresses to its goal, the tonic. The simplicity with which this is accomplished constitutes – for me at least – one of the

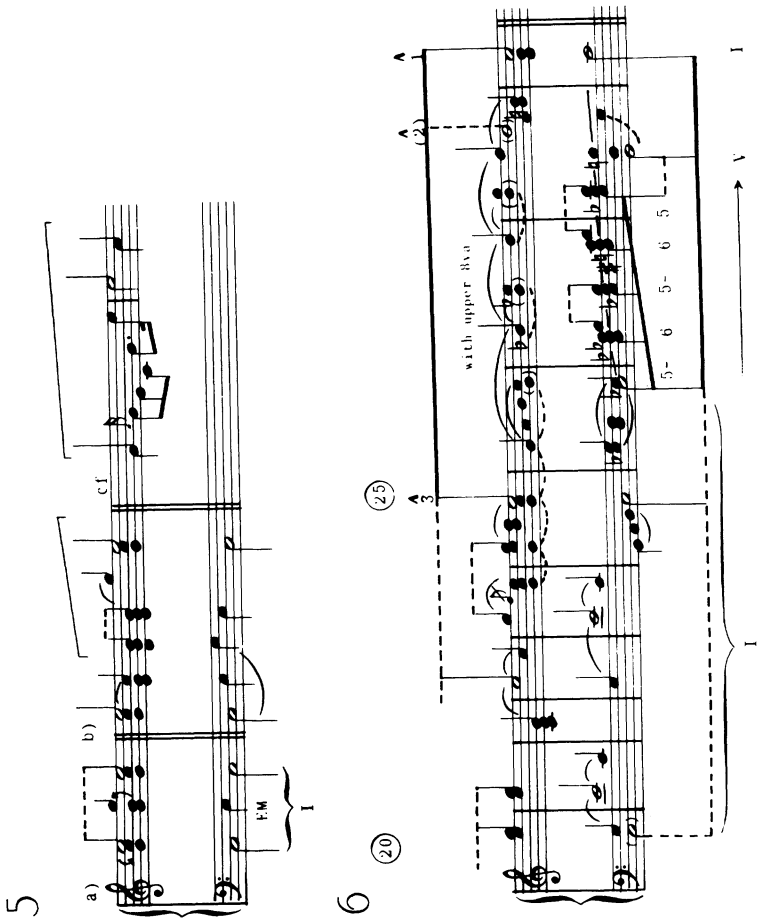
most beautiful and admirable features of the piece.*3

As Example 6 indicates, g^2, the top-voice tone of mm. 13-19, continues into the beginning of the a' section, effecting an overlap with the preceding section and permitting the hesitant entrance of the theme in the left-hand part. The right-hand part of mm. 24-25 lies an octave above the corresponding idea of mm. 3-4. This change of register stabilizes e^2 in preparation for the forthcoming structural descent. In addition it fulfills the expectations created by the falling thirds g^2-e^2 of mm. 13-19. Note the parallelism between the g^2-$f\sharp^2$-e^2 of mm. 15-16 (where g^2 predominates) and the g^2-$f\natural^2$-e^2 of m. 25 (which gravitates to e^2).

As Example 6 indicates, I read the contents of mm. 26-27 quite differently from those of mm. 5-6 of which they form a contrapuntal inversion. As in many other pieces changes in the contrapuntal organization require us to hear one – and sometimes more than one – of the constituent melodic lines in a changed manner. In the left-hand part of mm. 5-6 the harmonic implications of the sequential fourths (the lower tones are dominants of the upper ones) creates an emphasis on the upper tones. The harmonic implication is removed now that the fourths occur in the top voice. In addition the upper tones of the fourths now constitute octave doublings of the bass whereas the lower tones produce a satisfactory counterpoint (the bass of mm. 26-27, incidentally, is a slight variation of the alto part of mm. 5-6). For these reasons I hear the lower tones of the fourths as forming the main direction-giving element. While the bass is still in transit to the V, the melody begins a "premature" arpeggiation of the G^7 chord with minor third; the b♭ gives way to the required leading-tone in m. 28. By starting in the middle register (m. 26) and adding the upper octave at the end of the measure, Schubert strongly indicates that the lower tones of the octaves are fundamental and the upper ones are doublings. The structural resolution of the melody, therefore, occurs on c^2, in the same register as the initial e^2, but reinforced by its upper octave. The doubling is required to balance the rather heavy left-hand part of three tones in close position.

