AN APPROACH TO THE TEACHING OF MUSIC COMPOSITION, ILLUSTRATED BY AN ORIGINAL WORK FOR ORCHESTRA, SYMPHONY WITH PROLOGUE

DISSERTATION

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By

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CHAPTER I

INTRODUCTION

Philosophies of dualism have been a major force in Western heritage for nearly 3000 years. Almost all inquiry has been, and, to a large extent is today, still dominated either explicitly or implicitly by dualistic concepts. In particular, the concepts of "mind and matter", or "mind and body", are perhaps those aspects of dualistic philosophy which have had the greatest impact upon our culture in the past, and which, with little loss of strength, continue to exert their influence upon much of the thought in the world today.

Concerning the "mind and body" aspect of dualistic philosophy, John Dewey has said, "It would be impossible to state adequately the evil results which have flowed from this dualism of mind and body, much less to exaggerate them".¹ His position is clear: that the troubles of our world may in large measure be attributed to the influence which this aspect of dualistic philosophy has had in the shaping of our values, morals, social norms, faiths and beliefs.

There is a tendency today to discard the dualistic manner of looking at the world, especially in the physical sciences, such as astronomy and physics, where the "theory of relativity" and the "field theory" are now generally accepted. The fact that these theories are accepted in the physical sciences, however, does not indicate that they are found acceptable in those areas where man's values, beliefs, morals, social norms and faiths are more directly involved. For the physical sciences, according to the dualistic philosophy, are on the "matter" side of the "mind-matter" dichotomy. Since this is the case (according to dualistic philosophy), we need not be concerned about the morality of theories pertaining to the physical sciences. They are, by definition, outside the sphere of direct human concern.

For the sake of clarification, consideration must be given to the fact that we today are, of course, very directly concerned with the consequences accruing as a result of knowledge gained through research in the science of physics, especially in regard to atomic power. This concern, however, expressed as it frequently is from a dualistic ground, arises in relationship to the "mind" half of the "mind-matter" dichotomy. The possibility of direct concern over the field theory -- or any other theory -- in the science
of physics (or any other physical science) is not likely by those who hold the dualistic philosophy because physics and the other physical sciences are conceived to have an existence independent from direct human concerns. It is rather in the application of these facts that direct concern arises. In the application of these facts to human goals, the dualist cannot accept either the scientific method or the method of intelligence because, according to his philosophy, (1) religion, ethics, morals, values, etc., from the other world tell him how (2) in this world, he can apply the brute facts which science provides.  

2 It is of interest to notice that the scientists themselves may be in large part responsible for this attitude toward science. Dewey has this to say:  

... Many workers in science found that the easiest way in which to procure an opportunity to carry on their inquiries was to adopt an attitude of extreme specialization. The effect was equivalent to the position that their methods and conclusions were not and could not be "dangerous", since they had no point of contact with man's serious moral concern. This position in turn served to perpetuate and confirm the older separation of man as man from the rest of nature and to identify the split between the "material" and the moral and "ideal". (From John Dewey, Problems of Men, from an article entitled "The Democratic Faith and Education" (1944) (New York: Philosophical Library, Inc., 1946), p. 28.
The fact is that the field theory, or, philosophically speaking, the transactional theory, is found to be less and less acceptable as areas which are closer and closer to man's direct concerns are considered. While relativity and field theory are accepted almost without question in astronomy and in physics, the areas of biology and psychology, sciences which may be considered closer to man's direct concerns because they deal with life, have won only a partial victory in this direction. And in the social sciences and the humanities the transactional point of view is hardly even considered. Dewey very clearly indicates this state of affairs, and makes the point in the following manner:

Thus it has come about that when scientific inquiry began to move from its virtually complete victories in astronomy and physics and its partial victory in the field of living things over into the field of human affairs and concerns, the interests and institutions which offered resistance to its earlier advance are gathering themselves together for a final attack upon that aspect of science which in truth constitutes its supreme and culminating significance. On the principle that offense is the best defense, respect for science and loyalty to its outlook are attacked as the chief source of all our present social ills. 3

In the areas of the fine arts and music the situa-
tion is perhaps the most chaotic of all. It is in these areas that we are most likely to hear it said that science and intelligence have no work to do. This state of affairs is not the result of the unimportance of these areas. As John Dewey has said,

... Long before the present [world] crisis came into being there was a saying that if one could control the songs of a nation, one need not care who made its laws. And historical study shows that primitive religions owe their power in determining belief and action to their ability to reach emotions and imagination by rites and ceremonies, by legend and folklore, all clothed with the traits that mark works of art. The Church that has had by far the greatest influence in the modern world took over their agencies of esthetic appeal and incorporated them into its own structure, after adapting them to its own purposes, in winning and holding the allegiance of the masses.  

In spite of the importance of fine arts and music, however, the presence of intellectual chaos is too much in evidence within them. In these areas, indeed, vagueness itself is given a positive value. Artists and musicians, when confronted with a question concerning the rationality of their feelings, are forced, for the most part, to do one of two things. They may admit, in spite of the strong admonition against it

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from the intellectual heritage of our culture, that they simply gain aesthetic appreciation from the vagueness which attends their manner of going at their art. Often, however, they give "better" reasons by claiming that their appreciation comes from a transcendental realm. When the latter choice is made, certain advantages seem to result. The artist or musician finds support for his view within the dualistic aspect of his culture. The necessity of explaining much which he does not know can be completely and arbitrarily, if he so chooses, avoided by maintaining that anything he cannot convey belongs to the other world and, by definition, falls outside of any possibility of communication. Some provide a "protective coloring" for themselves in this way. The lack of ability to communicate does not, according to their philosophy, necessarily indicate ignorance. It can (and often does) mean that the knowledge they have is "intuitive". Whatever they claim as knowledge, it follows, must be taken on faith, therefore.

Another feature of our culture, which is at least an indirect result of the dualism discussed above, may be said to be our tendency to treat the whole of life as if it could be contained in "water-tight compartments". The musician is particularly adept at this manipulation,
with accompanying ill consequences that are comparable to those resulting from a too rigid adherence to dualistic philosophy. The fragmentation of the many aspects that make up the whole of music often occurs. Thus, we find those who insist that the only way to come at music is through melody, or through harmony, or through rhythm, or form, or culture, or by means of some other particular aspect of music. This criticism is not meant to apply to the specialist who may very well treat a particular aspect of music while at the same time recognizing that he is dealing with only an aspect of music, having no intention of divorcing it from the whole of music as this appears in actual experience. It is directed, rather, toward the musician who insists that his way is the one way through which music may be properly understood; that his way of coming at the problem is the best or only way.

The criticism, for example, is directed toward the "practical" musician who believes that the "theoretical" musician is a bit stuffy. It is directed in an equal degree toward the "theoretical" musician who feels that the "practical" musician is something of a lowbrow. It is directed toward the "melodist" who feels that the way to musical understanding is through melody, and equally toward the "harmonist" who feels that chord construction is the key to the understanding of music. It is directed
toward those who explain music by reference to form, rhythm, culture, tone color, the harmonic series, directness of sound, etc.; toward those who insist that music must be combined with words -- or must not be combined with words. In a word, the criticism is directed toward all who believe that music is something that can be largely explained by reference to one factor or a limited group of factors such as those suggested above.

The Problem Defined

The purpose of this study is to relate, and to interrelate, the different aspects of the composition of music mentioned above in order that the teaching of composition may be conceived within a larger frame of reference. This will be done within the framework of the "transactional" approach, which is here considered to be analogous to the "field theory" of the physical sciences.

Special attention will be given to the manner in which the harmonic series and other factors combine to bring about the preference for certain scales, melodic leaps, chords, and tone colors that have evolved in Western culture. A symphony, written in connection with the study, will be used in illustrative ways throughout the discussion of these factors.
Suggestions will be made for the teaching of music composition consistent with the approach taken by the study. Certain ways in which the teacher of music composition may draw upon the factors under consideration will be suggested.

Assumptions

The following assumptions are applicable to the present study:

1. The human organism is in and of this world. It is of the order of nature.

2. Man's behavior belongs to the realm of natural phenomena; it does not transcend experience.

3. Methods and techniques which are of use in the study of physical phenomena can be adapted and utilized in the study of human behavior, whether social, moral or aesthetic.

4. The field theory in physics, or, philosophically speaking, the transactional approach, is the most promising one so far conceived. By "transactional" is meant that any phenomenon, or, to use the term in its widest possible context, the whole of life experience, is composed of many factors, all of which operate in dynamic interrelationships with one another.

5. Factors noted for examination or study in any phenomenon are abstractions which are of use only in the interest of better understanding. They cannot be divorced from context in the actual life situation.

6. Music is a natural phenomenon and thus can be treated transactionally, as can other kinds of experience.
Resources

The following are the most important of the many resources drawn upon:

1. A symphony written as a part of this study and which is quoted in full in the latter portion of this project.

2. Literature in the history, theory and composition of music will be used as deemed relevant.

3. Philosophical writings, particularly those which utilize transactional principles, will be used for the formulation of the methodological framework of the study.

Limitations of the Study

The symphony written as part of this study is complete, ready for performance. The theoretical portion, basic as it is to the final form of the symphony, is suggestive only. No attempt to elaborate in detail the principles set forth in the writing was made. Moreover, if these principles are found to be valid, it is suggested that much additional research will need to be done. In particular, there will be a need to determine to what extent the different aspects of composing contribute to the whole of composition.

Traditional "theory", that is, the examination of different styles of composition at various times in history, is not seriously considered, except, perhaps,
in the consideration of structure in Chapter IV. Other more genuinely theoretical approaches to music were also in large part omitted.

Finally, forms resulting from the combination of music and literary art, such as opera, oratorio, mass, art song, etc., do not receive attention.

Scope of the Study

The written portion of the study is essentially theoretical, while the musical portion is essentially practical. It must be emphasized, however, that this use of contrasting terms rejects the dualistic position, "theoretical" versus "practical". Considerable theoretical knowledge was available when the symphony was begun; and in the writing of the symphony new theoretical insights were attained. This interaction continued to the end of the entire project, and continues still. "Theoretical" and "practical", therefore, are nothing more than convenient terms, used to emphasize certain aspects of a total action.
CHAPTER II
MUSIC AS A MEDIUM OF EXPRESSION

In a general way philosophic systems may be said to be divided into two major groups: "other-world" and "this-world" philosophies. Language, as viewed by the first-mentioned philosophies, is seen as a tool through the use of which the Truths of the other world, however dimly they may be perceived, can be communicated. The latter group accepts language as a means by which the truths and values arising in this world may be communicated, believing the first group to be unwisely turning away from the empirical world, which it may know, in the interest of assuming another world, which it may not.

If the position taken in this writing is one in agreement with the "this-world philosophies", it is because of the belief that the theoretical and practical aspects of music can be adequately explained by reference to empirical data. As Edna Heidbreider says, "It is curious that psychologists have shown so little interest in the psychology of human readiness to make these [otherworldly] surplus constructions".¹ An im-

plication seems to follow — namely, our proneness to accept the proposition that a real world exists apart from our experience leads us to a failure to recognize that, even if such a world may be said to exist in some non-human sense, it is significant only insofar as conscious beings may in fact interact, or transact with it. If this is true, much of the mysticism may be taken away from music, with a resultant joining of the theoretical and practical aspects of music. It is toward this goal that a major portion of that which follows is directed.

A Description and Some Limitations of Several Media of Expression

The communication of an idea or a feeling demands the use of language. It is well to remember, however, that different ideas or feelings often find more adequate expression in one language medium than in another. It is because of the diversity of the ideas and feelings which man must express that the many different media of communication, that is, the different language forms, have come into existence.

The most basic need of man, of course, is to keep alive. The newly-born infant continues to live only when adults adequately attend him. The infant soon
begins to communicate in his own way without the use of a formal language, but day by day he finds himself in situation after situation which permit him to make more and more use of formalized language in his quest for a greater security in the satisfaction of basic needs.  

