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THE SCIENCE OF VOICE

THE SCIENCE OF VOICE

An Application of the Laws of Acoustics, Anatomy, Physiology and Psychology to the Problems of Vocal Technic, Including Sections on Music and Interpretation, Acoustics, Advice to Those Interested in the Radio and Talking Movies, and Descriptions of Original Researches

by

DOUGLAS STANLEY, M.S., Mus.D.
Fellow of the Acoustical Society of America
Fellow of the American Society for the Advancement of Science

With a Section on Interpretation and Musicianship by
ALMA STANLEY, B.A.

And a Section on Physical Principles by
STANLEY WATKINS, B.Sc.

and

THREE APPENDICES
OUTLINING THE DEVELOPMENTS
OF THE LAST DECADE

THIRD EDITION
(REVISED AND ENLARGED)

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DEDICATION AND ACKNOWLEDGMENT

I dedicate this book to the late Dean Holmes C. Jackson, head of the Department of Physiology of New York University Medical School, who not only put at my disposal the use of a laboratory in the University for the purpose of research on the subject of the human voice, but who also aided me very greatly in the preparation of this book and who spent a great deal of time and unstinted effort in working out with me the diverse, knotty questions in physiology involved.

Douglas Stanley

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PREFACE

Since the publication of the second edition of this book in 1932, I have continued my researches and have established many new facts concerning the function of the human voice.

In the years which have intervened, I have also done a great deal of teaching and have gathered much new data with regard to the application of the principles I have laid down to the training of the voice.

These new findings and methods of procedure are discussed in Appendices One and Two.

The fundamental principles stated in the first edition of this book have in no wise been modified, but, in the first and second editions I purposely avoided any detailed discussion of the methods of procedure which should be adopted in the training of the pupil's voice, for fear of being misunderstood, and because it is extremely difficult, if not impossible, for anyone to learn how to sing, or how to teach, from the printed word alone. In spite of this fact, I have now gone into the question of procedure in some detail. I have done this because I want to help the teacher and the student as much as possible, and also because many of the statements I have made have been misunderstood. Such misunderstandings have, in some cases, lead to the adoption of dangerous and harmful practices by those who, having read the book, have endeavored to teach without working under my guidance.

After many years of work on matters dealing with the talking movies, in which field he was a pioneer, Mr. Stanley S. A. Watkins of the Bell Telephone Laboratories—the author of Section Three of this book—has recently been working on the Voder. This piece of apparatus enables the operator to synthesize speech and singing from their elements. It provides an interesting check-back on our statements with regard to vowels, consonants and the vibrato. Mr. Watkins gives a brief description of this instrument in Appendix Three.

In discussing the registers, I have used the terms upper and lower register when speaking of women's voices, and falsetto and lower register when speaking of men's voices. In view of the fact that the upper register of a woman's voice is exactly the same thing as the falsetto of a man's voice, I now use the term falsetto to designate the light register of the voices of both sexes. There is a certain virtue in the use of this word, since the term falsetto indicates something false, and the woman who uses falsetto only is not really singing at all, in the legitimate sense of the word, any more than would be a man who did the same thing. Any one-register singer of either sex must always be throaty, irrespective of whether it is a man singing lower register only, or a woman singing falsetto only. This law is absolute; there are no exceptions.

DOUGLAS STANLEY

New York City
1939

THE SCIENCE OF VOICE

SECTION I

VOCAL TECHNIC

In order that the reader may fully understand all that is set down in the text which follows, it is highly desirable that he should supplement the study of this book with further reading. The works listed in the Bibliography under the subjects of Anatomy, Physiology, Psychology, and Acoustics should be consulted throughout Section I. While studying this section the reader should constantly refer to Section III

CHAPTER I

INTRODUCTION

All that is known about the proper use of the human voice must be based upon our knowledge of the physics of sound (acoustics), anatomy, physiology, (the laws of function), psychology, and upon an understanding of music, interpretation, diction and phonetics, and dramatic utterance. Any approach to the subject not so based must inevitably fall into innumerable errors and fallacies. This is why the author realized that research upon the principles of vocal technic had to be undertaken by a *group* of specialists in each of the fields of science involved. The findings set forth in this book are the result of many years of co-ordinated effort and research by just such a group.

The human voice is a sound-producing instrument and as such is subject to the laws of physics. Any statement about vocal technic that is in conflict with these laws must be untrue. Furthermore the vocal apparatus is an anatomical structure which must function according to the laws of physiology. Hence any statements about voice, or any teaching directions which are given to the student of voice, should conform with the laws of physiology. Those which do not so conform must be fallacious and harmful.

All physical actions are, in the last analysis, the outcome of mental concepts. Thus our findings must be in accordance with the laws of psychology, and the training of a voice must depend largely upon the inculcation in the pupil's mind of the proper mental concepts.

The first great principle of vocal technic is that the act of phonation is *one* co-ordinated act involving the tension and co-ordination of broad groups of muscles. This co-ordination depends upon the mental concept of the singer. When the technic is good the concept is relatively correct, and when it is faulty the concept is incorrect and involves the co-ordination with the act of phonation of wide groups of interfering muscles.

These interfering muscles must be thrown out of action and the faulty co-ordinations must be broken up. The proper training

of the muscular system which should be in action depends largely upon the elimination of the antagonistic action of those interfering muscles which should not take part in the act of phonation.

The improper co-ordination of the muscles of the jaw, neck, the constrictor muscles of the laryngeal pharynx (throat), etc., with the act of phonation occurs as the result of inhibition or fear, or because of a faulty concept of what good tone really is.

The process of training a voice depends not only upon the proper development and co-ordination of the muscles which should be used in the act of phonation and the throwing out of action of the antagonistic muscles, but it is also a psychological process, since inhibition and fear must be eliminated and the proper mental concepts inculcated.

Direct conscious control over narrow groups of muscles in the human body is physiologically impossible of accomplishment. Hence direct, conscious control over the muscles which actuate any member which takes part in the act of phonation is impossible. Thus no direction should be given to the pupil which implies direct control over the muscles that actuate the thorax (the breathing apparatus), the larynx (the vibrator) or the pharyngeal cavities (the resonator). Any direction by the teacher that involves such direct conscious control is not only impossible of accomplishment, but also actively injurious. Any attempt on the part of the pupil to follow such directions must result in mental confusion. This will develop further inhibitions with the accompanying co-ordination of antagonistic, interfering muscles with those which should take part in the action of phonation.

The act of phonation is one co-ordinated act that cannot be taken apart, but directions may be given to the pupil applying to the action or position of any member which does not or should not take part in this act. Thus the position of the jaw, the lips, the posture of the body, etc., may be regulated, according to the requirements of the moment. In order to develop and properly co-ordinate the muscles which actuate the breath pressure (the motive force of the voice) attention must be paid to the proper training of the vibrato and correct posture, as well as to the attack. The only possible method by which the laryngal muscles may be developed is through the isolation, separate development and ultimate co-ordination of the registers. The development of the pharyngeal muscles must be worked out through the engendering of the concept of *pharyngeal* (throat)

vowel formation, the carrying up of the lower register, vigorous singing, register co-ordination, etc. An almost infinite number of general directions, and directions which serve to amend the mental concepts, may be used.

The psychological side of the subject, while of vital importance, is so individual that but few rules can be given, and the teacher must study the psychological make-up of each individual pupil and proceed accordingly.

A 'great natural voice' is merely the result of an absence of inhibition and of correct mental concepts. In other words it is psychological and physiological and not anatomical, despite the fact that the vocal organs must be healthy and the 'ear' good.

When a fine natural voice is handled by a teacher who does not understand the scientific principles which underlie the laws of vocal technic, the innately correct mental concepts may not be destroyed for some years. This is why some uninformed teachers may have pupils who sing really well. It may take several years for the false mental concepts engendered by the teacher to take effect. In the long run, however, the outcome is inevitable, and the voice will start to deteriorate. Such rapid deterioration of the voices of most of the great singers of the world, at just about the age when they should be in their prime, is only too well known. This deterioration and ultimate loss of voice is due, in practically every case, to incompetent instruction.

Where the natural technic is sufficiently fine, purely negative technical training may suffice for the voice to last to a ripe old age, but proper training definitely insures the singer against vocal deterioration.

It is evident that the competent teacher of vocal technic should thoroughly understand the fundamental facts underlying the physical laws of sound and the application of these laws to the physiology and anatomy of the voice producing organs, from which the basic principles of vocal technic must be deduced. The correct use of the voice depends primarily upon the development and proper co-ordination of the muscles of the thorax, pharynx, and larynx. Training of the voice must then become a matter of so training these muscles by vigorous exercise that they will co-ordinate most efficiently; at the same time, taking steps to throw out of activity those muscles which interfere with such development and co-ordination.

Most emphatically, vocal technic cannot be taught by imi-

tation or by trying to produce the best possible quality of tone under the existing state of muscle development. Imitation is especially unsound since no two voices are of the same timbre, and any attempt to copy another person's quality must inevitably result in an endeavor to accomplish the impossible. Every individual voice has its own characteristic timbre which must be found, and in no way tampered with. Furthermore, the pupil does not hear his own voice correctly. A probable explanation for this is that false tension will give direct communication with the inner ear and will produce a sensation of full and mellow quality to the singer himself when the actual quality of the tone is merely 'thick.' A well produced tone is not properly heard by the singer himself, until it has been reflected back to him from the walls of the room, and therefore it will not sound as full to him as would a 'thick,' 'throaty' tone.

The process of vocal training is one of muscular development, and, during this process, many crude and ugly sounds must inevitably be made. This is especially true at a certain stage of development when the lower register is being carried up.

During the course of training much of the singing done must be loud since, as has been emphasized, we are developing muscles and, in order to do this, they must be vigorously exercised. The pianissimo tone should be one of the last phases of the technic to be taught. It is, in practically every case, the worst feature of the beginner's technic, and therefore to build upon it is fatal, since the singer would merely be developing his faults.

When the voice is properly trained, it is possible for the singer to go from fortissimo to pianissimo and vice versa without any change of quality (vowel), and to phonate as vigorously as he may desire without forcing his voice or distorting the quality.

Under proper conditions it is possible to vary the quality or timbre to an almost infinite degree. This is done by means of vowel modification; but with the artist it is quite unconscious and is merely the result of the act of emotional expression. It implies a perfect control of the vowel forming parts. Thus, when the technic is correct, the singer is able to express himself perfectly by means of 'color', and one of the greatest aims and objects of vocal training is to enable the singer to 'express'. The false idea of 'placing' the voice would absolutely eliminate this ability by giving him a fixed quality for any specific tone or series of tones, and where this fallacy is carried to extremes, the voice will be of practically the same color throughout. Thus, when

the pupil is told to "place it forward" or "into the head" he will be endeavoring to maintain a constant quality.

It is only possible to sing a tone without strain when the resonance conditions are correct, and these conditions alter with each change of pitch or of vowel. When the proper resonance conditions are not obtained, the limits of range are never attained. Curtailment of range will also result from improper development of the laryngeal muscles. Actually the range of every properly trained voice should be at least three octaves, and in some cases, nearly four can be reached.

It might be well to emphasize the fallacy of employing *sensation* as a method of teaching vocal technic. Descriptions of sensations by the teacher and attempts on the part of the singer to duplicate those sensations are, in actual practice, impossible of accomplishment. We are all too familiar with the lack of words to describe a given feeling whether it be an emotion or a form of pain. The description is most often based upon the supposed cause, i. e., 'cutting' pains, 'burning' pains, etc. Since, however, sensations are not only imperfectly described, but the causes also very improperly localized, it follows that a particular feeling in the mouth, throat, palate or nose may not indicate anything occurring in these localities. The cause for the sensation may be elsewhere. All that has been said is especially applicable to muscle sensation. When muscles are functioning properly, they give rise to no conscious sensation. It is only when a strain is placed upon them that they do produce a sensation. Hence definite sensations in singing will more often be indications of a fault than otherwise. Upon the whole, therefore, descriptions of sensation by teachers, and student mimicry, are doubtful means with practically no value in instruction. If the method has any success, it is because of other contributing factors.

The invention of the phonograph, telephone, radio, movietone, vitaphone, etc., has contributed to the wonderful advance in knowledge on the subject of sound made during recent years by physicists and has made it possible to establish definite laws of vocal technic and to conduct serious and useful research upon the subject.

It is at last possible to bring science into the studio and to formulate many really definite laws of the technic of singing and speech. This has been impossible in the past since such apparatus as the oscillograph, the harmonic analyzer, vacuum tube amplifiers, sound filters, high speed cameras, etc., are but re-

cent inventions. We must not blame the vocal teachers of the past for their lack of knowledge—they had no means of investigating their subject. The competent teacher of today should, however, thoroughly understand the laws of physics and physiology.

CHAPTER II

REGISTERS IN WOMEN'S VOICES[1]

There are two groups of muscles: the arytenoid (Figs. 1 and 2) and the crico-thyroid (Fig. 5) groups, which act as tensors of the vocal cords. The preponderance of effect of one group over the other determines a register. There are consequently two, and only two, registers in the human voice.

The larynx consists of a framework of cartilages articulated together and connected by elastic membranes or ligaments, two of which —the true vocal cords—project into the interior of the cavity. Above, it is attached to the hyoid bone, and below, to the trachea, which connects with the bronchi. It opens above into the pharynx.

The principal cartilages are: (1) The *thyroid cartilage*—commonly known as the 'Adam's apple'—consisting of two flat lateral plates which are united in front to form an angle of about 90 degrees with one another. (2) The *cricoid cartilage,* which is shaped like a signet ring with the wide portion at the back. (3) The two *arytenoid cartilages,*

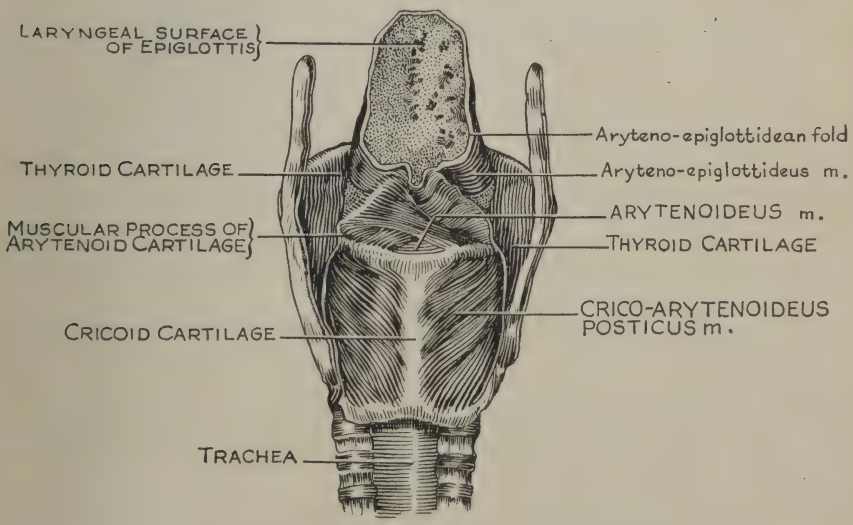


FIG. 1. MUSCLES OF LARYNX; POSTERIOR VIEW

[1] Among the misleading terms used in speaking or writing of vocal technic are the expressions 'head voice' and 'chest voice'. In this book the terms 'upper register' and 'lower register' will be employed.

which articulate with the posterior of the cricoid cartilage. They are small and of an irregular pyramidal shape.

The vocal cords are joined at the back to the arytenoids and in front to the angle of the thyroid cartilage. Thus they come together in front and can be brought together at the back when the arytenoids are approximated. During respiration the arytenoids are separated and the vocal cords form a triangle, with the apex in front.