The cadential V-I of mm. 28-29 supports a melodic progression which is the inversion of the one found in mm. 7-8. Here, however, the descending diminished fifth has a different meaning from the ascending one of m. 7; it substitutes for the melodic supertonic ($\hat{2}$) as connection between $\hat{3}$ and $\hat{1}$. Schenker remarks*4 that such substitutions for the $\hat{2}$ frequently occur in short compositions. This one is particularly appropriate in

EXAMPLE



view of the motivic reference it provides. The d^2 in parentheses in Example 6 represents the underlying melodic tone substituted for and bypassed in the actual piece.

THE B PART

If the reader will play through the first part of the piece he will discover that it stands on its own and makes musical sense apart from the piece as a whole. If he tries the same experiment with the second part (mm. 30-58) he will find that it cannot stand alone; its meaning becomes clear only in the context of the whole piece. The reason is the following: The first part expresses a complete musical thought leading, both in the melody and harmony, to a stable conclusion on the tonic. The G major section, on the other hand, never reaches a definitive conclusion in the melody; the top voice, as we shall see, remains centered on d^2. (Middle sections of three-part song forms, incidentally, often express complete harmonic-melodic progressions; the Trio of Opus 94 No. 6 offers a convenient comparison with our present piece.)

Measures 30 - 37

These eight measures form the a section of the middle part. In mm. 30-31 g^1 is prolonged by a sequential two-note pattern featuring its lower and upper neighbors. As Example 7 indicates, the upper neighbor, a^1, should be considered the primary one. The origin of this neighboring progression lies in the grace-note figure of m. 1; the melodic succession g^1-a^1-g^1 is to play an important role throughout this middle part.

Example 8 presents a graph of the entire eight measures. The reader will note that I consider the V, the harmonic goal of the first phrase to "arrive" at the $\frac{6}{4}$ on the downbeat of m. 33 rather than at the D-chord of the preceding measure. The reasons for this admittedly odd reading are the following. The sustained G drops out of the left-hand part at the beginning of m. 32 and the lowest tone of the broken chord (verticalized from the second beat on) takes over as bass. As I hear it this fact does not become manifest until the downbeat of m. 33 where the impression of a melodic and rhythmic goal clearly obtains. The d o m. 32, on the other hand, seems to function mainly as consonant support for the passing a^1 of the melody.

In m. 34 d^2 appears; it will be intermittently present throughou

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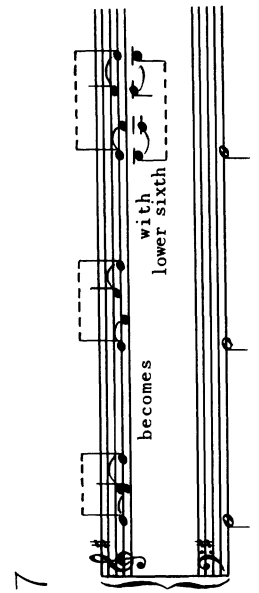

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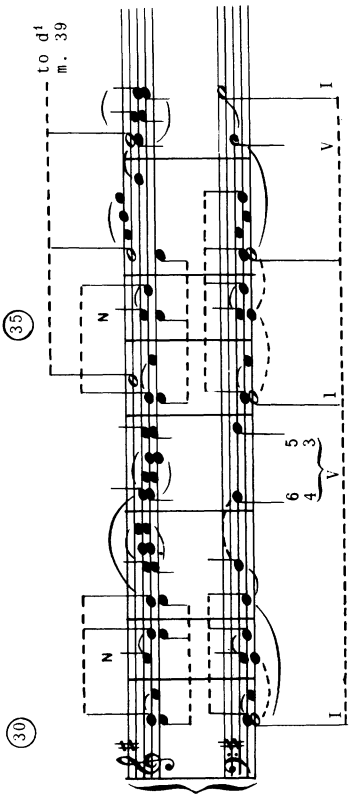

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the B part and functions as the central top-voice tone. The contents of mm. 34-37 are pretty straightforward and my analysis should be clear from Example 8.

