BLEND IN CHORAL SOUND

THESIS

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by

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PREFACE

There is a need for a systematic collection of ideas concerning blend in choral sound. Many authorities discuss blend, but their concepts of the term are very divergent. These divergent concepts lead to emphasis of various factors which are important to the development or achievement of blend in choral sound. This emphasis in turn leads to various methods of achieving blend.

Authorities ascribe several definitions to the term blend, as it relates to choral tone. These definitions should be studied collectively in order that a clearer concept of the term blend in choral sound may be developed.

In studying blend in choral sound, several factors are generally deemed important. No study has been made which leads to a consensus concerning the relative importance of these factors. Scientific studies have been made of these factors, but the results have not been compiled and presented in one source.

Authorities employ various methods in working with the factors which affect blend in choral sound. No study has been made which includes these methods.

It is hoped that this study will contribute to the colecting and organizing of ideas regarding blend, including

its various definitions and its important factors. It is also hoped that this study will contribute to the understanding of these factors as they relate to the achievement of blend in choral sound. It is intended that this study will present this information in such a manner as to be of assistance to the musician in the field of choral music.

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CHAPTER I

STATEMENT OF THE PROBLEM

The Purpose

The purpose of this study was to determine what is referred to by the term "blend" in choral sound, and to investigate the problems associated with this concept.

Sub-Problems

Analysis of the problem statement led to subordinate questions, or sub-problems, which may be stated as follows:

1. What is desired by the authorities in the way of blend in choral sound?

2. What factors do authorities consider to be important in achieving blend in choral sound?

3. What are the acoustical properties of the factors that affect blend in choral sound?

4. What are the authorities' recommendations concerning the achievement of blend in choral sound as it relates to each of the various factors?

Definition of Terms

1. The term "blend" has several denotations amoung authorities. These differences are presented and discussed in detail in this study. A dictionary definition of blend is

> v . . . 1. to mix or mingle; now, to mingle, combine, or associate so that the separate things mix, or the line of demarcation, cannot be distinguished . . . 2. to harmonize or produce a harmonious effect; . . . n. 1. A thorough mixture; . . . (2, pp. 286-287).

Blend as defined by some choral authorities means "The perfect fusion of the tone of a number of different voices, whose various characteristics mix so as to result in one beautiful sound." (1, p. 223), or "the uniformity of the quality of tone within and between voice sections" (3, p. 56).

2. The word "authorities" refers to choral directors, teachers of choral techniques and choral conducting courses, and qualified persons who have written about choral techniques.

3. The term "acoustical properties" refers to the measurable component parts of sounds as determined by scientific study.

4. The term "scientific study" refers to the methods of research as used by the trained scientist.

Delimitations

1. This study was designed to study blend in choral sound. It did not study the factors influencing blend between the choral group and an accompanying instrument or instrumental ensemble.

2. This study was not limited to analysis of scientific principles as they exist in group singing but studied the

properties of the individual voice and their effect on the achievement of blend in choral sound.

3. This study did not go into extensive detail concerning methods of individual private voice instruction. Private voice study techniques were discussed only when their use was recommended as being of value in group study.

4. The study was not limited to printed or published materials. Information was also gathered from letters, interviews, and questionnaires.

Basic Hypothesis

The basic hypothesis of this study was that there was no systematic collection of information and ideas concerning what is desired by the authorities in blend in choral sound, the factors involved in achieving this blend, and the acoustical properties of these factors.

Basic Assumptions

The following assumptions seemed basic to this study:

1. That the concept of blend in choral sound could be defined and discussed.

2. That authorities in the choral field have formulated definite ideas concerning blend and the methods they use to achieve it.

3. That scientific studies have been made to determine the acoustical properties of the factors affecting blend in choral sound.

4. That knowledge of the acoustical factors affecting blend would be beneficial to the choral conductor.

Methodology

The material for Chapter Two, "Historical Background", is divided into two sections, "The scientific Study of Sound" and "Blend in Choral Sound." The data were collected from fourteen books, two magazine articles, and articles from Grove's Dictionary of Music and Musicians. One unpublished master's degree thesis was used and three books are quoted as secondary sources. The data were arranged in chronological order beginning with the ancient civilizations of the Hebrews and Greeks.

The evidence for Chapter Three, "Factors Related to the Achievement of Blend," was collected from twenty-nine books, twelve periodical articles, two unpublished master's degree theses, one unpublished book, and one pamphlet. Other key sources of evidence used in Chapter Three were one hundred and four authorities (See Appendix A) whose names were selected from The Choral Journal (the official publication of the American Choral Directors' Association), music school catalogues and interviews. These authorities were reached by a questionnaire (See Appendix D). The questionnaire was accompanied by a letter of transmittal (See Appendix B) which explained the survey and its relationship to the thesis.

To encourage the return of the questionnaires, a follow-up double post card (See Appendix C) was sent three weeks later. A total of fifty-nine questionnaires was received from the authorities, representing approximately a fifty-seven per cent return. Complete questionnaire results are given in Appendix D.

Plan of This Report

Chapter Two, "Historical Background of the Scientific Study of Sound and the Historical Background of the Concept of Blend in Choral Sound," is divided into two sections for each of the preceding topics. The section dealing with the study of sound begins with the ancient Greek mathematician Pythagoras. The emphasis in the section is on the development of the study of musical acoustics when possible.

The second section of Chapter Two presents a chronological history of the concept of blend in choral sound. It begins with the Hebrew civilization and concludes with a discussion of the concept of blend in the mid-twentieth century.

Chapter Three divides into the following sections; definitions and concepts of blend in choral sound, rhythmic unity, vowels, quality of tone, vibrato, intonation, selection of voices, classification of voices seating or standing arrangement, balance, and acoustics of the room. The importance of each factor to choral blend is discussed. The material comes

from books, periodicals, and the questionnaire results. Then, where relevant, each factor is discussed from the scientific standpoint. This material comes from books and periodical articles. The authorities' recommendations concerning the relationship of the factor to the achievement of blend in choral sound is then presented. This material comes from books and periodicals.

Chapter Four is divided into three sections. The first is summary and conclusion. The third section of Chapter Four consists of recommendations to researchers, teachers, publishers, composers, and arrangers. These are made from an analysis of the material which was available for this report.

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CHAPTER II

HISTORICAL BACKGROUND

The Scientific Study of Sound

The desire to understand the art of music has probably existed since shortly after the creation of music. According to Ulrich and Pisk, "Writings on music as well as the practice of music in China can be traced back approximately four thousand years" (20, p. 7). These cultures had very definite rules to be observed in connection with their music, but these rules can hardly be called a science.

The origin of the science of sound can be traced to the remarkable Greek mathematician, Pythagoras, about 550 B.C. There is no written account of his work except through descriptions written by his disciples. The accounts are not accurate, and it is difficult to determine just what his teachings were.

He originated the device for studying vibrating strings, now known as the Monochord. Pythagoras discovered that a string sounding an octave is exactly one-half the length of the string emitting the fundamental; he announced the law that "the simpler the ratio of the two parts into which the vibrating string is divided, the more perfect is the consonance of the two sounds" (16, p. 3). Aristotle, about 350

B.C., wrote treatises on philosophical subjects. There are numerous scattered sections relating to music and sound. There is an account of music in "Book VIII" of Politics, and theatrical music is described in his Poetics. Physics and Meterology contain references to sound.

The following account of Aristotle's opinion on the accompaniment of vocal music is worthy of note:

> Why do we listen with greater pleasure to a solo sung to a flute than to one sung to a lyre? Is it because anything becomes still more pleasant when mingled with what is more pleasant? Now the flute is more pleasant than the lyre, so that singing would be more pleasant when it mingles with the flute than with the lyre. Further, that which is mingled is more pleasant than that which is unmingled, if there is a simultaneous perception of both the elements (2, p. 922).

Aristoxenus (320 B.C.), a pupil of Aristotle, was a musician who thought that the ear is the ultimate judge of consonance and dissonance. Of his more than four hundred writings dealing with philosophy, ethics, and music, the only works which have come down to us are three volumes, The Elements of Harmony, which are probably the oldest works on music which have come to us directly from the author.

The Romans derived their music almost wholly from the Greeks. Vitruvius, about 50 B.C., was a celebrated Roman architect. His treatise, De Architecture Libre Decem, discusses the acoustic properties of theatres:

> All this having been settled with the greatest pains and skill, we must see to it, with still greater care that a site has been selected where

> the voice has a gentle fall, and is not driven back with a recoil so as to convey an indistinct meaning to the ear. There are some places which from their very nature interfere with the course of the voice, . . . those places in which the first sound uttered that is carried up high, strikes against solid bodies above, and being driven back checks as it sinks to the bottom the rise of the succeeding sound . . . those in which the voice spreads all round, and then is forced into the middle, where it dissolves, the case endings are not heard, and it dies away there in sounds of indistinct meaning . . . those in which it comes into contact with some solid substance and recoils, thus producing an echo, and making the termination of cases sound double . . . those in which it is supported from below, increases as it goes up, and reaches the ears in words which are distinct and clear in tone (21, p. 153).

Ptolemy, the famous astronomer, wrote on the principles of music of the time in his work Harmonics, written about A.D. 130. Of this work Charles Burney comments:

> He passes suddenly from accurate reasoning and demonstration, to dreams, analogies, and all the fanciful resemblances of the Pythagorean and Platonic schools: discovers Music in the human soul, and the celestial motions: compares the rational irascible, and concupiscent parts of the soul, to the 8th, 5th, and 4th; makes the sciences, and the virtues, some Diatonic, some Chromatic, and some Enharmonic: turns the Zodiac into a Lyre, making the equinoctial the key-note of the Dorian mode: sends the Mixolydian to Greenland, and the Hypodorian to the Hottentots! . . . He seems to have been possessed with an unbounded rage for constructing new scales . . . having a facility and a pleasure in calculating, seems to have sported with the scale, and wantonly to have tried confusions, by dissecting and torturing it in all possible ways (4, pp. 354-357).

For more than sixteen centuries following Vitruvius there was little development in science and there seems to be no development whatever in the knowledge of sound. Cajori says

> Obscurity and servility of thought, indistinctness of ideas, and mysticism characterize the Middle Ages. Writers on science were merely commentators, and never thought of bringing statements of ancient authors to the test of experiment . . . The writings of Aristotle became well known and assumed supreme authority. Woe unto him who dared to contradict a statement made by Aristotle! In physics, Aristotle's authority remained unshaken until the time of Galileo (5, p. 21).

Francis Bacon (15-61-1626) is credited with beginning our scientific era. While he made no striking additions to the knowledge of science, his theories on the new method of experimentation did help further the cause of scientific study.

The science of sound as we know it begins in the seventeenth century with Galileo (1564-1642).

> In his treatise on Two New Sciences, published in 1638, we find perhaps the first enunciation of the principles of sound which are really scientific. The science of sound was thus established three hundred years ago. Galileo says: "Impelled by your queries, I may give you some of my ideas concerning certain problems in music, a splendid subject" (16, p. 9). He then discusses in a perfect manner, which could hardly be excelled today, the phenomena of vibrating strings, and deduces quantitively the laws of strings, giving the relations between frequency (without determining the actual number of vibrations) and demonstrates the ratios of frequencies for various musical intervals, such as the octave, 1:2, and the fifth, 2:3. Resonance and sympathetic vibration are very completely explained. He gives the causes of consonance and dissonance as they are understood today. There are descriptions of several experimental demonstrations. The treatment, covering only about fifteen pages, is concise and fundamental (15, p. 9).

Cajori (4, p. 109) explains Galileo's contributions concisely: "Only two methods of investigation were known to the

ancients, the philosophical and the mathematical: to these Galileo added a third, the experimental."

The Franciscian Friar, Martin Mersenne (1588-1648), has often been called "Father of Acoustics." He wrote the first extended treatise on sound and music, entitled Harmonie Universelle, published in Paris in 1636.

Athanasius Kircher (1620-1680), a professor of mathematics in the College of Rome, wrote Musurgia Universalis, published in Rome in 1550. This is an encyclopedia of the knowledge of sound of the seventeenth century. Basically Kircher adopted the philosophy of Pythagoras. Some of his experiments are important because of the scientific apparatuses he built for his experiments.

Sir Samuel Morland of London published, in 1671, a small book entitled Tuba Stentoro-Phonica, describing his design for a "loud speaking trumpet" (18, p. 18). Others suggested improvements in its design, and the improvements of Cassegrain, Conyers and Matthew Young should be mentioned.

The Accademia Del Cimento of Florence was established in 1657 and is generally regarded as the first organized scientific academy. Its efforts mark the first serious attempt to determine the velocity of sound. The members of the Accademia were, for the most part, disciples of Galileo. The Accademia repeated many experiments of earlier scientists to check and further their work.

The Royal Society of London, formed in 1670, contributed much to scientific thought. Two Englishmen, who are not well known, contributed important papers on acoustics to the early volumes of the "Philosophical Transactions of the Royal Society."

> The first paper on musical acoustics to appear in the transactions of the society (Phil. Trans.) was communicated in 1677 by Dr. John Wallis, F. R. S., under the title "On the Trembling of Consonant Strings, a New Musical Discovery." Wallis begins by reminding his readers that sympathetic vibration at a unison (resonance) 'has been long since observed.' He goes on to describe a new musical discovery made three years earlier by William Noble, a Master of Arts of Merton College, Oxford, concerning sympathetic vibrations in strings that were not in unison.
> . . . . . .
> The second paper referred to above was communicated in 1692 by Francis Robartes, F. R. S. It was entitled "On the Defects and the Musical Notes of the Trumpet and Trumpet Marine" (11, p. 978).

Sir Isaac Newton (1642-1727) marks the beginning of the scientific method based upon logical theory and experimentation. He attempted to establish a relationship between the seven colors, red, orange, yellow, green, blue, indigo, and violet, and the tones of the musical scale. Attempts to establish a relationship between colors and music can be found throughout history.

Newton also attempted to find the velocity of sound, and his calculations have been proven basically correct. His explanations of the movement of sound prevailed for a hundred years, until 1816, when Laplace (1749-1827) revised parts of Newton's equation dealing with the elasticity of gasses.

The equation, as revised by Laplace, leads to calculated values for the velocity of sound which are used at the present time.

According to Miller, "A careful search fails to reveal any major contributions to the science of sound which arose in the 18th century. Musical instruments were improved and previous experiments were repeated and the results refined and validated" (16, p. 37).

> The eighteenth century was the era of the calculus, which had been "invented" by Newton and Leibnitz. Many eminent mathematicians applied the method to various problems in sound and developed the theory of sound. Very elaborate and extended treatments were given to various kinds of vibratory movements in elastic media. Brook Taylor gave the earliest theoretical treatment of the transverse vibrations of strings in 1715; Euler wrote on A New Theory of Music in 1739, and D'Alembert on The Elements of Music, Theoretical and Practical, in 1752. Bernoulli wrote a treatise, On Sound and the Tones of Organ Pipes, in 1762; Lagrange gave an extended treatise on The Nature and Properties of Sound in 1759, and Riccati on Vibrating Strings in 1768 (16, p. 42).

In the nineteenth century, the science of sound was developed by many different investigators. Dr. Thomas Young (1773-1829) studied the motions of vibrating strings by means of light reflected from the string itself. J. B. Biot of Paris (1774-1862) conducted experiments on the speed of sound in metal pipes.

In 1815, Nathaniel Bowditch, of Salem, Massachusetts, described the curves representing the combination of two simple harmonic motions. Lissajous of Paris developed this work further, and these curves are generally known as

"lissajous' Figures." In 1822, J. B. J. Fourier of Paris (1768-1830) published a treatise on The Analytic Theory of Heat. This work describes Fourier's work in which he investigated and formulated a theorem concerning the multiplicity of musical tones. Fourier made no applications of his theorem to acoustical problems, but it is important in the study of sound.

H. Matthews of London, in 1826, published a book on Observations on Sound: showing the causes of its indistinctness in Churches, Chapels, Halls of Justice, Etc. with a system for their construction.

J. D. Colladon and J. K. F. Sturm measured the velocity of sound in water in 1826. In 1899 Threlfall and Adair performed experiments on the velocity of sound in water by using explosions of dynamite under water.

Sir Charles Wheatstone (1802-1875) performed many different types of experiments dealing with the science of sound. He proposed a fixed-pitch theory of vowels in 1837.

> Johann H. Scheibler (1777-1837), a silk manufacturer of Crefeld, without a scientific background, was impressed by the inadequacy of the existing methods of tuning; he experimented with the monochord, the guitar and tuning forks and developed a method of tuning by means of beats. His further investigations related to the organ and piano, scales and temperament, and to the accurate determination of pitch. His tuning-fork tonometer, first described in 1834, provided the means by which the first fundamental determination of absolute frequency was made (16, p. 55).

George S. Ohm is famous for his work in the field of electricity. In 1843 he formulated a Law of Acoustics which

states that "pendular vibrations in air are the only vibrations perceived as pure tones, and all varieties of quality in different musical sounds are the result of particular combinations of pure tones" (12, p. 35).

A. Mason of France, and C. Sondhauss of Germany performed experiments in which they directed a stream of air against an isolated sharp edge or "lip," which produces a tone in the absence of any air column. Other men have worked in this field also, and the work of V. Hensen (1900) and R. Wachsmuth (1904) has led to the "Edge Tone" theory for the explanation of the tones in lipped pipes and in musical instruments of the flute type.

Joseph Henry (1799-1878) was Professor of Mathematics in Albany Academy from 1828 to 1832, when he was appointed Professor of Physics at Princeton. A charter member of the National Academy of Sciences, Henry did outstanding research on architectural acoustics. He did much work planning and designing the new building for the Smithsonian Institution (16, pp. 63-64).

Alexander J. Ellis (1814-1890), a Fellow of the Royal Society and President of the Philological Society, was a student of phonetics. He translated Helmholtz's Tonempfindungen and added extensive annotations (1875-1885). He published several papers in the "Proceedings of the Royal Society" on the perfect musical scale, just intonation,

temperament, and the physical constitution of musical chords. Ellis performed exhaustive studies of musical pitch in both its artistic and scientific aspects.

Alfred M. Mayer (1836-1897) did research on consonance and dissonance on beat tones. Inventions by Alexander Graham Bell (1847-1922) of the telephone in 1876, and by Thomas A. Edison of the phonograph in 1877, were important in the scientific study of sound.

In the nineteenth century, several men who were primarily musical instrument manufacturers contributed to the science of sound. The names of Theobald Boehm, Adolph Sax, Victor Mahillon, and D. J. Blaikley should be mentioned.

In the last half of the nineteenth century, four men are outstanding for their contribution to the science of sound. John Tyndall (1820-1893) was a popular lecturer and author of books on science. Miller says "His contributions to science are more due to his very genial and inspiring personality, and to his exceptional ability as a popular lecturer, rather than to his researches" (16, p. 81). He did make important original investigations in various branches of physics. In sound he studied fog signals and their audibility, and singing flames and high pressure sensitive flames.

Hermann L. F. von Helmholtz (1821-1894) of Potsdam, Germany, is truly one of the outstanding men in the study of science of sound. Helmholtz was interested in physics but studied at the Army Medical School and eventually became

a military surgeon. He held various teaching positions; among them were Professor Physiology in Konigsberg, Professor of Physiology at Bonn and Heidelberg. While at Heidelberg he published his two masterpieces, Handbuch der Physiologischen Optik (1856-1866), and Die Lehre von den Tonempfindugen als Physiologische Grundlage fur die Theorie der Musik (1862).