The length of and tension on the vocal cords are determined by the action of the two groups of laryngeal muscles: (1) The *crico-thyroid* muscles. These muscles, two in number, approximate the thyroid and cricoid cartilages in front, and thus stretch the cords (Fig. 5). (2) The

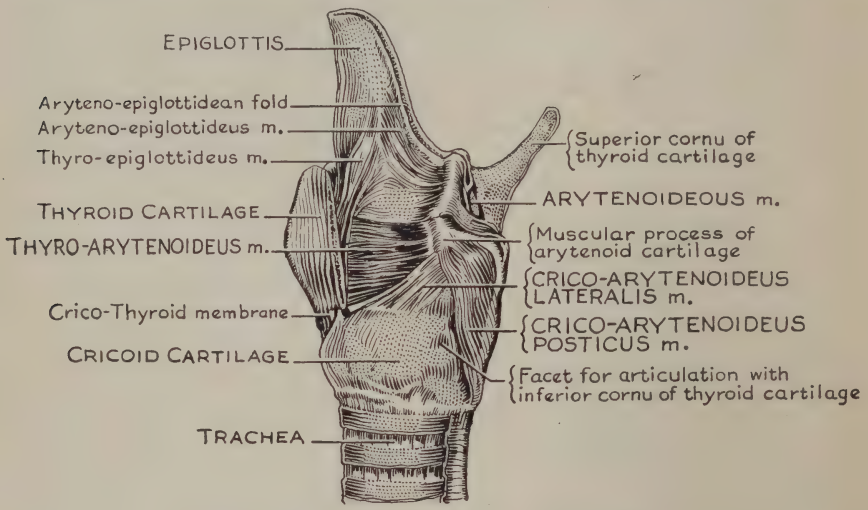


FIG. 2. MUSCLES OF LARYNX; LATERAL VIEW

arytenoid muscles. Of these muscles, which are seven in number, six act as tensors of the vocal cords and one—the arytenoideus—acts as the approximator of the arytenoid cartilages and thus of the vocal cords. The arytenoid muscles which act as tensors of the vocal cords are: (a) The posterior-arytenoid muscles, which draw the outer angles of the arytenoid cartilages backwards and inwards, and thus rotate the vocal process outwards. They approximate the vocal cords when acting with: (b) The lateral crico-arytenoid muscles, which draw the muscular processes of the arytenoids forwards and downwards, thus rotating the vocal processes inwards and approximating the vocal cords.

The simultaneous action of the posterior and lateral crico-arytenoid muscles does not rotate the arytenoid cartilages but draws them inwards, thus narrowing the glottis.

(c) The thyro-arytenoid muscles. These muscles tend to modify the elasticity and consistency of the vocal cords and to render the free edges more prominent. They thus tend to keep the lips of the glottis parallel.

For further information the reader is referred to the works on anatomy and physiology listed in the Bibliography.

A register may, therefore, be defined as a co-ordination of laryngeal muscles in which one or the other of the tensor groups predominates. In the untrained or improperly trained voice, one or the other or both of these groups may be undeveloped, under which circumstances proper co-ordination between the registers will be lacking, and in extreme cases, one group may be so undeveloped that the register determined by this group is virtually lacking. The improper registration of women's voices falls into three classes:

(1) The lower register only may be used. This technic is characterized by a loud, 'thick' and unpleasant quality, and an extremely limited range of about one octave. It is the type of phonation employed exclusively by the 'coon-shouter' or 'jazz-singer' and cannot, for a moment, be considered as real singing.

(2) The upper register only may be used. This is very common, since the proper method of development and co-ordination of the muscles of the larynx has not, until now, been understood. Thus, when there is a pronounced break between the registers the teacher has heretofore in many cases been forced to use one register only—the upper. The result is a voice of very limited power, no real ability to swell the tone, and a curtailed range, although the range is not nearly so limited as that which is found in the first class, where the lower register only is used. Such light voices may have a range of slightly more than two octaves.

In actual practice, the use of the pure upper register alone is extremely rare if not unknown, since a singer who employs this technic will inevitably have to 'thicken' the lower tones of this register in order that they may be audible. The result of such 'thickening' is the slight admixture of part of the lower register with the upper.

The diagram on page 10 will indicate schematically the manner in which the registers function, when the voice is properly used. Consideration of this diagram indicates that the upper register comes more and more into prominence, as the pitch rises, or, on a single tone, as the intensity becomes less.

Thus, considering any single tone, the pianissimo utilizes the upper register only, which is swelled to a certain point, depending upon the pitch, when the lower register is *added*. At this point the upper register muscles retain their tension, while the subsequent increase in tension is then taken up by the lower register muscles.

The point at which the lower register muscles should come into play is determined by the point at which the upper register muscles would become 'overloaded'. Overloading of the upper register muscles is one of the principal causes of voice strain, but the lower register muscles, when developed, are sufficiently strong to hold the tension for even the maximum breath pressure, so that, when the registers are co-ordinated, strain is impossible.

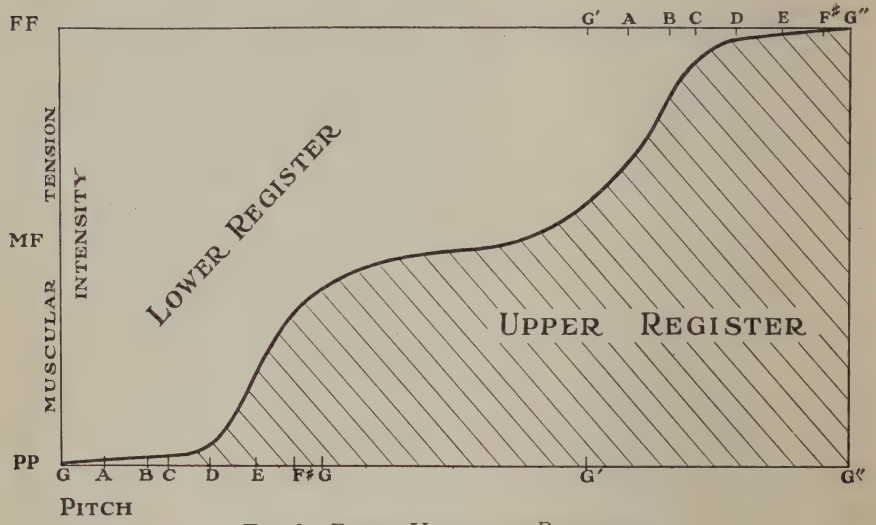


FIG. 3. PROPER USE OF THE REGISTERS

If the upper register muscles are undeveloped, it is impossible for them to take on sufficient tension alone to swell to the desired point where the lower register muscles should come in, so that one of two things will happen. Either there will be a crack between the registers, or the lower register muscles will come in too soon. This is the case of mixed registration. In bad cases, the upper register will never function alone. Thus, in practice, there are two classes of pupils: one uses mixed registration and the other has a break between the registers. This, of course, leaves out the very rare class which has a practically perfect technic. The second class is in far better condition than is the first, since the registers must be totally separated before any vocal development is possible.

When the upper register is mixed, the lower register will, in all probability, be in the same condition. The voice will always be 'thick', and the enunciation poor.

It is highly probable that the upper register is primarily

actuated by the arytenoid group of muscles (Figs. 1 and 2) and the lower by the crico-thyroid muscles (Fig. 5). Thus, if this is true, the addition of the lower register, as the tone is swelled, merely means that beyond a certain breath pressure the tension of the vocal cords is held by additional tension on the crico-thyroid muscles and below this intensity or pressure the arytenoid muscles are able to do the work practically alone. As the pitch rises, the arytenoid muscles are able to hold the tension in an increasing degree, so that the crico-thyroids are called into play at an ever-increasing intensity.

Under proper conditions the arytenoid muscles are fully developed, and are able to hold the cords in tension up to the point where the crico-thyroids should come into play; but, when the development is incomplete, there is a gap which results in a break. Smooth co-ordination can only take place when both sets of muscles are fully developed, and when there is no mechanical interference such as will occur when the pharyngeal muscles are not fully developed and the throat, therefore, collapses and constricts. The act of swelling should be performed by the co-ordination of the lower register with the upper and not by forcing the latter. Therefore singing with the upper register alone is extremely injurious. When the registers are properly co-ordinated, it is impossible for the singer to force the vocal apparatus, provided that the resonance cavities are properly adjusted and held rigid. A strained tone is, in most cases, a somewhat soft one in the production of which too great a load is put upon the smaller muscles which actuate the upper register. The singer who is either trying to build up her voice from a soft tone or to develop it up and down from the middle of her range will inevitably force and strain the vocal apparatus. There is a type of light singing, apparently effortless, which is the most insidious possible method of injuring the voice. Many a case of total loss of voice is due to this cause since, when such a singer attempts to swell the tone, she will push on a constricted throat and will thus directly interfere with the muscles of the larynx and strain them. Nodules will often be formed on the vocal cords of such a singer. Correctly produced, pianissimo singing is one of the hardest phases of the technic and should not be attempted until the voice is well developed; it must be accomplished by means of a *pure* upper register co-ordination of the laryngeal muscles and a perfectly controlled *rigid* throat. As will be shown later the resonance conditions must remain absolutely

constant at all intensities. Control of intensity should belong properly to the laryngeal adjustment.

(3) To the third class belongs the singer who uses two distinct registers, one for the upper and middle part of the voice and the other for the low. This technic also is very common, and although far from satisfactory, it is the best of the three. The partial use of the lower register, if only for a few of the lower tones, will, to quite a great extent, relieve the upper register muscles. Such a singer may have a fully developed range of three to four octaves, provided that the resonance conditions are fairly correct. With this technic, a voice may have good, full, low tones, but it is relatively very weak in the middle where the breath expulsion is extremely high (see Chapters VII and VIII). The upper tones, if properly resonated, may be fairly full and of good quality, but there will always be a very pronounced tendency to force, 'thicken' and mix the middle, and in less degree, the upper part of the voice.

It is, of course, most unsatisfactory from the point of view of the singer who wants to be able to express herself and 'let herself go' to know that she can only swell to a certain point without impairing the quality and ultimately forcing so badly that her voice will crack. In order to sing really expressively, it is essential that the artist should have such a perfect technic that she can swell every tone to the desired intensity and also adequately control the 'color'. This condition implies, primarily, a proper co-ordination of the muscles of the larynx, as well as a perfect control of those of the pharynx.

The following is the proper way for the teacher to set about training the voice of a pupil: he must first find and *isolate* the registers, and, at this stage, they will sound and feel very far apart, but it is vital that they should not be made similar by the 'thickening' or mixing of the upper register.

In developing the voice, exercise of the muscles involved in one register assists in the correct production of the other.

Of course, it is impossible to sing a tone without using all the laryngeal muscles in some degree, and the development of the group which is weak will aid the other set.

Thus the strengthening and carrying up of the lower register will help the upper tones directly, even before there is any co-ordination between the registers, and it has been found that the mere singing of low tones loudly with the pure lower adjustment has added several tones to the top of the voice in the

upper register, at the same time greatly improving the power and the quality of all the upper tones.

The inverse is also true, since the purification and development of the lower register often depends upon the isolation and development of the very high upper register tones.

Sometimes the only possible method of 'finding' the lower register is by 'purifying' the upper, in other words, by removing the 'thickness' or mixture from the latter.

It may appear strange that the singing of loud low tones assists in the production of tones exactly one octave higher and vice versa, but, when one considers the question from the standpoint of muscular development, the explanation becomes quite apparent, since muscles which help are being developed, and a sense of pure registration is being engendered.

One of the first mistakes of many teachers of voice is that they *thicken* the middle part of the voice so that it will apparently sound more like the lower register. Only a pure upper register tone will co-ordinate with the lower register and any thickening process results inevitably in mixture of the registers which will absolutely destroy co-ordination.

There are many instances in which either one of the registers may predominate according as the pupil talks in the lower or the upper. For example, in the cases of many actresses the lower register is accentuated, since it is incumbent upon them to make themselves heard in a large auditorium, and this is usually the only possible method which they possess of accomplishing this result. Here the isolation and development of the upper register are of primary importance and must be undertaken first. The reverse situation, in which the pupil speaks in the upper register only is, however, more common. Here the lower register will at first be very weak and the production of a tone with this adjustment will be rather uncomfortable. Pressing on this register and trying at the same time to obtain the proper resonance conditions will quickly develop it, and in quite a short time it will become very powerful.

This register, or rather the muscles which control it, will be developed by starting with low tones and singing loudly in as pure a lower register adjustment as possible.

In order to develop the muscles it is vital to obtain the greatest possible differentiation of registration. Anything like a mixed registration will act against such development, since the pupil will merely be straining the vocal apparatus.

The development of the upper register is accomplished by obtaining the purest and least thickened tone possible and taking it up very high. The pure register will usually be discovered from that part of the voice which lies above D on the G staff.

When the two registers have been isolated, the upper must be brought down and developed without thickening, and the pupil should, when the proper stage of development has been reached, be told to add the lower to the upper on one tone—a middle one at first. In order to do this, it is necessary for her to be extremely careful not to thicken the quality, and when the upper-register tone is free from thickness, this process will be found far easier of accomplishment than one would expect. The chief factor in co-ordinating the registers is the resonance adjustment which should not vary during the change, and this implies a perfectly controlled rigid throat (not neck). Much will be said about the rigidity of the resonance cavities in this book, since it is a vital factor in proper technic, despite the fact that many vocal teachers tell their pupils to "relax the throat." Any movement of the jaw or lips may, in the early stages, tend to change the position and shape of the singer's throat and must, therefore, be carefully avoided when she is trying to add the lower to the upper register.

The process which may appear very startling to many vocal students is the carrying up of the lower register. The muscles which govern this adjustment have never been used for the higher tones and therefore this process will at first be a difficult and uncomfortable one.

As the scale is ascended the intensity must be increased and the quality, which will not be pleasant, may at first have to become 'whiter' and 'whiter' (more shrill). The pupil must not be allowed to worry about these circumstances since they are a necessary concomitant of vocal development.

The lower register may at first go approximately only to about F on the bottom space of the G staff; after a little while it will reach to B, then to D, then to F on the top line and it will ultimately extend over practically the entire range of the voice. Both sets of muscles should be stretched at each lesson and when the proper stage of development has been attained, the 'adding' process should be worked out until the co-ordination of the laryngeal muscles is complete.

Finally the two registers will co-ordinate (not blend) so perfectly that the pupil will not feel which register she is using.

When the lower register is first used for the upper tones the quality may, necessarily, have to be very white (thin, or shrill) and not at all pleasant, but, as soon as this adjustment is established it is rather easy to make the tone mellow and beautiful simply by the addition of a little "more throat". This phase of the subject will be dealt with later, and all that need be said here is that such a mellowing is merely a question of vowel modification.[1]

The vowels generally used for the carrying up of the lower register are *ah* and *a* (as in *man*) pronounced, in the early stages, as thin and 'white' as possible for the highest tones which can be reached. As the muscular system becomes stronger, and the control of the pharyngeal muscles greater, less bright vowels can be used, and, finally, it will be possible for the singer to form all vowels perfectly. It is, in fact, the only way in which perfectly pure vowels can be phonated.

Various exercises must be given to the pupil in order to make her pronounce all the vowel sounds exactly the same in both registers.