No other formalized language compares with verbal language as an instrument of communication in the interest of satisfying the basic needs of man. In this sense, verbal language is unique. But shortly after the baby learns to communicate at the level of speech, verbal language comes to be used for other purposes as well. We find the child satisfying his intellectual needs by asking questions and by manipulating ideas. The play of the 3-year-old is to a large extent characterized by this sort of manipulation; and this intellectual interest, through the medium of verbal language, continues (or, at least, may continue) throughout the life of the individual.

But verbal language is of still further value. It almost goes without saying that this medium can be used effectively in the description of nature or the

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telling of a story, as in a poem or in a novel. And, although aesthetic values pervade all verbal language to some degree, it is at least occasionally very highly stressed, as, for instance, in the following lines by Poe.

To the swinging and the ringing
Of the bells, bells, bells,
Of the bells, bells, bells, bells,
Bells, bells, bells —
To the rhyming and the chiming of the bells.3

Or,

"Ugh! ugh! ugh! — ugh! ugh! ugh! — ugh!
ugh! ugh! —ugh! ugh! ugh! — ugh! ugh! ugh!"4

Or in the following lines by Swinburne,

And Pan by noon and Bacchus by night,
Fleeter of foot than the fleet-foot kid,
Follows with dancing and fills with delight
The Maenad and the Bassarid;
And soft as lips that laugh and hide
The laughing leaves of the trees divide,
And screen from seeing and leave in sight
The gods pursuing, the maiden hid.5

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4 Ibid., p. 276.

5 The Complete Works of Algernon Charles Swin-
Beyond doubt verbal language is the most versatile of all the media of expression. It is only in the area of precise measurement — the area where mathematical symbolization is supreme — that verbal language seems incapable of adequate expression.

The language of mathematics is not as much used as is verbal language in the satisfying of immediate needs, although it must be noted that the language of mathematics may at times be indispensable in this

burne; edited by Sir Edmund Gosse, C. B., and Thomas James Wise. Vol. VII, from a tragedy entitled "Atlanta in Calydon" (London: William Heinemann Ltd., 1926), p. 272. It is interesting that Swinburne took pains to make it clear that his poetry was to be judged from a more strictly aesthetic point of view than most poetry. He once wrote:

... It would be an absolute waste of time, for one who assumes it as indisputable, to enter into controversy with one who holds it as disputable that the two primary and essential qualities of poetry are imagination and harmony; that where these qualities are wanting there can be no poetry, properly so called; and that where these qualities are perceptible in the highest degree, there, even though they should be unaccompanied and unsupported by any other great quality whatever — there, and only there, is the best and highest poetry. (Ibid., Vol. XIV, from an essay entitled "Wordsworth and Byron", p. 161.)

Swinburne obviously stresses or, perhaps, overstresses, the aesthetic role in poetry (if "imagination and harmony" can be thus translated) at the expense of all other qualities.
function when quantitative precision is demanded. It is, however, another medium through which our intellectual needs are in part satisfied. But even though both verbal language and, to state a sharp contrast, the language of mathematics serve as vehicles for the exercise of intellectualization, there is an important difference: where verbal language is best suited to a more or less "general" manner of coming at problems, mathematical language is capable of precise measurement. For example, we may wonder about the value of the new car that a friend has just acquired. Through verbal language we discover that it is in the low-price field, that it is within his means, etc. This is quite different from a new kind of value knowledge that we come by when we discover that its price is, in terms of the more precise language of mathematics, $1995, F.O.B., Detroit. The language of mathematics, then, insofar as it functions in the intellectual area, is more suited than is verbal language to precise measurement.

It is not as obvious that aesthetic needs can be satisfied as completely through the medium of mathematics as through the medium of verbal language. Yet, such is the case. Professors often compliment their colleagues for the "beautiful demonstration" of a geometric principle. The professor who is giving the
compliment is referring, whether he is fully aware of it or not, to the relationships of the various steps in the demonstration, to the efficiency of the symbols used, to the relationship of the verbal explanation to the pointer — in a word, to the aesthetic quality of the demonstration. Numbers and other symbols can be arranged to form patterns which take such a hold upon us that we "fall in love" with the whole subject-matter field. It is, in fact, this means-ends relationship that is of such great importance in whatever we do. As Dewey has said:

The difference between external and intrinsic operations runs through all the affairs of life. One student studies to pass an examination, to get promotion. To another, the means, the activity of learning, is completely one with what results from it. The consequence, instruction, illumination, is one with the process. . . . If we run over in mind a number of such cases we quickly see that all the cases in which means and ends are external to one another are non-esthetic. This externality may even be regarded as a definition of the non-esthetic.

It thus becomes clear that not only the so-called "arts", but any field of human activity, may be involved when an individual is reacting aesthetically. Cantril calls this sensing of value the "value attribute"

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of experience and sums up his view of this aspect of experience by saying:

The outstanding characteristic of man is his capacity to sense value attributes in his experience and to seek an enhancement of these value attributes through participation in new situations. The standard of value attributes each person uses is influenced by his own unique biological and life history. Only by introducing these concepts can an intrinsically reasonable account of the subtle aspects of the experiences of man be provided. While such concepts may appear to be metaphysical today, research in the biological and physical sciences indicates that such concepts do hold the possibility of eventual scientific understanding.

The language of mathematics can be used both directly and indirectly in the expression of man's ideas and feelings concerning nature. Einstein may be said to have expressed his conception of nature directly through his mathematical formulae, while musicians and artists may, to some degree at least, express their conceptions of nature indirectly through their mathematical understandings of the science of acoustics, the laws of visual perspective, of geometric forms, etc. In a like manner, artists and musicians may express cultural values indirectly through the medium of

mathematical language as, for example, in Bruegel the Elder's painting, "The Wedding Dance" (1566), where a continuous, curved, elevated "pathway", conceived through the medium of solid geometry, serves as a mathematical basis for the work. When we consider the direct expression of cultural values through the medium of mathematical language, we find that verbal language is so often a co-existing factor that "pure" examples are difficult to find. It could be said, however, that a young woman weighing herself uses mathematics as a language, through the medium of which she expresses her feelings concerning her own weight in relationship to the cultural value which, to some extent, determines what she "ought" to weigh.

It must also be noted that the use, both direct and indirect, of the language of mathematics changes cultural values and, for that matter, our conception of nature as well. To refer to Einstein again, our conceptions of nature since the presentation of his insights have already changed markedly. And this new conception of nature has, in turn, changed our cultural values as well.

It seems clear, however, that in many situations

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other language media are better suited than is mathematics to the expression of our views of nature and of cultural values. One such area which, along with its aesthetic emphases, considers this directness in relationship to nature and cultural values to be an important factor contributing to its raison d'être, is the area of the visual arts.

The visual arts are suited both to the artistic representation of nature and to cultural values, and to the expression of the beauty of relationships. The fact that strong controversies exist as to which should be considered the function of art is in itself strong evidence that either one, or a combination of them, may easily be expressed through the media of the visual arts. There is much evidence that a combination of cultural and aesthetic values accounts for those works of art that have survived the test of time. To take a single example, the Parthenon can be analyzed both in the light of its geometrically conceived relations (aesthetics) and in terms of its religious significance in the culture of ancient Greece.\footnote{For a rather complete exposition of this point of view, see John Dewey, \textit{Art as Experience}, \textit{op. cit.}, pp. 99-105.}

It must be pointed out that the intellectual phase
of the visual arts is inevitably a component part of the creating and the appreciating of the art work. This can range from decisions of a general nature, such as resolving whether a fence should be in front of or behind a tree, to a more precise decision related to the appropriateness of using the circle or the triangle as the basic motive for a particular painting.\textsuperscript{10} The somewhat popular notion that scientists think and artists feel is absurd. As Dewey puts it, "Only the psychology that has separated things which in reality belong together holds that scientists and philosophers think while poets and painters follow their feelings".\textsuperscript{11}

\textbf{Description and Limitations of Music as a Medium of Expression}

Music is similar to the visual arts in that the intellectual phase of music is inevitably a component part of the art work. These arts are similar, also, in that they are both concerned, within the limits of their respective domains, with the expression of the beauty of relations. The language of music, however, with a

\textsuperscript{10}For analyses of art works from this geometric frame of reference, see Helen Gardner, op. cit., pp. 13, 134, 392, 444, 462, 478, 536, 543, and 564.

\textsuperscript{11}John Dewey, \textit{Art as Experience}, op. cit., p. 73.
fairly high degree of common agreement, has been designated as a language which functions primarily in order that aesthetic aspects of our experience may be emphasized. If this is true, the major emphasis of music may be said to be the expression of aesthetically valued relationships within the limits of auditory experience.

This is not to imply that nature and cultural values are excluded. To the contrary, nature does not present us with isolated sounds, if it may be said "to present" us with sounds at all. What we hear are the sounds of trains, the sounds of crying babies, the sounds of whistles, of flutes and violins, of orchestras — of something; of something. Even were we to try to put these associations "out of mind" when listening to an orchestra playing so-called "absolute" music we would find the feat impossible of accomplishment.

It is clear, therefore, that music is not divorced from our conception of nature and from our cultural experiences. In fact, even though consciously conceptualized subject matter is not necessarily present (or preferably not present, if we may accept the view of the musician who stresses an "absolute" function of music), it is nevertheless always there in some degree of consciousness, coloring, enhancing, shaping the whole of music which we perceive. In short, these non-verbalized as-
sociations are integral parts of the whole of music. To speak of music in such a way as to exclude these parts is to speak not of music in any way in which we experience it. It is to speak of nothing at all, unless it is to speak of air waves that may be measured, if not heard as music.

It is of interest to note that different language media are used when different expressive purposes are pursued. "The eye", says Dewey,

gives the scene in which things go on and on which changes are projected -- leaving it still a scene even amid tumult and turmoil. The ear, taking for granted the background furnished by cooperative action of vision and touch, brings home to us changes as changes. For sounds are always effects; effects of the clash, the impact and resistance, of the forces of nature.¹²

The point is further emphasized, with certain reservations, when the art of literature is also excluded from the realm of sound.

In contrast with the arts so far mentioned, literature exhibits one unique trait. Sounds, which are directly or as symbolized in print, their medium, are not sounds as such, as in music, but sounds that have been subjected to transforming art before literature deals with them. For words exist before the art of letters and words have been formed out of raw sounds by the art of communication.¹³

¹²Ibid., p. 236.
¹³Ibid., p. 239.
It is interesting in this connection to observe that, psychologically speaking, the thunder itself is terrible or awesome, which is very likely the reason that Thor, the god of thunder, was given such a high place in the hierarchy of the gods in ancient times, even attaining the status of the most important god in some cultures. By way of contrast it is less usual, again speaking psychologically, to place the terribleness in something we see. We do not perceive so much that the sword hanging over Damocles' head is itself terrible as we conceive ourselves to be terrified by the scene which we see. To the extent that this is true, the trombones playing fortissimo will exert a more powerful emotional effect over us than, say, a flaming red in a painting. Or at least it must be admitted that, if the flaming red produces a like emotional effect, this effect is more likely to be a result of cultural associations than is necessarily the case with some music.

It would seem then, although it must be emphasized that what is here involved is only a matter of degree, that sound as perceived in the language of music tends to affect our emotions directly, whereas the other language media tend to affect our emotions only indirectly through interpretation and analogy.

If this is true, it is not difficult to understand
why the frame of reference for the musician is likely to be substantially different from the frame of reference held by one who works and communicates in other language media. The different frames of reference are each important and each is dependent upon the goal being pursued. To take extreme examples, the goal of the musician may be primarily the direct expression of feeling, while the goal of the research worker, although it is to be hoped that he achieves aesthetic satisfaction in the process of the doing of his work, may still be primarily precise measurement. Literature and the visual arts fall between these two extremes and it is interesting to observe, although there is much controversy concerning these different emphases in the visual arts, that Dewey writes, "Apart from the emotional effect of formal relations, the plastic arts arouse emotion through what they express. Sounds have the power of direct emotional experience." Dewey, as this statement reveals, emphasizes the intellectual and subject-matter phases more in the visual arts (which is, as has been pointed out before, the language most allied with music), than he does in music.

In this chapter we have given consideration to the place of the language of music in the total life scene.