Although Helmholtz is considered to be one of the outstanding men in the study of sound, his researches in this field do not constitute a major part of his work. Much of his work was in physiological optics, electro-dynamics, hydrodynamics and meterology. He also wrote and lectured on philosophical and esthetic problems.

Helmholtz approached the study of acoustics largely from the physiological aspect. His specific contribution to the study of sound is his study of tone quality. Helmholtz built on the work of Ohm, analyzing the typical musical instruments by ear and by his specially-designed resonators, which he used to emphasize the partials of musical tones. He was thus able to isolate and identify the partials of the complex tones he heard. Part of the value of Helmholtz's work is shown in the following account by Miller:

> Helmholtz was a personal friend of Theodore Steinway, one of the original "sons" of Steinway & Sons, pianoforte makers of New York, who for a time lived in Germany. Helmholtz's investigations included the acoustic problems involved in tone-production in the piano; Steinway incorporated Helmholtz's suggestions in pianos which were sent to Helmholtz for experimentation. This combination of maker and researcher led to important improvements which have been universally adopted (16, p. 85).

Karl Rudolph Koenig (1832-1901) was from Konigsberg, Prussia. He studied at the University of Konigsberg and earned his Ph. D. degree there. Koenig became famous for the excellent quality of the acoustical apparatus which he designed and built. He devoted his spare time and profits to original research in sound. Miller describes the work of Koenig:

> It is difficult to describe Koenig's original researches separated from his instruments, for both are unique and mutually dependent. Every piece of apparatus that he constructed was designed for a planned investigation. Koenig's publications are numerous and are of fundamental importance; these relate to the physical characteristics of vowels, the nature of tone quality, the effect of the phases of components on tone-quality, combination tones, and the highest audible and inaudible tones.
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> . . . . . .
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> As already stated, he probably did more to develop the science of sound than any other one man; he devoted his whole being and his whole life, for half a century (he died at the age of sixty-nine years) to this one field of work, and he brought to it a mental and intellectual power and a manual dexterity not surpassed by any. In personality and temperament, in his attention to details, in the use of finished apparatus, beautifully constructed and elaborately calibrated . . . (16, pp. 90-91).

Lord Rayleigh, the Third Baron Rayleigh (1842-1919), is an important figure in the history of the science of sound. He was awarded the Nobel Prize in Physics in 1904. Rayleigh is the author of a great work, The Theory of Sound, published in 1877-1878. This work is sometimes referred to as "The Principia of Acoustics."

> A great part of his theoretical work consists in resurveying the work of his predecessors, and elaborating their theory into precision and completeness.
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> . . . . . .

> His experimental skill equalled his mathematical analysis in effectiveness. He performed countless experiments which were carried out with simple and usually homemade apparatus, the accessories being crude and even rough, but so thoughtfully designed as to demonstrate the point at issue. Of discoveries sensationally new there is perhaps not one to record, though his experiments have justified many theoretical conclusions and have suggested new points of view. His researches on the perception of direction and binaural hearing and audition in general (1907) and on singing and sensitive flames are important (16, p. 93).

The science of sound in the twentieth century has grown, as have all the sciences, at a remarkable rate. An important milestone was reached on December 27, 1928, with the formation of "The Acoustical Society of America." This organization has grown steadily, publishes its own journal, and is a major contributing factor to the scientific study of sound.

The most obvious developments in the field of acoustics have been in technology. Acoustics has played a major part in the development of radio, talking motion pictures, and television. The recording and reproducing of sound through records, tape recorders and hi-fidelity sets is a major industry.

In the field of musical acoustics, many men have made out-standing contributions. Carl E. Seashore has studied measurement of musical talent, musical esthetics, intonation, analysis of musical performance, psychology of music and vibrato. Some of the men who have worked with Seashore are Milton Metfessel, Arnold Wagner, Joseph Tiffin, and Harold Seashore.

Blend in Choral Sound

The concept of blend in choral sound probably had a rudimentary beginning when primitive people began to attempt to improve the unity of their singing. Mees traces our choral tradition to the early Hebrews and Greeks:

> While choral music was undoubtedly practiced among the barbarous and uncivilized peoples from time immemorial in connection with the dance as an essential element of their religious ceremonies, it is to the music of the Hebrews and Greeks, the inheritors to the Egyptian and Assyrian theories that the tone-art of the early Christians, out of which the tone-art of today, is directly traceable (15, p. 3).

The following passage is probably the earliest reference to the desirability of achieving a unity of sound.

> It came to pass, as the trumpeters and singers were as one, to make one sound to be heard in praising and thanking the LORD; . . . (3, Chapter 3, Verse 13).

The Greeks used the chorus in conjunction with their dramas. Mees explains the place of the chorus in the Greek drama and something of the technique of its performance:

> The place occupied by the chorus was the orchestra, a platform erected in front of and a little below the level of the stage, with which it was connected by steps, as at times the presence of the singers was required on the stage proper. With the action of the drama the chorus was not identified. Although composed of men only, it represented a body of men or women who, standing as no immediate relation to the characters in the play, annotated the occurrences with words of advice, warning or comfort. At points of rest, between the scenes or acts, the chorus sang longer lyric pieces referring to the progress of the plot and its ethical purpose. In these intermezzi, -- to use a familiar term -- which were accompanied by appropriate gestures and most carefully designed evolutions, responsive effect,

> semi-choruses, and individual singers were employed. The chorus was kept in time and step and in accord with the instrumentalists by the corypheus, who marked the rhythm by clapping his hands, or by stamping his feet, which were clad in sandals with wooden or metal soles so that the beats might be more distinctly heard. Such a conductor was subsequently called by the Romans manuductor if he made use of his hands, pedicularius if he made use of the feet (15, pp. 12-13).

Vocal technique received more than passing attention from the Greeks. Aristotle wrote on the subject;

> We all breathe the same air, but we emit different sound owing to the difference in the organs involved through which the breath passes to the region outside. These are the windpipe, lungs and the mouth. But the greatest difference in sound is produced by the blows of the air and the shapes assumed by the mouth. This is evident, for all the differences of voice arise from this cause, and we see the same people imitating the voices of horses, frogs, nightingales, cranes, and almost every other kind of living creature using the same breath and the same windpipe, by driving the air from the mouth in different ways (1, p. 800a).

Aristotle also discusses problems related to the achievement of blend.

> Why does a large chorus keep the rhythm better than a small one? Is it because they look more to one man, their leader, and dance more slowly, and so more easily achieve unity? For mistakes occur more frequently in quick singing. Now a large chorus attends to its leader, and no one by differing from the rest would render himself conspicuous by making himself heard above the rest: In a small chorus, on the other hand, individuals can make themselves more conspicuous; they, therefore, vie with one another instead of looking to their leader (2, p. 922).

Christianity has been a major contributing factor to the development of our present day choral culture. Arthur Mees wrote:

> In the Latin Church, which with Rome as its head, was destined to direct the course of church music, the first step towards bringing order into the chaos of conflicting traditions was taken with the foundation of singing-schools at Rome by Pope Sylvester in 314. This was one of the most noteworthy occurrences in the history of choral culture, for it led to the organization of the oldest choral body in the world, the Sistine Chapel, nominally at least still in existence, which served as the prototype for all choral institutions up to the time when, about the end of the eighteenth century . . . (15, p. 25).
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> . . . . . .
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> The influence of the singing schools became more and more apparent in the course of time. The ecclesiastics, who were trained in these institutions from boyhood up and began their activities as members of the choir, became so interested in their musical studies that they neglected their other duties. It was their one aim to excel in beauty of tone production, smoothness of execution and expressiveness of utterance (15, pp. 27-28).

Choirs throughout the middle ages were generally small. Finn states:

> The practice of the ages favored small choirs, although the musicians did not probably allege a scientific reason for this. Even in the great basilicas of the Continent and in the Cathedrals of England, the regular service choirs probably averaged not more than twenty-five voices. The full quota of the Sistine Choir at the zenith of its glory was thirty-two (11, p. 189).

Further comment is made by Thurston Dart on the size of choirs in the middle ages.

> Repeated references in, for instance, the establishment books of the Chapel Royal or the diaries of the Sistine Chapel make it clear that the minimum number of singers required for a full choral service in the sixteenth century was from twelve to sixteen . . . To decide the maximum size is more difficult, and in any case this was probably governed by the amount of money the owner of the choir could afford to spend on keeping it up. On special occasions like the festivities of the

> Field of the Cloth of Gold, or the magnificent wedding celebrations of the Medici family, the records of the time show that very large numbers of singers and players took part.
>
> Secular music is another matter altogether. Pictures of fifteenth and sixteenth century singers singing chansons, frottolas, and madrigals always show very small groups of solo performers, not choirs. A certain amount of supporting evidence comes from the musical sources of the time . . .
>
> Choir books for sacred music are often very large and written in very large notes, and many pictures exist showing a group of a dozen men and boys grouped round a lectern holding a single book of this kind. But secular choir books were smaller, and they cannot be used by more than three or four performers at once. And music books of all kinds were so extremely expensive in earlier times that very few musicians could have afforded to buy two copies of the same work. Inventories of the musical libraries of cathedrals, clubs and private persons never show more than one copy of any particular set of pieces, and there is no reason to distrust evidence of this kind (7, pp. 51-52).

According to Donington, "Late renaissance and baroque church singers, especially of such famous bodies as the Vatican Sistine choir, were trained in bel canto, and used the same technique, often the same embellishments, as their secular colleagues" (8, p. 460).

In order to gain evidence as to how choirs must have sounded in the matter of blend, it is important to understand the requisites for good singing in the period in question. Duey summarizes the principles of bel canto:

> A good ear along with its correct use to insure exact intonation was almost unanimously held to be the prime requisite for a singer among all the writers in whatever country we have under survey (9, p. 100).
> . . . . . .
> Great interest was shown in keeping the tongue, teeth and lips out of the way in order that the voice could

> come forth free from all constraint and without being forced through the nose (9, p. 110).
> . . . . . .
> the ideal voice was one of evenness in quality throughout the entire range, with perfect intonation (9, p. 125).

That blend in choral sound was desirable in the choirs of the Renaissance is shown in the following instruction to singers: "When singing in concert or ensemble the performer must listen to be sure he is not more prominent than the others" (10, p. 90).

According to Mees, "About the end of the eighteenth century, amateur singing societies, independent of all church affiliations, sprang into life" (15, p. 25).

While there is a noticeable lack of information on choral techniques of the nineteenth century, one can understand the type of choral tone desired through studying authorities on musical style.

Generally, the type of tone desired for choral music of the nineteenth century is a fuller, more dramatic tone. A major addition to vocal tone of the nineteenth century was the use of vibrato. The differences in the demands of music of the sixteenth and the music of the nineteenth century are illustrated by Morris: ". . . the polyphonic Palestrina composition demands relatively pure timbre, the flute-like voices are needed to create the ethereal illusion. On the other hand a composition from the Romantic era such as Brahms' "Requiem" demands a vigorous full bodied choral tone" (19, pp. 31-32).

That blend was desirable in choral performances of the late nineteenth century and the early twentieth century is shown in the following quotation from Joseph R. Foley published in 1939:

> Only in the past half-century has this situation changed. What is standard in our day was virtually unknown fifty years ago. Attention to tonal beauty, blending of voices and parts, interpreatation of various schools of composition--and acceptance of them as well--enlarged the horizons in the field of choral music. These and other factors have collaborated to produce in the United States a standard of choral art that in most respects is unsurpassed anywhere (11, Foreword).

Jones presents a survey of the more recent history of blend in choral sound:

> . . . It was not so long ago that the finest compliment we could pay to a choir was that every member was a soloist in his own right. We considered the profusion of vibrati emerging from such a group as choral blend, and the individuality of such voices operating together as choral color.
>
> After this we went through a period when we attempted to do just the opposite, to wipe out every vestige of individuality of voices or vibrati, and to select for our choral ensembles only a certain kind of innocuous, impersonal, emasculated voice which we collected and to which we then applied methods of tone production, further to include even more similarity and colorlessness. There evolved a definite pattern of chorus construction. This resembled a pyramid with a bass of firm foundation tapering to a soprano section of highly selected thin voices. This was the era which particularly upset voice teachers. They felt that choral singing would destroy the most important aspect of the voice, its individuality. In a sense this was true; the methods used at that time did discourage individuality.
>
> Our current rebirth of the choral art is indicative of the emergence in our time of the full expressive potential of the human vocal organ used as a concerted instrument. We are not singing a method or a particular kind of sound. We are beginning to free this vocal apparatus provided us by nature, so it may function normally,

naturally, fully and interpretively in the infinite variety of which it is natively capable (13, p. 18).

Summary

The scientific study of sound can be traced to the Greek mathematician Pythagoras, about 550 B.C. The Greeks, Aristotle and Aristoxenus, wrote treatises dealing with music and acoustics. The Romans learned much from the Greeks. Vitruvuis and Ptolemy wrote of music and acoustics.

The scientific study of sound as we know it began in the seventeenth century with Galileo. Mersenne wrote the first extended treatise on sound and music entitled Harmonic Universelle. Mersenne has been called the "Father of Acoustics."

The first organized scientific society was the Accademia Del Cimento of Florence, established in 1657. The Royal Society of London was formed in 1670 and contributed much to scientific thought.

There were no great contributions to the science of sound in the eighteenth century.

Helmholtz is one of the outstanding men in the study of sound. Helmholtz, who worked during the last half of the nineteenth century, contributed much to the study of tone quality. Helmholtz built resonators which he used to emphasize partials of musical tones, enabling the partials to be isolated and identified.

Lord Rayleigh, another important figure in the history of the science of sound, is the author of The Theory of Sound,

published in 1877-1878. This is an outstanding work in the field of acoustics.

In the twentieth century "The Acoustical Society of America", organized in 1928, is a major contributing factor to the scientific study of sound. The most outstanding developments in the science of sound in the twentieth century have been in the technological field. Carl Seashore has done much work in the field of musical acoustics.

The history of blend in choral sound is difficult to trace. The beginning of the concept can be traced to the desirability of improving the unity or togetherness of singing. The Hebrews attempted to sing together, and it is shown that the Greeks used a conductor to improve the unity of their singing.

The singing schools founded by Pope Sylvester in 314 A.D. contributed much to the improvement of choral art. The fact that blend was desired in the Renaissance is known because singers were admonished to make certain their voices were not more prominent than the others.

In the nineteenth century a full, dramatic tone quality was desired. This led to the concept in the later nineteenth and early twentieth centuries that the best choral tone was that which resulted when every member was a capable soloist. Following this there was a period when choral directors attempted to destroy all individuality of voices in attempting to achieve blend.

More recently there seems to be a rebirth in the choral art in which neither complete individuality nor the lack of it is sought but rather a mean between these two extremes in which no one particular method or kind of sound is preferred over another.

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CHAPTER III

FACTORS RELATING TO THE ACHIEVEMENT OF BLEND IN CHORAL SOUND

Introduction

Chapter III is divided into the following sections; definitions and concepts of blend in choral sound, rhythmic unity, vowels, quality of tone, vibrato, intonation, selection of voices, seating or standing arrangements, balance, and acoustics of the room.

It seems logical that before discussing the factors relating to the achievement of blend in choral sound a discussion of definitions and concepts should be presented. The order in which the factors relating to the achievement of blend in choral sound are presented rather arbitarily. Questionnaire results of the order of importance of the factors are used as the primary basis for determining the order in which they well be discussed. However, when factors are discussed together in a majority of published sources, these factors will be discussed consecutively in this study.

Definitions and Concepts of Blend in Choral Sound

The concept of blend in choral sound is difficult to describe and define. Most authorities have a mental conception of blend in choral sound; the problem is finding adequate words to express this concept. Many authorities have defined and discussed blend in choral sound. Morris writes:

> The essence of choral tone is the manner in which the individual voices of the ensemble are blended into the whole, i. e., the process by which a group of individual voices are brought together into a composite unifeid choral tone, which sacrifices individual quality except as it contributes to the whole.
>
> . . . . . .
>
> The result of these processes of fusion is the choral blend of the ensemble. On close examination of the terms choral tone and choral blend we find them to be practically synonymous. The slight difference is in the connotation each carries with it. The connotation of the term choral blend is tied up with the process of its achievement. If we speak of the blend of a chorus we are usually conscious to some degree of what has gone into the building of that blend. The term choral tone on the other hand usually refers purely to the product, or audible sensation (29, p. 5).

Helvey states: "The problem of blend is the mixing of all types of voices, qualities, colors, and intensities into one common tone quality that is the best possible for that particular group" (18, p. 147).

Most authorities agree that blending of voices refers to mixing of the voices. The difference of opinion is primarily in the degree to which the director mixes the voices in achieving blend in choral sound.

Jones would submerge all individuality:

> A perfectly blended mixed chorus sounds like a mixed quartet of super voices. Similarly, the different sections, heard alone, sound like solo voices of more than human power and richness, never like a mere group of individuals singing together. For perfect blend, all individuality must be submerged, and no individual voice should be audible. This is one of the places where the whole is greater than the sum of all its parts (22, p. 29).

Finn's concept of blend in choral sound is somewhat different.

> . . . There must be no single elements, either individual voices or groups of voices, so prominent as to attract attention to themselves.
> . . . . . .
> The aim (achieving blend) is merely to provide a certain aura between the choral lines. For instance, the soprano line, maintaining its treble clarity and all its other characteristic qualities, can be brought close to the alto line. There must be no tonal-vacuum between the lines. Similarly the alto line can approach the tenor and the tenor the bass line (13, pp. 167-168).

Basically, there are two definitions of blend in choral sound to which most authorities subscribe.

1. "The perfect fusion of the tone of a number of different voices, whose various characteristics mix so as to result in one beautiful sound" (7, p. 223).

2. "Blend refers to the uniformity of the quality of tone within and between sections" (46, p. 56).

The questionnaire presented these two definitions, and asked the directors to indicate which of the definitions they felt was most nearly correct. The results are shown in the following table.

TABLE I

PREFERENCES OF 59 DIRECTORS ON THE QUESTION OF DEFINITION OF THE TERM BLEND

Definition	% Preference
The fusion of the differing qualities of tone, whose various characteristics mix so as to produce one sound . . .	67
A uniform quality of tone within and between sections.	22
Both.	11

The essential difference in the two definitions is that the first recognized the differences of tone qualities of individual voices and without actually attempting to change the basic tone quality of the individual, seeks to mix it into one sound.

The second definition implies that a uniform quality of tone within and between voice sections is essential to blend in choral sound. The authorities who subscribe to this definition of blend in choral sound, attempt to change the tone qualities of individual voices in order to achieve blend in choral sound.

Most authorities agree that blend refers to the mixing of the individual voices and sections. Writers on choral conducting and choral techniques stress either the mixing of differing qualities of tone from individual voices and sections, or the achievement of choral blend through striving to make

individual or sectional tone qualities alike as much as possible. The choral directors who responded to the questionnaire overwhelmingly favor the concept or definition of blend which stresses the mixing of varying qualities of tone within and between sections.

Rhythmic Unity

Importance

Rhythmic unity is an important factor in the achievement of blend in choral sound. Kink says: ". . . the lack of precision in the attack or in the release will disturb the ensemble effect. All rhythmic figures must be performed correctly and precisely by every member of the group" (23, p. 43).

In the questionnaire for this study the directors were asked to grade factors according to importance in the achievement of blend in choral sound. The average grade for rhythmic unity ranked sixth in importance of the thirteen factors listed. Of the directors responding, 59 per cent graded rhythmic unity "very important"; 30 per cent graded it "important"; 11 per cent graded it "a factor, but no of primary importance"; no directors graded rhythmic unity as "not important."