Only when the two registers are developed and co-ordinated is it possible for the singer to avoid forcing her voice when she swells a tone to fortissimo, and only under such conditions can that beautiful mellow depth of tone, which should be the goal of every singer, become attainable. To the one who wants to squeak and merely sound 'sweet' there is really nothing to say. The *art* of singing depends upon variety of 'color', or in other words, the ability to produce all conceivable qualities, and upon the control of intensity. The singer who sounds merely 'sweet' is actually straining her voice with every tone she sings.

Real art implies not merely sweetness, but also grandeur, breadth, nobility. These are the concomitants of a proper technic.

[1] The explanation of this "addition of a little more throat" in order to mellow the tone is based upon an understanding of the resonating of the vowel (see Chapter V). The bright vowel will be characterized by higher frequencies than will the more mellow one, and therefore the use of a somewhat longer resonance cavity will produce a less bright vowel and thus a more mellow quality (see Chapters XL and XLI, Section III).

CHAPTER III

REGISTERS IN MEN'S VOICES

In the case of a man we have, as would be expected, exactly similar conditions, since the male larynx and resonance cavities do not in any way differ from those of the female, except in as much as they are larger.

There is, therefore, no radical difference in the process of training male or female voices. In fact, all types of voices should be developed along similar lines, since the proper physiological conditions are fundamentally constant.

Thus there is a low register which is carried practically all the way up the voice and there is an upper register which is brought in more and more as the singer ascends the scale or as he softens the tone so that at the pianissimo or at the top of the range this registration should be practically pure.

While many women speak in the upper register, no man does so. For this reason the upper register of men is in most cases practically lost, and at first only reveals itself as a thin, weak, effeminate and rather unpleasant sound which is known as the 'falsetto'.

Why the importance of the falsetto has been so completely lost sight of by most vocal teachers is a mystery, since it is perfectly apparent that every great singer uses a developed and properly resonated falsetto which is actually an integral part of his voice. Whenever a man with a really fine technic sings quietly to himself he will invariably use this register. Of course his falsetto is developed and does not sound 'false' but it is, to the trained listener, obviously this adjustment.

Some light tenors who do not sing properly will use the falsetto for a soft high tone without having co-ordinated the registers, but in this case the tone will sound "out of the voice" and rather silly, although even this is technically better than producing the pianissimo by means of a constriction of the throat.

As in the case of a woman, the range of a properly used man's voice should be at least three octaves, but baritones whose technic is faulty think that E or F on the staff is a high tone and G an extremely high one, in fact many of them are limited to E flat. This is quite absurd—a properly used baritone voice should

extend to about high C, although the true depth and richness will usually be partially lost at about A, so that the higher tones should not be sung in public.

It is, of course, absolutely necessary for a singer to have at his command at least three or four tones higher than any note he is ever called upon to sing in a song or aria written for his type of voice. This, of course, applies equally to women. Thus a coloratura soprano should be able to sing as high as B above high C, or even to double high C. The tenor voice should extend to F or F sharp above high C for a lyric and to about E for a dramatic tenor. These ranges are not exceptional when the voice is properly trained, but, under existing conditions, the subject of vocal technic is so little understood by those who profess to teach it that such ranges are almost unheard of, except in the case of a great artist who is born with a practically perfect natural adjustment. All really great singers have very extensive ranges.

In training a man's voice, it is first necessary to find and develop the falsetto. It must be snug with a dark quality, using a dark *e* sound (rather like the French *u*). This dark, pure falsetto tone is first discovered at rather high pitches and becomes very weak as the pupil descends the scale. The breath expulsion is very high owing to the undeveloped condition of the muscles which actuate this register. The high breath expulsion must not, under any circumstances, be interfered with or the pure falsetto will be lost and the singer will find himself producing a sort of light, 'throaty' mixed register tone[1] which is most injurious. This does not mean that the falsetto should be sung softly; on the other hand it must be produced as loudly as possible, provided that the *pure* register is maintained. It will, however, necessarily be weak at the start although, ultimately, the upper tones of a well produced voice are in a great measure developed from falsetto tones. These tones are very powerful ones. Thus the muscular system which actuates this adjustment must be strengthened by singing absolutely pure falsetto tones on the dark *e* vowel as loudly as possible, and by carrying this register up, and most important, down. The falsetto will, ultimately, extend over practically the entire range of the voice, although it will be a mere whisper at low pitches.

[1] This is the technic of that abomination—the 'radio tenor.' High tones, when properly produced, employ the *co-ordinated falsetto.* Unco-ordinated falsetto should never be used in performance! The development and co-ordination of the falsetto is only a means to an end—not an end in itself. The actual use of unco-ordinated falsetto in performance is degenerate, inartistic, and utterly to be condemned.

Later the falsetto may be brightened and the bright *a* and *ā* vowels may be used. When this can be done without losing the pure registration, the falsetto must necessarily have been greatly strengthened and developed.

Then, just as with a woman, the male singer must learn to go from the falsetto to the lower register. This is, of course, done by keeping the throat rigid at the moment of adding the lower register and not changing the resonance conditions.

At the same time, the lower register must be trained and the proper resonance conditions obtained, the quality becoming progressively somewhat brighter as the singer ascends the scale. Similar resonance conditions should, of course, be used for both the registers. The high tones may at first be too bright, but later a greater mellowness will be attained, as in the case of a woman, by means of vowel modification which implies the use of a longer throat cavity as a resonator (see foot-note on page 15).

It is not necessary to go into any more detail since all that has been said about the woman's voice is equally applicable to the man's.

Ultimately the upper register becomes so perfectly developed and co-ordinated that it is apparently lost as falsetto and the entire voice is then one continuous whole, the range extending practically as far as the falsetto will reach.

It is impossible to sing a high or a pianissimo tone of even passable quality without the use of the falsetto.

Under no circumstances should the student attempt to sing a high tone pianissimo except in the upper register. Before the process of development and co-ordination is complete the falsetto sounds silly, but the most injurious thing a man can do is to sing high tones softly in the lower register, since he will, under these conditions, inevitably employ a 'throaty', mixed technic—in other words, he will be relaxing and constricting his throat and thus singing with it held practically closed.

Great men singers are born with so complete a co-ordination of the laryngeal muscles that, as a rule, they do not know that there are two registers, and some of them would be most indignant if they were told that they were using falsetto. Unfortunately for the teaching of this subject those who sing best generally know the least about vocal technic, since the apparatus works perfectly and unconsciously for them. When great singers commit themselves to paper they do indeed become quite delightfully childish on this subject. But what does a great singer know of acoustics or physiology? It is not to be expected of him.

CHAPTER IV

VOCAL CORDS AND RESONANCE CAVITIES

The vocal cords (Fig. 4) which are the free edges of a fold of the mucous membrane lining the interior of the larynx, are about three-eighths of an inch in length. They are attached together in front at the angle formed by the two sides of the thyroid cartilage and behind to the arytenoid cartilages. The free edges form the sides of an isosceles triangle whose apex is at the re-entrant angle of the thyroid cartilage and whose base is formed by a line drawn between the arytenoid cartilages. As these cartilages approach or separate from one another the base

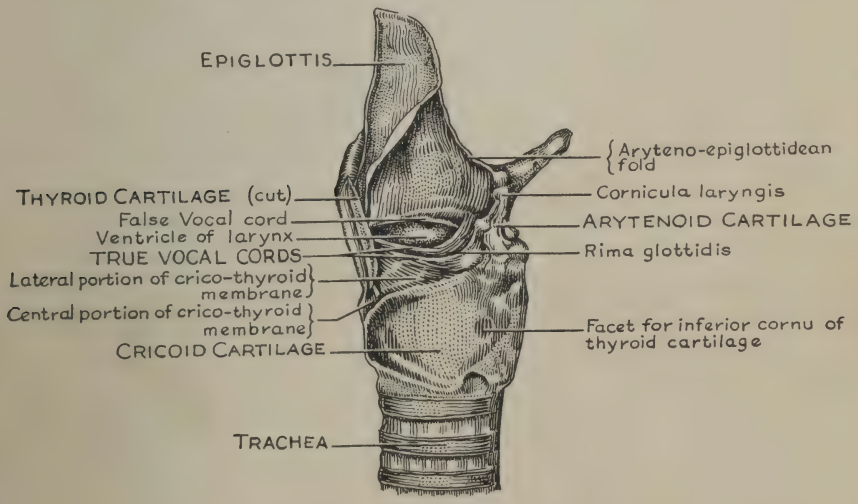


FIG. 4. LATERAL VIEW OF INTERIOR OF LARYNX

of the triangle becomes shorter or longer. Thus the free edges of the cords may be brought into vertical contact or they may be separated, so that during inspiration the space between them is wide enough to allow the air to pass freely without the emission of sound. At a certain point of approximation, when breath pressure is applied below them, sound will occur, through their being set into vibration.

As regards the position of the cords with reference to each other, there are two methods of actuating them. When they are not in contact, the air will pass out in a continuous stream, 'bow' the cords and thus set them vibrating. This method is inefficient because much air is required to produce little sound. It is the method employed in pianissimo singing when the technic is correct.

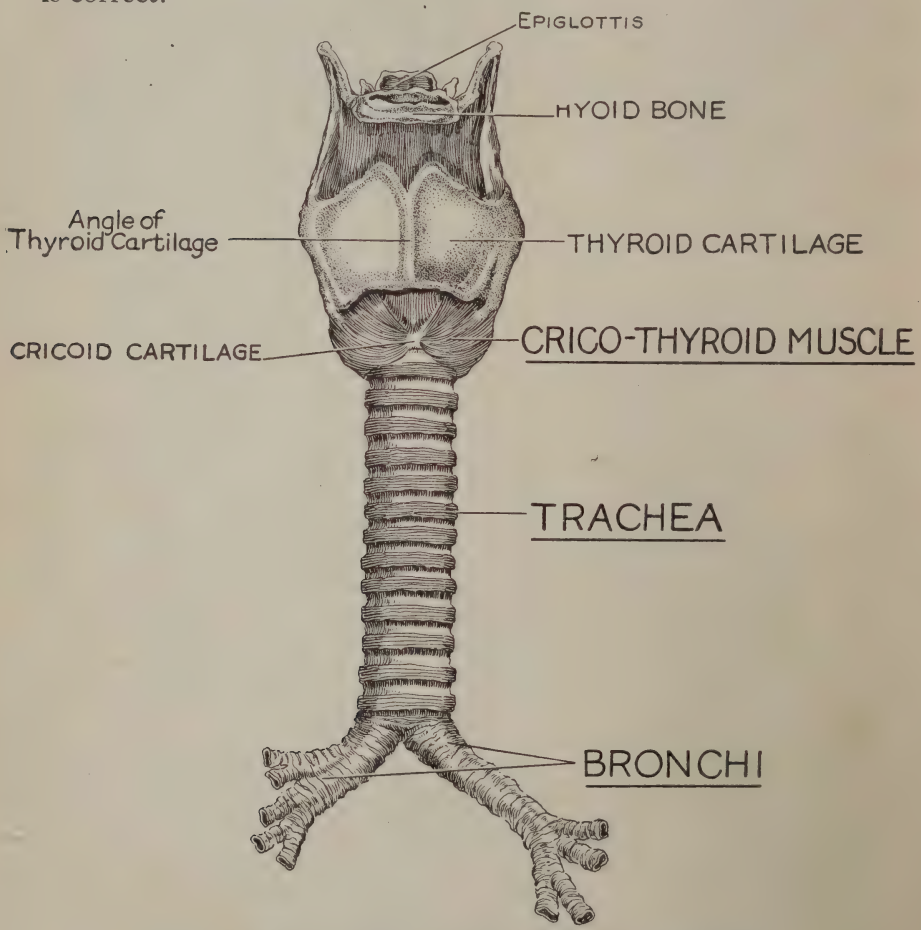


FIG. 5. OUTLINE SHOWING GENERAL VIEW OF HYOID BONE, LARYNX, TRACHEA, BRONCHI, AND CRICO-THYROID MUSCLES

If the cords are approximated the air will be expelled in a series of small but very rapid puffs following the opening and closing of the slit made by the free edges of the cords. These puffs will correspond in frequency to those of the tone which is being phonated. The latter is the more efficient method for the production of sound.

Hence it is that by one method or the other the vocal cords are brought into vibration which consists of a very large number of frequencies of extremely low intensity. This is so because

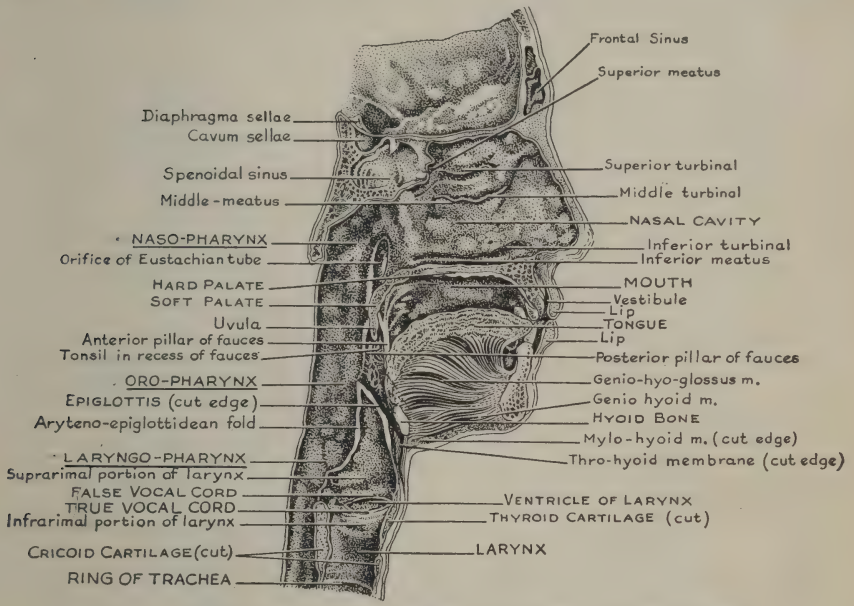


FIG. 6. VERTICAL SECTION OF MOUTH, PHARYNX, LARYNX AND NOSE

the vocal cords vibrate at their full length to give the fundamental, which is varied by their length and the degree of tension on them, and also subdivide into a number of segments giving many overtones of higher pitches (see Section III).

The intensity of the sound produced by the larynx alone is very slight, but above the larynx is a set of resonance cavities. These cavities are so constructed that they can assume an enormous variety of shapes and sizes.

Thus above the larynx there are cavities which can be so shaped that they will resonate at certain definite pitches. These cavities will thus *pick out* the frequencies to which they are tuned and all the other frequencies initiated in the larynx will be very weak (see Section III).

The cavities which could act as resonators are: (1) the mouth; (2) the laryngeal pharynx (the top of the throat); (3) the oral pharynx (the back of the mouth); (4) the nasal pharynx (the cavity behind the soft palate); (5) the post-nasal cavities (cavities of the nose); (6) the trachea and bronchi (air passages below the larynx); (7) the sinuses of the head. All of the foregoing are shown in Fig. 6 except the trachea and bronchi; these are in Figs. 4 and 5.

A clear picture must be gathered of *the vocal cords* which *produce a number of different frequencies* and of *the cavities* so adjusted that they *pick out certain of these frequencies* (see Chapters XLI and XLII, Section III).

In the case of the singer who uses his voice properly, the resonance adjustment is perfect, or as nearly so as is possible when the human factor is taken into consideration. Certain frequencies should be resonated with the greatest possible efficiency and others should not be resonated at all. When the proper frequencies are resonated, the tone quality will be good, the vowel sound true and there will be an absence of those overtones which, if they were present, would give a harsh, unpleasant, non-carrying quality. The *fundamental* should be very strong.