It is believed that life is experienced as a totality and that the different language media constitute different aspects of the whole of life — that the different language media interrelate dynamically, or transact, in the total life situation. In the following chapters the frame of reference is more or less restricted to certain aspects of the language of music and the way in which they transact in bringing about the totality of the language of music. The language of the science of acoustics, in particular, the harmonic series, is one aspect of music, the importance of which may be all too often underemphasized. It is here taken to be of such importance that a discussion of the relationship of this aspect of science to music composition will be the subject of consideration in Chapter III. In a like manner, form, or structure, has a bearing of such importance upon the problem of this study that it will be considered alone in Chapter IV. In neither instance, however, will these aspects be treated as if they somehow represented the whole of music. Moreover, as each is treated, the symphony written as part of the study will be referred to specifically to illustrate the general emphases which are appropriate to the approach to music composition here developed.
CHAPTER III

THE ROLE OF THE HARMONIC SERIES IN THE THEORY OF MUSIC

The harmonic series has been involved with the theory of music to at least some degree since the time of ancient Greece. It was then that Pythagorus found experimentally that a string vibrated not only at its full length but also separately, both in halves and in thirds; and that the vibrating of the string in halves and thirds produced tones an octave and an octave plus a fifth above the fundamental. Although composers and music theorists often composed and wrote as if they had knowledge of partials above the 3rd, it was not until 1629 that a theory which considered the problem in a manner other than as related to proportion came

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1Zarlino (1517-1590) is an interesting example of one who seemed to have this knowledge at his fingertips. Concerning his knowledge of the harmonic series, however, Redfield says,

It should not be inferred . . . that Zarlino had any conception of the partial tones, even the slightest inkling of their existence. His reasoning was based entirely upon the sounds produced by strings whose relative lengths were 1, 1/2, 1/3, 1/4, 1/5, and 1/6. That the string itself naturally divides into segments of these relative lengths, and thus actually produces the harmonia perfetta, was a conception entirely beyond the comprehension of musicians of his day. (From John Redfield, Music, A Science and an Art (New York: Alfred A. Knopf, 1928), p. 79.

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into being. Descartes, in that year, entertained such a theory. Concerning Descartes in this connection, Scherchen says,

... Descartes correctly noted that these sympathetic notes were probably set up by division of the vibrating string. (Letters, 1629, Nos. 27 and 106.) Unfortunately he did not pursue the problem further, wrongly assuming that the partition of a string into vibrating subdivisions, and the consonance of the different kinds of vibration resulting from it, only occurred in faulty strings.  

Claude Perrault (1614-1688) was one of the first to suspect tone color to be related to the overtone series. Scherchen quotes Perrault as saying, "Every note is composed of several consonant notes which combine to create one sound." And, "Even the simplest sound is really a collection of infinite partial sounds (bruits partiaux) which combine to make one complete sound. Nevertheless there is always one partial sound, stronger than the rest, which gives to the total its particular character." 

With Joseph Sauveur (1653-1716), however, the sci-
ence of the harmonic series came of age. Without examining the methods he used to determine the facts of the harmonic series, three of the conclusions he drew, as listed by Scherchen, should be stated. They are:

1. Overtones are directly caused by the partial vibration of a string and they also occur through partial vibration of the same part that is producing the primary overtones.

3. Overtones are perceptible up to the 128th harmonic (i.e., the seventh octave).

4. The lowest odd overtone are the most audible.

Scale Formation

The conception of the harmonic series, as formulated by Sauveur, and confirmed by Helmholtz in 1863, and by Miller and other 20th century scientists, has today found almost complete acceptance. Its implications, however, in regard to music, are often less than completely understood. Many theorists tend to give only passing comment to the series, saying that, in any final analysis, the formation of scale patterns (to take a single example) are dependent upon the culture within which the scales are found -- that, in a word, scale patterns are culturally derived.

5Ibid., p. 37.
There is, of course, much evidence to support this point of view, with the hundreds of different scales throughout the world. There is one fact, however, that would seem to indicate that the harmonic series is always a factor: namely, every known culture today makes use of the octave (the 2nd partial) and the 5th (the 3rd partial reduced by an octave) in its scale formations. The fact that use is made in all cultures of these lowest three tones of the series seems to indicate that some factor other than factors related to culture as such is involved.

The harmonic series is now of course quite clearly understood and accepted, and can be approximately notated upon our conventional staff as follows:  

\[ \begin{array}{c}
3 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 & 16 & 17 & 18 & 19 \\
\end{array} \]

It should be noted that an assumption is made as a base for the discussion which follows. It is this: if the

6In the examples that follow the tone C is arbitrarily considered to be the fundamental unless otherwise stated.
harmonic series is a factor in the creating of a system of music, the various scales, melodic leaps, chords, etc., will tend to approximate tones low in the harmonic series. Conversely, if the harmonic series is not a factor in the evolving practice of music, there will be little if any correlation between scales, melodic leaps, etc. in actual use, and approximations, of the lower tones of the series.

The term "approximate" is used advisedly, since the harmonic series is found to be mathematically analyzable in terms of geometric principles, whereas the scales which are in use at least tend to be more or less forced into an arithmetic frame. This is particularly true in Western music, where the equal tempered scale is now used almost to the exclusion of all others. The fact that this discrepancy between the language of the science of acoustics and the language of the music theorist existed, or at least tended to exist, however, did not necessarily prohibit musicians (sub-verbally, if not verbally) from approximating the arithmetically based scales to the geometrically conceived harmonic series.

The ancient Greeks were perhaps the first to conceive the idea of adding perfect fifth upon perfect fifth until the basis of some sort of scale was achieved. One of the stopping places was after the fourth such
super-position.

When brought into the confines of the octave, the scale that we still know as the "pentatonic" scale was achieved.

Since it is the thesis of this writing that many factors interrelate dynamically in the evolving of musical theory and practice, a consideration of the possible influence of the harmonic series is also a legitimate enterprise.

If we take the five lowest different (non-duplicated) members of the harmonic series and place them in such a way as to be within the confines of a single octave, and progress from lowest to highest, we find the following series of notes:
This is, of course, an approximation of the pentatonic scale still in use in many primitive cultures today. The fact that the 7th partial (the 4th lowest different member of the series) is slightly closer to what we call B-flat than to what we call A is not a serious drawback to the theory. On our tempered instruments of today the 5th note of the pentatonic scale is, of course, A, but primitive cultures whose instruments (and voices) are not manufactured according to our tempered scale, produce scales, the fifth tone of which may be neither A nor B-flat, but something in between. We thus find that both the traditional method of superimposing fifths and approximate correspondence with low-ranking members of the harmonic series may be considered factors in the formation of the pentatonic scale.

If we continue this line of approach and approximate all the non-duplicated tones lower than the 16th member of the series, the following scale is formed.

\[ \text{\textbackslashGRAPHIC}\]

This scale, as Hindemith points out, "has been of importance in musical practice, but never in musical theory".

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If this is true, it would seem that there is, to the degree that this scale is of importance in practice, evidence to support the view that the harmonic series is a factor in scale formation. Even though this may be granted, however, another line of attack is needed if a more direct relationship is to be established.

As has been previously mentioned, the 3rd member of the harmonic series, or the dominant, is used in all cultures throughout the world and is considered to be second in importance only to the fundamental of the series, or the tonic. In Western music the dominant is unanimously and deliberately chosen as a pillar which, along with the tonic, serves as the very foundation of music. This is to be expected, since, with the harmonic series used as the frame of reference, it is the 2nd lowest and thus the 2nd most prominent different member of the harmonic series.

If we modulate to the dominant for the 4th tone of the major scale and continue using the overtones of the dominant fundamental until the octave is reached, we find that the overtones used are no higher than those

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8 The 2nd member, or the octave, can be considered to be more important than the dominant, but this tone can also be considered to be a duplication of the fundamental. Since modulation is to be considered, the octave will here be treated as though it were serving the latter function and no other.
used in the pentatonic scale — that is, no member of the series higher than the 9th partial is needed.

It may be easier to observe the manner in which the overtones are utilized by substituting duplicate members of the harmonic series for the lower-numbered partials shown above.

Perhaps of equal interest is the fact that the chromatic scale can be analyzed very efficiently using the same approach.

Or, to substitute again, the higher duplicating partials for the lower-numbered ones, the following:
The point to be emphasized is this: by shifting the fundamental from tonic to dominant at the opportune moment, both the major and the chromatic scale are easily analyzable from the point of view of approximating the tones of the harmonic series. It is not meant that this is the only explanation of the scales so far discussed. The point of view taken here is that the more ways in which scales can be intellectualized, whether from the point of view of the harmonic series, from the point of view of aesthetics, of culture, etc., the more likely a scale is to be valid. In other words, our existing scales are likely to be the product of many factors, all of which interrelate dynamically as factors involved in our conception of the totality of that which we call a scale.

If the foregoing explanation is acceptable as one facet of the whole of the explanation of some of our scales, it seems clear that musicians through the course of Western history have not been disinclined to manipulate what they felt to be valid through their understanding (fully articulated or not) of the science of acoustics, for their own purposes. The harmonic series does not modulate by itself — the musicians "modulate" it, if we may be permitted to use the term here as a
transitive verb.\(^9\)

It was suggested earlier (p. 35) that the most reasonable modulation, when using the harmonic series as a frame of reference, would be to the most prominent different member of the harmonic series, other than the fundamental, and that this tone is the 3rd member of the series, or the dominant. If we continue this line of reasoning, it would seem that the next most reasonable tone to which to modulate would be to the next most prominent, or the next lowest, member of the harmonic series different from the fundamental and its dominant. And, as a matter of fact, this tone, the major 3rd (the 5th tone, the 3rd non-duplicated tone of the harmonic series) is used as a new center to which modulations proceed and it is used often enough to have been named the "mediant" cadence.

Practice in Western music, however, does not conform to this line of reasoning. The third most important tone to which modulations occur is not the 3rd of the scale, but the fourth degree. And since the F first occurs even approximately as the 21st member of the series, some other explanation is clearly demanded.

\(^9\)Traditional usage intends that the term "modulation" be utilized only when another key is involved. Here the term will be used when a shift of fundamental occurs, whether to another key, or simply to another chord of the same key.
It has previously been pointed out that, when we use the harmonic series as a frame of reference, the relationship between tonic and dominant is strong because of the fact that the first different partial of the tonic chord is used as the root of the dominant. We might say that, when we shift the fundamental from C (assuming C to be the tonic) to G, we are using the G as a tone common to both tonic and dominant. In other words, we can call this a "common-tone modulation" and the strongest possible common-tone modulation, since only the two lowest different tones of the series are involved.

It was previously mentioned that the term "modulation" is here used to indicate a shift of fundamental, whether to another key or simply to another chord of the same key. Similarly, the term "common-tone modulation" is ordinarily used to indicate a shift from a fundamental within a key to a fundamental of another key as, for example, from C to A-flat.

Here, as was the case with the term "modulation", the term "common-tone modulation" will also be used to indicate a shift of fundamental, whether to another key or not.
There is only one other modulating possibility which, from the point of view of the harmonic series, can be as strong. This is the reverse of the tonic-dominant relationship, where, instead of the 3rd partial of the tonic being used as the 1st of the dominant, the 1st partial of the tonic is used as the 3rd partial of whatever chord would result when this common-tone modulation is effected. This, of course, gives us the sub-dominant chord. It must be mentioned, also, that these two modulations give us a departure from the tonic up a 5th and down a 5th, a happy circumstance in relationship to the aesthetic feeling we have for balance, symbolized roughly, perhaps, in the old adage, "What goes up must come down".

If it is granted that the common-tone modulation principle mentioned above is sound, the simplest beginnings of scale formation are created by modulating the interval of the 5th (the fundamental and 3rd partial) to its two most related positions.

![Common-tone modulations from the fundamental to the 3rd partial, and from the 3rd partial to the fundamental](image-url)
Or, with a little editing, the following:

It will be noticed that the resulting tones are those common to the major scale and all forms of the minor scale in the major-minor system of the Western world.