Measures 38-50

Example 9 explains the b section with its extended prolongation of the V of G. Note the persistent use of A^1 as fifth of the D-chord below the functional bass; in m. 45 the rising third A^1-B^1-C adds the seventh to the chord (cf. the right-hand part of m. 32). A passing motion within the V leads to the G of m. 51; the bass progression echoes, in a differing harmonic context, in low register, and in broadened time values, the right hand part of m. 36 and can possibly be traced back to the filled-in fourths of mm. 4 and 5. Example 10 concerns a detail, the contrapuntal background of the melodic dialogue of mm. 38-41.

Measures 51-58

The a′ section (mm. 51-58) is the same as mm. 30-37 except for the minor coloration of the first phrase. This, of course, is in marked contrast to the C major part where the recapitulatory section shows a structural function very different from that of the opening one. We can therefore dispense with a graph of mm. 51-58. Example 11 offers two reductions of the entire B part and indicates that the neighboring figure g^1-a^1-g^1 underlies the entire middle voice; d^2, of course, acts as the sustained top-voice tone.

Measures 59-66

These measures contain the retransition to the reprise of the A part. This section has a number of compositional tasks to perform. It must accomplish a harmonic reorientation through which G ceases to be a stable center and becomes an active element pointing to and demanding the reappearance of C. This is accomplished here in the most usual fashion, by means of the seventh, $f\natural^1$ (mm. 63-66). In addition the melody must prepare the lower register of the beginning of the A′ part; this is brought about by the descending progression d^2-c^2-b^1-a^1-g^1 (mm. 58-62). The tones leading down to the g^1 are prolonged by progressions filling in descending thirds; melodic thirds, descending and ascending, have dominated the entire middle part. Schubert solves the structural problems, but in a somewhat perfunctory and unimaginative way; I, for one, find the obvious sequential elaboration of the descending fifth (and the persistent rhythmic repetition) rather hard to take. The one

EXAMPLE

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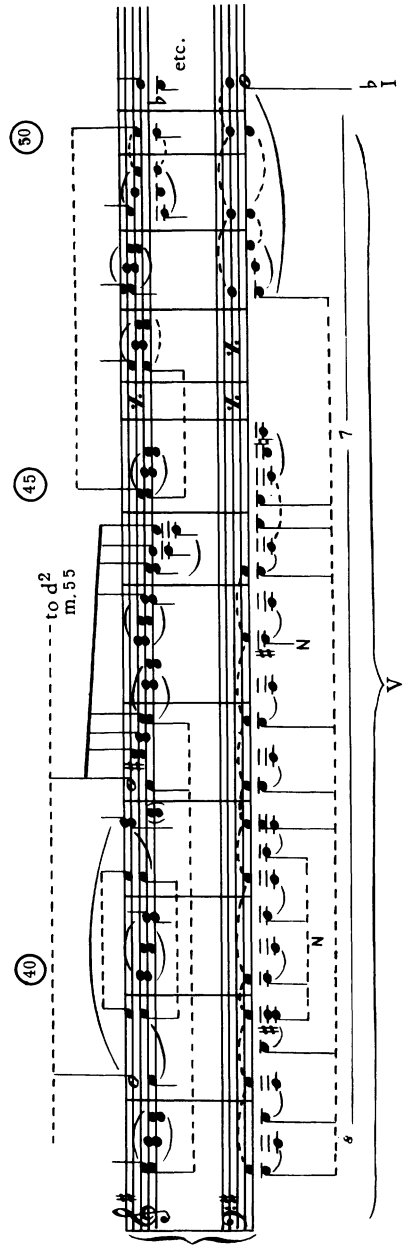

EXAMPLE

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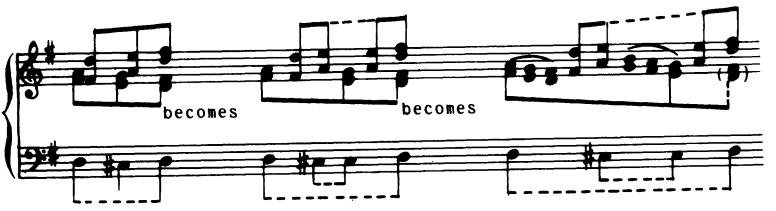