Probably the most vital factor in the proper production of the voice is the elimination of the mouth as an important resonance cavity. In faulty speech, or singing, the mouth will act as the principal resonator of the vowel, and the worse the technic, the more definitely will this cavity so function.

When the technic of the speaking or singing voice is correct, the jaw, lips and cheeks can be moved to a very large degree without altering the quality of the tone or the purity of the vowel sound. Conversely the jaw, lips and teeth may be kept in constant position while the quality and vowel are very widely varied.

It is necessary to be quite clear about this. The statements that these parts may be kept in constant position and that they may be moved do not apply to the base of the tongue, which is a most important factor in the shaping of the pharyngeal cavities, and any forced movement of the front of the tongue may tend to change the position of the base, and in this way change the shape of the pharyngeal resonance cavities.[1]

If a cavity acts as a selective resonator it will have a certain natural period and any alteration in its size or shape will change this frequency. Thus, in the cases cited above, it is impossible for the mouth cavity to be acting as a resonator of controlling importance in the determination of the quality since, if it were so doing, when it was moved the timbre (the vowel) would inevitably change and, conversely, if it did not vary in

[1] This is why exercises for flattening the tongue or pressing it against the teeth during the act of phonation are utterly destructive. Unqualified teachers ruin thousands of voices each year through this procedure.

size and shape, the vowel (the timbre) would of necessity remain constant.

Let us now consider what happens when the mouth cavity determines the quality (the vowel): the condition which must be fulfilled is that this cavity has to be held rigid in absolutely constant position since any change in its size or shape would alter its resonance characteristics and thus modify the vowel.

In order that the shape of the mouth may be held fixed, all the parts which border it must, likewise, remain in constant position, i.e., lips, jaw, cheeks and also soft palate and tongue.

But the tongue and the soft palate are vitally important in the setting of the pharynx in its entirety, and therefore the possibilities for adjustment of the pharyngeal cavities would be extremely limited and the delicate adjustment which is so necessary for the proper resonating of the fundamental would become virtually impossible.

It is evident, then, that if the mouth cavity is *set* for the resonating of the vowel, there is little possibility of adjustment of the other cavities which must resonate for the fundamental, and therefore the singer with such a technic cannot possibly resonate the fundamental properly.

In addition to this handicap the fact that the tongue and jaw have to be set, tends to engender very great tension of the muscles of the neck and also to reflect false tension to and impede the proper adjustment and co-ordination of the muscles which govern the larynx and its nearby structures. This false tension in the neighborhood of the laryngeal pharynx still further tends to inhibit the proper adjustment of this cavity and thus renders the proper resonating of the fundamental still more impossible of accomplishment. Actually it is, under such conditions, absolutely impossible for the singer to obtain proper resonance adjustment.

Let it be quite clear then, that whereas there is no direct connection between the bands of vowel frequencies which are fixed irrespective of the fundamental, and the fundamental frequency itself, when the mouth cavity is set for the vowel, the position of all the other resonance cavities is, in a large measure, also determined. This renders it impossible for the singer to resonate the fundamental properly.

When the pharyngeal cavities are used as the principal resonators, the conditions are far different, since there is an almost infinite range of possibilities for inter-adjustment among these cavities themselves. In addition to this the jaw and tongue

are left free so that the neck muscles can remain relaxed as can those of the jaw. Thus there will be no interference between these muscles and those which regulate the larynx and the laryngeal pharynx. The freedom of the tongue is, of course, vital, since this member is, as has been stated, of fundamental importance in the shaping of the laryngeal pharynx.

Again, the general freedom of the mouth, jaw, tongue, lips and cheeks allows the singer to articulate, or form consonants, properly without any interference. Clear, rapid articulation would, of course, be quite impossible were these parts held in fixed position for the vowel.

Emphasis upon this point is necessary, since the false idea that the mouth should be the chief vowel forming cavity has come to be the accepted theory of most teachers of singing, speech, languages and phonetics, and even of many writers on physiology. So far has this fallacy been carried, that in many books dealing with this subject, mouth positions for the vowels are pictured.

Thus, under proper technical conditions, the following cavities act as the principal vocal resonators: the trachea and the bronchi, the laryngeal pharynx, the oral pharynx, the nasal pharynx.

It is also quite evident that the nasal cavities as well as the head sinuses cannot be of any great importance as resonators since they are not adjustable and they are thickly lined with mucous membrane. They may, however, affect certain fixed overtones which make up less than five per cent of the energy in the tone. The other ninety-five per cent is determined by the vowel and the fundamental which must be resonated by adjustable spaces.

One further point: the singer or actor who uses his mouth cavity as the resonator of the vowel has perforce to make all sorts of ugly grimaces in so setting his mouth and lips into the various vowel positions. From the purely aesthetic point of view the facial gestures so produced, which have no bearing whatever upon the context of the words, are most distressing. From the point of view of the talking movies such grimacing is absolutely fatal, since here the facial expressions which are enormously enlarged are of vital importance.

CHAPTER V

ENERGY DISTRIBUTION IN THE TONE AND RESONANCE ADJUSTMENT FOR THE VOWEL

In the previous chapter the resonance cavities were discussed and those which should be used, under proper technical conditions, were designated. The question which at once arises is: Which of the frequencies initiated at the larynx should be resonated?

A great deal of research work has been carried out by physicists on the analysis of spoken and phonated sounds. Careful measurements have been made, and the fact has been established that the energy in the tone is divided between two factors: (1) the fundamental; (2) the vowel. This matter is treated at greater length in Section III.

There is some conflict of opinion as to the relative proportion in which the fundamental and the vowel should be found, since different voices give widely different results. It seems, however, to be probable that the singer whose technic is good resonates the *fundamental* far more strongly than does the one whose technic is faulty, or in other words, that a large proportion of fundamental is a factor in good quality.

Disregarding the very small proportion of the energy in the sound which is affected by the resonance of the fixed cavities—the post nasal cavity and the sinuses—the tone is composed entirely of vowel and fundamental. The highly damped nature of the fixed cavities—they are lined with thick folds of mucous membrane—indicates that they could be responsible for, at any rate, considerably less than five per cent of the total energy in the tone.

A consideration of the results already obtained would indicate that the fundamental should represent about fifty per cent of the total energy in the tone, varying with the pitch—the lower the pitch the smaller the percentage of fundamental present and vice versa.

The vowel sound is determined by the resonating of frequencies in certain bands which are *independent of the pitch of the fundamental.* These bands are found in two main

regions. The following table of vowel frequencies is taken from a paper published by the late I. B. Crandall in *The Bell System Technical Journal* of January, 1927, page 100:

ah as in *father*	825	and	1202	vibrations	per second
a as in *mat*	758	"	1825	"	" "
aw as in *fort*	602	"	955	"	" "
e as in *met*	568	"	1879	"	" "
ay as in *mate*	540	"	2108	"	" "
oo as in *you*	407	"	793	"	" "
e as in *meet*	381	"	2435	"	" "

As far as the authors of this book know, all the work of any importance which has been done upon the vowel frequencies, including the above, has been carried out with *average* voices. Our problem, however, is the establishment of what may be designated as the ideal conditions for the perfectly used voice. Pure vowels, produced by singers and speakers whose technic is correct, will probably show quite widely different results. Good singers employ the pharyngeal cavities as the principal resonators, while those whose technic is faulty use the mouth as the principal resonator and shape and set it for the vowel. As a result of this, they form vowels which sound thick. This thick-sounding vowel formation would lead one to suppose that properly produced vowels are characterized by somewhat higher frequencies than badly produced ones. Another fact, which indicates that properly formed vowels are of higher frequency than badly produced ones, is that it is possible for a soprano or contralto to phonate *oo* and *ee* at pitches higher than the lower values given in the above table. In view of the fact that the fundamental is the lowest frequency which can occur, this would be impossible of accomplishment were not the lower vowel frequencies higher than these values indicate.

We have, therefore, only the pharyngeal cavities and the mouth which can act as vowel resonators, and actually the chief difference between the singer who uses his voice well and the one whose technic is faulty lies in the degree to which the pharynx is used as the resonator. In the case of the faulty singer, the mouth, jaw and lips are carefully 'set' for the vowel and the pharynx is more or less relaxed and constricted, while, in the case of the singer whose technic is good, the mouth is not set but the pharynx is definitely tensed and held in position.

However accurately the pharynx may be 'set', the mouth is a connected cavity and it must, obviously, have some effect upon the quality. The vital point, however, is that it must be

of *secondary* importance and that it should never be 'set' for the vowel.

There are three possible arrangements of the pharyngeal cavities in addition to the inter-adjustments possible within these arrangements. They are:—

1. The entire pharynx—laryngeal, oral and nasal—which may act together for the lower frequencies.

2. The laryngeal and oral pharynx together, which may act without the nasal pharynx, which can be cut off by the soft palate. This cavity resonates for higher frequencies.

3. The laryngeal pharynx itself. This cavity can act alone when the opening to the mouth is sufficiently great. It is used alone for the highest frequencies (see Fig. 6).

In order that the vowel may be strongly resonated and kept unchanged, the pharynx must be held *rigid*; it is then a very efficient resonator, and, at the same time, it will not fluctuate. Proper rigidity keeps the pharynx 'patent', whereas relaxation of the pharyngeal walls allow the latter to come, more or less, into approximation and produces the condition of 'closed' or constricted throat. The so-called 'throaty' singer is one who, having relaxed his throat, starts to sing, and with the inception of the act of phonation, brings the constrictor muscles of the laryngeal pharynx into play, thus improperly approximating and holding closed the pharyngeal walls. Relaxation of the throat at the moment of attacking the tone will inevitably produce constriction, since a relaxed throat is, of necessity, practically closed, and the bringing into action of the muscular system, which is used for the act of phonation, will 'set' this position. This constriction of the laryngeal pharynx will also have an adverse effect upon the laryngeal action and the singer who relaxes and constricts his throat will inevitably strain the laryngeal muscles.

The sense of strain in the throat of a singer whose technic is faulty is due to this constriction of the pharyngeal muscles, and to rigidity of the neck muscles, which should be relaxed. Constriction of the pharyngeal muscles is apt to produce tension in the muscles of the neck. A firm, *rigid* throat does not produce a feeling of strain, but on the other hand gives a sense of security, which is so often mistaken for relaxation. A firm, rigid throat allows the neck muscles to remain relaxed. In other words, when the throat is firm and tensed, the neck muscles are generally relaxed; while tension of the neck muscles is a result of relaxation and constriction of the muscles of the pharynx. Thus, in simple language, when the outside muscles, which can be seen,

are tensed, the inside muscles, which cannot be seen, are relaxed and constricted, and vice versa.

The question of vowel phonation must be very clearly understood: the vowel is determined by fixed bands of frequencies, irrespective of the pitch of the fundamental. It must, therefore, be determined by a 'set' of the resonance cavities which is, in some degree, independent of the pitch of the tone being sung.

To sum up: the chief resonators of both the vowel and the fundamental should be the pharyngeal cavities, and while the mouth must have some influence upon the quality, this effect should be the minimum possible. Under no circumstances should the mouth, jaw or lips be shaped for the vowel. The chief difference between the singer who uses his voice well and the one who uses it badly lies in the degree to which the pharynx is used as the resonator of both the vowel and the fundamental.

CHAPTER VI

RESONANCE ADJUSTMENT FOR FUNDAMENTAL

In the previous chapter it has been shown that the principal resonance cavities of the properly used human voice are the pharyngeal cavities, and that while the mouth must have some effect, the more the action of the back cavities predominates, the better is the technic.

In Section III the question of resonance and the properties of resonance cavities is discussed, and it is shown that as the pitch rises, the size of the resonance cavity should become less, or the opening greater or both. This gives the key to the question of proper resonance adjustment (see Chapter XLI).

There are three possible general arrangements of the pharyngeal cavities in addition to the very wide range of inter-adjustments which can take place within these general conditions. They are as follows:

1. *The maximum size will be obtained when the lower cavities—the trachea and bronchi—are brought into action.* Thus, for the lowest tones, these cavities are used with the necessary arrangement of the pharyngeal cavities above them. These cavities are, in other words, added to the pharynx for the low tones (Figs. 5 and 6).

There can be little or no doubt that these cavities situated below the pharynx must be added if the fundamental for the lower tones is to be properly resonated. The actual pitch at which they should be added varies somewhat for different vocal organs—it may be from middle E flat to about middle F.

The term "chest resonance", sometimes applied to the use of these cavities, is most misleading, since it is the trachea and bronchi which act as resonators and not the 'chest'.

The fact that these cavities are not adjustable would seem to introduce a difficulty. There are, however, two ways in which this difficulty may be explained.

(a) If they are used per se, they must have a very wide resonance range and must, therefore, be able to resonate with a fair degree of efficiency over a range of about an octave.

If this were true, one would expect to find a point of maximum efficiency at about the middle of the range in which these

cavities are used. Although there is some evidence of this in the case of low voices—basses, low baritones and contraltos have remarkably powerful tones around low B—it is by no means true of all voices. In fact a dramatic soprano attains the maximum power in the lower range of her voice at about middle F—one of the highest tones for which this arrangement of cavities is used.

(b) *The lower cavities may act together with the laryngeal pharynx.* Here we have the apparent difficulty of the slit of the glottis which lies in between the two resonance spaces. However, the actual slit is very minute and it is, therefore, highly probable that the vocal cords, vibrating at the same speed as the composite air cavity, merely connect the two parts, which then act as one cavity.

The wide range of adjustments possible with the laryngeal pharynx is quite sufficient to deal with all the frequencies which are resonated with this arrangement of cavities. In other words, the partial tuning of the upper part of this composite cavity is amply able to take care of the resonating of the fundamental for the low tones.

In this connection it is interesting to note that I.B. Crandall, in the paper referred to on page 26, gives some evidence to indicate that "the trachea may have a very important role in fixing the lower frequencies produced by the vocal apparatus".

Thus the evidence at hand would seem to indicate that the low tones are resonated with the trachea and bronchi plus the laryngeal pharynx which acts as the adjusting part of this composite cavity.

2. *The pharynx in toto—laryngeal, oral and nasal—may be used* (Fig. 6). This arrangement will give the next largest cavity and should be used for the middle tones. The soft palate can be drawn away from the back wall of the pharynx thus allowing the nasal to connect with the oral and laryngeal pharynx.

3. *The laryngeal pharynx per se may be used.* This arrangement, which gives the shortest possible cavity, should be employed for the highest tones in the voice.

The closing off of the nasal pharynx, by means of the drawing up of the soft palate, will allow the laryngeal pharynx and the oral pharynx to act without the nasal pharynx, and a wider opening to the mouth will allow the laryngeal pharynx to act per se (Fig. 6).

The rather generally accepted notion that the high tones are "head tones" is obviously fallacious. When a pupil is told to

"place the high tones in the head," the natural inference which would be drawn is that the larynx should be grafted in the head. If this is not what is meant, then the implication must be either that the resonance must be "in the head", which is not only a vague statement, but also an absurd one, since the 'head' would imply the brain cavity, or—more logical but still untrue—that the upper pharyngeal cavities must be used for the high tones.

It is this false idea which is, in many cases, responsible for the very limited ranges of badly taught singers. Let it be emphasized: for the proper resonating of the high tones the upper pharyngeal cavities must be eliminated as resonators and the laryngeal pharynx must be employed alone.

Within these three classes of arrangements of the resonance cavities there is an extremely wide range of possible modifications. Thus, for example, the upper middle tones may be resonated by means of a long throat cavity, or by means of a cavity which includes a shorter throat with the addition of the upper pharyngeal cavities. However, when these upper (nasal and oral) cavities are used for the upper middle tones the vowel resonance will be affected and the quality will tend to become 'dark'. When this color is desired this adjustment should be used.