If the gaps in the scale (indicated by the question marks) are to be filled in from the combined frames of reference of the harmonic series as it influences chord formation and common-tone modulation, we must call upon a higher member of the harmonic series than the 3rd partial. The next lowest partial different from the two constituting the interval of the perfect 5th is, of course, the 5th partial, or the tone a major 3rd up from the fundamental.

There are two ways in which this new tone can be utilized. We shall first consider it (the fifth partial) as a tone which, in addition to the 3rd partial, may also be used as a pivot tone in a common-tone modulation.
common-tone modulations from the fundamental to the 3rd partial, and from the 3rd partial to the fundamental

\[ \text{\textbackslash begin{align*} }
\text{\textbackslash e_1 \textbackslash f_3 \textbackslash g_1 \textbackslash h_1 \textbackslash i_1 \textbackslash j_1 \textbackslash k_1 \textbackslash l_1 \textbackslash m_1 \textbackslash n_1 \textbackslash o_1 \textbackslash p_1 \textbackslash q_1 \textbackslash r_1 \textbackslash s_1 \textbackslash t_1 \textbackslash u_1 \textbackslash v_1 \textbackslash w_1 \textbackslash x_1 \textbackslash y_1 \textbackslash z_1 \textbackslash A_1 \textbackslash B_1 \textbackslash C_1 \textbackslash D_1 \textbackslash E_1 \textbackslash F_1 \textbackslash G_1 \textbackslash H_1 \textbackslash I_1 \textbackslash J_1 \textbackslash K_1 \textbackslash L_1 \textbackslash M_1 \textbackslash N_1 \textbackslash O_1 \textbackslash P_1 \textbackslash Q_1 \textbackslash R_1 \textbackslash S_1 \textbackslash T_1 \textbackslash U_1 \textbackslash V_1 \textbackslash W_1 \textbackslash X_1 \textbackslash Y_1 \textbackslash Z_1 \textbackslash A_1 \textbackslash B_1 \textbackslash C_1 \textbackslash D_1 \textbackslash E_1 \textbackslash F_1 \textbackslash G_1 \textbackslash H_1 \textbackslash I_1 \textbackslash J_1 \textbackslash K_1 \textbackslash L_1 \textbackslash M_1 \textbacklash end{align*} } \]

The tones now available are the following:

\[ \text{\textbackslash begin{align*} }
\text{\textbackslash e_1 \textbackslash f_3 \textbackslash g_1 \textbackslash h_1 \textbackslash i_1 \textbackslash j_1 \textbackslash k_1 \textbackslash l_1 \textbackslash m_1 \textbackslash n_1 \textbackslash o_1 \textbackslash p_1 \textbackslash q_1 \textbackslash r_1 \textbackslash s_1 \textbackslash t_1 \textbackslash u_1 \textbackslash v_1 \textbackslash w_1 \textbackslash x_1 \textbackslash y_1 \textbackslash z_1 \textbackslash A_1 \textbackslash B_1 \textbackslash C_1 \textbackslash D_1 \textbackslash E_1 \textbackslash F_1 \textbackslash G_1 \textbackslash H_1 \textbackslash I_1 \textbackslash J_1 \textbackslash K_1 \textbackslash L_1 \textbackslash M_1 \textbacklash end{align*} \]

When arranged within the confines of an octave, the harmonic minor scale is formed.

\[ \text{\textbackslash begin{align*} }
\text{\textbackslash e_1 \textbackslash f_3 \textbackslash g_1 \textbackslash h_1 \textbackslash i_1 \textbackslash j_1 \textbackslash k_1 \textbackslash l_1 \textbackslash m_1 \textbackslash n_1 \textbackslash o_1 \textbackslash p_1 \textbackslash q_1 \textbackslash r_1 \textbackslash s_1 \textbackslash t_1 \textbackslash u_1 \textbackslash v_1 \textbackslash w_1 \textbackslash x_1 \textbackslash y_1 \textbackslash z_1 \textbackslash A_1 \textbackslash B_1 \textbackslash C_1 \textbackslash D_1 \textbackslash E_1 \textbackslash F_1 \textbackslash G_1 \textbackslash H_1 \textbackslash I_1 \textbackslash J_1 \textbackslash K_1 \textbacklash end{align*} \]

It will be noticed that the B-natural is the least stable of all, since it springs from a tone (the 5th partial -- E-natural in the diagram above) which is not used in the scale when it is established. This perhaps explains the fact that the B-natural of the minor scale is the tone to be altered when the "natural minor scale" is produced. It almost goes without saying that
the A-flat is altered to A-natural, in traditional harmony, only when it is used either immediately before or immediately after a B-natural, and thus may be considered more or less a means by which the B-natural can be more smoothly approached or left.

The other way in which the 5th partial can be utilized is by adding it to the fundamental and the 3rd partial, modulating by using only the first and third partials.

\[
\text{common-tone modulations} \\
\text{from the fundamental} \\
\text{to the 3rd partial,} \\
\text{and from the 3rd partial to the fundamental}
\]

When these tones are arranged within the confines of an octave, the major scale is formed.

\[
\text{If the transactional approach is to live up to its final test, the use of both the 3rd and the 5th partials for the purposes of both common-tone modulation and}
\]
filling in the vertical chord should give us another more involved scale. All of the possibilities, including common-tone modulations between the 3rd and 5th, and 5th and 3rd partials, are given below.

- common-tone modulations from the fundamental to the 3rd partial, and from the 3rd partial to the fundamental
- common-tone modulations from the fundamental to the 5th partial, and from the 5th partial to the fundamental

The tones from these examples, arranged scalewise in ascending order, appear below.

Two things are of interest to us here. It is ob-
vious that the chromatic scale is represented with the exception of the F-sharp (or G-flat). It is very interesting that the tone missing is the "diabolus in musica" himself — the tone which has given theorists so much trouble throughout the history of music — the tone that Hindemith puts in a class by itself. The tone is apparently a member of the chromatic scale in spite of the fact that it is so distantly related to the fundamental. A gap exists if it is omitted. Composers and theorists have evidently felt that this single gap must be bridged.

Also of interest is the fact that the two tones which distinguish the harmonic minor scale from the major scale appear twice in the example above — perhaps another bit of evidence that the harmonic series, conceived as simultaneously influencing both chord structure and common-tone modulation, is a useful way of explaining the evolution of the harmonic minor scale.

Although it is held that the foregoing explanation involving the simultaneous use of the harmonic series as it influences vertical structure and common-tone modulation is the basic one in the explanation of our scales, other factors may still be involved. A further examination of the major scale, for example, will show aesthetic principles to be prominent. The
first four tones have the same set of relationships as the last four tones.

It goes without saying that group I begins with the fundamental. It must be noted, however, that group II begins with the most important partial other than the fundamental and its octave: the 3rd member of the series.

Another way of conceiving the major scale, once it has been established according to the basic principles set forward above, is exemplified below. It will be noticed that, in this example, partials higher in the series are drawn upon.

This particular conception of the scale has certain advantages where rhythm is concerned. A strong rhythm can be achieved both up and down the scale. (In the
example following, the eighth notes barred together indicate that no modulation is taking place).

Further extensions of this principle are possible by taking other tones of the scale and modulating to them and their overtones instead of to one of the two suggested above. Here it will only be said that the series seems to be involved in the formation of the pentatonic, major, minor and chromatic scales. The manner in which other factors are involved in the minor scale, however, is very interesting and special attention will be given them in relationship to the various forms of the minor scale.

Of importance is the fact that the minor scale does not achieve the aesthetic balance that the major scale does. When we consider, for example, the balance between the two "halves" of the minor scale, we are doomed to disappointment. The two halves simply do not match.
It is almost as disappointing when the ascending melodic version of the minor scale is used.

It is also disappointing when the natural version of the minor scale is considered.

The minor scale is also disappointing when considered from the rhythmic point of view, at least in comparison with the strong rhythm springing from the

It is interesting, in this respect, that the dorian mode of medieval times, perhaps the most popular
major scale. (Again, the eighth notes barred together, when they occur, indicate that no modulation is taking place. In order to equate the influence of the harmonic series in both major and minor, no partial higher than the 9th is drawn upon).

Harmonic minor scale

\[
\begin{align*}
\text{C:} &\quad 9\text{Ab}:3\text{F:}1\text{G:}1\text{Ab:}1\text{E:}3\text{C:}1\text{E:}3\text{Ab:}1\text{G:}1\text{F:}1\text{Ab:}3\text{C:}9
\end{align*}
\]

of the church modes, manifests this balance.

Dorian mode (transposed)

If our theory is correct, the dorian mode has gone out of favor because, in spite of its inherent balance, it does not admit the influence of the harmonic series to a great enough degree.
Natural minor scale

If the minor scale is not as satisfactory from these points of view as is the major scale, some other explanation must be sought. This explanation is here considered to be in relationship to the purpose of a particular composition. The expression "Everything's right with the world" is not as symbolic as it may at first appear to be — emotions associated with the happier side of life are ordinarily expressed, in Western music, through the use of the major mode — which is to say that, when the major mode is used, "Everything is right" with the felt (but not necessarily intellectualized) result of the transaction among the harmonic series, aesthetic principles related to balance, rhythm, etc. Symbolically the musician is expressing to a greater degree an adjustment to his world when he uses the major mode;
this scalar system tends to draw transactionally from more different frames of reference than does the minor scale.

Conversely, if the purpose of the composition is the expression of the more "negative" emotions, such as sadness, grief, etc., it would not be reasonable, from the point of view of transaction, to write the music in such a way that "everything would be right" with the many factors involved. Such efficiency would work against the intent of the composer. He must be, transactionally speaking, less than completely efficient if the desired "negative" emotion is to be adequately portrayed. In other words, degrees of transactional efficiency are techniques which the composer has at his disposal. When he wishes to portray a "happy" emotion he tends to use the major scale — the scale in which more factors transact; when he wishes to portray a "negative" emotion, he tends to use a scale which is not as effective, speaking from the point of view of transaction. In our culture, this "negative" purpose has been expressed through the use of the various forms of the minor scale.

It must be mentioned in closing this section that the influence of man's desire for the transactional manner of expression is often evident. The ascending
version of the melodic minor scale, for example, is perhaps somewhat of an improvement in this direction over the harmonic minor. The 3rd of the minor scale is often changed from the minor to the major as in the case of the Picardi third. And in Beethoven's 5th Symphony in c minor, the whole last movement is written not in c minor at all, but in C major — surely evidence of the most dramatic sort that supports the contentions of the transactional point of view.

**Melodic Intervals**

Melodic intervals seem not to be as much affected by the overtone series as are the scales previously discussed or, as will be shown later, as is the constitution of chords. In fact, the use of melodic intervals seems to be more determined by the distance that must be skipped than by any other factor. In spite of this, however, the harmonic series does operate to some extent. The following is a consideration of the different melodic intervals, primarily from the point of view of approximate correspondence with a member of the harmonic series.

The major 2nd and the diatonic half step, both ascending and descending, are the basic intervals in both the major and minor (and most other) scales. The fact that the one version of the minor scale which con-
tains an interval of $1\frac{1}{2}$ steps is known as the harmonic minor scale, while the version which avoids this interval is known as the melodic minor scale, bears witness to this fact. These intervals are derived from the particular scale in which the composition is written and the scale, in turn, as has been shown previously, is derived, in part at least, from the harmonic series.

Although the major 2nds and the diatonic half steps are the basic intervals, other intervals are used in melody writing, also. There seem to be at least three factors which determine the acceptability of these different intervals:

1. The width of the skip. The wider the skip the less likely it is to be acceptable. This is surely because the wider skips become farther and farther removed from the basic melodic interval of the stepwise progression.

2. The direction of the skip. This tendency may be explained by reference to the very nature of the harmonic series. Since, when a melodic tone is sounding, the overtones which are a composite of the original tone are sounding above and not below the original tone, there can be said to be some preparation for the upward progressing interval -- and this preparation may permit, to some degree, a smoother and, hence, a more acceptable interval. The acceptability of the ascending minor 6th and the tendency to reject the descending minor 6th are the examples, within the octave, where this factor seems to be the determining one.
3. Approximate correspondence with low overtones of the harmonic series. More will be said about this aspect of the analysis as we progress.