Writers on choral techniques explain several important factors pertaining to rhythm and rhythmic unity. Wilson writes:

> " . . . rhythm is first of all movement or change, and order or change, and order or regularity is brought to it.
>
> In music, rhythm is primarily the quality of flowing movement. The factor of order or regularity is represented by meter. It is sometimes referred to as time, which is an abbreviation for time-signature. We do not refer to 2/4 time or 3/4 rhythm, but the 2/4 or 3/4 meter or time. The flowing movement is designated as the rhythmical pattern, and the regularity of beat is designated as meter or pulse.
>
> In choral music, rhythm evolves from either (1) the natural cadence or inflection of the words, (2) the dance or bodily movement, or (3) a blending or fusing of these two. These factors give a conductor the approach to the treatment of rhythm in artistic singing (46, p. 58).

Recommendations Concerning Rhythmic Unity

Several methods are suggested as an approach to rhythmic unity. The following method, suggested by Smallman, is popular. " . . . Tap them out with your finger or a pencil. Sing them on a monotone with a neutral syllable, beating time with finger or toe. Sing them on a monotone with the words, . . ." (36, p. 150).

Smallman further suggests that the long notes should be stressed no matter where they are in the measure. Singing should have rhythmic highlights and lows. It is better to exaggerate rhythmic contrasts than to ignore them (36, p. 150).

Accentuation is the art of correlating the strong and weak components of metrical construction. Accentuation is of primary importance to all musicians and especially conductors.

Accentuation simply means the timely use of louder and softer tone (13,p. 16-19). Smallman explains the different kinds of accents.

> Dynamic accent consists of attacking a certain tone more abruptly and forcibly than its surrounding tones . . . Voices also can use this type of attack, (accent) by letting a designated tone stand out as suddenly and abruptly louder than its fellows (36, p. 81).
>
> . . . . . .
>
> The second type of accent occurs in speech when we sustain a work, drawing out its sound for a longer duration than it would normally have, in order to direct attention to that word. This is known as the agogic accent . . . In perfect compositions the most important accent of music will stress the most important points of the text (36, p. 73).
>
> . . . . . .
>
> Aside from these automatic increases and relaxations of breath pressure, there are times when certain tones are "pressed into prominence" by the breath. This is a form of accent which is typical of vocal technique. It is more vocal in character than the dynamic accent. The pressure accent should be used abundantly by the vocalist (36, p. 92).
>
> . . . . . .
>
> In good choral singing, the important words always receive an accent. This accent may be of the dynamic, agogic, or pressure type (36, p. 106).

Many authorities suggest that the rhythm of the words is the most important aspect in achieving rhythmic unity.

> Perhaps the surest and simplest method of developing what eventually will be a spontaneous sensing of rhythmical nuance is to read poetry aloud . . . To convey the metric feeling thus acquired to the more restricting and more difficult patterns of modern music, I recommend . . . Read aloud the Latin. Read aloud an English version in the same meter. Sing the Gregorian melody. Sing a modern setting (13, p. 30.

Wilson explains the relationship between the rhythmic patterns of the music and the emphasis of the words.

> There are times when the rhythmic patterns of the music should not match or be determined by the desired emphasis of the words, but it may be dictated by the musical effect intrinsic in the phrase. In such cases it is expedient to warn the singers to stress or accent the unaccented beats. The normal metrical stress must give way to the stronger rhythmical urge intrinsic in the verbal and melodic line (46, p. 49).

Timing of consonants, vowels, and dipthongs is stressed by many writers. Anticipation of consonants and of the vanish or second vowel sound of a dipthong are particular problems. Consonants which can be sustained, such as r and l are most often anticipated and demand special attention when working with untrained singers (29, pp. 30-31).

Garretson says: "Following the initial consonant, move to the vowel sound as quickly as possible-- and sing on the vowel" (15, p. 180).

Waring has devised a method of achieving rhythmic unity on vowels, consonants, and diphthongs.

> Be conscious of the placement of each tone syllable within the time value of the note or notes on which it is sung.
>
> Begin every pulse or beat of music with a vowel sound.
>
> The visual impression of words and notes is that the word and the note begin simultaneously. This is true only if the word begins with a vowel. The enunciation of all initial consonants must be completed prior to the instant the beat (or its subdivision) occurs . . .
>
> If this rule is not followed, one of two undesirable results must occur: (1) Either the consonant will be slighted and clarity of enunciation will suffer, or (2) if the consonant begins simultaneously with the time value allowed the syllable, all the words will have delayed or "behind-the-beat" sound. It can readily be seen that this rule is applicable more particularly to sustained consonants than to short consonants which cannot appreciably delay the entrance of the vowel.

> Give subsidiary vowel and tuned consonant sounds a proportionate, rhythmic amount to the full time value. . . . . The amount of time allotted to these subsidiary sounds is governed by considerations of tempo and taste. . .
>
> The final consideration in determining the amount of time which should be given to subsidiary vowels and consonants is the style of the music being sung. The appropriate fraction of time to be given to tone-syllables (especially hummed consonants) varies with the period, tradition, mood, and intent of the music (37, pp. 6-7).

Summary

Rhythmic unity is an important factor in the achievement of blend in choral sound. A popular method of teaching rhythmic unity involves tapping and singing on a monotone with a neutral syllable. Factors relating to rhythmic unity include: proper execution of accents, correct emphasis on the rhythm of timing of vowels, consonants, and diphthongs.

Vowels

Importance

There is almost unanimous agreement that one of the most important factors, if not the most important factor in the achievement of choral blend is unity of vowel. The desirability of homogeneity of vowel sound is stressed in virtually every discussion of the achievement of blend in choral sound. Coleman states, " . . . blend of tone is largely dependent upon the exact uniformity in the shape of vowels. Not that one particular vowel-shape is right and another wrong, but

there must be a standard" (7, pp. 57-58). Marrier also stresses the importance of the vowel.

> The vowel carries the musical line. It is in the vowel that we find the most immediate means of achieving beauty in song, and for this reason it, that is, the vowel, should at the outset of the training period receive the lion's share of our attention. The tones or vowels emitted by our singers must be beautiful to listen to, whether as sounds they are loud, soft, high or low. That they be beautiful is of the essence for they have no other reason to exist at all. We often refer to the tonal beauty of this or that singing ensemble as having an ideal "blend" of the voices (16, p. 35).

Wilcox also places extreme importance on the uniformity of the vowel. The blending of voices into a pure composite tone on any vowel is automatically secured when all the singers form uniformly good phonetic vowels (43, pp. 59-60).

Further evidence of the importance of the uniformity of vowels in the achievement of choral blend is shown by the questionnaire answer: "(Good blend is achieved when) . . . the same vowel sound is used within and between sections." Of the directors responding, 78 per cent indicated that good blend was achieved when the same vowel sound is used within and between sections. The complete results of this question are shown in the following table.

TABLE II

OPINION OF 59 DIRECTORS CONCERNING THE CHARACTERISTICS OF GOOD BLEND

Characteristic	% of Directors Who Feel Item is a Characteristic
1. No individual voices are disernible	78
2. The same vowel sound is used within and between sections	78
3. The same quality of tone is used within and between sections	64
4. Perfect intonation is obtained within and between sections	62
5. There is equal volume from all individuals and sections	26
6. No individual sections are disernible	19

The directors were asked to grade various factors according to importance in the achievement of blend in choral sound. Of the directors responding to the question, 83 per cent rated uniformity of vowels as "very important"; 17 per cent rated uniformity of vowels as "important". No directors rated uniformity of vowels any lower than these values. Uniformity of vowels was rated as the most important factor in the achievement of blend in choral sound.

Acoustical Properties of Vowels

According to Miller: "Vowels are speech sounds which can be continuously intoned, separated from the combinations and noises by which they are made into words" (28, p. 217).

A dictionary definition of a vowel is: "A speech sound uttered with voice or whisper and characterized by the resonance from the vocal cavities" (46, p. 2860).

There has been much research into the acoustical properties of vowels. This knowledge is extremely desirable if one is ever going to attempt a beginning in the improvement of the voice. The following facts concerning vowels have been definitely established: (1) any vowel is characterized by the presence of a definite group, or groups, of partials; (2) the partials that make up a certain characteristic group are much the same regardless of the fundamental frequency; (3) vowel sounds are produced by means of a "modulating" process consisting of shaping the mouth and pharyngeal cavities so that the proper order and intensity of partials are developed by resonant action (9, p. 157).

Two theories have been proposed in connection with the explanation of vowel sounds. They are called the fixed-pitch theory and the relative-pitch theory. These two theories are are discussed by Wood:

> When a given vowel sound is sung, does the singer always emphasize the partial of a certain order--i.e., the third, fourth, etc.--whatever its pitch, or does he always emphasize a fixed pitch whatever the order of the corresponding partial may be? For instance, a soprano singing the vowel sound a as in 'father' emits a note of which the following is an analysis obtained by D. C. Miller using his phonodeik:

Partial	Frequency	Energy, %
1	308	9
2	616	6
3	924	69
4	1,232	8
5	1,540	5
6	1,848	1
7	2,156	-
8	2,464	-
9	2,772	-

If, now, a bass voice sings the same vowel-sound, of course at a different pitch, will the prominent partial be the partial of the same order as that of the soprano, or the partial nearest to the same pitch? Is it the relative pitch of the strong partial or its absolute pitch that defines the vowel-sound ah? The analysis of this vowel-sound sung by the bass voice at once solves this problem for us. It gives:

Order of Partial	Frequency	Energy, %
1	154	1
2	308	3
3	462	1
4	616	1
5	772	12
6	924	66
7	1,078	7
8	1,232	7
9	1,386	1

We see at once that the prominent partial is fixed in pitch. This view is verified by extending the observations to other singers and other notes. Always there is a strong partial in the neighborhood of the frequency. . . . These results have been generally confined by other observers using different methods of analysis, except that all the vowels seem to be characterized by two prominent regions of pitch, the higher one being less important in the series of vowels to which Miller assigned only one. A region of pitch in which all partials are strengthened is called a formant, and we may say that for every vowel there are two formants of fixed pitch (49, pp. 73-75).

Richardson ascribes three formants for vowel sounds and states that the frequency ranges of these three formants overlap for the various sound. The first or lowest formant

(depending on the vowel) lies between 200-1200 cycles per second; the second lies between 600-3500 c/s; and the third between 1500-4500 c/s. Generally, the lowest frequency formant has the greatest amplitude, the second formant next, and the third has the weakest.

Formant frequencies vary considerably as do the relative amplitudes, for any given sound from speaker to speaker, and to a lesser degree, with successive utterances of the same speaker (32, p. 214

Table III (32, p. 214) summarizes averaged data from 76 voices on fundamental frequencies and frequency positions of the three principal formants for men, women, and children, and also averaged formant amplitudes for several of the sustained vowel sounds.

The data given are the average of measurements for English speaking men, women and children who had predominately general American dialectal backgrounds. The average formant frequencies are given separately showing the large differences between the averages for those three groups of talkers. The report does not show large difference of relative amplitudes of formants between the classes. The relative amplitudes are based on the amplitude of the first formant as a reference (32, p. 215).

TABLE III

AVERAGE FUNDAMENTAL AND FORMANT FREQUENCIES AND AVERAGE RELATIVE AMPLITUDES OF FORMANTS OF SUSTAINED VOWELS

(Reproduced from Technical Aspects of Sound) (32, p. 215).

Fundamental Frequencies (c/s)										
F_1										
M	136	135	130	127	124	129	137	141	130	133
W	235	232	223	210	212	216	232	231	221	218
Ch.	272	269	260	251	256	263	276	274	261	261
Formant Frequencies (c/s)										
F_2										
M	2290	1990	1840	1720	1090	840	1020	870	1190	1350
W	2790	2480	2330	2050	1220	920	1160	950	1400	1640
Ch.	3220	2730	2610	2320	1370	1060	1410	1170	1590	1820
F_3										
M	3010	2550	2480	2410	2440	2410	2240	2240	2390	1690
W	3310	3070	2990	2850	2810	2710	2680	2670	2780	1960
Ch.	3730	3600	3570	3320	3170	3180	3310	3260	3370	2160
Formant Amplitudes (db)										
L_1	- 4	- 3	- 2	- 1	- 1	0	- 1	- 3	- 1	- 5
L_2	-24	-23	-17	-12	- 5	- 7	-12	-19	-10	-15
L_3	-28	-27	-24	-22	-28	-34	-34	-43	-27	-20

While the chart (Table III) is quite complex, it is included because of its thorough treatment of the qualities of vowels. The following chart by Wood is less difficut to understand.

TABLE IV

CHARACTERISTIC FREQUENCIES OF THE VOWEL-SOUNDS

(Reproduced from The Physics of Music)
(28, pp. 242-253)

Speech Sound	Low Frequency	High Frequency
u (pool)	400	800
u (put)	475	1,000
o (tone)	500	850
a (talk)	600	950
o (ton)	700	1,150
a (father)	825	1,200
a (tap)	750	1,800
e (ton)	550	1,900
or (port)	500	1,500
a (tape)	550	2,100
i (tip)	450	2,200
3 (team)	375	2,400

The frequency given is in every case the center of a range of pitch within which all partial tones are strengthened; this range is sometimes considerable. The vowel sounds oo and ee involved formants of very low pitch, accounting for the great difficulty in producing these vowels with good enunciation on high notes. Notes with pitches above that of the formant can have no partial tones in the range of the formant, thus the appropriate frequency cannot be evoked (49, p. 76).

Miller explains the process of singing a vowel.

> The jaws, tongue, and lips, trained by lifelong practice in speaking and singing, are set in the definite position for the vowel, and the mouth is thus tuned unconsciously to the tones characteristic

> of that vowel. At the same time the vocal chords of the larynx are brought to the tension giving the desired pitch, . . . When the air from the lungs now passes through the larynx, a composite tone is generated, consisting of a fundamental of the given pitch accompanied by a long series, perhaps twenty in number, of partials, usually a low intensity. The particular partials in this series which are most nearly in unison with the vibrations proper to the air in the mouth cavity, are greatly strengthened by resonance, and the resultant effect is the sound which the ear identifies as the specified vowel sung at the designated pitch (28, pp. 242-243).

Recent evidence indicates that there are at least five air cavities associated with voice production. These cavities are forced into vibration; and if the natural frequency of any one cavity lies near the natural frequency of one of the partials, the cavity vibrates and the partial is strengthened. From the point of view of vowel enunciation, two of these cavities are important, the mouth and pharynx; the remainder are effective in other modifications of quality which can be made not changing the vowel. The natural frequencies of the mouth and pharynx are altered by changing their volume and the width of the aperture by movements of the tongue and lips. In summary, the vocal cords determine the pitch of a note, the mouth and pharynx determine the vowel, and the remaining cavities determine the musical quality (49, pp. 76-77).

Recommendations Concerning Vowels

In attempting to achieve uniformity of vowels, the first step is to decide on what vowel sound is desired. Since each vowel has many shadings of pronunciation and quality, there

can be no one correct interpretation and pronunciation for any given vowel. The criteria must be the dramatic requirements inherent in the music.

One must have a clear mental concept and a mechanical technique for the production of vowels and consonants; however, the emphasis should always be on expression. Freedom of tone production should be sought, but good work on vowels is not an end in itself. It is a technique for expressing the emotional content of the music (17, p. 155).

Most authorities agree that the choral ensemble should be able to sing different types of literature and that different types of vowel sounds are required for the different moods of the music. Morris expresses the need for the choral conductor to understand this:

> A repertoire of poetic imagery for the provocation of vowel coloring should be standard equipment for the choral conductor. As an aid to achieving a higher degree of homogeneity of vowel sounds this technique should not be overlooked. Such descriptions of vowel quality as light or heavy, happy or sad, dark or bright, colorful or plain, and soft or hard, are sometimes quite effective (29, pp. 23-24).

Many writers stress the importance of imitation in achieving uniformity of vowels. The conductor is suggested as the model in many cases. Morris writes:

> The most efficient method of approaching homogeneity of vowel pronunciation is that of imitation. The importance of vowel sounds and their homogeneous conceptions in determining tone quality demands that the choral conductor have a thorough knowledge of word pronunciations and be able to demonstrate correct vowel sounds to the chorus (29, p. 23).

Helvey stresses the responsibility of the conductor for establishing the correct vowel and adds that the singers should be taught to listen and think of vowel production.

> The production of the vowel by a choir is dependent upon the mental conception of the vowel on the part of the director. He must determine the color and shade of the vowel that fits the particular mood or expressive content of the music. It is the uniformity of the vowel on the part of all members of the choir that determines the tone color or quality. Again, this is the responsibility of the conductor. In working with untrained singers, it is important not only to develop a uniform color of the vowel if the choral group is to become an expressive unit.
>
> The teaching of intent listening and thinking of vowel production to the choir members is very important in the accomplishment of proper vowel production and tone quality (18, pp. 20-21).

The singer must be alert and he must think the vowel at all times. The director can help by demonstrating how a vowel can gradually change while one is singing it. "Ah," for example, can drift into "uh."

It is important for choirs to use their lips and tongue properly since facial expression plays a large part in producing the proper vowel. Obviously, the mouth must be open comfortably when singing "ah", but to sing "ee" in the same position would distort the tone because it is unnatural for the "ee" vowel. This should be demonstrated to the singers. At the same time they should be shown the correct lip position for producing all the vowel sounds (12, p. 48).

Further information concerning the physiology of the production of vowels comes from Delattre: "The vocal tract varies in shape from that of a uniform pipe (same section

area throughout) closed at one end (the glottis) and open at the other (the lips). The more the vocal tract approximates the shape of a uniform pipe, the more the high formants are favored by a resonance, and inversely (15, p. 6).

Soft singing is suggested as a means for achieving uniformity of vowels. Fuhr suggests this approach:

> . . . let it be the aim to preserve a uniform, soft quality which prevents the emergence of harsh, ungraceful tones, which put a premium upon purity and ease. This does not mean, however, that if homogeneity of quality is preserved as a fundamental objective, the singers will be able to achieve mellow tone color and ease even in the more brilliant vowel forms which are so vital to the tonal color scheme . . . Most of the objectionable vowel quality encountered in choral groups is the result of oversinging or of muscular tension. Insistence upon a soft dynamic level will help enormously toward guiding both singers and directors toward the desired ends (14, p. 74).

Eisenkrammer also stresses singing the same vowel softly or lightly. Early church music is excellent for this because the harmony is simple. The singers are less inclined to strive for effect and more inclined to seek clearer vowels to blend this kind of music (12, p. 48).

Helvey found that: "Most writers seem to agree, however, that the study of the vowel should evolve from the music under study and not from meaningless exercises of vocal technique. It is important . . . that all exercises stem from, or lead to, the interpretation of the actual music under study (18, p. 21).

Questionnaire results from this study, while not specifically dealing with the vowel, indicated most directors use both vocalises and concert performance material in attempting

to obtain blend. Table V shows the rehearsal techniques used for obtaining blend in choral sound. The question was: In order to obtain blend do you use . . .

TABLE V

REHEARSAL MATERIALS OF 59 DIRECTORS FOR OBTAINING BLEND

Material	% of Directors Using
Concert Performance Material	9
Vocalises	1
Both	89
Other (Diction Exercises)	1

Fred Waring has developed a method for achieving uniformity of vowels.