In order that a tone may be properly sung, it is essential that the fundamental should be accurately resonated, and the more precise this adjustment for the fundamental, the better will be the tone. Where a vowel should be sung on a tone the pitch of which is higher than the vowel frequency, the vowel must be distorted, since otherwise the tone cannot be properly sung. In other words, the fundamental is the lowest frequency present, and any attempt to form vowels which are determined by frequencies lower than the fundamental is to try the impossible.

At very high pitches—e. g. F above high C—no true vowel sound can be distinguished. *a* (*ah*) as in *father* can be sounded as high as 1200 vibrations a second. A true *ee* vowel cannot be phonated above 400 vibrations per second etc. The necessary modification will take the form of brightening, and the vowel will become brighter and brighter as the scale is ascended until it is finally lost as the true vowel sound. Some vowels lend themselves to brightening better than do others and such vowels can, as would be expected, be phonated at higher pitches. Thus *ah* and *a*—high frequency vowels—can be carried up further and brightened more than can *oo* and *ee*.

In the earlier stages of training it is easier for the pupil to control a short than a long throat column. Thus, for the upper middle tones, he is able either to employ a short throat column with the upper pharyngeal cavities added or a short throat column alone, which will produce an unduly bright quality. The excessive use of the upper cavities will produce an overly dark tone in view of the fact that the pupil is apt to overshoot the mark, when adding the extra cavity, and shape a cavity of too low frequency for the requirements. Thus, if in the early stages he is to form the vowel back and resonate the fundamental with the pharynx, he has perforce to sing a tone which is either too dark or too bright. The question as to which he should be instructed to do depends upon his special faults and requirements, and much of the skill of the teacher depends upon his ability to determine which direction will help and which will hurt the pupil. No rules can be given since each case has to be considered upon its own particular merits. As the pupil develops and his voice changes the directions have to be modified and altered.

The best and most mellow quality is obtained when the maximum throat cavity for the particular pitch is used. This quality can only be obtained when the pharyngeal muscles are fully developed, and any attempt to 'make' this quality before the muscular condition necessary has been attained will merely result in a thick, 'throaty' sound which will destroy all progress and injure the vocal organs.

In carrying up the lower register, it is usually necessary for the pupil to produce unpleasantly bright sounds on the highest tones to which this register will stretch. As it is carried higher and higher, the pitch where brightening is necessary rises, until the point is reached, at about high C, where a bright quality is correct. Even here the quality may be too bright, and the proper timbre is not achieved until the pharyngeal muscles are fully developed.

In order to carry up this register, the throat must be held absolutely rigid. The intensity of a tone sung in the lower register is far greater than is that of one of the same pitch sung in the upper, and the greater the intensity, the more rigidly must the cavity be held. As a singer increases the intensity, the cavity which is resonating will tend to collapse, and it is essential that he should have sufficient control over the muscles which govern the cavity—or cavities—to hold them firmly in position and over-

come this tendency. This means that he must be able to balance the tendency of the cavity to collapse by means of the addition of more tension on the muscles which hold it 'patent'. In view of the fact that, as has been stated, it is easier for the beginner to hold a short than a long throat cavity, it is evident that he will usually perforce have to employ the overly bright quality until such time as the muscular system of the pharynx is fully developed. Any attempt on his part to 'make' the quality mellow will result in the partial closure of the laryngeal pharynx or 'throatiness'.

The idea of placing the upper tones higher and higher in the head, as the scale is ascended, will also result in throatiness. Furthermore, the tonal intensity will tend to diminish long before the highest tones are reached, and in the upper range, where the most dramatic and intense tones should occur, his voice will become weaker and weaker. The tension on the constrictor muscles of his throat will increase where exactly the reverse should be occurring—i.e., the tension on the muscles which hold the throat open should be increasing. This strain will be most pronounced in the area where he is endeavoring to produce the "head tones" and will progressively increase above this point, since he is trying to force the resonance in cavities, the natural period of which is departing further and further from the proper frequency, as the scale is ascended. At the same time, the endeavor to obtain the sensation of the voice being "in the head" will tend to make him do the only action which will engender this feeling—namely, constrict the throat more and more.

The fact that the throat has to be held more and more rigidly as the intensity increases, would, at first flush, lead one to suppose that it is easier for the singer to produce a soft than a loud tone. This is, however, absolutely contrary to the facts of the case. It must be clearly understood that the entire act of phonation is *one* complex co-ordination of muscles. Thus, when the singer produces the tone vigorously, the entire apparatus which is used for the act will come into full tension. Here, then, the throat will be most likely to take on its proper tension, even if the muscles which hold it in position are not quite fully developed. On the other hand, when a soft tone is produced, the breath pressure is less and the tension on the laryngeal muscles is also less—this despite the fact that the breath should be escaping more quickly and the cords are held at their proper tension for the pitch. The throat cavity, however, must be held absolutely firm and, when the muscles which perform this action are weak,

the lack of general effort which accompanies the act of quiet phonation will not be sufficient to keep the weak throat muscles patent. This is most emphatically so in the case of the singer whose technic is 'throaty', since here the constrictor muscles will be over-developed and will tend to overcome the less vigorous impulse to the insufficiently developed muscles which should be holding the throat open. Actually most pupils are, in a more or less pronounced degree, 'throaty'. For this reason soft singing should never be attempted until the muscles which hold the pharynx open are fully developed. Any attempt to sing pianissimo tones, before this stage is reached, will result in an ever-increasing 'throatiness'.

If the resonance cavity has one natural period and the cords are vibrating at quite another frequency, the extra muscular tension necessary in order to force the cavity to resonate at a frequency to which it is not tuned will tend to strain the entire muscular system of the vocal organs. Thus the intonation will usually be faulty—either flat or sharp. Much of the singing off pitch, so often heard, is therefore due to false resonance adjustment.

When the resonance conditions are correct, it is possible to phonate pure vowels up to the point where the lowest vowel frequency is at the same pitch as that of the fundamental, and in male voices this means that they may be formed throughout the entire range of the voice. Above a certain frequency, as already stated, a woman is limited, since her voice is pitched an octave above that of a man.

When there is any idea of "head voice," the singer will be imposing upon the tone a fixed quality, so that all vowels will in some degree be distorted, and at the point where the so-called 'head-tones' are produced, the vowel will become so distorted that it will, to all intents and purposes, be unrecognizable. A good test of a singer's technic is to tell him to sing up the scale on a fixed vowel—preferably *ah*. If the purity of the vowel becomes distorted at a certain point, the upper tones are being improperly resonated. These faulty methods are the cause of much singing in which the words are so badly pronounced as to be quite unintelligible.

The whole question of proper vowel phonation is a somewhat complex one. The fundamental difficulty lies in the fact that there are only five vowel letters—*a*, *e*, *i*, *o*, *u*—whereas there are over eighty definite vowel sounds in the English language alone and many others in foreign languages.

There is a phonetically proper pronunciation for every word in the English language and this should not really depend upon whether the language is spoken in America or in England. Certain vowel sounds present special difficulty to Americans and others to Englishmen. In each country there are certain words which are very commonly mispronounced and an important phase of the work of the vocal teacher is to instruct the pupil in the perfect pronunciation of each and every word.

Proper vowel production, with all the delicate shades and differences of vowel sounds, is only possible when the ability to make fine adjustments of the vowel forming parts has been attained and such adjustments are only possible when the pharyngeal cavities are used as the principal resonators of the voice.

Consider, for example, the simple vowel *ah*. Only great singers and actors can really sing or say a pure *ah* and most people distort this vowel either by 'nasality', 'thickness' or 'whiteness' The indications for vowel pronunciation which can be given in a dictionary are of limited value since they are insufficient to cover all the fine shades of perfect vowel formation. In this branch of the subject imitation must be resorted to.

CHAPTER VII
THE BREATH

In most books dealing with the subject of vocal technic the question of breathing is given the place of first importance. In this work mention of the breath appears only after the questions of registration and the resonance conditions have been discussed. The reason why this side of the subject is not so greatly emphasized will soon become apparent.

One of the greatest and most injurious fallacies propounded by many vocal teachers is the idea that the breath should be voluntarily controlled during the act of phonation. By "breath-control" is meant the control, by means of the expiratory muscles, of the expiration of the breath during the act of phonation. The vocal student is told that he must control the rate of expiration of the breath all the time he is singing. This curious notion is developed to such a degree that the pupil is actually given exercises for "controlling the breath". He is made to inhale and exhale without singing, at the same time voluntarily regulating the speed at which the breath is inhaled and expelled. Thus he is directed to inspire slowly, taking as deep a breath as possible, and then to exhale, timing these two actions. His improvement is supposed to be indicated, in a great measure, by the development of his diaphragm, and by his ability to inhale and exhale a steady stream of air at any desired rate. Various exercises are set for this purpose and he is adjured to control the outgoing air during the act of phonation.

It is of course true that the practice of such exercises does develop the vital capacity somewhat, but the question of the bearing of vital capacity upon the ability of the singer to sustain a tone has been carefully investigated by the author of this book, and the following results have been obtained: the average vital capacity of an individual is about 3000 cubic centimeters and the limits are about 2200—5000 c.c. Under conditions of proper phonation the breath expulsion for a ***mf*** tone has been found to be as low as about 36 c.c. a second. Thus, by dividing 3000 by 36, it is evident that such a singer could theoretically hold this tone about 83 seconds and assuming that but 50 per

cent of the breath may be used in the production of sound, it will be seen that 42 seconds is well within the range of possibility. This is far longer than the duration of the longest phrase ever written. Thus the average, undeveloped vital capacity is more than sufficient for any conceivable requirement under really good technical conditions.

Again, in the case of a singer whose voice is quite undeveloped, the breath expulsion has been found to be as high as 280 c.c. a second and this would only allow him to hold a tone about six seconds. It will at once be seen that proper vocal development may increase the ability on the part of the singer to hold a tone seven times, or 700 per cent, whereas the greatest possible increase in vital capacity conceivable would be about 40 per cent. The relative unimportance of the vital capacity is definitely demonstrated from these figures.

Having considered the relatively insignificant advantage of thus developing the vital capacity, let us consider the very great disadvantages of these exercises. It is absolutely inevitable that the singer who has been made to think of his breath while phonating, through the practice of "breath-control" exercises, will become "breath conscious". The moment he finds himself in this condition he is in serious trouble, since he will inevitably develop a pronounced tendency to pant. Experience with many pupils who have been subjected to this sort of training has shown this actually to be the case in a very pronounced degree. Such "breath consciousness" during the act of phonation always results in an increase of many hundred per cent in the breath expulsion. Indeed the first and greatest task for the teacher, in such a case, is the engendering of the idea that the pupil must *forget all about breath* during the act of phonation. He must not be allowed to take too full a breath at any time, until this injurious psychological condition has been destroyed. Under such circumstances it is sometimes a good plan to have him sit down while singing, since this may tend to stop him from becoming "breath-conscious".

Every 'trick' imaginable must be employed in order to eliminate this fatal "breath-consciousness", the ill effects of which are to be met with only too often, and it is, indeed, sad to see how many singers break phrases, gasp for breath, inspire noisily etc. Nearly all of them have been the victims of the "breath-control" fallacy.

These considerations lead us to still another point: the act of phonation is an extremely complex one and entails the use and

co-ordination of a very large number of muscles. Thus the muscles of the pharynx, larynx, thorax etc. are all functioning. In addition to these muscles which should be used, there are a very large number which are actually brought into play, while the technic is imperfect, such as those of the jaw, neck etc. The conscious control of a small group of muscles is often easy of accomplishment. Thus, for example, the tongue may be flattened *when the pupil is not singing,* the breath may be expelled at any desired rate when he is silent etc., but such conscious control helps him not at all as soon as he starts to sing.

The functioning of the broad group of muscles used during the act of phonation so predominates over the conscious control of a limited group of these muscles that all such control is absolutely lost. In actual practice any such attempt to control a limited group of muscles, which are part of a larger group that co-ordinate for a complex act, such as the act of phonation, will merely result in a false consciousness and therefore a wrong tensing and co-ordination of these muscles. Thus the singer who tries to control the tongue consciously during the act of phonation will find that in practice it seems to be always getting in his way and arching in the most disastrous fashion. The only way in which a false position of the tongue can be changed is by forgetting all about it and getting better resonance adjustment and better conditions generally from the technical standpoint. This fault will then be found to have corrected itself automatically.

This is one of the great principles of teaching vocal technic: *the pupil must never be given any directions which pertain to a narrow group of muscles, provided that such a group is used in the act of phonation,* and therefore all directions given must be of a rather broad and general nature unless they refer to muscles which are not used in the act of phonation.

The inevitable result of directions which indicate control over a narrow group of muscles which are used in the act of phonation is the false tensing and improper co-ordinating of this group. This is, of course, exactly what will happen when the singer is taught "breath-control".

We will next consider the actual function of the breath in the act of phonation. The breath is, of course, the motive force of the voice; it is the pressure of the breath under the vocal cords which brings them into vibration. Furthermore, the question of the proper manner in which the breath should be *inspired* is one of considerable importance, so that the pupil who

inspires in a faulty manner must be taught to perform this act properly. Faulty inspiration may interfere with the proper adjustment of the larynx and pharynx. Nevertheless the pupil must not, under any circumstances, be allowed to think of his breath *while he is singing,* and any attempt to consciously control the rate of emission of the breath is fatal. The fundamental law of breathing is that the pupil must be taught to *inspire properly* and then *forget all about the breath.*

As has been pointed out in Chapter IV there are two possible ways in which the breath may bring the vocal cords into vibration:

1. The vocal cords may be practically touching, and in this case the pressure of the breath underneath them will cause the air to escape in a series of rapid puffs in the following manner: the cords will be stretched so that they have a definite length and tension which will determine the pitch, and the adjustment of the resonance cavities will regulate both the degree to which the fundamental is resonated and also the overtones which are being resonated or picked out, these overtones being vowel determined. The fundamental—the slowest rate of vibration of the cords which can occur at a given length and tension —will be determined by the natural period of their whole length, and the puffs which determine this frequency will, therefore, be emitted at this rate. As they vibrate, the cords will open to emit a puff and will then close again, and this opening and closing, or fluttering, will of course depend upon their natural period.

In addition to this rate of emission of the puffs there will be higher speeds determined by the division into segments of the vocal cords (see Section III). These vibrating segments will also allow more rapid puffs of air to pass according to their rate of vibration and such puffs, superimposed upon the lower frequency puffs which determine the fundamental, will produce the overtones.

Of course these puffs will cause the air in the adjusted resonance cavities to vibrate or resonate since these cavities are, at any rate approximately, so shaped that they have the same natural period as that of the vibrating segments or of the puffs for which the segments are responsible.

This puff method, with the cords in virtual approximation, is by far the most efficient way in which sound can be produced by the vocal apparatus. It should be taking place at

the normal intensity of the voice—at *mf*—under proper technical conditions.

In order that the singer may then swell the tone from normal intensity *(mf)* to *ff*, it is quite clear that, since after this point of highest efficiency has been reached, it is only possible for him to increase the intensity by augmenting the volume of the puffs, this must be accomplished by "doing more work". The act of swelling the tone by working harder will actually take the form of increasing the pressure of the breath, but it is vital that the singer should not think in these terms, but merely in the vague terms of singing more vigorously or increasing the amplitude of the vibrato (see Chapter XIV). If he does think of expelling the breath faster, the result could be the reverse from that which he desires, as will be seen when the question of reducing the intensity from *mf* to *pp* has been discussed. However, it must not be overlooked that in going from *mf* to *ff* the breath expulsion does rise under conditions of proper phonation, although the singer need not, and indeed should not be actively conscious of this fact.