The descending melodic interval of the octave is the permitted melodic interval most affected by the principle of approximate correspondence with a low-ranking member of the overtone series. It is permitted in spite of the fact that it is the widest possible interval within the confines of an octave and also in spite of the fact that its motion is downward rather than upward. The ascending octave is also acceptable because of the approximate correspondence with low members of the harmonic series (fundamental and the 2nd partial) and because it is an ascending interval.

The ascending 5th is also acceptable because of the approximate correspondence with low-ranking members of the harmonic series (ratio 2:3) and because it is ascending. The inversion of the ascending perfect 5th, the descending perfect 4th, is permitted in part because of the aesthetic principle previously mentioned, roughly characterized in the adage "What goes up must come down". It may be mentioned, however, that this factor may not be strong because of the fact that the 6ths and 7ths, the inversions of the 2nds and 3rds, are, with one exception, not as freely permitted. The main factor
involved in the wholehearted acceptance of the descending perfect 4th, however, can safely be said to be the approximation of low members of the harmonic series. The ratio is, of course, 4:3.

The ascending perfect 4th is, simply enough, the ratio 3:4, the reverse of the descending perfect 4th. Its inversion, the descending perfect 5th, also can claim its acceptance by reference to its low ratio, 3:2.

The ascending major 3rd is good in relation to all three of the aforementioned criteria: the ratio is low (4:5); the direction of the interval is upward; and the width of the interval is not great. Its inversion, the descending minor 6th, is poor on all three counts. Its direction is downward; it is a wide interval; and the ratio, 8:5, is not sufficiently low.

The ascending minor 3rd is acceptable from all three criteria, its ratio being 5:6. It must be pointed out, however, that in the case of the minor scale the ratio is almost in the stratosphere of the overtone series (16:19) and that the purpose of expressing negative emotions by the use of fewer transacting factors is again involved, as was previously suggested in the discussion of scales. The descending major 6th, the inversion of the ascending minor 3rd, is not acceptable, apparently because of a combination of the principles
involved in the width of the skip and the fact that it is a downward interval, since its ratio is fairly low, 5:3. The fact that there is one partial (the 4th) which is skipped in this ratio may also be a factor which contributes to the fact that it is ordinarily not accepted.

The ascending major 6th is apparently traditionally prohibited largely because of the breadth of the interval, although the fact that the ratio (3:5) skips the 4th partial may, as was suggested in the instance of the descending major 6th, be another factor. The descending minor 3rd, the inversion of the ascending major 6th, is acceptable because of the narrowness of the interval and because of the fact that the ratio (6:5) is low. The same qualifications as were suggested in the discussion of the ascending minor 3rd, however, apply with equal force in the consideration of the descending minor 3rd (see preceding paragraph).

Passing mention has already been given to the ascending minor 6th. It has many characteristics which would tend to prohibit its use: (1) it is a wide skip; (2) it is not low in the harmonic series (ratio: 5:8); and (3) even when it is found in the series, the 6th and 7th partials must be skipped. But in spite of these factors, it appears that (1) the width of the skip is not too great; (2) it is not too high in the
series; and (3) the fact that the ratio skips the 6th and 7th partials is not so important that the fact of its upward movement cannot swing the tide to its acceptance. It is apparently a close decision, but most theorists agree that it is an acceptable interval.  

The inversion of the ascending minor 6th, the descending major third, is, of course, acceptable because of the narrowness of the skip and the lowness (5:4) of its ratio.

The ascending and descending major and minor 2nds have been discussed above. Their inversions, the ascending and descending major and minor 7ths, are often

12It must be mentioned that the ratio 8:13 is also a possibility, especially in minor. It is especially satisfactory when the home tone is common to the two chords.

The fact that an A-flat is sounding in the I chord (as the 13th partial) tends to prepare the listener for the A-flat when it appears in the IV chord. When the G is held over, the ratio 8:13 is to some extent continued in spite of the addition of the F's below.
found unacceptable for the same reasons as were the ascending and descending major 6ths.

The remaining interval within the octave, the tritone, is probably the most intriguing of all. Hindemith gives the various statuses that this interval has had in different periods in Western music history in the following words:

Musical theory has always been at odds with the "diabolus in musica", and has always treated it with a peculiar mixture of love and hatred. Theorists at first tried to get around it. Then a settlement was made; the treatises of mediaeval theorists are an endless chain of attempts to accommodate "mi contra fa"; solmization is the attempt to take in the unwelcome guest with impunity. Finally, the tritone became the pet of harmony. Yet even for us it remains a civilized demon — "der Geist, der stets verneint": the spirit that ever denies.

Since the inversion of the tritone is another tritone, it is obvious that this interval stands alone when it is compared with any other interval which, of course, always has its complementing inversion. There is a fac-

\[ \begin{align*}
\text{13}\text{In this presentation both } & \text{ and } \\
\text{are, for the sake of convenience, considered to be tritones.}
\end{align*} \]

\[ \text{14Hindemith, op. cit., pp. 83-84.} \]
tor, however, that may account for much of the acceptance which it has had. This is the cognizance (at a sub-verbal level, if not at a verbal level) of the fact that the tritone occurs not too high in the overtone series. The ratio is 5:7.

\[ \text{\includegraphics{tritone}} \]

The fact that the 7th partial has long been considered to be unfit for musical purposes is no reason to rule out the approximation of the interval within the limits of our ability to do so with the scales which are available to us. Such a theoretical position would rule out the possibility of a satisfactory explanation of much of the compositional practice of the last 300 years or more. At the same time, it is highly possible that this conflict is responsible for the contradictory opinions expressed by theorists when they look upon this interval in such diverse ways as the very "diabolus in musica" and the "pet of harmony".

Modern composers have a tendency to use the melodic interval of the tritone in ways other than as an integral part of the dominant 7th progression. This interval also occurs in relation to the fundamental of the series.
It is the 11th partial.

\[ \text{It is from this presentation of the tritone in the harmonic series that the melodic use of the interval in the following example springs.} \]

The last two tones of the last measure, in the bass, illustrates the point.

\[ \text{It is almost unnecessary to say that such a melodic progression is prohibited by traditional theorists.} \]

**Harmonic Intervals**

The case for the influence of the harmonic series upon harmonic intervals is more clear-cut than is the

\[ ^{15}\text{From the symphony composed for this study, p. 6. Page numbers concerning the symphony will refer to the pages of the symphony itself, not to the page numbers of the dissertation.} \]
case of its influence upon melodic intervals. The composer is usually most bent upon expressing his most subtle personality in the composition of melody. The composing of harmony, in contrast, tends to be less bent upon the transactional expression of the whole of music. It turns more to composition more related to the science of acoustics and of form or rhythm.

Music first existed as a single undoubled melody. It was surely not long before men and women began to sing the same melody but, because of the differences between their voices, at the octave rather than at the unison. Here may be said to be the first time that a tone from the harmonic series forecast, in a small way, further combinations to come.

The next step, the addition of the 3rd member of the harmonic series, was a long time in coming, first appearing in the organum of the 9th century.¹⁶

It must be pointed out that the 3rd member of the series was used both above and below the fundamental, thus giving us organum at both the 5th and the 4th. This is mentioned particularly in order that it be perfectly clear that the tones of the overtone series are here conceived as being only one factor which, along with the intellectual, emotional, aesthetic, cultural, etc., has always had a hand in shaping that which we know as music. In the following example it will also be noticed that some freedom of voice movement is coming into compositional practice.

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18 Ibid., p. 540.
As soon as three-part writing came into existence (late 12th or early 13th century), the 5th and the octave became the mainstays of the harmonic structure, the final chord, if the composition were in three parts, ordinarily looking like this:

\[ \begin{array}{c}
    \text{\textbf{3}} \\
    \text{\textbf{1}} \\
\end{array} \]

The next step was the addition of the 5th member of the harmonic series which produced a still more complicated chord, the chord that is still of such great importance today -- the major triad.

\[ \begin{array}{c}
    \text{\textbf{3}} \\
    \text{\textbf{1}} \\
\end{array} \]

The 7th tone of the series, the next lowest different tone, soon occurred, but not as a consonance, as might have been expected. Rather, it was definitely considered a dissonance and, of course, strict rules were established in order that the tone would not be improperly used.\(^{19}\)

\(^{19}\) Many theorists believe that the 7th partial is not a basis for the flatted 7th degree of the scale -- that the 7th partial is unfit for musical use. If this
While the ease for the consonant flatted 7th degree of the scale may be controversial, the same cannot be said for the 2nd degree of the scale which, when modulation is not considered, springs from the 9th partial. Even Beethoven uses this member of the harmonic series as a consonance in his 6th symphony, although it must be admitted that his concern was very likely more with the concept of "dominant over tonic", caring little for the possible relationship that this concept, in turn, has to the harmonic series.

is true, it would explain why the flatted 7th of the scale was so strongly considered dissonant. On the other hand, Debussy certainly used the flatted 7th degree of the scale as a consonance in his parallel dominant 9th chords; and the modern popular arranger does not hesitate to use the flatted 7th, as well as the major 6th degree of the scale, simultaneously, apparently because he senses that both the B-flat and the A can lay some claim to consonance because of the nearness of both of them to the 7th partial.
In the symphony composed for this study, the use of this overtone is also exemplified, at the points marked by an "x" below.

For purposes of contrast with traditional theory, it may be interesting to observe one of the earlier, and
more traditional, versions of this particular phrase of the symphony. The three comparable chords are again marked by an "x".

The use of the next different interval, the 11th member of the harmonic series, or the tritone, is first found in full bloom with Stravinsky. The symphony composed for this study also makes extensive use of this interval, as between the low G-flat and the high C in the following example.\textsuperscript{20}

\textsuperscript{20} For this passage in context, see pp. 111-12 of the symphony.
In modern music, the harmonic series is drawn upon for harmonic use at least as far as the 19th partial (where the minor 3rd first appears). Bartok, in his Mikrokosmos, uses the major and minor 3rds simultaneously over and over again. In his piece "Wrestling", his final chord makes simultaneous use of both the major
and minor 3rds.  

In the symphony composed for this study, major and minor 3rds are also used simultaneously (in the last measure below).  


22 See p. 3 of the symphony for this passage in context.
There are at least two ways of analyzing the use of the major and minor 3rd at the same time. One would be to refer the practice to the merging of the major-minor system into a new system; the other would claim that both the 5th and the 19th partials were used as consonances. The fact that the minor 3rd is above the major 3rd in the last example would indicate that some consideration was given to the structure of the overtone series, where, of course, we find the first minor 3rd nearly two octaves above the first major 3rd. The absence of the 7th, 9th, 11th, 13th, 15th, and 17th partials in the makeup of the chord would seem to indicate, nevertheless, a preference for choosing this particular "consonance" (if we may call it such) from the experience previously had with the major-minor system. Particularly in the case of the major versus minor it is suggested that the harmonic series is at best a factor second in importance. The cultural past seems a much more likely source from which primarily to base our present simultaneous use of the major and minor 3rds.

At the same time, however, present-day composers are tending to draw upon higher and higher tones in the harmonic series. Bartok, in a piece called "Minor Seconds, Major Sevenths", gives us the following interest-
ing example in which chords are built out of the interval of the half step.\textsuperscript{23}

\begin{center}
\textit{Molto adagio, mesto, }\textbf{\textit{d} = 56}
\end{center}

(ped.)

In the accompanying symphony, the following clusters occur:\textsuperscript{24}

\begin{center}
\textit{Molto adagio, mesto, }\textbf{\textit{d} = 56}
\end{center}

\begin{center}
(ped.)
\end{center}

\textsuperscript{23}Bela Bartok, \textit{Mikrokosmos}, Vol. VI (\textit{op. cit.}), p. 16.