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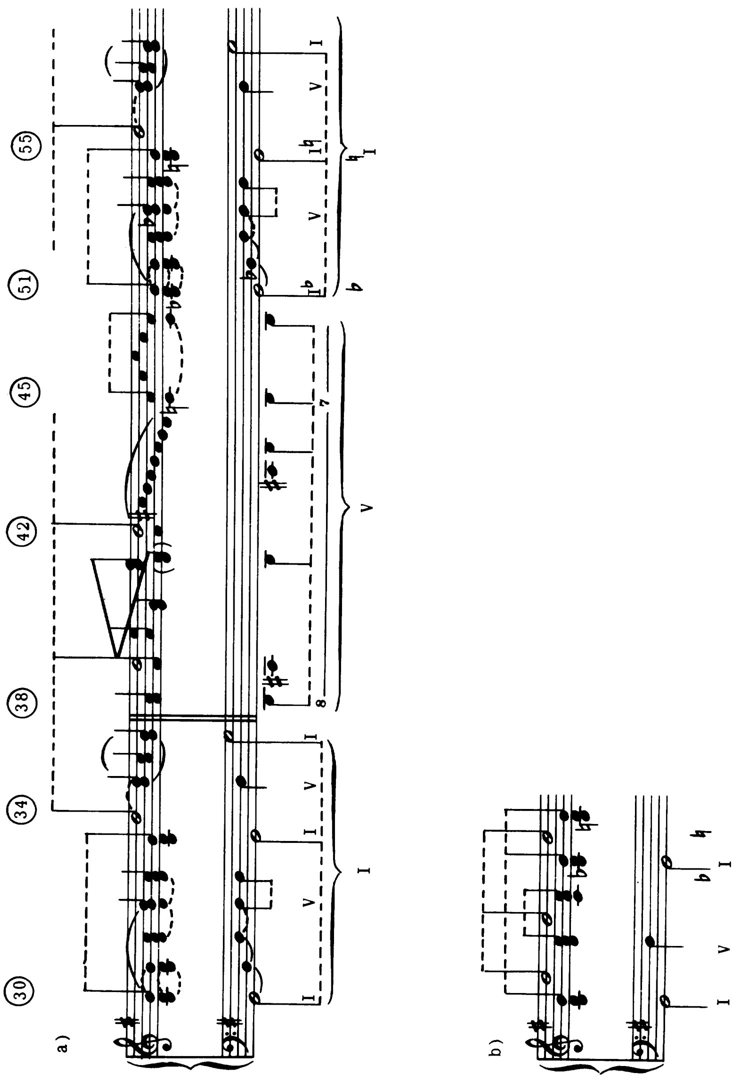
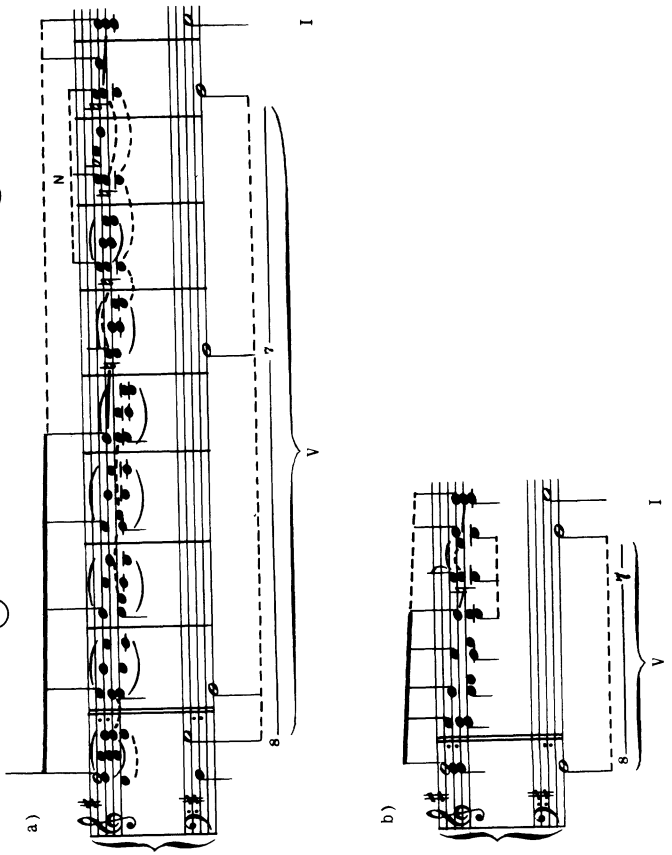