2. The other manner in which the breath may act upon the vocal cords in the production of sound is by means of a bowing effect. Under these circumstances the vocal cords will be separated to such a degree that the puff method is impossible. In this case the air will pass out in a stream, and this stream of air will 'bow' the vocal cords into vibration. This method is, of course, relatively very inefficient as compared with the puff method, and the breath expulsion will be very much greater.

Now, in going from the softest to the loudest possible tone, the conditions which must be fulfilled are that neither the pitch nor the vowel may be altered in the slightest degree, and this ability to swell the tone with apparently constant pitch and quality from *pp* to *ff* is one of the greatest tests as to whether the singer is using his voice properly or not.

One further point with regard to the pianissimo: the ultimate pianissimo is, of course, a whisper. There can be no question as to how the whisper is produced. The basic characteristic of this method of voice production is that it has no tonality, or in other words, that the fundamental or pitch cannot be varied. This fact indicates that the vocal cords are not brought into vibration. Thus, in the case of the whisper, the vocal cords are quite separated while the vowel-forming cavities alone produce the sound. Under these circumstances the breath expulsion will

of necessity be very high, and experience shows this to be the case.

This brief consideration of the whisper is a further indication of the fact that in going from ***mf*** to ***pp*** the proper laryngeal action should be the progressive separation of the vocal cords from the position of greatest approximation for the ***mf*** to the practically total separation for the whisper, when the phonation of a fundamental becomes impossible.

It is a very easy matter for a 'throaty' singer to soften the tone merely by losing resonance, which implies the closing off of the laryngeal pharynx and a progressive change in the quality. Under such circumstances the breath expulsion will be relatively low, since the closure of the throat will check the breath. This is, of course, *not* the way in which the singer should produce a soft tone. With such a technic the actual result will be that the softer the intensity of the tone being phonated, the more closed will be the laryngeal pharynx, and the greater the closure of this cavity, the lower will be the breath expulsion.

Thus the breath expulsion of a singer who uses this type of technic will increase as the intensity rises and decrease as it becomes less. This is merely a case of 'throaty' technic. One further point about this faulty method of singing: since the amount of breath expelled—as the singer increases the intensity of the tone—rises regularly, we find happening here just what should occur were the idea of "breath-control" correct. This 'throaty' method of voice production would indicate that all the singer has to do, in order to augment the intensity, is to increase the rate of expulsion of the breath, and that the ability to sing at different intensities should merely imply a capacity for controlling the rate of expulsion of the breath. But this is the method of controlling the intensity employed by a 'throaty' singer and any attempt to reproduce these conditions by means of "breath-control" will obviously merely lead to throatiness.

Since the resonance cavities must be kept absolutely constant in size and shape at all intensities for a given vowel and fundamental, there is only one possible way in which variations of intensity should be made between ***mf*** and ***pp***. This is by means of changes in the laryngeal adjustment—by the gradual separation of the vocal cords. In other words, the intensity of the tone should be diminished by the progressive separation of the vocal cords without any change in the set of the resonance cavities—i.e., with constant quality. This is the proper method of decreasing the intensity from ***mf*** to ***pp***.

Under such circumstances the breath expulsion will increase as the intensity is diminished. This question, as will be shown later, has been carefully investigated, and it has been found by experiment that this is exactly what actually occurs in practice, under conditions of proper vocal technic. Thus the breath expulsion should rise somewhat in going from ***mf*** to ***ff*** and should also rise, to a greater extent, in going from ***mf*** to ***pp***. This immediately indicates the fallacy of the idea of controlling the outgoing air during the act of phonation, since an increase in the rate of expulsion of the breath at ***mf*** may have the effect of either increasing or of diminishing the intensity.

Again, the actual rate of expulsion of the breath is a very complicated matter. It depends upon the following variable factors: (1) the degree of approximation of the vocal cords; (2) the set of the resonance cavities; (3) the intrapulmonic breath pressure; (4) the intensity of the tone.

Since these conditions are widely variable, not only individually but in relation to one another, and also since the slightest change in any one of these factors will have a very great effect upon the actual result, it is obvious that any estimate of the amount of breath required would be an absolutely insoluble problem even for a mathematician. Any idea that the singer should make this estimate during the act of phonation is merely absurd. Yet this is just what "breath-control" would imply. If, however, it might mean holding back the breath, this action can be accomplished completely—with the result that phonation would cease; and if it mean pumping out the breath, this act can also be perfectly accomplished, with the result that all the air could be forced out in about one second—with practically the same result.

In considering the question of the intrapulmonic pressure we are faced with the fact that this pressure should probably remain fairly constant except for intensities louder than ***mf***. The pressure of the air in the lungs during the act of expiration (phonation) is determined by the pressure exerted upon the lungs by the expiratory muscles (abdominal and costal). In singing this pressure should primarily be *regulated by the size of the glotteal slit*. Herein lies the fundamental fallacy of the "breath-control" idea which holds that this function lies in the respiratory muscles alone.

No method of measuring intrapulmonic breath pressure in the human being has yet been devised. This might be determined were the size of the glotteal slit as well as the rate of breath ex-

pulsion known. Measurement of the former during the act of phonation presents, at present, insurmountable difficulties. Consideration of the rate of expulsion of the breath is discussed in Chapter IX.

It has been stated that the intrapulmonic breath pressure should, under conditions of proper phonation, remain practically constant from ***mf*** to ***pp***. The reason for this lies in the fact that variations in the output of air will be compensated for by the alterations in the size of the glotteal slit. Thus, if the output of air is doubled and the size of the slit is also doubled, the pressure will remain constant. This is probably about what happens between these two degrees of intensity.

In going from ***mf*** to ***ff*** the breath pressure will necessarily be raised, since the efficiency of the puff method of phonation is maximum at ***mf*** and cannot be further increased. In the case of proper phonation the ***mf*** is determined by the fact that this is the normal intensity of the voice, or inversely, the ***mf*** for any given voice, when the technic is correct, will be determined by the point of greatest efficiency. Thus this intensity, determined by the point of maximum efficiency of the action of any given vocal apparatus, determines the natural power of any particular voice provided that the technic is correct.

At any given stage in the laryngeal development a certain breath pressure will be necessary; but, as has been intimated, this pressure will change very rapidly when variations in the glotteal slit are produced as the result of the development of the laryngeal muscles. That the singer cannot estimate this pressure in terms of breath is, of course, apparent. What he must do, however, is to work sufficiently hard for a full, free tone to be emitted under the best possible conditions at any particular stage in his development. Let it be emphasized that this necessary amount of "work done" is changing very rapidly as he improves technically.

The second factor regulating breath expulsion is the proper adjustment of the resonance cavities. Until quite a high stage of vocal development is reached, the necessary work which must be done in order to sing a full and relatively free tone is enormously greater than it will ultimately be when the resonance cavities are properly adjusted. This is one of the reasons why the range will be so very greatly curtailed when the resonance adjustment is faulty, since the intrapulmonic pressure will rise to such a degree that at a certain pitch phonation will become impossible. The reason why the breath pressure will have to be

increased so very much, under conditions of incorrect resonance adjustment, is apparent, since some resonance can be forced in a cavity when it is out of phase with the vibrating cords, but the amount of work required in order to force resonance in this manner will be extremely great, and increasingly so as the set of the resonance cavities departs further and further from the proper shape. This means that the amount of energy supplied to the vocal cords will of necessity be very great, and the breath-pressure will therefore have to be greatly augmented.

Now, at the stage in the vocal development where the lower register is being carried up, the resonance conditions will usually be faulty, since this register is originally found for the low tones which are resonated in the trachea and bronchi. Thus the pupil will almost inevitably associate this register in his subconscious mind with the 'chest' quality. This will lead to a thickening of the tone—i.e., the use of resonance cavities tuned for pitches lower than the ones being phonated. Thus the pressure necessary for the production of the sound which will be emitted will inevitably be too high. The fact that the upper register has not at this stage been co-ordinated with the lower, will still further increase the strain. Thus, the required effort will be excessively great and the resultant sound will be crude and thick. This is an unavoidable stage in the development of the laryngeal muscles, since it is only in this manner that the muscles which actuate the lower register can be brought into play, and exercise is essential to muscular development. Such conditions are ultimately corrected by the co-ordination of these muscles with those which actuate the upper register and by the gradual improvement of the resonance conditions.

It is interesting to note that this is one reason why any teacher who merely tries to obtain the best possible quality at any stage in the development of the pupil's voice will, in actual fact, never accomplish anything of real consequence. The pupil must inevitably go through stages where the quality is not good, in order to develop the muscular system of the voice.

At this stage we have somewhat similar conditions to those existing in the method of vocal technic employed by 'jazz' singers. This type of 'voice-user' has only one object—the desire to make a lot of noise; and this noise is, of necessity, extremely crude and unpleasant. The 'coon-shouter' uses the lower register alone and absolutely unco-ordinated with the upper, not only for singing but also, in most cases, for speaking. Under such conditions the resonance adjustment is always very faulty

and for this reason alone the breath pressure has to be excessively high. This condition is further aggravated because of the lack of co-ordination of the laryngeal muscles. The excessive breath pressure thus produced in the thorax makes itself apparent in the swelling of the veins of the neck and the tensing and standing out of the muscles of the neck.

Let this point, however, be quite clear. The cure does not lie in telling the pupil to relax the muscles of the neck or to develop less pressure in the thorax, since such directions convey absolutely no real import to him while he is singing. The only possible cure lies in the proper development of the laryngeal muscles, in co-ordinating these muscles and in the attainment of the proper resonance adjustments. As the pupil improves along these lines he may later be told to work less hard, and this direction will often be necessary since, having been forced to work very hard for quite a long time in order to phonate, the idea of excessive work may have become a habit which must be destroyed when it is no longer necessary. Of course the exact stage in the development of the pupil when he may be directed to work less hard must be properly gauged by the teacher since, if this is done too soon, progress will cease.

The art of teaching depends largely upon the giving of proper directions to the pupil. Thus, as has been stated, it is always inadvisable for the teacher to give any direction which implies direct control over a narrow group of muscles or considers only a small part of a complicated action such as that of phonation. Any direction as to the position of the tongue, the larynx, the soft palate, the breath pressure, the muscles of the neck etc., comes under this heading and contradicts the facts of physiology. The pupil may, however, be directed to open or to partially close his jaw or to open, spread, or narrow his lips, since these members are under very direct conscious control and when the technic is correct *they do not function in the act of phonation.*

In obtaining the proper technical conditions, the problem which is ever before the teacher is the nature of the directions to be given to the particular pupil at any given instant. Thus at one stage it may help a particular pupil if he is directed to spread his lips in order to obtain the necessary brightness for the upper tones, and later this direction will have to be reversed. This spreading of the lips may, at one time, help in the pharyngeal resonating of the tone, and at another it may tend to bring the mouth into play. Another direction, which is helpful at cer-

tain stages, is to hold the jaw and lips in constant position. Under certain circumstances the opening of the mouth at certain pitches, or at all pitches, may be beneficial and under other conditions it may be injurious. At a certain stage the pupil may have to be instructed to "go for it" as hard as possible and later this direction may, in a great measure, have to be reversed. Directions to pupils vary, not only with the particular stage in the development, but with each separate pupil. Such directions are merely devices which help at the particular moment and they must never be considered as fixed laws.

With regard to intensity, we find a very interesting factor in the development of the voice. The normal intensity—***mf***—has been defined as the softest tone which is produced under conditions of maximum efficiency—i.e., when the puff method of actuating the vocal cords is called into play. This natural intensity of any given voice has to be *found*. At first the puff method will only occur when the pupil is singing very vigorously, and therefore the quality is apt to be rather thick and noisy, so that the intensity may appear to become somewhat less as he improves. This is, however, only true of apparent intensity, since the better produced tone will have more correct resonance conditions, and will therefore have more carrying quality in an auditorium. However, it may, and usually will, sound less noisy in a room. The teacher should never assume that he knows what this "natural power" is until the technic is, to all intents and purposes, correct. One of the most important and interesting phases in the training of a voice is the finding of its natural power. The same sort of thing applies equally to the timbre, or in other words to the natural quality of any given voice, which should never be pre-assumed, since it will not be revealed until the singer is using his voice practically perfectly. This quality will then be absolutely individual.

The giving of the proper directions to the pupil is not so difficult a matter as might be supposed, provided that the teacher has natural talent for his work as well as the vitally necessary knowledge of the sciences underlying the laws of vocal technic. It is evident that anyone who lacks this knowledge is not justified in teaching at all. The directions given should always be for the correction of some particular physical fault or faults of the moment. They must be physiologically possible of accomplishment and must therefore either refer to parts that should not be used in the act of phonation, or be of a general nature. As the technic changes (such changes may take place during the

progress of one lesson) the directions must be modified in order to embrace other faults.

It will, then, be seen that the purpose of this book is not to enable the reader to teach himself how to sing, since this is an impossibility, but to state and prove the fundamental facts about vocal technic and to indicate the manner in which the competent teacher should proceed.

In closing this chapter it is essential that the reader should be absolutely clear as to exactly what is so definitely condemned with regard to the fallacious teaching of "breath-control." Let it then be stated that it is the word '*control*' which is objected to.

The breath must be inspired properly, and when this is not done the teacher should take special pains to give definite instructions as to the correct method of inspiration. The development of the breathing apparatus is, indeed, most beneficial, provided that it is not immediately associated with the idea of phonation.

The fundamental fact is that the most harmful thing a singer can do while phonating is to attempt to control the outgoing breath in any conscious manner whatever. He must, definitely and entirely, forget all about his breath as soon as he starts to sing.

CHAPTER VIII

BREATH AND THE REGISTERS

In Chapters II and III it is stated that the breath expulsion for a tone sung in the upper register is, under proper conditions of resonance, far higher than that for the same tone sung in the lower register. This of course applies in a much greater degree to the lower and middle tones than to the upper ones, in which the upper register co-ordination of the laryngeal muscles should predominate.

In the process of training a voice, the only possible method of strengthening the muscles of the larynx is to isolate the co-ordinations which determine the registers, and in this way to work on the muscles which predominate for each register *separately*, paying special attention to those of whichever register is the weaker.

The purest possible co-ordination in which the upper register muscles are used, is first found with moderately high tones, and inversely, for the lower register, greatest purity is discovered with relatively low ones. Only by working upon purified co-ordinations can the muscular system of the larynx be properly developed.

To ensure the use of the pure upper register it is vital that the resonance conditions should be properly adjusted. In order to obtain such conditions, the upper tones may have to be sung very 'white' or bright, so that the throat alone is acting as the resonator of the fundamental. Again, since it is far easier, in the earlier stages, for the pupil to control a short than a long throat cavity, this brightness may in some cases have to be carried down several tones. Usually, however, the pupil will be best able to retain the pure upper registration for the upper-middle tones by adding the upper pharyngeal cavities and in this case the quality will become darker. The important point is that the pure upper registration must be retained, and the means of doing this depend upon the particular case. The whole underlying idea is that a pure register must be used vigorously so that the muscles which govern it are developed. Thus the pupil must be made to sing these upper register tones as loudly as possible without mixing them with the lower register and with-

out thickening them, which has much the same effect, and also without using the mouth as the principal resonator. Actually this produces a very soft tone in the middle of the voice.