\textsuperscript{24}See pp. 29-30 of the symphony for this passage in context.
These examples seem to indicate that analysis from the point of view of the harmonic series may well be fruitful, at least insofar as some composers are concerned. It is particularly interesting that one combination of tones, the simultaneous use of the 4th and 5th degrees of the scale, was studiously avoided whenever possible in the symphony composed for this study. This is thought to be the least usable harmonic interval because of the great distance upward one must go in the harmonic series to find the F when C is the root. It is almost past the stratosphere of the series — it is the 21st member.
The Harmonic Series and the Qualities of Musical Instruments

In recent years it has become well known that the quality of an instrument is characterized by emphases upon certain members of the harmonic series. Since the formulations of the principles of the harmonic series by Sauveur and Helmholtz, different experimenters have held that phase relations do, to some extent, affect the tone quality, but Miller writes that "the question [of phase relations] has been extensively investigated by [Lindig, Lloyd and Agnew and] many others, with a consensus of opinion that Helmholtz's [statement of the principle] is justified". 25

This can be brought into focus more clearly by contrasting three members from the three major sections of the orchestra: the strings, the woodwinds and the brass. The instruments used for purposes of illustration will be the violin, the flute and the French horn.

The string section is unanimously admitted to be the most expressive of the orchestra, no doubt because of the great control string players have over the tone production. The very fact that we find the emphasis

upon different partials in each of the four strings contributes to the variety of tones which the violinist can produce.

![Diagram of violin strings]

*Fig. 1 -- Analyses of violin tones (After Dayton C. Miller, The Science of Musical Sounds, p. 198.)*

It will be noticed that a great variety of emphasis occurs even among these different strings of the same violin. Of particular interest is the fact that the fundamental in the case of the G string is so weak that it would seem that a different tone would predominate. Concerning this Miller says, "The ear perceives a fundamental in the lower tones of the violin, and this must result from a beat-tone produced by adjacent higher
partials which are strong". 26

The relative emphases of the overtones of the flute, when diagrammed, look quite different from the emphases of the violin.

![Graph of flute tones]

Fig. 2 -- Analyses of flute tones.

(After Dayton C. Miller, The Science of Musical Sounds, p. 193.)

Again, it should be noticed that when playing forte in the low register it would appear that the octave would

26Ibid., p. 197.
sound. Of this Miller says:

When the lower register is played forte, it is in effect overblown, and the first overtone becomes the most prominent partial as shown in the third line [of figure 2 above]; the fundamental is weak, being just loud enough to characterize the pitch. The player is often conscious of the skill required to prevent the total disappearance of the fundamental and the passing of the tone into the octave. The tones of the low register, when played loudly, have as many as six or eight partials, and at times these sounds suggest the string quality of tone.27

It is interesting to observe that the relative lack of overtones in all registers, except the low when played forte, suggests the reason why the flute is often called upon to play passages which are meant to portray "purity" (as pastorale sections, etc.). When more overtones are present, however, as in the low register when played forte, a quality similar to the strings, whose tones are also a composite of many overtones, is suggested.

The French horn, whose quality has often been said to be the richest and the most mysterious of all, has a complicated set of overtones which supports these judgments. The scale of the diagram below runs to the 30th partial rather than to the 15th, as was the case with the diagrams of the tones of the violin and the flute.

27Ibid., p. 193.
This instrument is richer in overtones than any other instrument in the orchestra. Much could be said about the different tone qualities of the horn, and about the many other instruments, but this would carry us beyond the major purpose of this study. 28

In summary here it may be said that this chapter was concerned with (1) the transaction of the various factors of music in the scales, melodic leaps and chords

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28 For those who are interested in more detailed discussion of tone qualities, see Miller's book, esp. pp. 58-69 and Chapters VI and VII.
of Western music, and (2) in particular, where, how, and to what extent the harmonic series entered into this transactional process. It is suggested that the harmonic series has been a major factor in the constitution of the several scales of Western culture and, by implication, since melodic leaps are integrally related to the scales from which they spring, to the melodic leaps as well.

It is further suggested that the harmonic series, combined with mathematical considerations, to a large extent governs the make-up of the chords and that, apparently, the harmonic series is alone responsible for the various tone colors of the orchestra.

Finally, it is suggested that the purpose of a particular composition must always be taken into account. If the purpose is the expression of a "negative" emotion, a tendency to use a musical system that does not quite "fit" from the several frames of reference may be noted; if the purpose is the expression of a more "positive" emotion, the composer will be more likely to use a musical system which is analyzable from more different points of view.

Thus, in this chapter, the manner in which the harmonic series transacts with other factors in the formation of scales, melodic leaps and chords, and, to a limited extent, the role the harmonic series
plays in the production of the different tone colors, has been explored. It must be emphasized again, however, that the thesis of this study is that the separate factors, such as the ones taken up in this chapter, are not capable of being separated in actuality from the whole of music. To think of melody, or harmony, or rhythm, or any other single aspect of music without structure is nonsense. It is equally impossible to conceive of form without content. In the following chapter, however, the structural aspect of music as it functions in dynamic interrelationships with other factors will be emphasized. A structural analysis of the symphony written as a part of this study will be used in the pursuit of this concern.
In Chapter II a consideration was given to the manner in which the language of music differs from other language media. Chapter III centered around the role of the harmonic series in the theory of music, although it was emphasized that this factor was only one of several which contribute to the theory of music. In this chapter, form, or, as the title implies, structure, will be considered largely in reference to the symphony composed as an integral part of this study.

Form, Rhythm and Structure

There has been a tendency in recent years for form to be considered to be only another aspect of rhythm. There are dissenters from this position, however. Not the least imposing of those who disagree is the noted musicologist, Curt Sachs. Concerning this problem Sachs has said:

The concept of form . . . includes a number of non-rhythmical qualities that may be just as strong as rhythm, if not stronger. In the first place, there is pure melody. The form of a rondo depends upon the recurrence, after separating episodes, of a certain leading melody, in which the exact correspondence in the sequence of notes seems more important than their rhythm. In the second place, there is pure harmony. The title "Symphony in C major" implies the outstanding, structural role of C major -- as a starting
point, an ever-recurring feature, and an end and goal. Of late, our analysts have found tonality to be the structural principle even of operas, particularly Mozart's and Wagner's, with the C major of the Meistersinger as the best-known example. And the basic formal principle of a fugue by Bach is its plan of modulation from key to key.

What is meant by the phrases "pure melody", "pure harmony", (and, by implication, "pure tonality" and "pure modulation"), is not entirely clear. In context, however, it appears that what is meant is that melody and harmony (as well as tonality and modulation) can be divorced from their rhythmic context. If this is granted, it must be admitted that a Form of pure melodies, a Form of pure harmonies, etc. would be a useful phraseology by which Form could be distinguished from rhythm. There are those, however, who believe that to take the rhythm away from a melody is to take away the melody itself. If they are right, it would appear that the term "rhythm" may be used interchangeably with what has traditionally been known as "form".

Before this can be done, however, even assuming that we are attacking the problem from the latter point of view, another aspect of the problem must be considered. In a different context, Sachs says:

Let us not quarrel over the trifles of words. Everybody is entitled to call the ABA of a da capo aria a rhythmic structure or, if he so chooses, even the four movements of a symphony. They represent indeed what Plato called a rhythm: ἁμνήσεις τάξις, an 'order of movement.' At a pinch, they might represent even Heusler's "organization of time in parts accessible to the senses," if the structure is unusually clear-cut. But the accessibility to the senses is open to doubt. For any longer piece is very definitely at variance with the finding of modern psychology that "the maximum filled duration of which we can be both distinctly and immediately aware" is twelve seconds. . . .

The reference to "modern psychology" made above by Sachs gives the immediate impression that the science of psychology supports the view that rhythm can not possibly be a factor in a composition which has a duration longer than twelve seconds. The use, in the quotation above, of the phrase "distinctly and immediately aware", however, indicates that no such separation was necessarily intended. A different interpretation is given to this "principle" in this study.

It is believed that there are different levels of rhythm which are all perceptible through the use of the senses. At the simpler level, that aspect of rhythm which is easily felt with a minimum of intellectual effort can very legitimately be designated by the term

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2Ibid., p. 17.
"rhythm", while the more complicated phenomena of tone in time, which may well require a great deal of intellectual effort interacting with the development of the emotional aspect of the musical experience can just as legitimately be referred to by the term "form" or "structure". It must be emphasized, however, that the distinction here made is arbitrary. Rhythm is structured. Structure is rhythm.

It is the contention here, therefore, that the difference between these two terms ought to be marked off as follows: (1) rhythm is tone in time which emphasizes the emotional responses with a minimum of intellectual effort, and (2) form is tone in time which, because of its complexity, demands a greater expenditure of intellectual effort, thus bringing about a response that is not necessarily predominantly emotional, but one which more equally draws upon both emotional and intellectual responses in dynamic interrelationships. If it were commonly understood that these two terms differed in this manner, and in this manner only, these terms would be used throughout. Since the use of the term "form", however, may unavoidably carry with it connotations that are not intended, the term "structure" will be used to indicate the more complicated aspects of rhythm discussed above. The term "form", then, will be re-
stricted to designating a conventionally named structure, such as the ABA form, the sonata-allegro form, and the like.

Shakespeare, in "Romeo and Juliet", begins his play in the following manner:

PROLOGUE

Enter Chorus

Chorus

Two households, both alike in dignity,
In fair Verona, where we lay our scene,
From ancient grudge break to new mutiny,
Where civil blood makes civil hands unclean.
From forth the fatal loins of these two foes
A pair of star-crossed lovers take their life;
Whose misadventured piteous overthrows
Doth with their death bury their parents' strife.
The fearful passage of their death-mark'd love,
And the continuance of their parents' rage,
Which, but their children's end, naught could remove,
Is now the two hours' traffic of our stage;
The which if you with patient ears attend,
What here shall miss, our toil shall strive to mend.

Exit.

ACT I. SCENE I.

[etc.]³

The Prologue, consisting of pages 1 and 2 of the symphony presented here can be said to be analagous to

Shakespeare's prologue in that, along with serving as an important unit in the structure of the symphony, it also "sets the stage" for that which is to follow.

**The Over-all Structure**

The symphony composed as part of this study consists of three movements, the first and third of which are very closely related. The second movement functions as a divider between the first and third movements, from the point of view of balance, as well as providing relief from the serious intent of the neighboring movements. More will be said about the middle movement at a later time.

The relationship between the first and last movements is very strong in spite of the fact that the last movement is in the sonata-allegro form, while the first movement consists of a theme with eight structural variations. The interrelationships can perhaps best be illustrated by comparing, melodically and structurally, the final variation of the first movement with the opening section of the last movement. A consideration of the first few measures of each of these sections, as well as a comparison of the structure of the sections as a whole, may be of interest.
(From first movement, Var. VIII, p. 42. The complete section from which this example is taken continues to the end of p. 46.)

(From last movement, opening section, p. 154. The complete section from which this example is taken continues to the double bar on p. 83.)
From the melodic point of view, it will be noticed that, by beginning the first example above one measure later than the second, and by compressing the last three measures of the latter example into one measure, the bass lines of the two examples are almost identical.

(Bassline from first example)

(Bassline from second example)

The latter phrase, as well as the first phrase, immediately above, can be interpreted to be four measures in length. It was only for convenience that it was not barred thus:

Although even the bass lines differ melodically through the remainder of these two sections, it is of interest to notice that the opening section of the last movement is very similar in structure to the last variation of the first movement. Of greatest importance, from the
point of view of aesthetic balance, is the fact that each of the two sections are exactly 22 measures in length.

The Prologue (pp. 1 and 2) also has its counterpart in the last section of the third movement. Once again, not only do the melodies correspond to almost the same degree, but each section has exactly the same number of measures. In this instance, there are 27 measures in each section. A diagram of the balancing function of these different sections may help clarify the point. (The dotted lines indicate sections of the symphony which are not, at the moment, under consideration).