> . . . To achieve absolute clarity, we have developed a method of enunciation, the essence of which is a rough and practical system of phonetics. We break down each word into its simplest units of sound. Each of these units is called a "tone syllable". . . Each tone syllable should be pronounced with exaggerated distinctness. After discipline is achieved, this exaggeration should be tempered and refined by good taste, and the mechanics of the method will not then be apparent in the actual performance. The group feeling for the true sounds of each word will, however, have been established and unison pronunciation will have become a subconscious habit (37, p. 3).

Waring further explains his system through the following rule concerning vowels.

> . . . Be conscious of all the vowel sounds, and sing them with what seems like exaggerated distinctness. . . Before a choral group can achieve real clarity of enunciation, the singers must be made aware of all the

sounds in each word. Rule I (above) deals with the sounds of the vowels, a, e, i, o, u; and also with w and y which have vowel sounds.

To help the group become conscious of all the vowel sounds in a word or syllable, and particularly in dipthongs (combinations of two vowel sounds) and tripthongs (combinations of three vowel sounds), tone-syllables are spelled phonetically as in the examples below. Not all the shades of difference in the single vowel sounds can be indicated accurately in the tone-syllable spelling without impractical complexity; the "spelling" of vowel sounds is that of common usage.

Dipthongs:

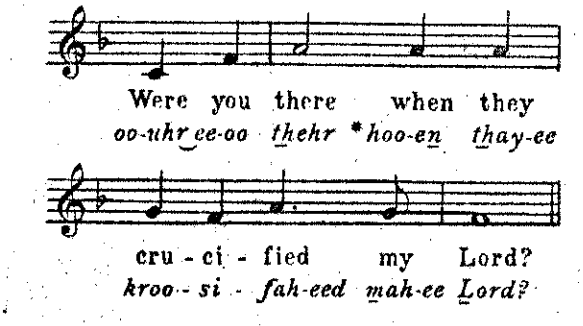
a	is ay´-ee or eh´-i depending on tempo
i	is ah´-ee or ah´-i
o	is oh´-oo
u	is ee-oo´
ou or ow	is ah´-oo
oy or oi	is aw´-ee or aw´-i*

*The sound designated by aw is actually a sound between aw and short o. In our publication it is consistently written aw for convenience.

Tripthongs:

woe	is oo-oh´-oo
yea	is ee-ay´-ee
wide	is oo-ay´-eed
yoke	is ee-oh´-ook

Example of the application of Rule I:



*Wh in tone-syllable spelling always take the sound of hoo, as hoo-ah-ee (why), hoo-aht (what), hoo-ehr (where). The initial syllable hoo should be enunciated distinctly and as quickly as possible.

> Careful attention to vowel sounds not only develop clarity of enunciation, but also blends and unifies the choral tone. Since the vowels and a few of the consonants are the only sounds on beautiful tone that can be sustained, legato singing will obviously benefit from a consciousness of all the vowel sounds in each syllable and from practice in singing each of these sounds (37, p. 3-4)

Summary

There is almost unanimous agreement that one of the most important factors, if not the most important factor in the achievement of choral blend is unity of vowel sounds. Vowels are speech sounds which can be continuously intoned, separated from the combinations and noises by which they are made into words. Two theories proposed in connection with the acoustical explanation of vowel sounds are the fixed pitch theory and the relative-pitch theory.

Quality of Tone

Importance

Quality of tone is closely related to vowels. Beautiful tone is unquestionably important in artistic choral singing. Helvey defines tone quality as: ". . . the nature, property, or character of a sound which is capable of vocal modulation or inflection as expressive of emotion, sentiment, passion, or the like" (18, p. 13). Finn refers to choral tone as ". . . the primary requisite for choral effectiveness" (13, p. 3).

Fuhr emphasized the importance of beautiful tone. ". . . No amount of superiority in other elements of rendition can atone for its absence. In singing, beauty of tone transcends even the text and is eloquent in any language or in none, for it voices itself in a medium which emotionally stirs singers and audience alike" (14, p. 40).

The importance of tone quality to blend in choral sound is stressed by many writers.

> The problem of securing good tone quality in a choral group is very closely related to the problem of securing good blend. For a flaw in tone quality will affect the blend of a choir, and a flaw in blend certainly will not produce good tone quality. One is dependent upon the other for the security of either. In the practical situation a choral director must attack both at the same time; they must progress hand in hand until perfection in both is achieved (24, p. 43).

In the questionnaire for this study the directors were asked to grade various factors according to importance in the achievement of blend in choral sound. The average grade for quality of tone was the fourth highest, following uniformity of vowels, and intonation within and intonation between sections. Of the grades given quality of tone, 68 per cent gave it a grade of "very important;" 28 per cent graded it "important:' 2 per cent graded it "a factor but not of primary importance;" and no directors graded it "not important."

Of the directors responding, 64 per cent indicated as being true that good blend is achieved when the same quality of tone is used within and between sections.

Acoustical Properties of Tone Quality

The human voice is capable of producing many diverse qualities of tone. Olson explains this:

> The human voice possesses the greatest flexibility of all musical instruments. The several reasons for this characteristic are as follows: The throttling action of the vocal cords converts a steady air stream supplied by the lungs into a pulsating one of the saw-tooth type which contains the fundamental and both even and odd harmonics. The fundamental frequency of this wave can be varied by the person at will over a range of about two octaves. The harmonic content of the vocal cords can also be varied to some extent. The output of the vocal cords passes into the vocal cavities. The vocal cavities possess several different discrete resonant frequencies which can be varied by the person in many ways. Some of the tones emitted by the vocal cords are accentuated, and some of the tones are attenuated. Thus it will be seen that the quality of the human voice can be varied in a complex fashion. The output can also be varied over a wide range. Almost all the emotions can be expressed by the voice. The reason for this is due to the great flexibility of the control of the frequency, the timbre and the output in the voice (31, pp. 226-227).

Bartholomew lists the following characteristics of good voice quality.

> The first characteristic is the vibrato. Good voice quality is inseparably connected with a smooth and fairly even variation occurring around a central mean about six or seven times a second in usually all three of the variables: pitch, intensity, and timbre. In a good voice this variation is more marked the louder the tone.
>
> The second characteristic is found in the total intensity. The individual with good tone quality is usually able to produce a tone of considerably more intensity than an individual with a poor quality.
>
> The third characteristic of good quality may be termed the low formant. Good male voices show a decided tendency toward strengthening a low partial somewhere in the general range of 500 cycles or lower. This in all probability takes place in the pharynx, which in the good tone is considerably enlarged and tensed through

lowering of the larynx and stretching of the epiglottis and sides of the throat. In the records so far analyzed, which were sung on middle C, 262 cycles per second, the good voices had relatively strong 2nd partials (523 cycles), while the poorer ones shifted to 3rds, 4ths or 5ths.

. . . . . .

This low formant may in some cases be the lower of the two vowel formants which contribute the particular vowel quality of the tone. However, there is usually a decided tendency in good voices to strengthen it relatively (sometimes at the expense of the upper vowel determining formant) and sometimes to lower it still more . . . This is an explanation of the typical modification of vowel quality in singing, the vowel definition being weakened or even sacrificed so that the "tone" may be enlarged.

. . . . . .

An overwhelming majority of the total number of records taken show the presence of a high formant usually lying for male voices between approximately 2400 and 3200 cycles. This formant is present in varying amounts in all male voices tested, although in some poorer ones the range runs up higher, even occasionally as high as 5,000 or 6,000. Speaking generally, the better the voice, or the louder the tone, the more prominent this formation becomes, at least during some part of the vibrato cycle.

. . . . . .

It must be borne in mind, however, that "2800" is not the sole, nor even the most important, determinant of good quality. Voices which possess it at the proper point and even which possess it in one large degree, may still be of poor quality due to lack of a suitable vibrato, or a low enough low formant, or of sufficient power. If these latter are present, the addition of a strong high frequency at the point for which the hearer's ear is most susceptible will have the effect of adding a very desirable "ring" or brilliance.

Investigations on the female voice have indicated the same four tendencies that have been noted (above) in the male voice, with the exception that: (1) the high formant centers still higher, perhaps around 3200 cycles, corresponding to a somewhat smaller larynx; and (2) some types of tone with much smaller percentage of high formant are accepted as good . . . As a matter of fact, in women there is a marked tendency for the high formant to drop out at some points as the pitch rises (1, pp. 26-32).

Recommendations Concerning Tone Quality

Several methods of dealing with quality of tone and its effect on the blend of the ensemble are suggested by writers on choral techniques. Morris found that

> Choral conductors seem in universal agreement about the necessity of a free, well supported tone by the members of the ensemble as a prerequisite to a beautiful composite tone. Any method by which this concept and the necessary habits can be taught is acceptable. Tonal beauty and not the method is the standard of evaluation (28, p. 18).

Jones suggests dividing the kinds of tone qualities into classes of light, medium and dark. The mood of the selection will determine which of the qualities should be used (22, p. 30).

In order to blend the tone qualities of different singers, Jones suggests that the director select one voice whose quality and color most nearly coincide with those desired. The other singers should try to sing with the same quality as the first. The singers should be added one at a time until all on the part are singing (22, pp. 32-33).

Specific problems dealing with blending of the less desirable tone qualities into the choral sound are discussed by many writers.

> . . . All that is necessary is to get the choralist to control the breath, and direct the sounding air current to one approved spot or region in the mouth where the sound seems to float on the breath. This spot or region lies between the front of the mouth--just where the teeth join the palate--and the lips, according to the kinds and quality of tone required. Of course it's more difficult to get a large body of singers to do this

> than a single individual, but there is always a good percentage who follow instructions and can successfully imitate a pattern, and this is the leaven which permeates the whole choir in time, . . . (8, pp. 21-22).

The forced tone, caused by improper production, is one of the principal destroyers of choral tone. Tension of muscles in the throat distorts the resonating cavities and consequently the harmonic pattern of the tone produced. The local tensions which cause the forced tone are usually a result of concentration by the singer on the singing process or a part of the singing process. The harmonic pattern of a forced tone is usually unhomogeneous with other voices (29, pp. 15-16).

To blend these heterogeneous tone qualities, these singers must be cautioned not to over-sing nor to sing so loud that their tone qualities are noticeable above that of the section (18, pp. 58-59).

Summary

Blend and tone quality are very closely related. The human voice is capable of producing many diverse qualities of tone. Characteristics of good voice quality are vibrato, tonal intensity, and low and high formant. In order to achieve good tone quality, it is suggested that choir members imitate one who has the desired quality. Another method consists of teaching breath control and placement. A singer with a forced tone which will destroy good choral blend should be instructed to sing softly.

Vibrato

Importance

Vibrato was found to be one of the characteristics of good voice quality. Some writers feel that vibrato is a definite factor in the achievement of blend in choral sound. Morris found that:

> The effect of vibrato on choral tone provokes controversial reactions from choral conductors. At one extreme is the conductor who considers the members of his chorus to be soloists and is relatively unconcerned with the vibrato. At the other extreme is the conductor who demands that the individual singer produce a perfectly straight tone (29, p. 24).

Christiansen is adamant in his opinion of the effect of vibrato on choral blend.

> Let me say, however, that the vibrato voices are the greatest menaces we have to contend with in our choir work . . .
>
> I have nothing against a vibrant, oscillating tone which may be very expressive of beauty, but singers overdo it. They have a much larger tone than the violin and when their voices wobble, flutter, and hover around the note, it is sometimes impossible to sing in unison, the result is a mess similar to striking F, F-sharp and G together on the piano.
>
> We must have straight voices, not the dull untrained kind--although that is far more preferable than the trained wobbler--but the straight voice with developed color (5, p. 123).

Most writers who mention vibrato feel that its effect on choral blend is through its effect on intonation.

If one voice is in the lower pitch level of its vibrato cycle and the other is at the higher pitch level, the resulting sound may encompass several notes. If this happens in all four parts at once the result is anything but clarity (42, p. 4).

Jones stresses the difference in the vibrato and the tremolo.

> ". . . The vibrato is essential in good tone quality; the tremolo is a fault which not only is most difficult to correct, but which makes the tone very unpleasant. The vibrato is caused by intensity impulses accompanied by a corresponding slight pitch change, and is a part of good tone quality. The tremolo is caused by faulty voice production and throat constriction and is a result of shaking muscles in the throat. The vibrato should occur with absolute regularity, and a frequency of from six to seven impulses per second in a tone of good quality. The tremolo is always faster, and has a wider pitch variation. The vibrato is essential in establishing good tone color. Fortunately, the vibrato speed varies with individual voices, otherwise the choral tone would become very monotonous . . . (22, p. 33).

Most writers feel that vibrato is an essential factor in choral tone. The presence of vibrato in choral tone enriches the tone. If vibrato is found in the natural voice it should be retained when singing in a chorus. A natural artistic vibrato is not undesirable, however, if the vibrato of a particular voice causes it to conspicuous, it should be changed or eliminated (29, p. 26-27).

In the questionnaire for this study the directors were asked to grade various factors according to importance in the achievement of blend in choral sound. The average grade for vibrato was relatively low, ranking tenth out of thirteen factors. Of the directors responding to this question, 40 per cent graded vibrato "very important;" 38 per cent graded it "important;" 20 per cent graded it "a factor but not of primary importance;" and 2 per cent of the directors graded vibrato "not important."

Acoustical Properties of Vibrato

Seashore has conducted extensive tests on the acoustical properties of the vibrato. His findings indicate:

> The vibrato in music is a periodic pulsation, generally involving pitch, intensity, and timbre, which produce a pleasing flexibility, mellowness and richness of tone.
>
> An artistic vibrato consists of a periodic oscillation in pitch in which the extent of oscillation for the best singers averages approximately a half-tone, and for string instruments approximately six or seven cycles per second, and is usually accompanied by synchronous intensity (2 or 3 db. in extent) and timbre oscillations which play a secondary role.
>
> . . . . . .
>
> By extent of pitch vibrato is meant the amount of the pitch change in the pulsation, usually expressed as a fraction of a musical step.
>
> The average extent of oscillation for artists is about six-tenths of a tone, roughly, a semi-tone . . .
>
> . . . . . .
>
> By variability is meant (a) the difference between the average extent of singers, and (b) the variability between the extent of oscillation from tone to tone of the group or of any singer. For artists, individual tones range from an extent of one-tenth of a tone to as much as a tone and a half, the variability of tones for any one singer being less than that of the group. Artists differ among themselves rather widely in the average extent of their vibratos. While the majority show an average in the region of a half to three-quarters step, . . .
>
> By regularity is meant the consistency of a factor within each tone . . . Artists and vocal students exhibit about the same regularity and variability in extent from cycle to cycle and less within any tone than from tone to tone. . . The lack of regularity may not be a differential between what is beautiful and what is not.
>
> . . . . . .
>
> No reliable relation between pitch extent and nasal, throaty, backward, covered or forward placement of the voice has been found.
>
> Vowel quality does not affect the vibrato extent.
>
> Sex differences are not significant . . .
>
> . . . . . .
>
> Men and women singing in different registers have no significant difference in extent, . . .

> Voluntary effort to increase the vibrato usually result in an increase of pitch extent.
>
> By rate of the vibrato is meant the number of vibrato pulsations per second.
>
> Fully fifty per cent of the artists' cycles are between the rates of six and seven cycles.
>
> Adult music students have the same average rate as the artists, while for children the rate is significantly slower.
>
> . . . . . .
>
> Loudness, tone placement and vowel quality have no effect on rate.
>
> . . . . . .
>
> The forms of the vocal tremolo and trill are not significantly different from the form of the vibrato in general, the tremolo might be defined as a vibrato that is very wide or very slow, and the trill represents the appearance of the vibrato with an extremely wide pitch extent which covers a recognizable tonal interval (35, pp. 349-356).

Recommendations Concerning Vibrato

Writers on choral techniques suggest several methods of dealing with problems they feel are caused by the vibrato.

Wide unpleasant vibratos can be reduced by throat relaxation. The voices which stick out because of wide or prominent vibrato should have individual training until the vibrato can be controlled. In no case should a vibrato be attempted if it is not present (34, p. 8).

Another method of dealing with excessively large vibrato is to caution these singers not to sing as loudly as the other members of the section (3, p. 84).

Weis adds that: ". . . If the vibrato is natural and not extreme, there is not much to be feared. If the person is adaptable and will listen carefully, the tone will usually

work out in the ensemble. If the vibrato is more than average the voice may need to be silent on the more delicate passages" (39, p. 10).

Summary

Many writers feel that vibrato is a definite factor in achieving blend. However, choir directors responding to the questionnaire rated vibrato relatively low in its importance to blend. If one voice "sticks out" because of too wide or prominent vibrato, the voice should have individual training until it can be controlled. Singers with such problems should sing softer than the other members.

Intonation

Importance

Intonation is considered to be one of the most important factors in the achievement of blend in choral sound. Wilson says that since good intonation is a prerequisite for any successful choral performance, it is also a prerequisite for effective blend. Both factors of interpretation must be approached simultaneously. Neglect of blend and balance is one cause of faulty intonation and conversely, faulty intonation is a presage of poor blend and balance (46, p. 222).

It is possible for a choir to be well blended and to lack tonality (the element of key feeling), but no blend is possible without good intonation ("in tuneness"). Intonation is both, a prerequisite to blend and an integral part of it.

It is impossible to have vocal blend without having harmonic blend (22, p. 33).

Kink places utmost importance on intonation.

> Securing good blend is closely related to intonation. It is a matter of merging one's voice with the rest of the group. This must be done horizontally and vertically; that is, the voice must be put in tune with those of the same part (horizontally) as well as with those of the other parts (vertically). The result is that which makes choral singing easier and grander than solo work. By putting the voice in blend, or in the groove, so to speak, with other voices, much is gained (23, p. 43).

Wodell states: ". . . the first and most important requisite to the blending of voices is that each voice shall be exactly in tune" (48, p. 122).

Helvey found that "most writers seem to agree that one of the most important factors in blend is intonation, or singing in tune" (18, p. 44).

The questionnaire results of this study also point to the importance of intonation in the achievement of blend. Of the directors responding to the questionnaire, 62 per cent indicated that perfect intonation was a characteristic of good blend. Complete results of this question are given in Table II, page 42 of this study.

The directors were also asked to grade factors according to their importance in the achievement of blend in choral sound. Table VI shows the results of this question.

TABLE VI

DIRECTORS' OPINIONS CONCERNING THE IMPORTANCE OF INTONATION

Intonation	% Very Important	% Important	% Not Primarily Important	% Not Important
Within Sections	80	17	2	0
Between Sections	69	29	2	0

Intonation within and intonation between sections are both considered very important by most directors. Intonation within sections is considered to be more important in the achievement of blend in choral sound.

Several writers suggest that the choir should sing in the untempered scale. A discussion of the different temperaments is important at this point.

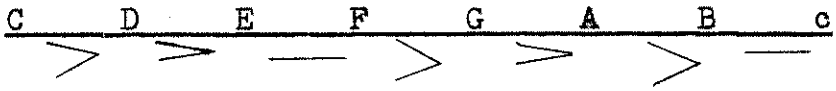
Acoustical Properties of Various Temperaments

There are four scale systems of particular interest to musicians, the just or pure scale, the Pythagorean scale, mean-tone, and the equal-tempered scale.

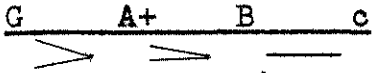
In the pure scale, the intervals agree with those found by the successive fractional division of a string; the ratio of the octave would be 1/2, that of the fifth 2/3, of the fourth 3/4, of the major third 4/5, and so (41, p. 650).