A man, in the early stages of development, is generally forced to use a very dark vowel in order that he may sing in the pure falsetto register. Any undue thickening or brightening of the falsetto is, however, injurious, since the actual result will be that the singer will not really be using the pure register at all, but will actually be employing a 'throaty' form of the lower register, or mixed registration. This is the type of voice production characteristic of the 'throaty' tenor and is very prevalent.

Proper vocal training depends upon the separate development and co-ordination of the registers and not on blending them, and this is why the first process in the training of a voice is the isolation of the registers. In many cases neither register is definitely identified. Thus, for example, in a woman's voice, there may be no true lower register in evidence when the upper register is mixed. Therefore, when the registers are naturally 'blended' or mixed, the vocal condition is technically very poor.

It is impossible for the pupil to co-ordinate the registers when they are mixed, so that mixed registration is a far worse fault than is the most pronounced possible break. In this case the teacher, in finding the pure registers, must reveal the break. Until this break is found there is no possibility of vocal development and the use of the voice in this condition is injurious.

The process is, then, as follows: the low tones must be sung vigorously, and if necessary, crudely, until definite registration has appeared and the break has been discovered. At the same time the upper register tones must be found and sung with the necessary degree of darkness. The pure upper registration, when found, must be brought down, with its purity maintained, so that the lower tones neither sound nor feel like the lower register. Of course, the quality must become darker as the singer descends the scale.

These pure registers can be built up to an enormous extent, and when they are fully developed it is not only possible, but in actual practice easy, for the pupil to co-ordinate them.

In the case of some men's voices, and especially in that of a light 'throaty' tenor, the process of finding the falsetto is a rather difficult one, and any vigorous work on the voice before this is done may prove injurious.

Let it be emphasized that one of the chief means we have of "making a voice" is this separation of the registers, which is the only possible method of developing the muscles which govern them. Mixing the registers merely results in 'throatiness,' forward vowel formation and lack of range, as well as absolute destruction of real quality and power and straining of the laryngeal muscles. The sort of false, light sweetness which is sometimes heard, especially with light tenors and sopranos, is the result of this mixing of the registers and is not really a true form of phonation at all, any more than is this cheap 'sweetness' a form of artistic expression.

It is an interesting fact that whereas only when the falsetto or the upper register of a woman is perfectly isolated can it be co-ordinated with the lower register, many pupils think that a thickened upper register tone is more like the lower register and that it will, therefore, "go through" more readily. In this they are, of course, mistaken.

And now we come to the angle at which these two phases of the subject—breath expulsion and registration—meet.

The breath expulsion is very high when the pure upper register is used, and this is especially the case when it is undeveloped. But, as has already been shown, the breath can be checked by means of closure of the laryngeal pharynx. Thus any attempt on the part of the singer to check the breath, which, it must be emphasized, is escaping at an almost uncomfortable rate with the beginner, will inevitably result in 'throatiness,' and the action of the larynx will be interfered with so that pure registration is impossible. With a man the result will be a thick, 'throaty' or 'nasal' lower-register tone. In the case of a woman, the same will occur when the lower register is relatively over-developed, and where this is not the condition, the upper register will be so thickened that the high tones will be unsingable, or at any rate, only singable under conditions of such muscular strain of the pharynx and larynx and excessive breath pressure as to cause irreparable harm.

The breath must not be checked when singing in the lower register, but the tendency to do this is not so great as with the upper.

When the registers have been isolated, their development becomes quite a straightforward matter. The process is merely one of developing the muscles by swelling the tone to the greatest possible degree without changing the registration or the

resonance conditions. This will, of course, only allow of a very limited intensity for the middle and lower tones when sung in the upper register. It will, however, be found that the strength of the muscles will quickly develop and as their power increases the breath expulsion will decrease. However, the breath expulsion for a woman's middle tones will be far too high until the lower register has been co-ordinated with the upper, when the drop will be very great.

CHAPTER IX

RESEARCH ON BREATH EXPULSION

Drs. H. C. Jackson, H. H. Sheldon, L. B. Ham, and the author of this book have conducted a research on the question of breath expulsion during the act of phonation.

In this work a comparison is made of the amount of breath expelled per second during the act of phonation with varying intensity and pitch.

The breath measuring device (called a spirometer) is connected to a large rubber tube which leads, in turn, to a rubber mask (a French gas mask was used) strapped tightly over the singer's face and under his chin. The other end of this tube discharges into a spirometer which takes the form of a light, air-tight box inverted in a tank of water. A two-way flutter valve in the tube allows air to be breathed in from the room but compels all outgoing air to pass through the tube into the spirometer. The gradual rise of the box part of the spirometer as it fills with air and floats higher and higher in the water gives a measure of the amount of breath expelled.

In the earlier experiments the rise of this box was recorded by a lever system by which a sharp point was pressed on the surface of smoked paper on a revolving drum, where it scratched a line as the box of the spirometer rose. This method was abandoned because of the fear that errors were being introduced by the friction of the sharp point on the paper, and an optical system was substituted. A spot of light was focused on a mirror fastened to the box. As the box rose a reflected beam from this light spot traced a line on a moving sheet of especially sensitized photographic paper. From this line it was possible to calculate the exact amount of breath expelled, since the spirometer had been carefully calibrated. While the rising box traced the breath curve, a clock, with a long arm which moved once a second and allowed a spot of light to strike the paper, marked off the seconds. In this way, then, the amount of breath expelled each second could be determined with a high degree of accuracy (Figs. 7a, 7b).

At the same time the sound produced was picked up by a telephone transmitter especially designed by the Bell Telephone Laboratories in order to avoid distortion. This transmitter was inserted in one of the eyeholes of the mask worn by the singer.

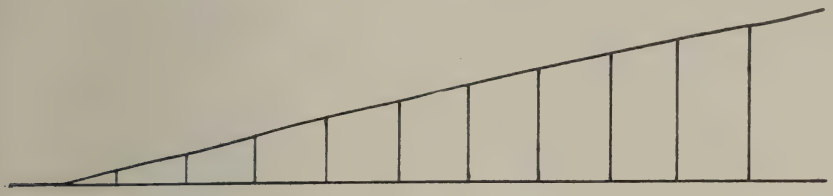


FIG. 7a

ONE OF THE BREATH-OUTPUT RECORDS MADE BY THE SPIROMETER, SHOWING A UNIFORM EXPULSION OF THE BREATH. THE VERTICAL LINES MARK SECONDS OF TIME



FIG. 7b

ANOTHER BREATH-OUTPUT RECORD WHICH IS MUCH LESS UNIFORM

The electrical impulses, corresponding to the sound produced, passed through a three-stage vacuum tube amplifier, also designed by the same company, to avoid distortion, and thence to an oscillograph, which is a device for recording on moving photographic film or paper the form of the sound waves produced in the mask by the singer. In order to obtain a reading of the intensity the paper was moved very slowly—about one foot in twelve seconds. The total area of the oscillograph curve for each second gave an approximate measure of the intensity of the sound produced inside the mask (Figs. 8, 9).

If a person sings into this apparatus two records are obtained. One gives a measure of the breath expelled per second (Figs. 7a, 7b) and the other of the loudness of the tone (Figs. 8, 9 and 37, page 278).

First a series of tones would be sung throughout the range of the singer's voice and a separate tracing taken of each. He would be instructed to produce tones of different pitches at mezzo-forte, or normal intensity, to keep the loudness as constant as possible and to hold the tone for about six to ten seconds. The same vowel, usually *ah*, would be used throughout.

Next he was told to sing three tones, one in the lower, one in the middle and one in the upper part of the voice, and several individual tracings were taken for each of these at different intensities.

From these tracings, curves could be deduced and plotted. One showed breath expulsion against pitch with intensity constant, and three showed breath-expulsion against intensity with pitch constant. Of course the vowel sound was kept as constant as possible.



FIG. 8

AN OSCILLOGRAPH RECORD OF A TONE. THE POINTS AND HOLLOWS ON THE CURVES INDICATE THE VIBRATO

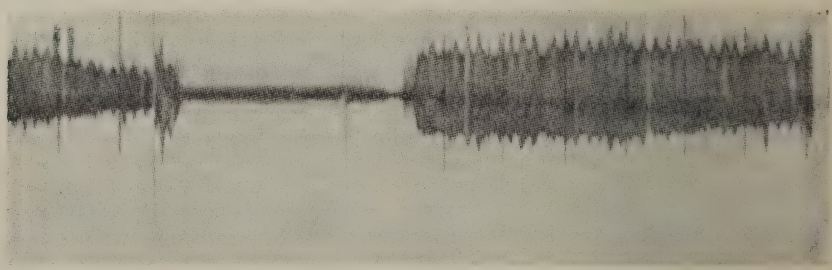


FIG. 9

ANOTHER OSCILLOGRAPH RECORD WHICH IS MUCH LESS REGULAR IN SHAPE, INDICATING A FAULTY VIBRATO

The oscillograph drum was moving too slowly to give any distinction between the fundamental and the overtones, factors

that determine the pitch and give an indication of the quality. This apparatus, when run at high speed, is capable of recording impulses up to about five thousand vibrations per second after the necessary calibrations have been made. At the low drum speed, however, a very accurate and illuminating reading of the vibrato was obtained (Figs. 8, 9). Investigation of the vibrato shows that it is one of the determining factors in the quality of the tone. The vibrato should be perfectly regular and have a frequency of about six beats a second. In voices of poor quality the vibrato was found to be irregular (usually too slow) and in some cases altogether lacking.[1]

From these breath-expulsion curves much could be deduced about the singer's technic.

The first point to be established was the ideal form of these curves. Now if the voice were emitted by a mechanical sound-producing instrument what form would these curves take? Any good piece of physical apparatus works most efficiently in the normal part of its range. Thus a dynamo will be most efficient when running at its normal speed and its efficiency will fall off if the speed is increased or decreased. Similarly any sound-producing instrument should work most efficiently at its normal intensity and in the middle of its range. This principle is generally true of all mechanical apparatus.

We would imagine, then, that these curves should take the form shown in Fig. 10, giving maximum efficiency at mezzo-forte and showing a falling off as the intensity is decreased below or increased above the normal for the particular voice being tested. Similarly for the pitch curves; the maximum efficiency should appear in the middle of the range and this should fall off as the limits (high and low) are reached (Fig. 11).

But a consideration of the physiological conditions also predicates this form of curve. Thus, as already shown, the puff method is, under conditions of proper phonation, being employed at ***mf***, and as the loudness of the tone is augmented from this intensity, the pressure of the breath must be increased. Since the puff method gives the highest efficiency possible, any increase from this intensity will of necessity demand an augmentation in breath pressure, and therefore the breath output will increase. When the intensity is diminished, the bowing method commences to come into play and since

[1] The vibrato is discussed in detail in Chapter XIV.

this is far less efficient than the puff method, the breath expulsion will increase. Thus, from a consideration of the physiological conditions, it will be seen that one would anticipate the same form of the breath-intensity curve as would be expected were the apparatus a sound-producing machine.

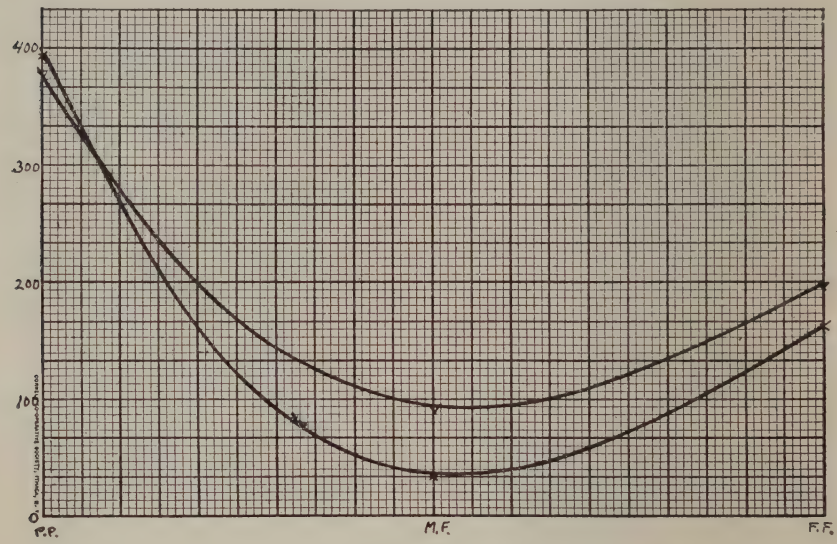


FIG. 10

The curves in Fig. 10 show how the breath ought to be expelled in producing soft, normal intensity, and loud tones. The *mf* requires the least breath. The soft tone uses most of all. This is the typical breath-output curve obtained from a well trained voice in which the registers are properly co-ordinated.

Similarly with the breath-pitch curve. If the muscular co-ordination of the larynx is correct it would seem obvious that the most efficient part of the voice and the easiest range for the singer is in the middle. The most efficient conditions should be those where the co-ordination of muscles is evenly balanced and this would be in the middle of the voice.

Now let us consider what will happen if the voice is used incorrectly. Suppose that the singer is 'throaty', or in other words, that he tends to constrict his throat as he decreases the intensity, instead of keeping the resonance conditions constant and allowing the laryngeal adjustment to accomplish this result. Under these conditions, the softer he sings the more constricted will be the throat. Thus the breath expulsion will be checked and hence diminish. As he increases the intensity he will have to force the air out against this virtually closed throat and the

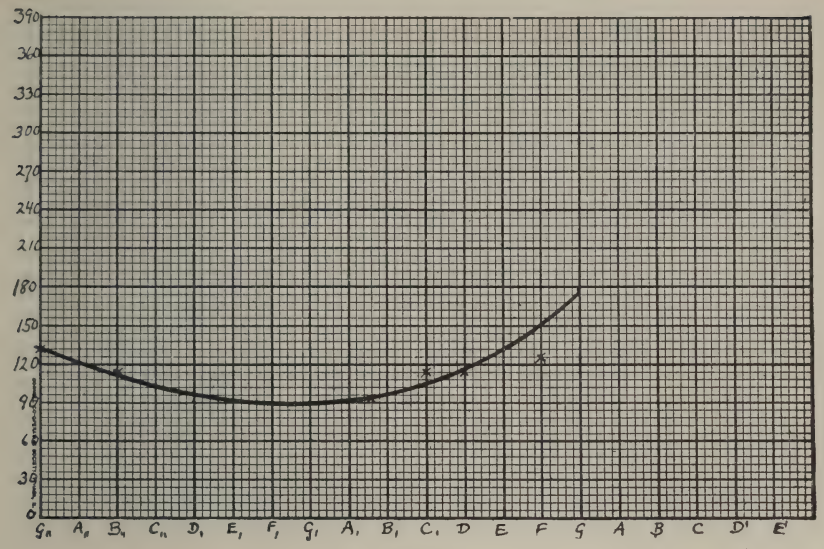


FIG. 11

The curve in Fig. 11 shows the relation of breath-expulsion to pitch for a well used voice. The lowest breath expulsion is in the middle of the range, and the efficiency falls as the lowest and highest tones are reached. Note also that the curve is fairly flat, indicating that the breath expulsion does not fluctuate very much with the pitch.

breath expulsion will necessarily rise. Hence such a singer will produce a curve similar to that in Fig. 12, which is practically a straight line. This is most interesting since such a curve is just what one would expect to find in good singing were the prevalent idea of "breath-control" true, and the carefully controlled breath were forced out at a greater rate as the intensity was increased. Thus the curve which would be expected by the advocate of "breath control", were he to state the logical result of his contention, is in actual fact the one produced by a throaty singer.

Readings taken for a number of voices of different caliber proved that the better the technic the nearer were the curves to the ideal form, and that any departures from this form indicated definite technical faults (Figs. 14, 15).