The first and last movements are similar also, structurally speaking, in that each movement is divided into three major sections. The first movement is divided into these three sections in the following manner (the page numbers are listed below):
Introduction (1-22)
Principal theme (23-51)
Subordinate theme (66-127)
Closing theme (meas. 128-135 from 1st theme; meas. 136-156 from introduction)
Transition (157-169)
Development, section I, from 2nd theme (170-227)
Development, section II -- fugal -- from 1st theme (228-256)
Development, section III -- from 2nd theme (257-308)
Transition (309-325)
Principal theme (326-354) (transition of principal theme from introduction -- 355-368)
Subordinate theme (369-430)
Closing theme (meas. 431-438 from 1st theme; meas. 439-459 from introduction (461-459)
Transition (460-472)
"Postlude" (very similar to introduction) (473-end)

The last movement is divided thus (the measure numbers are noted below):

I

I

II

II

III

III

I

Var. I

Var. II

Var. III

Var. IV

Var. V

Var. VI

Var. VII

Var. VIII

Logue 3-6 7-11 12 16 17 18 19 20 21 23 25 26 28 30 34 38 41 44 46

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<td>Theme</td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
<td>V</td>
<td>VI</td>
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The transition sections in the above diagram are not as clearly detached from the three major sections as they were in the case of the Theme and Variations movement. It is not intended that any strict criteria be set up to which the analysis must conform. The transition sections are set apart from the other sections in the diagram above only because it may indicate that there is some relationship in this respect, to the structure of the first movement.

It will be noticed, then, that the first and last movements may have enough structural similarity to permit the assertion that, structurally speaking, they are the "A's" of an ABA form which embraces the entire symphony. If we can assume that the second movement provides us with the contrasting structure, as symbolized by the "B" of the ABA form, a diagram of the entire symphony from this point of view would appear as follows:

\[
\begin{array}{ccc}
A & B & A \\
\hline
\text{First movement} & \text{Second movement} & \text{Third movement}
\end{array}
\]

A General Consideration of the Structure of the Different Movements

It has already been mentioned that the first move-
ment can be analytically divided into three major sections. It has not been suggested that the final section is very similar to the first section.

There are two themes which are particularly important in the first movement. One is the "Theme" of the "Theme and Variations" which may be seen on pages 3-6, and referred to in the ensuing discussion as "theme 1". The other is the "passacaglia" theme, appearing in its entirety in Variations VII and VIII (although it appears "in spirit" in the Prologue), and which is quoted below. This theme will, in the following discussion, be referred to as "theme 2".

Neither of these themes appears in more than skeleton form in the middle section (Variations III, III^1 and IV) of the first movement. In the first section (Prologue, Theme and Variation I), the means by which the above-mentioned themes are presented are as follows:
Prologue: Theme 2 is presented in fragmentary form; little if any reference to theme 1.

Theme: This is, of course, theme 1; theme 2 does not appear.

Var. I: Theme 1 is so predominant that this could be said to be a "melodic variation; theme 2 is of little importance, although fragments of it do occur.

In the last section (Variations VI, VII and VIII), the two themes are presented as follows:

Var. VI: Theme 1; theme 2 does not appear, although the pedal point in the bass may be said to prepare the listener for its forthcoming appearance.

Var. VII: Theme 2; theme 1 is not present in any clear-cut way, although "strong hints" are perceptible.

Var. VIII: Contrapuntal combinations of themes 1 and 2.

Although it may not be stated that there is an exact balance of the themes between the two sections, it is perhaps very clear that the ABA form may be said to symbolize these broad aspects of the first movement.

The second movement (Scherzo and Trio) is clearly of the ABA type. The Trio (pp. 58-69) serves as the contrasting material, the Scherzo (pp. 47-57; and pp. 70-81), with its appearances both before and after the Trio, serving as the "A's" of the ABA.
The final movement is also of this same general nature. Omitting from consideration the Introduction and the "Postlude", the exposition (measures 23-169) functions as the first "A" of the ABA form; the development (measures 170-325) functions as the "B"; and the recapitulation (measures 326-472), being an almost exact repetition of the exposition, functions as the final "A".

More Specific Consideration of the Structure of the Different Movements

It has already been mentioned that the Prologue, the Theme, and the first variation constitute the first section of the first movement; that Variations III, III* and IV constitute the second section; that Variations VI, VII and VIII constitute the last section; and that Variations II and V function as dividers between the first and second, and the second and third sections respectively. We may now consider the structure of the theme, or one of the variations.

The structure of the Theme (pp. 3-6) is not complicated. First is heard a 4-measure phrase which is, with very minor changes, repeated (measures whose numbers are, in the score, circled). The contrasting
material is 8 measures in length (those measure numbers in the score which are enclosed by a square), and, for the sake of more detailed analysis, it could be further reduced to two phrases, the first being 5 measures in length, the second being 3 (5 plus 3). The final phrase (measures whose numbers in the score are enclosed by a diamond) is five measures in length and is closely related melodically, harmonically and tonally to the opening phrase and its repetition.

The variations follow the structure of the Theme with minor deviations. All the measure numbers of the variations, as well as of the theme, are enclosed in circles, squares or diamonds in order that the relationship to the theme may be seen more readily.

It has previously been mentioned that the "Scherzo-Trio-Scherzo" arrangement of the second movement permits it to be considered an ABA form. Both the Scherzo and the Trio sections are so straightforward, structurally speaking, that a detailed consideration of the structure

4Melodically speaking, this material is not contrasting. It is contrasting, however, in that the melodic (and harmonic) material is heard in a different key. It is also contrasting in mood, since the climax (highest note) of the theme occurs in the 6th measure of this section. This climax (and the sub-climax in the following section, which consists of 5 measures) are integral parts of all the following variations.
seems entirely unnecessary. The following diagrams, however, may be of use when examining the second movement. The measure numbers of the first presentation of the Scherzo appear above the measure numbers of the second presentation of the Scherzo.

**SCHERZO**

Section I of Scherzo  Section II of Scherzo  Section III of Scherzo (very similar to Section I)

<table>
<thead>
<tr>
<th>1-12</th>
<th>13-32</th>
<th>33-40</th>
<th>41-55</th>
<th>56-73</th>
<th>74-93</th>
<th>94-105</th>
<th>106-117</th>
<th>118-135</th>
</tr>
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<tbody>
<tr>
<td>204-</td>
<td>216-</td>
<td>236-</td>
<td>244-</td>
<td>259-</td>
<td>278-</td>
<td>298-</td>
<td>310-</td>
<td>322-</td>
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<tr>
<td>215</td>
<td>235</td>
<td>243</td>
<td>258</td>
<td>277</td>
<td>297</td>
<td>309</td>
<td>321</td>
<td>end</td>
</tr>
</tbody>
</table>

phrase  phrase  phrase  phrase  phrase  phrase  phrase  phrase

a  phrase  \(a_2\)  b  \(b_1\)  \(b_2\)  \(a_1\)  \(a_2\)

(repeated) (repeated) (repeated) (repeated) (repeated) extended, extended, extended, extended,
and dissolved into transition about measure 85)

**TRIO**

<table>
<thead>
<tr>
<th>A</th>
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<tbody>
<tr>
<td>136-</td>
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<td>139</td>
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<td>140-155</td>
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<td>159</td>
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<td>160-163</td>
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<td>164-177</td>
</tr>
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<td>178-185</td>
<td></td>
<td>186-203</td>
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</tbody>
</table>

In- Phrase a  Phrase b  Phrase a, Phrase b  Phrase a, Phrase b

repeated  extended  extended, extended, extended, extended,
duction then dissolved into transition about transition about

measure 197
It has been previously mentioned that the over-all structure of the last movement can be symbolized by referring to the arrangement of the letters in the symbol ABA, excluding the introduction and the "postlude", which are, perhaps, more related to the symphony as a whole. In the following discussion of the more specific aspects of the structure of the last movement, we shall again refer to the diagram at the bottom of p. 88.

It will be seen that the principal and subordinate themes alternate from the beginning of the exposition to the end of the recapitulation. The introductory material returns in the latter half of the closing theme in both the exposition and the recapitulation, and it must be mentioned that elements of the material from the introduction are simultaneously present with the second theme material between measures 277 and 308 in section III of the development.

The principal theme is constructed as follows:

\[
\text{Phrase a} \quad \frac{(23-38)}{\text{repeated}} \quad \text{Phrase b} \quad \frac{(39-45)}{\text{Phrase a}^+} \quad \frac{(46-51)}{\text{Phrase a}^+}
\]

The subordinate theme has the following construction:
One more structural device must be mentioned. This is the use of the harmonic or melodic interval of the third. This interval is used in the Theme of the first movement as an integral characteristic of the melodies (in contrasting motion) themselves. The immediate emphasis of this interval makes its recurrence throughout the composition inevitable.

Some of the places where this interval, either harmonic or melodic, is particularly evident are listed below.

First movement

1. Variation I (harmonic)
2. Variation IV (harmonic)
3. Variation V (harmonic and melodic)
4. Variation VI (harmonic)
5. Variation VII (harmonic)
6. Variation VIII (harmonic)

Second movement

1. In Scherzo, 1st violins, meas. 86-109; 2nd oboe, 110-115; bsn., 116-128; 1st oboe, 129-130 (all melodic).
2. In Trio, clarinet, meas. 140-141, 142-143, etc. (all melodic).
3. In return of Scherzo, same relative positions as in (1) above.
Third movement (Introduction, principal and subordinate themes)

1. In first trumpet, the melodic use of the minor 3rds in introduction (meas. 1-23).
2. Considering the G-sharp as an embellishing tone, the minor 3rd at meas. 23.
3. This interval is emphasized by the addition of the horns in measure 46.
4. The trombones, in meas. 70-72 emphasize this interval (the E-natural is a passing tone).

In this chapter we have considered, for the purpose of illustrating the role structure plays in music, the structure of the symphony written as a part of this study. It is suggested that the dynamically interrelated result of rhythm and structure is a mandatory factor of all music -- that, although factors such as melody, harmony, tone color, etc. also are dynamically relating parts of the whole of music as we know it in the Western world today, "rhythm-structure" (if we may coin a term which is meant to mean the totality of rhythm and structure dynamically interrelating) is always necessary if the art of music is to exist.

It would be very easy, however, to misconstrue the meaning here intended. If we were to take as an example the most primitive music of the jungle, we would find, perhaps, a single drummer beating on a single drum. On the surface, the only factor operating is that of "rhythm-structure". If we look carefully, however, we find that
the directness of sound (see pp. 24-26 in Chapter II) is also a factor. Similarly, we find that different members of the harmonic series contribute to the tone quality which the drum possesses (see pp. 72-76 in Chapter III). The fact that these overtones are sounding also leads inevitably to the conclusion that harmony is in some degree present, especially in view of the fact that Sauveur found that "Overtones are perceptible up to the 128th harmonic" (see p. 30 in Chapter III). Even melody (at least non-modulating melody) can be said to be a factor in this most primitive of music, if the listener chooses, by use of his imagination, to emphasize different partials as the drum beats proceed.

In the much more highly sophisticated music of the "civilized" world, melody, harmony, tone color, directness of sound, culture, etc. are similarly to be seen as nothing more than intellectualized aspects of the whole of music. Modern scales, melodies and harmonies, even though they may be much more complicated because of our sophisticated use of modulation, equal temperament, etc. (see Chapter III, especially the first three sections), are still to be considered as being nothing more than aspects of the whole of music. The tone colors and the crescendos of the modern orchestra may seem qualitatively different from the sounds emanating from
the jungle drum. But these factors, too, are just as
dynamically interrelated, in our culture, with the
other factors which comprise the whole of music as they
are in the most primitive culture the anthropologist can
find.

Music is thus seen to be not a group of factors
added together (as Curt Sachs' "pure" melody, "pure"
harmony, etc. suggest -- see pp. 79-82 of this chapter),
but as a totality. The "factors" are nothing more than
abstractions which theorists may, and, for that matter,
must use as they engage in intellectual consideration
of the problems they confront -- but only for the sake of
greater conscious understanding. Once this understand­
ing comes about, the theorist must, in turn, disregard
the emphasis he has placed upon a single factor, or a
particular group of factors, if he is fully to experience
that totality which we have come to call music.
CHAPTER V

SUMMARY AND CONCLUSIONS

Music, in the considerations that have been given it in this writing, has been viewed as a special language, through the use of which different ideas and feelings can be expressed. It was suggested that the major function of the language of music was the expression of aesthetically valued relationships. It was noted, however, that other languages were also capable of aesthetic expressiveness; and that the language of music could, to some extent, also be utilized as a means by which intellectual values, cultural values, and values based upon our conception of nature may be communicated.