The ratios of the intervals between successive notes of the scale in the pure scale are C/D = 8/9, D/E = 9/10, E/F = 15/16, F/G = 8/9, G/A = 9/10, A/B = 8/9, B/C = 15/16 (25, pp. 9-10).

> If now we represent the major tone by $\rangle$, the minor tone by $\rangle\!\rangle$, and the semitone by ——, we can show this scale diagrammatically thus . . .



> It will at once be observed that A is not a major tone above G. If, therefore, we want to move into the key of G we need a new note, which for the moment we may call A+, to give the relationship we found for the first four notes of the scale of C, namely:



> In addition, of course, we require a new note in place of F, a semitone below G. Owing to the limitations of staff notation we call this new note F#; but it has nothing to do with F.
>
> The same process continues as we construct the scales for successive fifths D, A, E, & c. Each time the frequency of one note is slightly increased and one note is replaced by a new note, or, as we say sharpened . . .
>
> A similar thing happens if we move in the opposite direction to what are called flat keys. A new note is wanted altogether in place of B. For the four notes beginning with F we want a succession--major tone, minor tone, semitone; whereas the notes F, G, A and B give us a succession--major tone, minor tone, major tone. The new note to replace B must be a semitone above A. It is called Bb, but it has nothing to do with B. Observe that Bb is a major tone below c, for we have simply reversed the order for the intervals between A and C in the pure scale of C. Proceeding upwards, we find that d will not do for the scale of F. Actually d has a ratio of . . . 27/16, with F and the interval is made up of three major tones, a minor tone, and a semitone. d is therefore too high by the difference between a major tone and a minor tone. This is an interval with a ratio . . . 81/80, and it is called a comma . . . (25, pp. 11-12).

It can be seen when we modulate up or down the notes of the pure scale by fifths, some notes are either replaced by new notes, that is, sharps or flats, or displaced by intervals of a comma. Singers and string players can use the pure scale whereas other instruments, especially keyboard instruments, cannot.

Pythagoras showed that it was possible to construct a scale by calculating successive fifths above F, a scale on C in which all the whole tones have the ratio 8/9 and both semitones 243/256 . . .

> ". . . the Pythagorean system was the basis of the diatonic modes of plainsong. It was, however, inadequate when used to determine chromatic notes such as D#-Eb and G#-Ab which differe considerably when calculated by fifths, but must be treated as identical on an instrument, such as the organ, with fixed pitches and a limited keyboard" (41, p. 650-651).

When composers began to modulate more freely a revised system of tuning was needed. A system called mean tone temperament was devised.

> In this temperament the major third is tuned true; and all the tones are made equal to the mean of a major tone and a minor tone. The mean tone must, therefore, be half a comma less than a major tone and half a comma greater than a minor tone. All the major thirds, which are their sum, are therefore perfect . . . (25, p. 26).

The extent to which successive notes of the scale of just, pure intonation are tempered is shown in the table below.

TABLE VII

MEAN TONE TEMPERAMENT OF JUST SCALE

(25, p. 28)

1st degree	0	
2nd "	$-\frac{1}{2}$	comma
3rd "	0	
4th "	$+\frac{1}{4}$	comma
5th "	$-\frac{1}{4}$	
6th "	$+\frac{1}{4}$	
7th "	$-\frac{1}{4}$	
8th "	0	

The third system of temperament and the one used today for pianos and organs is the equal temperament.

> In the equal temperament all the tones are made equal and exactly twice the semitone. By this compromise modulation is made completely free and the maximum of convenience is secured by the sacrifice of some true intervals, and particularly that of the major third.
>
> The octave contains twelve tempered semitones, and it is the sum of six tempered tones . . . (25, p. 28).

The extent to which successive notes of the scale of just or pure intonation are tempered in the system of equal temperament is shown in the following table.

TABLE VIII

EQUAL TEMPERAMENT OF JUST SCALE

(25, p. 28)

1st degree	.0	
2nd "	.-2/11	comma
3rd "	.+7/11	"
4th "	.-1/11	"
5th "	.+8/11	"
6th "	.+6/11	"

Hanley discusses the just or pure scale, the Pythagorean and the equal tempered scales, and compares the features of each. Of the just or pure scale Hanley says:

1. Major 3rds and 6ths are the lowest of any of the scale patterns.
2. Major 7th is the lowest of any of the scale patterns, with resultant "dulling" of the leading tone.
3. Sharps are lower than enharmonic flats (C sharp lower than D flat), thereby diminishing the obviousness of "bright" and "dark" contrasts.

Hanley ascribes the following to the Pythagorean Scale:

1. Equal tones and small semitones appeal to the melodic sense.
2. Major 7th highest of any of the scale patterns, with resultant accentuation of leading-tone.
3. Major 3rd highest of any of the scale patterns.
4. Sharps are higher than enharmonic flats (C sharp higher than D flat), making for emphasis of "bright" and "dark" tone colors.

. . . . . .

> The Equal-Tempered scale may safely be thought of as taking a middle position between the Pythagorean and Just scale patterns. While it has no pure intervals as such, the variances are relatively small and are often disregarded by the uncritical listener. The clear definition between major and minor is disturbed, however, and some feel that an attendent drabness in tone coloring is the result.
>
> It would seem that proper use of these scale patterns, as related to the periods of composition for which they were intended, is basic both to problems of intonation and to problems of achieving appropriate "style" in performance. The close interaction between scale pattern and the composer's work calls for that same close alliance in the recreation of the composition at the hands of the performer. Thus, the claim that any one scale pattern may suffice for all musical situations is as absurd as the converse statement that any scale pattern may be applied to the music of any period (17, p. 11).

Grove's Dictionary of Music and Musicians gives the following charts which show the relationships between equal temperament and mean tone temperament, and pure or just temperament and equal temperament.

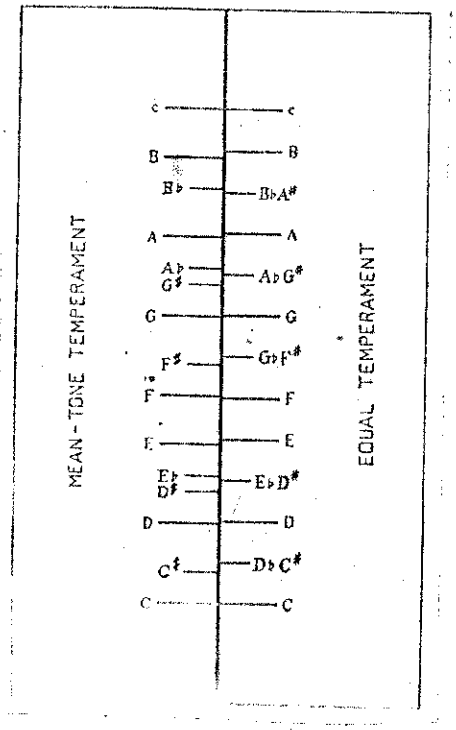


Fig. 1--(16, p. 380) Comparison of mean tone and equal temperament

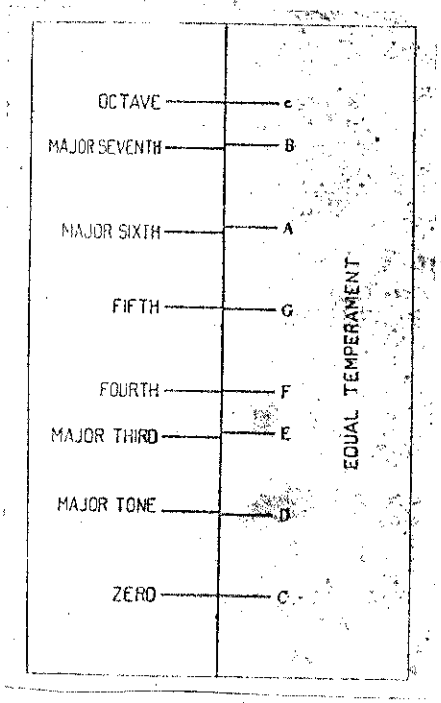


Fig. 2--(16, p. 382) Comparison of just intonation and equal temperament

Recommendations Concerning Intonation

The causes of poor intonation seem to be many and varied. Christy lists the following (6, p. 57).

1. Poor ventilation and improper temperature.
2. Incorrect diction.
3. Failure to think of beginning and consonants on the same pitch as the vowel which follows.
4. Incorrect posture.
5. Poor breath support, especially in pianissimo.

6. Lack of attention to music or conductor.
7. Tempo too slow and consequently "draggo"
8. Lack of familiarity with the music.
9. Lack of concentration on the given pitch.
10. Failure to keep a clear and vital conception of the tone in low register.
11. Fatigue of the vocal organs, or improper vocalization.
12. Failure of the vocal organs, or improper vocalization.
13. Registers too high or too low.
14. Failure to observe proper breathing places.
15. Wrong classification and placement of voices.
16. Difficult intervals or progressions.
17. Chronic "flat-ers" or "sharpers"
18. Nervousness or tenseness.
19. Growing stale

Most writers stress the importance of ear training or the improvement of aural perception as an aid in achieving intonation. Heylbut says, "As to the practical problems of a capella singing, the most important is ear accuracy, so that the singing may be kept within the scope of the absolute intervals for which the music was written" (19, p. 226).

Kink adds: "Many reasons are given for off pitch singing. Fundamentally, it is a problem of the ear. Its correction will be the result of ear work, using the ear, listening (23, p. 43).

Helvey's study reached this same conclusion: ". . . we should pay more attention to the possibility of training tonal memory as an aid to intonation. At least it would serve the purpose of making the students more pitch conscious. When they become pitch conscious, their intonation usually improves" (18, p. 49).

Roe makes the following suggestions:

> To sing in tune, every singer must hear mentally every pitch BEFORE singing it. Failure to do so causes careless singing, pitches and inaccurate attacks . . .
> As an exercise have the choir engage in a silent practice:
> Stop singing at a given signal--
> Sing silently--then
> Have them sing the pitch (use a song they are sure to know such as "America" or "Home on the Range") (Chapter III, p. 43).

Eisenkramer suggests a different approach:

> One way of doing it is by placing your section in a straight line, giving the same vowel at the same pitch. Have them sing this pure vowel with absolutely no color, and very softly. Then walk down the line, and, placing your ear close to each mouth, tell each singer whether he or she is on pitch, a shade above or below it. Call attention to the rest of the group to the different pitches of two voices that should be singing the same tone. Make them all acutely aware of this shade of difference.
> A good exercise that will help to develop exact pitch is to have everyone sing the same note (perhaps middle C) on the syllable we, prolonging the vowel o. When everyone in the group sings exactly the same pitch, you will hear a ringing sound in the tone (12, p. 48).

Helvey states that, "The greatest single factor in poor intonation in high school is mental lassitude and aural laziness. The great physiological changes of the adolescent period constitute a hurdle which the director must overcome in getting the students to assume their responsibilities of blending in the choir" (18, p. 157).

In order to correct this problem Roe advises: "The teacher of students who are lazy, tired, or not breathing deeply enough must convince his choir of the necessity of assuming good posture and breathing deeply. Breath control

exercises . . . used regularly in class will help build bodies, breath, and posture (34, p. 46).

Spend a suitable amount of time producing the best possible unison (octave if the group is mixed). The unison should be so perfect that the members feel that their own sound is almost being carried away from them. A comfortable pitch should be used. Direct complete attention toward listening. Let the basses sing the note first and have the choir listen as the sound focuses with all voices precisely on pitch and in perfect blend. Then add the other sections one at a time at the mezzo forte level. Stagger the breathing so that the unison can be held until it is completely in focus. The sustained pitch can be checked with the piano.

The next step involves the major third. There seems to be a natural tendency among singers to sing the third flat.

After the third is in tune, return to the perfect unison on the tonic. When this is accomplished, have all voices except the second altos and second basses move back to the third. This interval, if in tune and in a good accoustical environment, produces the discernible fifth and active overtone.

Finally, let the first sopranos and first tenors move to the octave and thus complete the harmony (27, p. 109-110).

Proper dynamic balance has an effect on intonation. Williamson says we find it much easier to keep the choir in tune if the basses increase amplitude when they sing the

low tones, and the sopranos decrease amplitude as they ascend (45, p. 22).

Williamson also suggests that the conductor should point out that many times a part will be duplicated at the unison or at the octave. He suggests that the singers should mark these places in their music and direct their attention to the tuning of these tones (45, p. 54-55).

Fuhr stresses the importance of a cappella singing in helping to develop independence and pure harmonization (14, pp. 62-63).

Wetzler suggests rehearsing the choir a cappella "so that they lean on themselves, not the organ, for accurate pitch. Even if you don't let your choir sing a cappella in front of people, it's good training to rehearse that way. It will improve the quality and confidence of your singers" (42, p. 4).

Faulty vocal technique is one of the more important causes of poor intonation. Roe lists the following causes of problems in vocal technique.

Problems in placement will be caused by

1) Rigidity of:
   a) the base of the tongue
   b) lips
   c) jaw
   d) chest
   e) pharynx

2) Not using enough breath pressure to make the vowel forms resonant.
3) Failure to open the jaw enough (modify the vowel) in the High Register.
4) Using too large a vowel form in the low voice register.
5) Failure to use pure phonetic sounds whenever possible. Allowing the vowels to be 'chewed'.
6) Fear of high notes, or singing high with a heavy chest quality will cause flatting. To correct have student sing more tenorish, but with his jaw open at the back.
7) Yawny tone production will cause flatting. Sing in the frontal masque.
8) Singing loudly with too heavy a tone quality will cause flatting.

(53, Chapter III, p. 27)

Fuhr suggests that if the group cannot maintain the voice ranges of the composition, the conductor should either choose another selection or change the key of the piece to bring it into the range of the choir (14, p. 63).

Cain also recommends that the conductor "pitch the numbers high, particularly in an extremely warm room, since warm air produces fatigue, resulting in the lowering of pitch. He also advocates that the choir can remain seated and perform just as perfectly as when standing (4, p. 94).

Fuhr points out that at times outside conditions cause difficulty in intonation. A room with a low ceiling and poor acoustical properties may cause the tone to be flat, whereas an echoing auditorium may produce sharpness. The efficient director will be aware of the external conditions that affect intonation and take steps to overcome them (14, p. 61).

Many writers suggest the importance of thinking low on pitches that ascend and thinking high on pitches that descend. This is primarily a matter of concentration.

Summary

Intonation is considered to be one of the most important factors in achieving blend. It is impossible to have choral blend without harmonic blend. Some writers suggest that the choir sing in the untempered scale. The scale systems of particular interest to musicians include the just or pure scale, Pythagorean, mean tone, and equal tempered. The Pythagorean system is preferred by most authorities because of its high thirds, sixths, and sevenths. Poor intonation can be the result of many causes. Ear training, concentration, correct posture, proper balance, and pitching the numbers higher or lower are suggested as means of improving intonation.

Selection of Voices

Importance

The selection of voices is usually the first step in building a choir. Most choral directors will at some time be given the opportunity to select voices for the ensemble rather than to have to accept whatever singers they can get.

In the questionnaire for this study, the directors were asked to grade various factors according to importance in the achievement of blend in choral sound. Selection of voices

was ranked fifth in importance after uniformity of vowels, intonation within sections, and quality of tone. Of the directors responding, 70 per cent graded selection of voices as "very important," 19 per cent graded it "important," 11 per cent graded it as, "a factor, but not of primary importance." No directors graded it as "not important."

Fuhr presents the problems and rewards of the proper selection of voices.

> In the massing of voices, either the worst or the best qualities may be magnified. If bad qualities are allowed indulgence, the result will be merely exaggerated error; if the best that each has to offer is encouraged, the objectionable individual elements will be attenuated and the good augmented. In this salutory phenomenon of fusion lies the clue to the means by which a schooled director can achieve remarkable results from raw material which, at its individual best, is but mediocre (14, p. 41).

Recommendations Concerning Selection of Voices

In the questionnaire for this study, the directors were asked to put various factors in the sequence or order of rehearsal they use to obtain blend in choral sound. The numbers given for each factor. This made it possible to compile an average order of rehearsal for all choir directors who responded to this question. Selection of voices was found to be first in the order of rehearsal.

Christiansen lists the following factors as testing points for choir membership (5, p. 123).

1. True to pitch in upper and lower octaves.
2. Vibrato
3. Breathiness
4. Attack without glottis stroke
5. Flexibility and smoothness of tone
6. Color: Fluty, reedy, or mixed (light, dark or medium)
7. Size of tone and blending quality
8. Even tone color throughout the scale
9. Breath control
10. Concentration and strength of personality
11. Memory and reading ability
12. Compass and best tones in the voice
13. The use of the language in singing
14. Rhythmic feeling

Some writers feel that the solo voice is a problem and should be avoided, or at least watched carefully, in selecting voices for the choir. These writers stress that the requirements for solo singing are different than for choral singing. The solo singer strives for individuality while the choir singer should strive only to blend with other voices (19, p. 266).

Christy explains that a resonant solo voice is usually a 'sore thumb' in a group of untrained voices because the vowel production is so much clearer and the voice so much more powerful (16, p. 48). Coleman feels that the trained adult female voice is the most difficult voice to blend in this respect (7, p. 3).

Male voices usually retain a blending quality regardless of age. But in female voices, a greater change is noticed in the maturing of the voice and in deterioration with advancing age. A voice that has been abused will begin deteriorating

around thirty-five or earlier, and a strong voice, even one that has been well trained, begins to lose its blending quality around forty (20, p. 70).

In the questionnaire for this study the directors were asked, "Do you consider the singer's age to be a factor in achieving choral blend?" Of the directors responding, 55 per cent answered yes; 43 per cent answered no; 2 per cent answered possibly.

The directors were also asked to rate the following age groups in order of difficulty in achieving blend. One equals most difficult, five equals least difficult. These numbers were averaged together to give a numerical value which represents the relative difficulty of the various age groups in achieving blend in choral sound. The following table shows the complete results of this question. The groups are ranked from least difficult to most difficult.

TABLE IX

DIRECTORS' OPINIONS CONCERNING RELATIVE DIFFICULTY IN ACHIEVING BLEND IN VARIOUS AGE GROUPS

Age Group	% Most Difficult 1	% 2	% 3	% 4	% Least Difficult 5	Average
Elementary	7	15	15	11	52	3.869
College	2	33	15	21	29	3.416
High School	8	13	52	19	8	3.062
Junior High	29	28	15	29	0	2.426
Adult	63	10	8	15	4	1.875

It is evident that most directors feel that the adult age group is the most difficult group in which to achieve a good blend. Elementary and college ages are considered to be the least difficult age groups in which to achieve a good blend.

Another question related to the selection of voices was, "The ability to blend is of (a) primary importance, (b) secondary importance, (c) not important." The complete results are given in Table X.

TABLE X

DIRECTORS' OPINIONS CONCERNING THE IMPORTANCE OF ABILITY TO BLEND IN THE SELECTION OF VOICES

Relative Importance	%
Primary Importance	65
Secondary Importance	33
Not Important	2

Most authorities stress that voices do not have to be able to be alike for them to blend. Individual voices differ widely in tone color. Certain overtones, missing from some voices are supplied by others. Tones perfectly produced, absolutely in tune, produce overtones which cannot help blending (22, p. 31-32).

According to Morris, a choir will take on various colors of blend with variations of loudness by either one, several

or all of the voices in the group (29, p. 32). Morris further states that the director should know the voices of his singers. A director who knows the contribution of each singer to the blend or quality of the chorus can get a variety of blends by instructing various members of the chorus to sing at different dynamic levels (29, p. 32).