EXAMPLE 12



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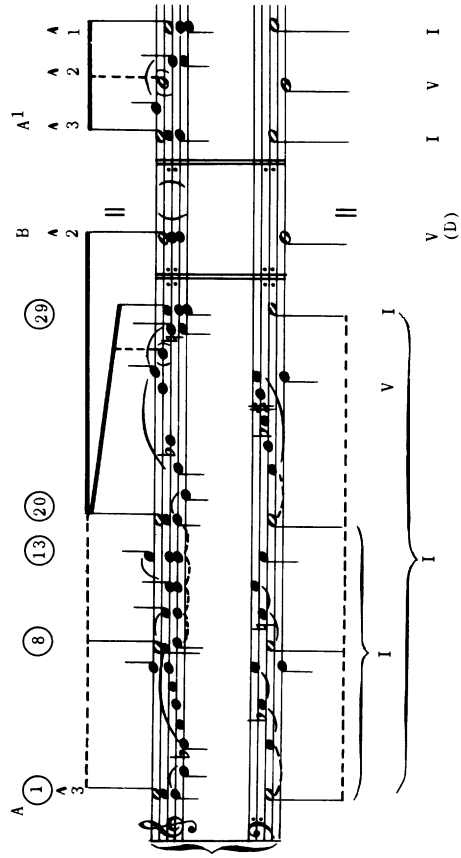

saving touch is the beautiful introduction of a^1 (mm. 64-66) with its reference to the important g^1-a^1-g^1 figure of the B part and its preparation for the final statement of the innocent grace-note motive that has led to such unforseen consequences. Example 12 explains.

THE PIECE AS A WHOLE

The key to understanding the structure of the piece as a whole lies in the recognition of the rather peculiar relationship subsisting between the A and B parts. This relationship can be characterized as combining a high degree of contrast with a binding harmonic and melodic connectedness. The G major of the middle part, in relation to the whole piece, represents a broadly expanded and tonicized V. This V supports d^2 as principal top-voice tone; in relation to the C major of the whole piece, d^2 represents the second degree of the scale ($\hat{2}$). The B part therefore, is grounded in a $\frac{\hat{2}}{V}$ sonority. Now the V, although it appeared as a structural element at the final cadence of the A part (and as a prolonging chord earlier), was never the basis of a large-scale prolongation. Indeed mm. 1-29 use the V just about as unobtrusively as is possible in major-minor tonality. The $\hat{2}$, also a fundamental component of the tonal system, is circumvented by the melodic substitution of m. 28. The B part, therefore, is related to the A part by means of elements underplayed or bypassed in the earlier part. This fundamental contrast is accompanied by others: the rhythms are repetitive and symmetrical in contrast to the fluid prose rhythms of the A part; the character is more given, more real than that of the searching, mysterious opening section.

Example 13 shows a synoptic reduction of the whole piece; having already presented two reductions of the middle part in Example 11, I have represented it here by its governing chord and top-voice tone. The graph indicates that the A and B parts together form the first segment of an interrupted linear-harmonic structure. The tension always generated by the technique of interruption, together with that caused by the contrast between the A and B parts, requires the reprise of A with its effect of completion and repose. Note that the first A part, in relation to the whole, constitutes a large-scale descent into the inner-voice region; the e^2 functions as a retained tone eventually connecting with the d^2 of mm. 34 ff. The B part represents the expansion of the interrupting V (divider). The reprise of A brings the second segment of the interrupted progression. *5

REFERENCES

1 I use the capital letters ABA′ to refer to the three main parts of the piece. Each of these shows a tripartite interior organization; I indicate the sections within each part by means of small letters aba′.

2 As I see it a group of tones becomes a significant compositional element if (1) it forms part of a pervasive foreground pattern through literal or disguised repetition, or if (2) it penetrates to deeper levels of structure.

3 I write this bearing in mind Joseph Addison's remark: "When we say a woman has a handsome neck we reckon into it many of the adjacent parts."

4 Heinrich Schenker, Der Freie Satz (Vienna, 1935); 2nd edition, Oswald Jonas, ed. (Vienna, 1956), Vol. I, p. 89.

5 Interruption frequently underlies this sort of tripartite organization either of whole pieces or of sections. See, for example, Schenker, Der Freie Satz, Example for Fig. 43a (Vol. II, p. 180), and Felix Salzer, Structural Hearing (2nd edition, New York, 1962), Example 500 (Vol. II, pp. 290-292).