In Chapter III, the relationship of the harmonic series to the theory of music was discussed specifically. It was suggested that the major, minor and chromatic scales may be largely explained by reference to interaction between (1) the harmonic series as it influences chord structure and (2) the harmonic series as it influences shifts of the fundamental. It was further suggested that the absence, in the minor scale, of certain factors relating to rhythm and aesthetic balance,
tends to make it more appropriate than the major scale for purposes of expressing emotions of a more negative nature.

The relationship of melodic intervals to the harmonic series was also discussed in Chapter III, with the conclusion reached that three factors contribute to the acceptability of melodic intervals, that an interval would tend to be found acceptable when:

1. The interval is narrow
2. Both tones of the interval approximate low-ranking members of the harmonic series
3. The direction of the skip is upward.

The relationship of chordal structure to the harmonic series was the third consideration of the chapter. Throughout Western history musicians have tended to reach higher and higher in the overtone series for more and more complicated chords and, as was noted, some composers (e.g., Bartok) are today building chords out of the interval of the half-step. The final consideration of Chapter III was that of the relationship of the harmonic series to the different qualities of the many musical instruments. Several diagrams exemplifying the emphases of different musical instruments upon different partials were presented.
The term, "Structure", was selected over the term, "Form", as the title of Chapter IV because of the tendency for some to feel that the latter term may be considered apart from the total context. The term, "Structure", on the other hand, is ordinarily felt to be used in context.

The symphony composed as a part of this study was used as a frame of reference in order that certain principles of structure could be observed. The relationships of the three movements were first considered. Later, the large sections of the individual movements were analyzed, and finally, some of the smaller sections were analyzed in terms of phrases and periods. The first movement consists of a Prologue, a Theme and eight structurally based variations; the second movement is a Scherzo and Trio; and the third movement is in the Sonata-Allegro form. The total time of performance is 28 minutes. Examples from the symphony are used throughout the theoretical portion of the dissertation.

Transactional philosophical concepts are basic to the study. Consideration will therefore next be given to the significance which this philosophic position has had in the theoretical portion of this writing.
The Significance of the Transactional Approach for the Study

The transactional approach assumes that all aspects of life experience operate in dynamic interrelationships with one another. The theory here set forth, viewed in its widest context, sees the language of music, therefore, as being one among many languages, all of which contribute to the whole of life. The language of music, of course, has its own particular emphasis -- otherwise it would have no reason for existing. But this is not to say that this language, or any other, can ever be completely divorced from the rest of the life process. No language, then, has a strict boundary which marks it off from any other. The concept, "language of music" (or the concept of language in general), from the transactional point of view, is only an abstraction which, it is almost needless to say, is of vast importance in the furthering of our understanding of life, but which may not be conceived as being anything but a dynamically functioning aspect of the whole of life.

The transactional conception forces a consideration of phenomena in the widest possible setting, yet it is equally applicable when the frame of reference is narrowed. Thus, when we narrow the framework from the whole
of life to the field of music, we may speak of the transaction among the various aspects of music. It is held that better composers do compose transactionally, whether or not they are aware of it, and whether or not they intellectualize the process in this way. It is held also that teaching within the confines of this frame of reference is to be highly preferred over the traditional approach because the latter tends, by compartmentalizing the many factors involved in the composition of music ("pure" melody, "pure" harmony, etc.), to stifle the forming of a dynamically interrelating conception of music by the student.

The somewhat novel theoretical approach in Chapter III, "The Role of the Harmonic Series in the Theory of Music", is in no way meant to be more than a possible solution to this one factor as it is involved in the total theory of music. If the suggestions offered are considered to be valid, they are valid only as they relate to the whole of music.

Some Cultural Aspects of the Study

This study, as has been emphasized, was concerned almost entirely with music of the Western world. The culture of the West is, in many respects, different
from the culture of the East. These two great cultures quite naturally find different purposes for music and, to some degree, the cultural differences explain the difference between the form of music in the East and in the West.

On a smaller scale, cultural differences are evident among the many differing sub-cultures of the Western world as well. Music appreciation teachers often ask the student to distinguish German music from French music, Italian from Spanish, English from that of the United States, etc. The tuning of the scale in relationship with the letter symbols of the tones depends also upon the particular culture. We now hear the works of Bach almost exactly a half-step higher than he heard them himself. And today "European tuning" has the A above middle C at 435 vibrations per second, while in the United States tuning dictates 440 as the number of vibrations for the A above middle C.

Music in the United States has undergone great change from colonial times, when music was almost non-existent, to the present day, when this country is one of the leaders in the musical world. Up to the beginnings of the 20th century, it could be said that the music of the United States was seldom if ever much more
than a pale shadow of the European music it attempted to emulate. Beginning with the 20th century, however, American innovations, such as ragtime, blues and jazz began to mirror at least some aspects of the culture that gave rise to them. The influence of jazz, in particular, is evident in such compositions as Gershwin's *Rhapsody in Blue* (1924), Gould's *Choral and Fugue in Jazz* (1936), Stravinsky's *Sacre du printemps* (1918), Carpenter's *Skyscrapers* and *Krazy Kat*, Krenek's jazz opera *Jonny spielt auf*, Shostakovich's *Suite for Jazz Orchestra* (1934), etc. It is indeed the exceptional American composition today which does not draw upon some aspects of native American music.

**Factors Constituting Music**

There are many factors making up the whole of music. Melody, for example, is one factor which is seen, in turn, to be determined in part by the physical makeup of the harmonic series, in part by modulation, in part by rhythm, by structure, by cultural influences, all of which transact in the producing of that which we call melody. It is different from harmony largely in that harmony is concerned with the vertical arrangement of tones, whereas melody is concerned with the horizontal
Rhythm is a mandatory aspect of all music. Even the most primitive African drum beats, which utilize neither melody nor harmony as we know them today, must have rhythm. And rhythm, to be communicable, must be structured according to some scheme or another. Structure, therefore, is also an indispensable aspect of all music. Since neither rhythm nor structure can under any circumstances be separated, it is only for convenience that we may say that the term "rhythm" is used to symbolize the immediately and directly felt sensation of tones in time, while the term "structure" is used to symbolize the less immediately and more intellectually conceived sensation of tones in time.

The harmonic series is another aspect of music considered in the study. The position here taken is that science cannot be divorced from art. In consequence, it is held that the harmonic series combines with modulation and cultural factors in the formulation of scales, melody and harmony. Moreover, insofar as we now know, it is solely responsible for differences in tone color.

The directness of sound (see pp. 24-26, Chapter II) is conceived to be a contributing factor, particularly in connection with the effectiveness upon us of different
dynamic levels. In particular, the huge crescendo emphasizes this factor to a marked degree.

The cultural aspect of music is one that many are prone to overlook. This is a mistake. It is in this area that we are most likely to be too adamant. Our limited experience leads us to believe that the way our own culture does things is the "right" way, and, conversely, that the way other cultures come at life (in this instance, "at music") is the "wrong" way. Anthropology today tells us, however, that cultural norms are instrumental in the fixing of values, attitudes and beliefs. We must, therefore, always be on guard to qualify any conclusions in regard to the particular time and place of any study. In this connection, the present study concerns Western music — in particular, the music of the United States — at the middle of the 20th century.

Other factors of music of course may well exist, but the present writing is confined to those listed above. The factors should never be thought of as separate entities. They should be conceived, rather, solely as different aspects of the whole of music — aspects that interrelate dynamically as the wholeness of music is experienced.
The Harmonic Series

Many theorists have attempted to explain music in terms of the harmonic series. There is almost unanimous agreement that there is some relationship between the first six partials of the series and the major chord — the so-called "chord of nature". Hindemith maintains that the scale found in the fourth octave of the harmonic series (ascending, C, D, E, F-sharp, G, A-flat, B-flat, B-natural, C) "has been of importance in musical practice, but never in musical theory".¹ And Redfield uses the 1st, 3rd, 5th, 9th, 15th, 27th, and 45th partials of the series built on F to explain the C major scale!² But, to the writer's knowledge, no theorist has suggested that scales, melodic leaps and chords are to be explained by combining the influences of the harmonic series with those of common-tone modulation and of culture. Such an explanation is offered in Chapter III.

This explanation, however, is not meant to be a panacea for the theory of music. If it proves to be

¹Paul Hindemith, The Craft of Musical Composition, op. cit., p. 27.

valid, it must still be considered as being only one aspect of music which transacts dynamically with the many other facets of the whole of music.

The Teaching of Music Composition

The traditional approach to the teaching of music composition has been dominated by the dualistic philosophy and, also, by the compartmentalizing of the various factors involved. The transactional approach is here suggested as an approach the teacher may use as a means to keep the whole of music continually in mind while, at the same time, the many factors involved may be presented by consciously abstracting them for examination and study.

The traditional pattern of approaching "theory" through the study of different styles in history is in no way discouraged by this conclusion, though the method appropriate to the transactional view will vary from the traditional failure to provide a widened perspective and understanding for the student. The music of Palestrina, Bach, Haydn, Mozart, Beethoven and Brahms is very much a part of our cultural heritage and should be considered for the role it has played. Even the "species counterpoint" of Fux is not to be decried -- it very clearly presents a manner of thinking which may be, if ef-
effectively dealt with, an excellent "intellectual counterpoint" for the student.

But traditional composers should not be thought to have attained a final answer to the problem (or problems) of composition. Thus, the teacher of music composition should think of the music of these composers only as facets that will contribute to the student's total understanding of music. For this reason, particularly in our culture, the student should become acquainted with ragtime, blues, jazz, twelve-tone technique, the technique of Hindemith and of Bartok -- and any number of aspects of the panorama of music presented in our culture today. The larger the frame of reference the student can attain, the fewer the limitations he will encounter in his pursuit of the understanding of the whole of music.

The teacher of music composition cannot neglect either the personality of the student or the culture from which he springs. These aspects should not in any event be considered hindrances -- rather, they should be considered definite assets from the basis of which a broader and deeper understanding of music may grow. Even the elimination of certain so-called "undesirable" knowledge that a student may bring with him to the
classroom is not to be considered. For all of the dynamically interrelating factors are to be considered in "that reconstruction or reorganization of experience which adds to the meaning of experience, and which increases ability to direct the course of subsequent events". The student, with whatever he brings to the compositional experience, is, within the view here developed, very much in the center of the teaching picture.

Music is to be conceived, so this study holds, as a language comparable to other languages. The teacher of music composition may then view the language of music as stemming from the same human needs and desires as do other specialized or general languages. As a language, it came into being in order that certain aspects of the total life desires of men could be attained in the same sense that other languages came into existence to satisfy other aspects of man's desires. It has been the contention of this writing that music came into being primarily to emphasize the aesthetic aspect of man's experience, while, to take a single example from another language, the language of mathematics came into

\[3\text{John Dewey, } Democracy and Education, \text{ op. cit., pp. 89-90.}\]
existence primarily in order that greater precision could be effected in qualitative realms.

The consideration of scales, melody and harmony in Chapter III, from the point of view of transaction among the harmonic series, common-tone modulation and culture, perhaps exemplifies most effectively the method by which the teacher of music composition may best teach. The "blacks" and "whites" of the traditional approach are not in keeping with the multi-factored approach offered here. Furthermore, the teacher may do his student and his society a great service if he always keeps in mind that neither he nor anyone else has all the answers. His students, though not initially promising, may some day create, or may today be creating, new solutions to some aspect of music. Man's creativity is a never-ending process.
SYMPHONY

with

PROLOGUE
TO JOAN

BILL

AND JUNE
The following pages of music are photostat copies. On many of these the print is very small and difficult to read.

UNIVERSITY MICROFILMS
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I, Lee William Stryker, was born in Paris, Texas on January 9, 1920. My primary education was received in Brady, Nebraska while my secondary education was received in Gothenburg, Nebraska. My undergraduate training was obtained at Oberlin College and Conservatory of Music where I received the degree Bachelor of Arts in 1950. I was awarded the degree Master of Arts from Western Reserve University in 1951. In 1952 I was admitted to the Graduate School of The Ohio State University where, during the academic year 1954-55, I was appointed a University Scholar.