Summary

The selection of voices is usually the first step in building a choir. Among considerations regarding selection of voices, some authorities include age as a factor affecting blend. Voices do not have to be alike to blend. A well trained voice will usually not blend with untrained voices. Many varieties of blend are possible through varying the dynamic levels of the differing tone qualities in the ensemble.

Classification of Voices

Importance

Classification of voices is primarily a matter of ". . . determining the singer's vocal range and voice quality, in order that he may be assigned to the voice part to which he is best suited, and by which he can make the best contribution to the group" (15, p. 16).

Morris summarizes the importance of classification of voices and its relationship to choral blend.

> If a conductor is to know the contribution of each singer to the blend of the chorus and efficiently establish the blend of tone which he wishes to create,

> he must be able to distinguish the various types of tone quality, and be able to classify them according to whatever scheme is most satisfactory for him (29, p. 34).

In the questionnaire for this study, the directors were asked to rank factors according to the sequence or order of rehearsal they use to obtain blend in choral sound. Classification of voices was found to be the second factor in the average order of rehearsal.

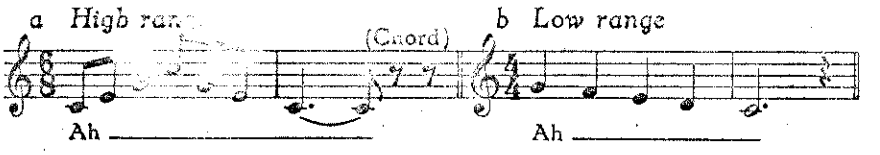
The directors were also asked to grade the factors according to importance in the achievement of blend in choral sound. Classification of voices ranked sixth in importance and was very close behind selection of voices. Of the directors responding, 56 per cent graded classification of voices "very important;" 33 per cent graded it "important;" 11 per cent graded it "a factor, but not of primary importance." No directors rated classification of voices as "not important."

Recommendations Concerning Classification of Voices

In classifying voices range and quality are considered to be the most important criteria. Most writers stress that both range and quality should be used in classifying voices and that neither should be used separately as a complete basis for classification. Wilson suggests

> " . . . Remember, a voice is classified by the quality as well as the range. This principle should always be followed. Take care because some altos sing as high as sopranos, some tenors sing as low as baritones and some basses sing as high as baritones. Misplacement of voices causes added difficulty with pitch and blend and balance.
> . . . . . .

2. Use a simple arpeggio vocalise on the vowel ah to determine the upper range of the voice. Use a descending five tone scale to determine extreme low range.



3. Sing some easy song to determine the quality of the voice and the ability of the student to sing a tune . . . (65, p. 257).

Garretson lists the ranges of the voices as follows:

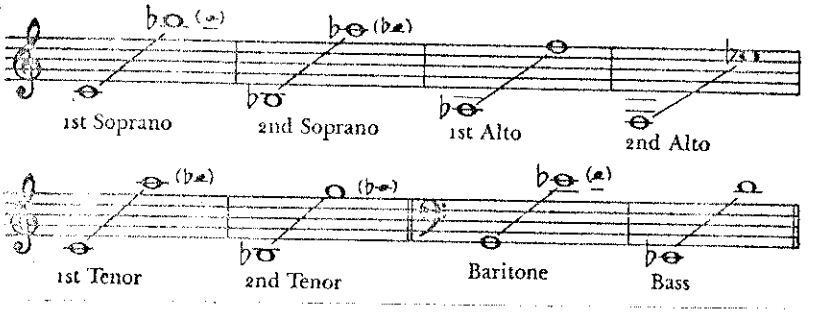


Fig. 3--Ranges of the voices

Garretson lists the following voice qualities as characteristic.

1st Soprano. . . . light flutelike, lyric quality.
2nd Soprano. . . . similar in range to the first soprano, more dramatic type of voice quality.
1st Alto . . . . . similar in quality to the second.
2nd Alto . . . . . a heavier, deeper voice quality, especially in the lower range, which is more fully developed than the 1st alto.

1st Tenor. . . . . light, lyric quality, especially in the upper range limits.

2nd Tenor. . . . . similar in range to the first tenor, but has a fuller, more dramatic, voice quality.

Baritone . . . . . often similar in quality to the second tenor, yet has a more fully developed middle and lower range (initial voice characteristics may be deceiving--it is in this category that many true tenor voices may be identified and developed. Periodical retesting is recommended).

Bass . . . . . a heavier, darker, deeper quality, especially in the middle and lower ranges of the voice.

Williamson holds that one can only classify voices accurately when (1) it is decided whether the quality is absolutely natural or not, (2) when one concedes that the range in most voices is rather wide and does not tell much about classivication, and (3) when the lift is recognized.

The lift is the place in the voice where less breath is necessary. The sound becomes easier to produce and the singer senses a spontaneous buoyancy in ascending scales (44, p. 23, 51).

Witherspoon further explains the classification of voices by lifts. As the pitch ascends the breath organs seem to increase in energy at the first note above the speaking range of the individual, seemingly to insure enough breath energy and exaggeration of vocal action to preserve the coordination of the voice organs for the higher pitches. This action, concerning pitch, quality, vowel sound and resonance, insures the progression of actions of the vocal organs forwards and upwards so that the pitch is correct, the overtones are kept

in harmonious ratio, the head resonance is duly increased, the quality is unimpaired, and thus the vowel is properly modified. This is the real beginning of the head voice, and it shows a considerable increase in the head resonance. Observable in every voice, it is a spot in the scale commensurate with the range of the voice (47, pp. 90-91).

> In the lyric coloratura soprano it occurs at C sharp or D.
> In the dramatic soprano, at B or C.
> In the mezzo soprano, at A or B flat.
> In the contralto, at G.
> In the lyric tenor, at C sharp or D.
> In the dramatic tenor, at C.
> In the baritone, at B.
> In the basso cantante, at A.
> In the basso profundo, at G.

According to Witherspoon, there is a very evident increase in head quality at these points in the scale. These differences, however, are not related to the "register."

The lift should be less perceptible in well trained voices, and is not observed in singers who use incorrect breathing (47, pp. 90-91).

Summary

Classification of voices is important in the achievement of blend in choral sound. The director should know the groups of individuals when needed, to help achieve the desired blend. Classification of voices enables the director to do this. Voices may be classified according to range, quality and by a system suggested by Witherspoon based on the lifts of the voice.

Seating or Standing Arrangement

Importance

Most writers feel that the seating or standing arrangement is an important factor in the organization of the choral ensemble. Wilson says that many factors enter into the choice of seating and standing formations. Some are for appearance, some attempt to improve intonation, and some give support to weak sections. However, the dominating reason should be blend and balance (46, p. 238).

Fuhr agrees: "All details of seating should be very carefully planned to create a maximum of solidarity in the group, and each member should be made to feel his personal responsibility in the complete functioning of the whole" (14, p. 30).

In the questionnaire for this study, the directors were asked to rate various factors in the order of rehearsal they used to obtain blend in choral sound. Seating arrangement was ranked third in the average order of rehearsal. Selection of voices and classification of voices were the first two factors in the order of rehearsal.

The directors were asked to grade various factors according to importance in the achievement of blend in choral sound. Of the directors responding to this question, 31 per cent graded seating arrangement as "very important;" 48 per cent graded it "important;" 17 per cent graded it "a factor

but not of primary importance;" 4 per cent graded it "not important." When these grades are averaged together, seating arrangement was one of the lowest factors in relative importance in the achievement of blend in choral sound.

Helvey's questionnaire asked the directors: "Do you use any system of seating to help blend the tone quality, such as reedy, flute, etc" (18, p. 71)? The results of his study on this particular question tend to substantiate the results of the questionnaire for this study. "Twenty-five directors did not use any system of seating, whereas fifteen directors did seat according to types of voices. Four recommended the seating of the better voices to the back of the various sections. Two suggested the seating according to quartets, and one suggested seating to mix up the sections" (18, p. 71).

The results of the questionnaires on these particular questions seem to indicate that directors do not feel that seating or standing arrangements are particularly important in the achievement of blend in choral sound. However, the results of the questionnaire for this study show to some degree the importance directors place on the seating or standing arrangement in the achievement of blend in choral sound. The directors were asked to sketch the seating or standing arrangement they felt was most conducive to good choral blend. Sixty-five seating-standing arrangements were drawn. The directors were also asked: If you do not use this arrangement, please

sketch the one you use and briefly tell why you use it. Seven arrangements were drawn. Of the directors polled, 89 per cent used the seating-standing arrangement that they feel is most conducive to good choral blend; 11 per cent of the directors polled used different seating-standing arrangements from the one they feel is most conducive to good choral blend.

Recommendations Concerning Seating Arrangements

The writers on choral techniques and choral conducting suggest many different seating arrangements for the various ages and types of choral ensembles. Only the arrangements that are discussed in relation to the achievement of blend in choral sound will be considered in this study.

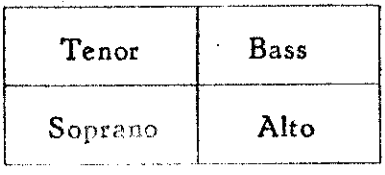


Fig. 4--Block seating-standing arrangement--1.

> Most four-part singing groups use this formation. It probably originated from the idea that the men were taller and should be in the rear while the high voices should be on one side of the platform and the low voices on the other . . . since there are more sopranos than any other part and fewer tenors, this formation affords a balanced appearance on the stage. Sopranos are invariably too prominent, musically and physically with this arrangement (46, p. 240-241).

Several variations in the block seating-standing arrangement are discussed by the authorities.

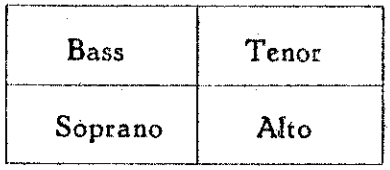


Fig. 5--Block seating-standing arrangement--2

> . . . In switching the tenors and basses (Fig. 5) the outer voices are on one side of the platform while the inner voices are on the other. Since these parts are closely allied at times in polyphonic writing, it is claimed that the performances of this style of music is improved by making the interplay of contrapuntal lines more striking. Also, the idea is advanced that pitch is improved with this arrangement because the fundamental tone of the basses will prevent the sopranos' from wavering from the key. This claim is vindicated only if the basses sing on pitch themselves . . . For the same reasons as in the preceding formation, (Fig. 4) blend and balance are difficult (46, pp. 240-241).

Several variations of the block seating-standing arrangement are suggested as being helpful in solving specific problems.

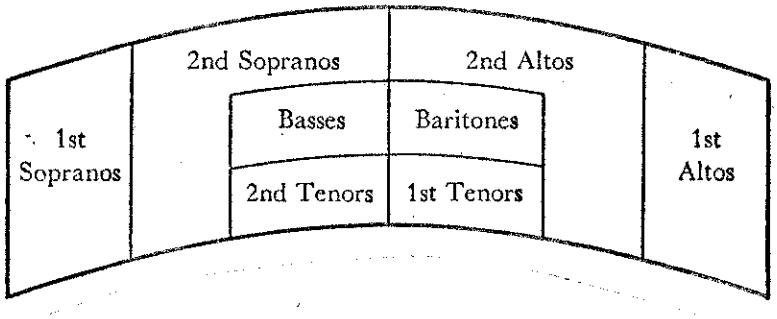


Fig. 6--Block seating-standing arrangement for choirs with weak tenor sections.

1. One of the problems confronting choral directors seems to be the development of tenor voices. By placing them in front of the choir they are more easily heard and may, therefore, sing in a more natural voice, thus improving the blend of the group.
2. At times the tenor part may need to be reinforced. If some of the second altos need to be utilized for this purpose, they will be close enough to effect a reasonably good blend.
3. The soprano and bass sections are relatively close together. The proximity of these two sections which are the outside two parts of the harmonic structure, can effect a stability to the chord and thus help to improve intonation.
4. The placement of a limited number of girls behind the boys can assist in the development of a better blend among the various sections. Choral blend is dependent to a great extent upon the ability of the singers to hear adequately the other parts. This seating arrangement in which the treble voices literally surround the male section increases the latter's awareness of the treble parts and provides increased tonal support, which is especially desirable for unstable adolescent male voices (15, pp. 20-21).

T 1	T 2	B 1	B 2
S 1	S 2	A 1	A 2

Fig. 7--Block seating-standing arrangement for eight part choir.

The sopranos generally overbalance the other parts and in this block arrangement a fused tone is difficult to obtain (46, p. 214).

A similar arrangement is discussed by Garretson and he finds it to be acceptable for the achievement of blend.

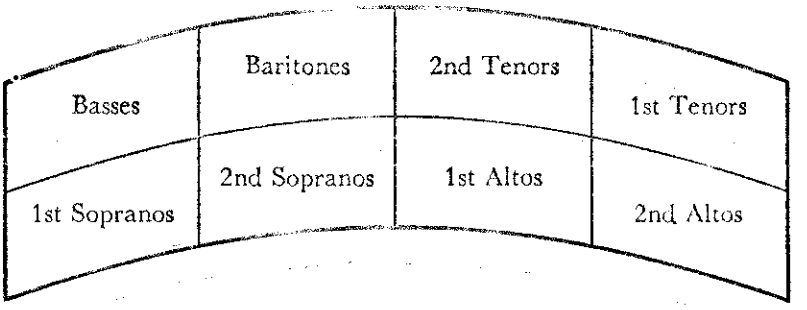


Fig. 8--Block seating-standing arrangement for eight part choir with weak tenor section.

In the event the first tenor part needs to be reinforced with altos, the proximity of the second alto section would provide the maximum support and enable the singers to achieve a reasonably good blend.

The proximity of the soprano and bass sections effects a certain stability to the harmonic structure and assists in improving intonation (15, p. 21-22).

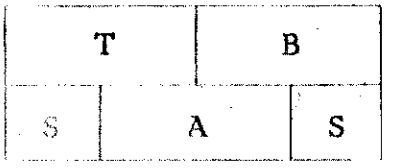


Fig. 9--Block seating-standing arrangement, sopranos divide to avoide overbalance.

Most mixed choruses are dominated numerically by sopranos . . . The first step in mixing voices is to divide the soprano section . . . If the conductor will listen from the rear of an auditorium to the blend and balance with this formation . . . he will be amazed and delighted with the improvement resulting from this simple change (46, pp. 242-243).

All of the preceding seating arrangements are basically block sections. Lambson conducted a study of various seating plans, including the block arrangement. Ten adjudicators evaluated the performance of two songs performed by members of the Collegiate Chorale of the Eastern Washington College of Education. Recordings of the performances were made and the judges were asked to evaluate and indicate their preference by sound on both the live performance and the recorded performance. Lambson found that the block seating plan seems acoustically superior for live performances of polyphonic music for more than four parts, however, it is inferior to the other seating plans for recordings and all performances involving microphones. The sectional block plan is practical both for rehearsing and performing. It is the most practical performing technique to use with non-select singers; it best provides sectional support for enept singers; it affords the most practical conducting control in regard to cueing entrances and indicating sectional dynamics (24, p. 52-53).

The most important characteristic of the block seating-standing arrangement is that voices of one section are together. Various arrangements are suggested which separate individual voices from other voices of the same section. The quartet arrangement is one of the most popular.

A	T	B	S	A	T	B	S
T	B	S	A	T	B	S	A
B	S	A	T	B	S	A	T
S	A	T	B	S	A	T	B

Fig. 10--Quartet seating-standing arrangement.

The quartet seating arrangement usually results in the achievement of better balance and blend. While the voice parts are arranged in rows from the rear of the choir, each singer is nevertheless able to hear himself better as well as the other voice parts (15, pp. 22-23).

Lambson adds:

> The quartet plan seems to be acoustically superior for the performance of four part homophonic music.
> . . . . . .
> The quartet plan has practical application as a rehearsal technique when it is used with a chorus of capable singers who need little help from the conductor for dynamics, attacks, releases, etc. (24, p. 53).

Diercks uses a seating arrangement similar to the quartet arrangement, in that he places each singer as far as possible from another singing the same part.

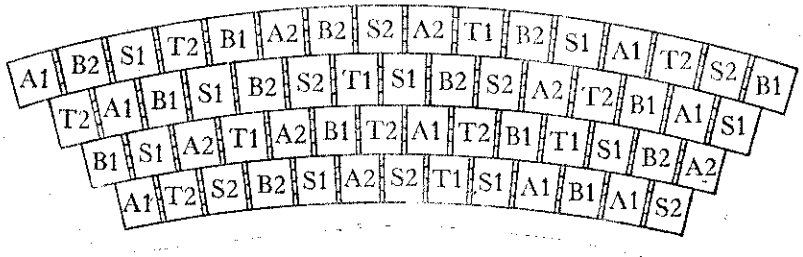


Fig. 11--Scrambled seating-standing arrangement.

Diercks evaluates this plan as follows:

> (1) A singer not surrounded by those singing his part hears his own contribution and can evaluate his efforts far more accurately as to intonation, dynamics, tone color and diction (vowel and consonant). So his individual effort ends to be better and a chorus is a summation of individual efforts.
> (2) One singer having a bad day will not influence his entire section so readily when not standing in a section. He may actually do better when scrambled than he might otherwise do. He will affect those on disparate parts less than those on his part.
> (4) Better balance of parts can be achieved because the director can distribute his forces with greater freedom. Remembering that the less secure voices are less able to adjust than the secure singers, we can understand that the person who is more accurate gives in to the less accurate in the interest of a blended or in tune chord. So again, separation of those on the same part is helpful. First, in training the less secure to rely on himself and second, to keep the more secure from "infection" by the less secure.
> . . . . . .
> (6) For many years most choral directors have striven for homogeneous vowels as a major factor in blending and rightly so. There are, however, other quality factors which must be preserved to insure the individuality of singers within the group and to enrich the choral tone. How can these disparate qualities be encouraged as desirable, and still have a fine blend and good intonation? By experimentation, one can learn to separate voices which act in a deleterious way upon each other (11, p. 7).

Lambson suggests: "Sectional block grouping might utilize the scatter principle to the extent that non-blending voices are kept apart within their respective sections" (24, p. 53).

In the questionnaire for this study the directors were asked to sketch the seating or standing arrangement they felt was most conducive to good choral blend. The following arrangements were drawn in addition to the quartet, octet and scrambled.

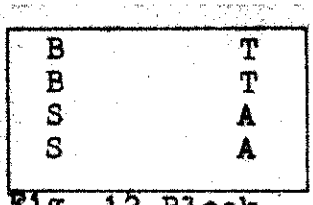
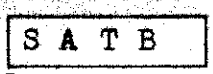
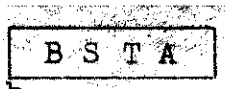


Fig. 12-Block seating-standing arrangement four rows

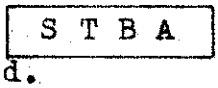


a.



b.

c.



d.

Fib. 13--Variations of block seating-standing arrangement

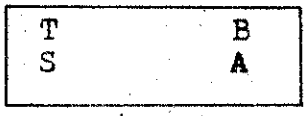


Fig. 14--Block seating-standing arrangement, two rows

Fig. 15--Block seating-standing arrangement, tenor in front surrounded

TABLE XI

DIRECTORS' PREFERENCES OF VARIOUS SEATING-STANDING ARRANGEMENTS FOR ACHIEVING BLEND

Arrangement	Percentage
Quartets	23
Octets	3
Scrambled, Mixed, Fruitbasket	20
Variations of Scrambled	6
Total	52
Block, Figure 12	15
Block, Figure 13	12
Block, Figure 14	3
Block, Figure 15	3
Total	48

The questionnaire for this study also asked: If you do not use this arrangement, (question fifteen) please sketch the one you use and briefly tell why you use it. Seven arrangements were drawn in answer to this question. Of the arrangements, two were quartets, one was scrambled, one was scrambled octets, and three were variations of the block arrangements.

The primary value of this question was that it determined the number of directors who used the seating arrangement that they feel is most conducive to blend. The directors who use a seating or standing arrangement that is different than the one they feel is most conducive to good choral blend represent 11 per cent of the directors polled. Thus 89 per cent of the directors feel that the seating or standing arrangement they use is the most conducive to good choral blend.

Since 53 per cent of the directors use the quartet, octet, scrambled, or a variation or one of these, most directors feel that a better blend is obtained by dividing the voices. However, 48 per cent felt that some form of the block sectional arrangement was more conducive to good choral blend.

Summary

Although many factors enter into the choice of seating and standing arrangements of a choir, the consideration of blend and balance is undoubtedly the most important. There are two basic types of seating arrangements, the block sections, and the mixed arrangements which include the quartet and

scrambled arrangements. The block sectional plans keep voices of the same classification together. The mixed arrangements such as the quarter or scrambled plans, separate voices of like classification. The block section arrangement seems to be superior for live performance of polyphonic music of more than four parts. It affords the most practical conducting control. Quartets or scrambled arrangements usually result in better blend and seem to be superior for four part homophonic music. Many directors use variations of these two types.

Balance

Importance

Balance is closely related to blend in choral sound. Many writers treat these two subjects together as though they refer to the same factor. Wilson describes the relationship between blend and balance and the difference in the two.

> Blend refers to the uniformity of the quality of tone within and between voice sections; balance refers to the equalization of the quantity of tone within and between voice sections. They are inseparable and utterly dependent upon each other. In other words, no balance; or conversely, no balance, no blend. After a conductor achieves what he believes to be a normal blend, he may observe that a few voices in one section or an entire section are two strong and the blend is gone. He may have attained an acceptable balance between sections and then discover that the quality of a few voices does not blend with the group and the balance is gone. Blend and balance must synchronize (46, p. 223).

Most authorities speak of balance with a connotation that agrees with Wilson's definition. In this study balance will

refer primarily to the factors of quantity or intensity of tone, not to factors such as quality or timbre.

Of the directors responding, 26 per cent marked, as a characteristic of good blend, that good blend is achieved when there is equal volume from all individuals and sections.

The directors were also asked to grade various factors according to importance in the achievement of blend in choral sound. Volume of sound was next to last in importance. Of the directors responding to this question, 21 per cent graded volume of sound "very important." This was the smallest percentage of this grade given any factor. However, 55 per cent of the directors gave volume of sound a grade of "important." This was the largest percentage of this grade given any factor. Of the directors responding, 21 per cent graded volume of sound "a factor, but not of primary importance"; and 2 per cent gave it "not important." While relatively speaking, volume of sound was not considered as important as other factors, over half of the directors rated it as "important."

Another of the factors which the directors were asked to grade is related to volume of sound. The factor, grading of tone in crescendo and diminuendo, received the lowest grade average of all the factors. Of the directors responding to the question, 24 per cent graded grading of tone in crescendo and diminuendo as "very important"; 47 per cent graded it

"important;" 28 per cent graded it "a factor but not of primary importance;" 2 per cent graded grading of tone in crescendo and diminuendo as "not important."

Acoustical Properties of Volume of Sound

There are several factors which are important in volume of sound. Olson defines and describes volume as follows:

> Volume is the psychological term applied to describe the musical characteristics of a tone involving the frequency, intensity, duration, harmonic content, spatical complexions of the sound sources, and boundary conditions of the environment. Volume should not be confused with intensity. It is a much more comprehensive term. Volume, however, is a function of intensity. Increasing the intensity level of reproduced sound appears to contribute to spaciousness. The addition of tones increases the volume. An increase in reverberation time increases the volume . . . The greater the number of harmonics, the greater the volume . . . The warble of the frequency of a tone as in the vibrato tends to increase the largeness or volume as compared with a single tone. The volume is proportional to the duration of a tone . . . The spatical distribution of individual tones affects the volume . . . From the foregoing it will be seen that volume is a somewhat intangible psychological characteristic of music . . . (31, pp. 260-261).

Intensity and loudness are often used as synonyms for volume of sound, Miller discusses these terms.

> The loudness of a sound is a comparative statement of the strength of the sensation received through the ear. It is impossible to state simply the factors determining loudness. . . for sound there is no available unit of loudness, and we are dependent on the subjective comparison of our sensations. Not only are the ears of different hearers of different pitches and, therefore, to sounds of various colors.
>
> . . . . . .
>
> The energy, or what we will call the intensity of a simple vibratory motion, varies at the square of the amplitude, the frequency remaining constant; it varies as the square of the frequency, the amplitude remaining constant; when the amplitude and frequency vary, the

> intensity varies as the square of the product of amplitude and frequency; or to express it by a formula, representing intensity by I, amplitude by A, and frequency by n, $I=n^2A^2$ (28, pp. 53-54).

Recommendations Concerning Volume of Sound

An important factor in determining the volume of each part is the number of singers singing it. Woodgate suggests, "For a small choir of sixteen, a good balance would be five sopranos, three contraltos, three tenors, and five basses, and each voice must be chosen to blend with the others (56, p. 13).

Fuhr writes:

> In mixed groups it is usually practicable to use two to four sopranos for each tenor, with a normal ratio of three to two between sopranos and altos. The number of basses should usually slightly exceed that of the tenors in order to give solidarity of the chords. Good foundational bass is an admirable quality in all units in which men's voices are engaged. It should again be stressed that the whole matter of balance is not merely one of numerical proportion, but of the tone core of each section (20, p. 14).

Finn says, "Gauge the proper amplitude of one natably broad voice by the amplitude of two normal light voices" (13, p. 168).

Finn presents a different and interesting point in the following:

> ". . . only a certain percentage of the playing or singing participants of a group contribute any audible sounds to the sum total . . . voices or instruments of the same quality and amplitude, sounding in true unison, increase the quantity of a first player or singer as follows (as it were, in a ratio of diminishing returns): (13, pp. 190-191).
>
> the second 21%
> the third 10%
> the fourth 6, 5/10%
> the fifth 4, 8/10%
> the sixth 3, 8/10%

Many authorities do not recommend attempting to balance the choir by any numerical basis, but rather through balancing all sections with the section with the least quantity of tone.

Coleman says, ". . . In order to achieve this balance it will be necessary to scale everything to the weakest part . . ." (7, p. 53).

The boy's voice in high school is stronger than the girl's. The soprano and alto sections should be larger than the bass and tenor. The choir should be balanced upon the power and quality of the bass section.

Better choral balance can be achieved if only light voices are selected for first soprano, second soprano voices may be larger. Singers should watch all ascending scales allowing no increase in volume unless called for in the music.

Weak and timid singers should be encouraged, while the stronger voices should be reminded of their responsibility to balance in achieving good musical results (24, pp. 158-159).

Williamson explains why the higher voices should be scaled down to the volume of the lower voices.

> ". . . when frequency doubles, energy squares. The doubling of frequency produces a tone one octave higher. Thus, when a soprano is singing three octaves above a bass, the energy produced in her voice is many times that of the bass, since frequency has been doubled three times and energy squared each time.
>
> . . . . . .
>
> The second acoustical law, "when amplitude doubles, energy squares," will be followed also. If the outside parts of the chord are three octaves apart, the soprano tone or top of the chord creates 12 times the energy that the bass tone or the bottom of the chord creates.

> To achieve a more equal balance, in the Westminister Choir we try to do as follows.
>
> The first soprano, made up of five voices, is divided. The two in the E lift sing the top of the chord, the three in the E-flat lift go to the first alto and the five first alto voices join the second alto, giving a numerical balance of two first, three second, five first alto, and eleven second alto. In our male voices, the heaviest second tenors join the baritone; and the two heaviest baritones join the bass giving a numerical balance of three first tenors, three second tenors, five baritones and eight basses. This method which allows eight second basses on the bottom of the chord and two first sopranos on the top of the chord is particularly advantageous on widespread chords. If there is still too much first soprano tone, we increase the amplitude of the second basses in their tone so they balance the energy created by the first sopranos (44, p. 22).

Some writers feel that there are times when a perfect blend or balance is not wanted. Smallman presents this opinion:

> From the horizontal or contrapuntal standpoint, we must give prominence to significant melodies in individual parts. This is especially important when one voice imitates another. In such cases, the imitating voices are given prominence while the other voices sing more softly as a part of the background (36, p. 62).

In the questionnaire for this study, the directors were asked to rate types of music in order of desirability of achieving blend (1 equals most desirable, 3 equals least desirable). The numbers given by the directors were averaged together so that a numerical value could be assigned to the different types of music, which enable them to be rated in the order of desirability of achieving blend. It should be pointed out that 80 per cent of the directors responding felt that good blend is equally desirable in all types of music.

The following table shows how the remaining 20 per cent of the directors rate different types of music according to desirability of achieving blend.

TABLE XII

DESIRABILITY OF ACHIEVING BLEND IN DIFFERENT TYPES OF MUSIC

Type of Music	Average Value of Desirability	% Most Desirable 1	% Less Desirable 2	% Least Desirable 3
Monodic Music	1.454	64	27	09
Homophonic Music	1.727	45	36	18
Polyphonic Music	2.600	10	20	70

Of the directors who rated this type of music, most feel that blend is more desirable in monodic music and least desirable in polyphonic music.

Summary

Balance and blend are closely related. Balance refers to factors of quantity and intensity, not timbre. Since volume of sound is a somewhat intangible characteristic of music, the director must depend primarily on his own ear as the judge of whether or not the ensemble is well balanced. Questionnaire results indicated that volume was not considered as important as other factors in achieving blend, nor was grading of tone in

crescendo and diminuendo. Many authorities recommend balancing the choir with the weakest sections. Higher parts should be scaled down to the volume of lower voices. Contrapuntal melodies necessitate lack of balance. At times different sections predominate for melodic purposes.

Acoustics of the Room

Importance

The acoustics of the rehearsal or performance hall have a definite effect on the blend and balance of the choral ensemble.

The acoustical conditions of the room affect timing, or rhythmic unity. In a small, acoustically dead room any small departure from perfect timing is very noticeable to the listener. In a large reverberant cathedral such slight inaccuracies will go unnoticed because the reverberation masks poor timing (29, pp. 29-30).

Finn says that if the room is signally lively the tempo should be retarded. In resonant rooms speed tends to create an impression of agitation.

Long halls of lofty lines are best, and normal tempo can be effective in rooms of this type (13, p. 70).

Scientific Studies of Acoustical Properties of Rooms

Watson describes the conditions for perfect acoustics in an auditorium.

"Perfect acoustic conditions in an auditorium may be expected when an average sound has a suitable loudness for all the auditors, with no echoes or distortions of the original sound, and when it dies out quickly enough so as not to interfere with succeeding sounds" (38, p. 23).

Beranek discusses balance and blend and the acoustics of halls.

> Blend is defined as a mixing of the sounds from the various instruments of the orchestra in such a way they seem harmonious to the listener (2, p. 68).
>
> The attributes of balance and blend are dependent on the architectural design of the sending end of the hall and the information that the conductors and musicians get back for the hall. The sending end of the hall includes the stage and the sound-reflecting surfaces overhead, at the sides, and at the rear of the stage. It also includes portions of the ceiling and side walls of the hall at the front of the audience . . . The sending end of the hall should mix or blend the sounds from the various performers in such a way that they are heard harmoniously by the listeners . . .
>
> . . . . . .
>
> When a group of performers play together in perfect unison we speak of good ensemble. Ensemble is partly a matter of skill of the conductor and the performers and partly a matter of the design of the stage enclosure or the reflecting surfaces at the sides and above the stage. Good ensemble depends also on the sound that the conductor and musicians hear from the hall itself (2, pp. 446-447).

The type and location of absorbing surfaces are important in the achievement of blend in choral sound because of the varying degrees with which different materials absorb high and low frequencies. In general, the higher frequencies will be absorbed more readily than the lower frequencies. The following table taken from a table by Olson and Massa shows the absorption coefficients of common materials. The higher the coefficient, the more effectively the material absorbs sound.

TABLE XIII

ABSORPTION COEFFICIENTS OF COMMON MATERIALS
FOR DIFFERENT FREQUENCIES

Material	64	128	256	512	1024	2048	4096
Brick Wall 18" unpainted	.024	.024	.025	.081	.042	.049	.070
Concrete, porous breeze, 2" blocks set in 1.3 mortar	. .	.15	.21	.43	.39	.39	.51
Masonite, 7/16" building board, bare	. .	.30	.31	.34	.37	.40	. .
Wood, sheathing, 0.8" pine	.064	.98	.11	.10	.081	.082	.11
Carpet, 0.4" pile, on concrete	. .	.09	.08	.21	26	.27	.37
Cork, 3/4" flooring glued down	. .	.08	.02	.08	.18	.21	.22
Wood, 3/4" pine blocks, laid in mastic	. .	.03	.04	.07	.14	.09	.15

The data shows that the higher the frequency, the more it is absorbed. The most desirable type of material to be used as an absorbing surface is one that absorbs the same amount at all frequencies.

Recommendations Concerning the Acoustics of the Room

Cain believes that the best shaped room is an oval or semi-circular room. A long narrow room presents a problem because of echoes and overtones, which may cause the conductor to force the tones of the chorus, resulting in an unpleasant tone quality.

The best room is one which is almost square and with a high ceiling. A room should have a ceiling with arches or which slopes toward a dome or peak. The room should not seat more than four hundred people (4, pp. 33-35).

Morris summarizes the acoustical problems of various rooms and their solutions.

> 1. In a highly reverberant room diction must be exaggerated.
> 2. When a stage has a high loft or other physical conditions which rapidly dissipate the sound, the chorus should stand as far out toward the apron as possible and listen to each other more intently.
> 3. In a dead auditorium the chorus should make an extra effort to sing as legato as possible.
> 4. If an auditorium is extremely absorptive of high frequencies, the sopranos may have to be instructed to increase in loudness and the bass subdued.
> 5. Music which is rapidly moving or which depends largely on the understanding of the text for its impact should be avoided when singing in a very live auditorium (29, pp. 37-38).

In the questionnaire for this study, the directors were asked: Do you prefer to a) rehearse, b) perform, in a room that is acoustically very live, moderately live, dead? The following table gives the results of this question.

TABLE XIV

DIRECTORS' PREFERENCES OF ROOM ACOUSTICS FOR REHEARSAL AND PERFORMANCE

Room Accoustics	Per Cent Rehearse	Per Cent Perform
Very live	9	30
Moderately live	86	70
Dead	5	0

Most directors seem to prefer to rehearse and perform in a room that is moderately live. However, some directors prefer to rehearse in a room that is not as live as the room in which they perform.

Summary

The acoustics of the rehearsal or performance hall have a definite effect on blend. The sending end of an auditorium should mix the sounds in such a way that they be harmonious to the listeners. An auditorium with arched or vaulted roof, seating not more than four hundred people, and which is almost square is the ideal room. If the choir is not performing under ideal acoustical conditions the director can compensate in

several ways. Some methods suggested are: in a highly reverberant room the tempo may be retarded; in a highly absorbant room the tempo may be accelerated; the diction should be exaggerated in the reverberant room; the choir should sing legato in the absorbant room.

Chapter Summary

Most authorities subscribe to the definition of blend in choral sound which stresses the mixing of varying qualities of tine within and between sections. A smaller but significant number of authorities believe that blend refers to a uniform quality of tone within and between sections.

Several factors are important in the achievement of blend in choral sound. Uniformity of vowels, intonation within sections, intonation between sections, quality of tone, selection of voices rhythmic unity and classification of voices were found to be the most important factors. Other factors of lesser importance are uniformity of production, breathing, vibrato, seating arrangement, volume of sound, grading of tone in crescendo and diminuendo, and acoustics of the room. Many of the factors of lesser importance are closely related to the more important factors.

Most authorities agree that to achieve blend, singers should concentrate on singing with good vocal quality, uniform vowels, precise rhythmic unity, and exact intonation within and between sections.

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CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to determine what is referred to by the term "blend" in choral sound, and to investigate the problems associated with this concept.

Blend in choral sound refers to the mixing of the individual voices and sections of the choral ensemble. Most of the authorities accept the following definition of blend by Coleman: The fusion of the differing qualities of tone, whose various characteristics mix so as to produce one sound.

Sound has been the object of much scientific study. The Greek mathematician, Pythagoras, studied the vibrations of strings, and devised a system of tuning around 550 B.C. The Romans, Vitruvius and Ptolemy, wrote of music and acoustics.

The scientific study of sound as we know it began in the seventeenth century with Galileo. Mersenne has been called the "Father of Acoustics." He wrote the first extended treatise on sound and music.

In the late seventeenth century the Academia Del Cimento of Florence, Italy, and the Royal Society of London were formed. These groups contributed much to scientific thought in the field of acoustics. There were no major contributions

to the science of sound in the eighteenth century. In the nineteenth century several men made contributions to the field of acoustics. Herman L. F. Von Helmholtz studied sound largely from the physiological aspect. He analyzed tones of musical instruments and the vowel sounds. Helmholtz's book, Tonempfindugen, was translated by Ellis, who also studied musical pitch in both its artistic and scientific aspects.

Karl Koenig is famous for the excellent quality of the acoustical apparatus which he designed and built. Lord Rayleigh wrote The Theory of Sound, which is somtimes referred to as "The Principia of Acoustics."

"The Acoustical Society of America" formed in 1928, is a major contributing factor to the scientific study of sound in the twentieth century. The most obvious developments in the field of acoustics in the twentieth century have been in the technological field. Major contributors in the field of musical acoustics in the twentieth century are Carl Seashore, Metfessel, Wagner, Tiffin, and Harold Seashore.

Beginnings of the current concept of blend in choral sound can be traced to early attempts toward improving the unity or togetherness of singing. The Greeks used a conductor to improve the unity in their choruses. The singing schools formed by Pope Sylvestor in 314 A.D. contributed much to the improvement of choral art. In the Renaissance singers were admonished to make certain their voices were not more prominent than the others.

In the nineteenth century it was felt that the best choral directors attempted to destroy all individuality of voices in attempting to achieve blend. More recently it seems that neither complete individuality or lack of it is sought but rather a mean between these two extremes.

The following factors, listed in order of importance as determined by the results of the questionnaire for this study, are considered to be important in achieving blend in choral sound: uniformity of vowels, intonation within sections, quality of tone, selection of voices, rhythmic unity, classification of voices, and uniformity of production. The preceding factors were rated as "very important" by more than fifty per cent of the directors responding to the questionnaire. Breathing, vibrato, seating arrangement, and factors of lesser importance are closely related to the more important factors. Vowels, intonation, tone quality, tone production, vibrato, and acoustics of the rehearsal or performance room were studied for their acoustical properties.

Vowels are speech sounds which can be continuously intoned, separated from the combinations and noises by which they are made into words. Two theories are proposed in connection with the study of vowels. Neither theory completely explains vowels but the fixed pitch theory is generally accepted as more nearly correct. Vowels are characterized by the presence of one or more definite groups of partials called

formants. The formants remain essentially the same regardless of the fundamental frequency of the tone. The vowels are produced by a "modulating" process which consists of so shaping the mouth and the pharyngeal cavities that the proper order and intensity of partials is developed by resonant action. Imitation, constant awareness, and enunciation of vowels and dipthongs, and soft singing are suggested as means of achieving unity of vowels.

Intonation is considered to be one of the most important factors in achieving blend. Systems of tuning are important to the choral director. The just, or pure scale, is based on the fractional divisions of a string. This system is not perfect. Calculation of the scale through the succession of fifths leads to the fact that the whole step relationships found between successive notes of the scale are not all the same size. Pythagoras recognized this and devised a scale with all whole tones of equal size. Semi-tones also were equal. This system is adequate on diatonic melodies. However, it is inadequate when used to determine chromatic tones of the scale. Mean tone temperament is a system of tuning in which the major thirds are tuned correctly. The interval between the major third is divided in half. This system is adequate until the modulation to a key not closely related to the originally tuned scale is required. The system of equal temperament was devised which allowed modulations to any key.

This system divides the octave into twelve equal semitones. The Pythagorean system is preferred by most authorities because of its high thirds, sixths, and sevenths. Ear training, concentration, correct posture, proper balance, and pitching the numbers higher or lower are suggested as means of improving blend in choral sound.

Characteristics of good voice quality are vibrato, tonal intensity, and low and high formant. Imitation is suggested as a means of achieving good tone quality. The importance of breath control and placement is stressed by some authorities. It is suggested that singers with undesirable tone quality be instructed to sing softly.

Vibrato is an essential factor in good tone quality. Characteristics of vibrato are perfect oscillation in pitch of approximately half a tone, six or seven cycles per second, and usually accompanied by synchronous intensity and timbre oscillations. A vibrato that is too wide can be detrimental to the achievement of choral blend, especially through its effect on intonation. Singers who have too wide or prominent vibrato should learn to control it. Singers with the problem of too wide or prominent vibrato should be instructed to sing softly.

The acoustics of the rehearsal or performance hall have a definite effect on blend. The sending end of the auditorium should mix the sounds in such a way that they be harmonious to the listeners. Factors which affect the acoustics of the

room are shape, size, and type of location of absorbing surfaces. An auditorium with arched or vaulted roof, seating not more than four hundred people, and which is almost square is the ideal room. If acoustic conditions are not perfect the director can compensate in several ways. Some methods suggested are 1) in a highly reverberant room the tempo may be retarded; 2) in a highly absorbant room the tempo may be accelerated; 3) the diction should be exaggerated in the reverberant room; 4) the choir should sing legato in the absorbant room.

Conclusions

1. The achievement of blend is an important aspect of choral sound.

2. Authorities in the choral field have formulated definite ideas concerning the definition of blend in choral sound, and the methods they use to achieve it.

3. Scientific studies have been made to determine the acoustical properties of the factors affecting blend in choral sound.

4. The choral conductor can use the knowledge of the acoustical factors affecting blend in choral sound to aid in the achievement of an artistic choral sound.

Recommendations

The conclusions for this study seem to imply areas for further research. Therefore, the following recommendations can be made.

Researchers should be aware of the following:

1. Further study should be made of the acoustical properties of choral tone.

2. Further study should be made of specific problems of blend in choral sound, as they appear in specific musical compositions.

3. Further study should be made of specific problems in aspects of blend in choral sound as they apply to musical style.

Teachers should consider the following:

1. Teachers should be aware of the contributions of science to the study of music, and employ this knowledge in teaching.

Composers should consider the following:

1. Composers should be aware of the problems associated

with the concept of choral blend and apply this knowledge as a technique in the composition of choral music.

APPENDICES

APPENDIX A

AUTHORITIES CONTACTED BY QUESTIONNAIRE

The asterik indicates the authorities who completed all or a part of the questionnaire and returned it.

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*Baar, Robert K., Murray State University Murray Kentucky
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*Cappadonia, A. C., State University of New York, Alfred, New York
*Caswell, Arnold F., University of Minnesota, Minneapolis, Minnesota
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Christiansen, Paul, Concordia College, Moorhead, Minnesota
*Collins, Walter S., Meadowbrook School of Music, Rochester, Michigan
*Craig, Donald, University of Wisconsin at Milwaukee, Milwaukee, Wisconsin
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de Varon, Lorna Cooke, New England Conservatory, Boston, Massachusetts
*Diercks, Louis H., Ohio State University, Columbus, Ohio
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*Dumas, Doyle A., Southeast Missouri State College, Cape Giradeau, Missouri
Englestad, Paul, McMurray College, Abilene, Texas
*English, Mary E., State University College, Potsdam, New York
*Evans, James W., University of Missouri at Kansas City, Kansas City, Missouri

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Imig, Warner, University of Colorado, Boulder, Colorado
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*Jones, Archie N., University of Missouri, Kansas City, Missouri
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Kenney, Jane, Texas Tech University, Lubbock, Texas
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Kirk, Theron, San Antonio College, San Antonio, Texas
Kjelson, Lee R., California State College, Hayward, California
Klein, Maynard, University of Michigan, Ann Arbor, Michigan
Krueger, George F., Indiana University, Bloomington, Indiana
Lieberg, Hardy D., Minot State College, Minot, North Dakota
*Lowrance, Robert S., North Fulton High School, Atlanta, Georgia
*Lynn, George, Westminster Choir College, Princeton, New Jersey

*Maier, Harvey E., University of Southern Mississippi, Hattiesburg, Mississippi
*Mason, Vite E., Ithaca City School, Ithaca, New York
*Mathis, Russell, University of Oklahoma, Norman, Oklahoma
McElheran, Breck, State University College, Potsdam, New York
*McKinley, Frank, North Texas State University, Denton, Texas
*Miller, Kenneth E., University of Missouri at St. Louis, St. Louis, Missouri
Moe, Daniel, University of Iowa, Iowa City, Iowa
*Nelson, Charles, David Lipscomb College, Nashville, Tennessee
*Newbury, Kent A., Alhambra High School, Phoenix, Arizona
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*Ohl, Ferris, Heidelberg College, Tiffin, Ohio
Page, Robert, Temple University, Philadelphia, Pennsylvania
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*Sanders, Hugh, Pampa High School, Pampa, Texas
Scoog, Alfred, Arkansas State College, State College, Arkansas
Shaw, Robert, Robert Shaw Chorale, Cleveland, Ohio
Simons, Harriet, State University at Frdonia, Fredonia, New York
Smith, Walter P., Plymouth Teachers College, Plymouth, New Hampshire
Snow, Harlan C., Shenandoah Conservatory of Music, Winchester Virginia
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Strohm, John A., Minot State College, Minot, North Dakota
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Umberson, George E., Eastern New Mexico University, Portales, New Mexico
Veld, Henry, Augustana College, Rock Island, Illinois
*Vickers, Gilbert T., Springfield College, Springfield, Massachusetts

*Vosburgh, Theodore, Northwood Institute, Midland, Michigan
Voth, Elvera, University of Alaska, Anchorage, Alaska
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Walls, Robert B., Oregon State University, Corvallis, Oregon
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Zetty, Claude, Trinity University, San Antonio, Texas

APPENDIX B

Letter of Transmittal

May 7, 1966

Dear

Since you are a recognized authority in the field of choral music, I am seeking your opinions concerning the problems of "Blend in Choral Sound."

I feel that there is a definite need for a systematic collection of ideas concerning the definition of "Blend in Choral Sound," what methods are used to achieve it, and the acoustical factors that affect the achievement of blend. I have undertaken this as a masters degree thesis at North Texas State University.

The enclosed questionnaire is designed so that it will take only about fifteen minutes of your time to complete. Please return the completed questionnaire in the enclosed envelope as soon as possible. Thank you very much.

Sincerely,

Larry D. Wyatt

Upon completion, the thesis will be on file at the North Texas State Library, where it will be available on inter-library loan. If you so desire, I will send you the results of the survey taken from you and other authorities in the choral field.

APPENDIX C

Follow-Up Post Card

Dear

Three weeks ago you were mailed a questionnaire on the subject of blend in choral sound. At this time I have not received your reply.

Please indicate on the other card and return it as soon as possible.

Sincerely,

Larry Wyatt

I am in need of another questionnaire. Please send another one. _____

I have received the questionnaire and will complete it and return it soon. _____

Director's Address

_____

_____

APPENDIX D

Questionnaire and Results

1. How important is the achievement of BLEND in choral sound?

   a. Very important 93%
   b. Secondary importance 7%
   c. Not important 0%

2. Which of the following definitions of blend in choral sound do you feel is more nearly correct? You may add to the definitions or write your own if you prefer.

   a. The fusion of the differing qualities of tone, whose various characteristics mix so as to produce one sound 67%
   b. A uniform quality of tone within and between sections 22%
   c. Both 11%

3. Good blend is achieved when? Check as many as you desire.

   a. No individual voices are discernible 78%
   b. No individual sections are discernible 19%
   c. Perfect intonation is obtained within and between sections 62%
   d. The same vowel sound is used within and between sections 78%
   e. There is equal volume from all individuals and sections 26%
   f. The same quality of tone is used within and between sections 64%

4. Do you consider the singer's age to be a factor in achieving a choral blend?

   a. Yes. 55%
   b. No 43%
   c. Possibly 2%

5. Rate in order of difficulty in achieving blend (1 equals most difficult, 5 equals least difficult).

Age Group	% 1	% 2	% 3	% 4	% 5	Average
Elementary	7	15	15	11	52	3.869
Junior High	29	28	15	29	0	2.426
High School	8	13	52	19	8	3.062
College	2	33	15	21	29	3.416
Adult	63	10	8	15	4	1.875

6. Rate the following groups in order of difficulty in achieving a blend (1 equals most difficult, 5 equals least difficult).

Group	% 1	% 2	% 3	% 4	% 5	Average
Mixed quartet to double mixed quartet	69	14	6	4	8	1.686
8-20 mixed ensemble	10	60	17	10	4	2.384
Small choir 20-40	0	10	69	12	10	3.345
Concert Choir 40-60	2	11	11	64	11	3.689
Large Choir or chorus-65-200+	26	0	6	4	64	3.792

7. Rate the following ensembles in the order of difficulty in achieving blend (1 equals most difficult, 5 equals least difficult).

Group	% 1	% 2	% 3	% 4	% 5	Average
a. SSA	18	10	27	18	27	3.245
b. TTBB	6	10	18	31	35	3.776
c. SAB	20	31	35	12	2	2.449
d. SATB	12	28	24	26	10	2.940
e. Unison	50	13	6	6	25	2.438

8. Blend is more difficult to obtain in:

a. Homophonic	26%	a. Unaccompanied music	33%
b. Polyphonic	42%	b. Accompanied music	37%
c. Equal difficulty	32%	c. Equal difficulty	31%

a. Consonant harmonies	20%
b. Dissonant harmonies	50%
c. Equal difficulty	30%

9. Blend is more desirable in:

a. Unaccompanied music	32%	a. Dissonant harmonies	6%
b. Accompanied music	4%	b. Consonant harmonies	22%
c. Equally desirable	64%	c. Equally desirable	72%

10. Rate in order of desirability of achieving blend (1 equals most desirable, 3 equals least desirable).

Type of music	% 1	% 2	% 3	Average
a. Monodic music	64	27	9	1.454
b. Homophonic music	45	36	18	1.727
c. Polyphonic music	10	20	70	2.60

11. In selecting voices for the choir, the ability to blend is of:

a. Primary importance	65%
b. Secondary importance	33%
c. Not important	2%

12. When beginning work on a new piece of choral music, do you attempt to achieve blend:

a. During the first rehearsal as opposed to	36%
b. During later rehearsals	64%

13. In order to obtain blend do you use:

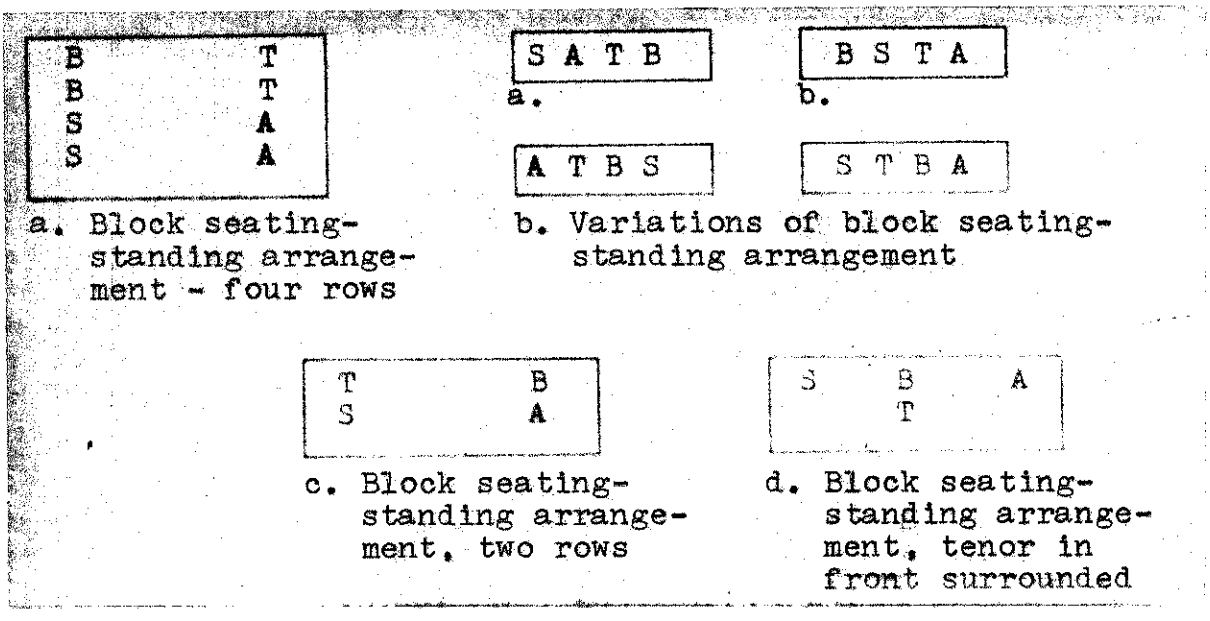
a. Concert performance material	9%
b. Vocalises	2%
c. Both	89%
d. Other (Diction Exercises)	1%

14. Sectional rehearsals affect blend:

Within the section,		Between the sections,	
a. Adversely	6%	a. Adversely	8%
b. Favorably	94%	b. Favorably	92%

15. Please sketch below the seating or standing arrangement you feel is most conducive to good choral blend.

The following arrangements were drawn in addition to the quartet, octet, and scrambled.



a. Block seating-standing arrangement - four rows

b. Variations of block seating-standing arrangement

c. Block seating-standing arrangement, two rows

d. Block seating-standing arrangement, tenor in front surrounded

15. (continued)

Arrangement	Percentage
Quartets	23
Octets	3
Scrambled, Mixed, Fruitbasket	20
Variations of Scrambled	6
Total	52
Block a	15
Block b	12
Block c	3
Block d	
Total	48

16. If you do not use this arrangement (question 15), please sketch the one you use and briefly tell why you use it.

Seven arrangements were drawn.

11 per cent of the directors polled used different seating-standing arrangements than the one they feel is most conducive to good choral blend.

89 per cent of the directors polled used the seating-standing arrangement that they felt is most conducive to good choral blend.

Of the arrangements drawn:
Two were quartets
One was scrambled
One was scrambled octets
Three were variations of block arrangements.

17. In the spaces on the left indicate the sequence or order of rehearsal you use to obtain blend in choral sound.

The numbers given for each item were averaged, giving a numerical value for each factor. Thus the order given is that for the "average" director. The number given on the

17. Continued

right indicates the number of directors who indicated the order of rehearsal for that particular item.

	Average	No. Directors Responding
a. Selection of voices	1.953	43
b. Classification of voices	2.073	41
c. Seating arrangement	3.073	38
d. Quality of tone	3.175	40
e. Uniformity of vowels	3.422	45
f. Intonation within sections	3.761	42
g. Breathing	3.789	38
h. Uniformity of production	3.815	38
i. Intonation between sections	4.175	40
j. Rhythmic unity	4.892	38
k. Vibrato	5.085	35
l. Volume of sound	5.567	37
m. Grading of tone in cresendo and dimuendo	6.000	33

On the right grade the following factors according to importance in the achievement of blend in choral sound. A = very important, B = important, C = a factor but not of primary importance, D = not important.

Factor	% A	% B	% C	% D	Average
a. Uniformity of vowels	83	17	0	0	2.791
b. Intonation within sections	81	17	2	0	2.782
c. Intonation between sections	69	29	2	0	2.666
d. Quality of tone	68	28	2	2	2.617
e. Selection of voices	70	20	10	0	2.586
f. Rhythmic unity	59	30	11	0	2.477
g. Classification of voices	46	33	11	0	2.444

17. Continued

Factor	% A	% B	% C	% D	Average
h. Uniformity of production	57	28	25	0	2.369
i. Breathing	47	28	25	0	2.195
j. Vibrato	40	38	20	2	2.155
k. Seating Arrangement	31	48	17	4	2.062
l. Volume of sound	21	55	21	2	1.957
m. Grading of tone in Creseendo and diminuendo	23	47	28	2	1.906

Other factors added by directors. Each was added by one director and given a grade of "A".

n. Posture
o. Listening
p. Color
q. Articulation of liquid consonants
r. Desire

18. Do you prefer to (a) rehearse, (b) perform in a room that is acoustically:

Rehearse:		Perform:	
a. Very live	9%	a. Very live	30%
b. Moderately live	86%	b. Moderately live	70%
c. Dead	5%	c. Dead	0%

19. Examples of choirs who achieve what I believe to be the most desirable blend.

Robert Shaw Chorale	21
Roger Wagner Chorale	12
Oberlin College Choir	9
Augustana Choir	6
St. Olaf Choir	6
Concordia College Choir	4
Luther College Choir	4
Lugher Nordic Choir	4
Norman Luboff.	3
Fred Waring	2
University of Illinois Choir	2
Ohio State University Choir	2

Many others received one vote.

20. Further questions concerning blend in choral sound that I feel should be investigated (Some directors used this space to add comments not necessarily to add question). All comments are included here.

    1. Knowledge on the part of the conductor of styles in choral literature--of the whole.

    2. Relationship of blend to the creative effort of the individual, i.e., the establishment of mood--color.

    3. Notes in scales a little sharper or reverse depending on each chord.

    4. Each group and set of voices differ as do the taste of directors. Blend should be in accordance with style of music.

    5. All performers must sing the same vowel of a syllable--the correct vowel.

    6. Blend means to mix and combine. Not to delete individual vocal color.

    7. What training is given in college to help neophyte teachers achieve blend.

    8. Who determines what is a good choral sound? Classify the different choral sounds.

    9. Perhaps the question of blend has been thought to be much too important--it has become the "end" rather than a means to a higher and more musical end. Blend is only a tool and ultimately these tools assume a secondary role during the moment music is being made.

    10. Effective enunciation of Latin, Italian and German.

    11. The blend between sections is not good for contrapuntal music. Each line should have its own timbre. A total homogeneity of timbre is useful in very little choral literature.

    12. Definition of blend--is blend something different (sound) than the individual in a section would normally produce, e.g. (St. Olaf), of is it a fusion with sensitive musical considerations?

20. Continued

13. Developing a correct, uniform production of tone.

14. Background of director. A fine singer, pianist, organist or instrumentalist does not necessarily qualify as a director.

15. Discussion on music in which the various voices (SATB) should each have a distinctive quality. European choirs tend to practice this.

21. I would like to receive a copy of the results of this survey.

a. Yes 84%
b. No 16%

BIBLIOGRAPHY

BIBLIOGRAPHY

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