The breath-pitch curve also indicated the range and the most efficient part of the voice. In the case of a woman, when the two registers are not co-ordinated and the lower is only used up to F or G at the bottom of the G staff, the curve was seen to take a form as in Fig. 13. This shows the lowest efficiency

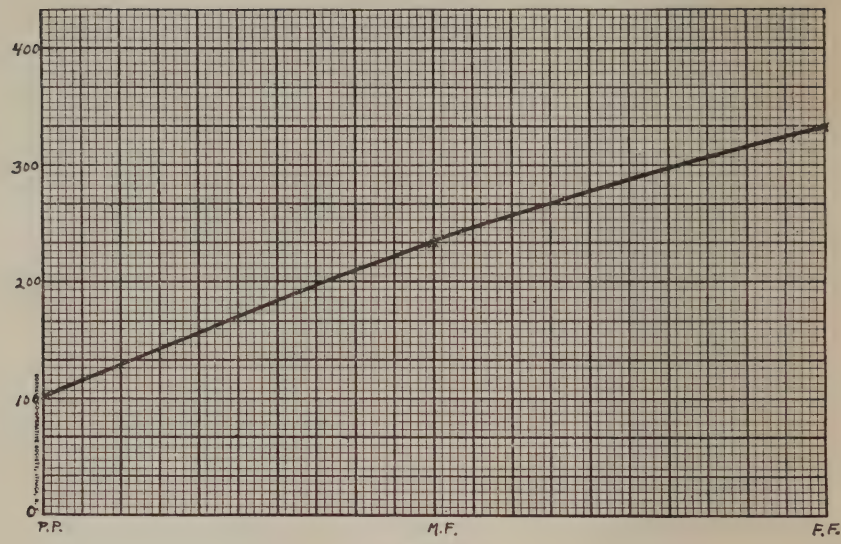


FIG. 12

The curve in Fig. 12 shows the relation of breath-expulsion to intensity for a throaty singer. Note that it is practically a straight line.

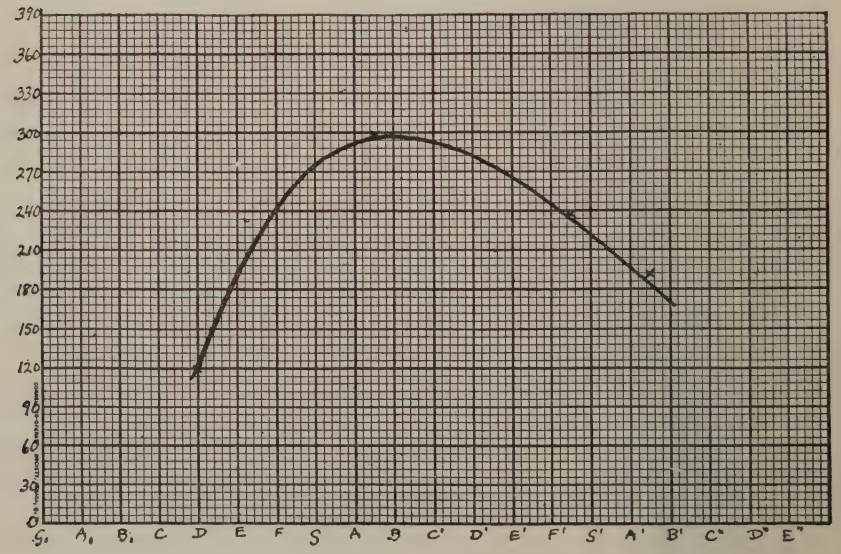


FIG. 13

In Fig. 13 the curve shows the relation of breath-expulsion to pitch for the same badly trained, throaty singer. Notice that the curve is absolutely reversed from the ideal form.

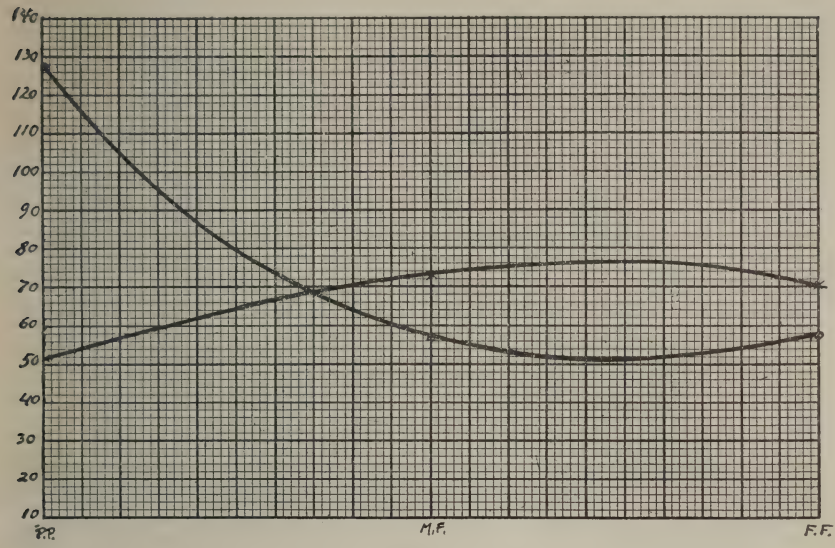


FIG. 14

In Fig. 14 the curve beginning at 50 on the left-hand scale was made before training was begun. It indicates a faulty technic. The other curve, made after some months' training, shows improvement. It begins to resemble in form the curve of a well trained voice—a curve bowed down in the center.

in the middle of the voice, a far higher efficiency for the low than for the middle tones and also a greater efficiency for the high than for the middle tones. This is easily understood since the upper tones are more characterized by the upper register adjustment than are the middle, and the laryngeal adjustment in the middle of the voice is, therefore, the most faulty. This curve is, then, the reverse of the ideal form.

If the voice is undeveloped generally, the whole lie of the curve will show too high a breath expulsion (Fig. 15). The best used voices show about what the general position of the curve should be.

In a case where the upper register only is used, the low tones show a very high breath expulsion and the bend in the curve is practically absent. Where the resonance conditions are faulty, the least efficient part of the voice would be the upper tones, since they could only be produced with great effort. The curve, in this case, shows a very great falling off of efficiency as those tones are reached, and the actual range in each case of this sort examined was shown to be very limited.

When the vowel formation is 'mouthy' the whole technic is likely to show the wrong indications. In one case examined, however, the singer (a tenor) whose speech was very faulty, resonated the tone rather well, and very well for the upper tones. Here the effect of the bad vowel formation was very clearly indicated by an extremely low efficiency for the middle tones. For the upper tones the pharyngeal resonance adjustment forced him to form purer vowels. This was all very clearly indicated in his curves, since a very low efficiency was shown in the middle of the range with great improvement starting at about

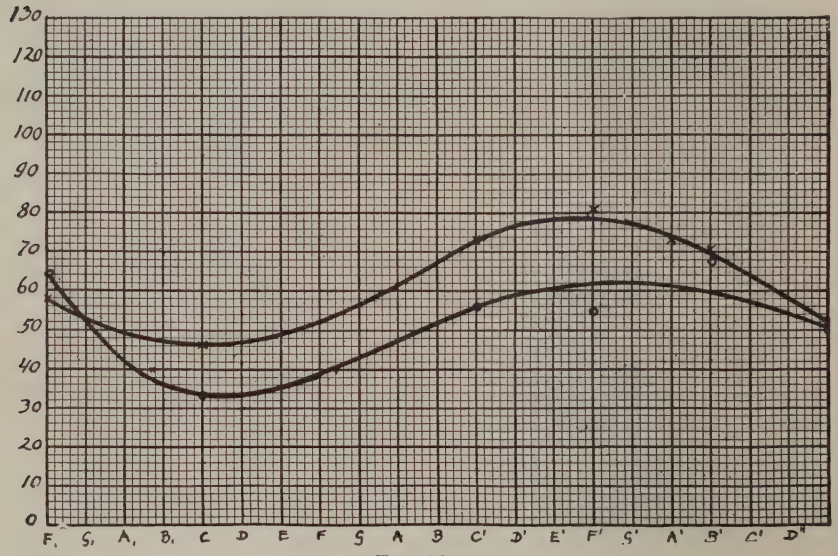


FIG. 15

The upper curve in Fig. 15 was made before training started, and corresponds to the first-mentioned curve in Fig. 14. The lower curve shows the effect of training in decreasing the amount of breath needed for each note. The twisted form of this curve shows that registration is still imperfect.

F♯ in the upper part of the voice. The correct resonating of the fundamental and the proper co-ordination of the laryngeal muscles (his falsetto was co-ordinated with the lower register for the upper tones) allowed him to reach very high tones. He could, in fact, sing a full and very good quality tone as high as E above high C.

When the breath-intensity curve is inverted, the indication is that the two registers are not co-ordinated and that the pianissimo is being produced by constriction of the throat.

Enough has been said to indicate how such curves can be 'read'. The actual process was as follows: tracings were taken and a technical criticism given on the following points, assuming that a voice in which these conditions were attained would be practically perfect technically, and of fine quality: (1) perfect development and co-ordination of the laryngeal muscles; (2) proper resonance conditions; (3) constant resonance conditions, when the pitch and vowel are constant, at all intensities; (4) proper vibrato.

When the full set of tracings had been taken, the breath-intensity and the breath-pitch curves were plotted, and from these curves independent deductions were made concerning the general technical conditions by Dr. Sheldon, who had not heard the voice. This reading from the curves was then compared with the technical or physiological criticism of the voice itself. The most interesting and convincing agreement was found between the two.

Thus it is now possible, from such curves, to give a really accurate criticism of a singer's technic without having heard him sing. In other words, this work has at last produced a real method of diagnosing a singer's technic which is not dependent upon personal likes and dislikes, and has, at the same time, given a means of showing what his faults are. This is very valuable, since it indicates what has to be done by the teacher in order to improve the technic and make the vocal apparatus function properly.

Just one further point: the vital capacity (the total amount of air which can be taken into the lungs) of each singer tested was measured by telling him to take a full inspiration and to exhale completely into the spirometer. It was found, as was to be expected, that there was absolutely no connection between the vital capacity and the amount of breath expelled during the act of phonation.

CHAPTER X
THE LARYNGEAL PHARYNX (THROAT)

Throughout the preceding chapters the laryngeal pharynx, (Fig. 6), which is that part of the throat situated immediately above the larynx, has been mentioned many times and its predominating importance as a resonance cavity been repeatedly emphasized.

The function of the throat in singing has become the bugbear of many vocal teachers and a rather strange fallacy has arisen. This fantastic idea is as follows: "The worst fault of a bad singer", they assert, "is 'throatiness'. Therefore", they argue, "the voice must be as far away from the throat as possible so that this fatal fault is avoided. Furthermore", they add, "the throat must be relaxed so that the voice is 'loose' and free." Their general dictum, therefore, is: "Relax the throat and get the voice into the head (or mouth—different teachers designate different places) and away from the throat!" And then they add, with extraordinary inconsequence: "Open the throat!"

The so-called throaty quality is the result not of a shaped, rigid, open throat but of constriction of the throat. When the walls of the laryngeal pharynx are at rest they are in a relatively closed posture. Thus the constrictor muscles will be in a relatively high state of tone (see Chapter XII). The application of the conscious nerve impulse for the initiation of the act of phonation will then tend to increase the reflex tone in these constrictor muscles. The throat will then be held constricted. The idea of relaxing the throat and at the same time opening it, is a direct contradiction in terms, since the only way in which it can be held open during the act of phonation is by tensing the extensor or opening muscles, thus inhibiting the action of the antagonistic constrictor muscles. It is physiologically impossible for the pharyngeal muscles to be relaxed during the act of phonation. There must be tension on either the extensor or the constrictor group.

Since the collapse of the laryngeal pharynx during the act of phonation virtually eliminates this cavity as an efficient resonator, the only resonance spaces which can then function are the

upper pharyngeal cavities and the mouth. This use of the upper pharyngeal cavities will produce a thick quality, while the mouth will become the chief vowel-forming cavity with the accompanying evils attendant upon its employment for this purpose. Other results of the collapsed throat are the 'nasal', the 'thin-screamy' or 'over-white', or the 'throaty' quality etc.

The throat cavity alone should function as the resonator of the fundamental as far down the scale as possible when a bright quality is desired and the upper cavities need only be added when the greatest possible size of throat column is no longer sufficient to so act. This point, where the upper pharyngeal cavities must come in, depends upon the actual size of the resonance areas and varies with different voices, and for varying colors.

During the early stages of training, the upper pharyngeal cavities will unavoidably have to be utilized at far higher pitches than in the later stages, when the muscles of the throat are well developed and properly controlled. Thus, when the throat cavity is only under partial control, the pupil may have to employ the upper pharyngeal cavities up to about high C. Later he will be able to use the throat cavity in an ever increasing degree when this point will drop several tones, provided a bright color is desired.

Of course, the process is as follows: for the very high tones a very short, widely-opened throat cavity should be used for the resonating of the fundamental, and as the scale is descended the length and size of this cavity must be increased. For a bright tone this resonating of the fundamental with the throat only may be carried down, until it is impossible to resonate the tone properly without adding another cavity. At this point the upper pharynx must be added, while the whole of the throat cavity should be retained. The alternative is to use less of the throat and more of the upper pharynx, or in extreme cases very little of the throat, and a great deal of the upper pharyngeal cavities. This is undesirable unless a very dark quality is wanted, since at the point where the upper cavities are added, there will be a definite transition not only of the adjustment but also of the quality which may tend to become thick.

Then, as the singer descends the scale, more and more of the upper pharyngeal cavities have to be utilized. Still lower, a point will be reached at which the whole of the pharyngeal cavity, taken in toto, is insufficient to resonate the fundamental properly and here the 'chest' resonance must be added.

Under proper conditions, the correct resonating of the tone is a very straightforward and simple matter. For the low tones the throat, or the throat plus the upper pharyngeal cavities, is the chief resonator of the vowel, and the 'chest' (probably plus the laryngeal pharynx) of the fundamental. As the scale is ascended, the fundamental is resonated first by the throat plus the upper pharyngeal cavities, and then by the throat alone, which is progressively shortened for each ascending tone. The act of gradually modifying the adjustment of the resonance cavities will ultimately become unconscious on the part of the singer. This action should actually become psychologically similar to the reflex tensing of the vocal cords, which merely depends upon the singer's sense of pitch. Thus, in the end, the set of the resonance cavities should merely depend upon the singer's mental concept of pitch and timbre, or vowel-quality. He should, however, always be conscious of pharyngeal resonance at all pitches.

It may be as well to mention here that the fact that the throat is far and away the most important of the resonance cavities of the voice is by no means surprising, in view of the fact that it is a large open cavity relatively free of damping folds of tissue, and that it is the cavity *nearest to, and immediately above, the vocal cords,* and this is just where one would expect the principal resonance cavity to be situated.

The beautiful mellow quality so much desired by singers is largely dependent upon the use of the maximum possible throat column as a resonator. Prior to the attainment of complete control over the pharyngeal cavities, the singer will inevitably form either overly dark vowels, in which the upper pharyngeal cavities are functioning too much, or excessively bright ones which can be resonated with a relatively too short throat column per se. This, of course, implies that he is forming the vowels pharyngeally (probably the mouth is in action in both cases). As the control becomes greater, it is a relatively easy matter for him to merely "add more throat" and thus change this bright or thick sound into a beautiful mellow tone. Any attempt to *make* a mellow quality, before this control over the throat cavity is attained, is futile and will only result in an exaggerated thickening of the quality and the more pronounced use of the mouth as the vowel resonator. The closure and constriction of the throat, in conjunction with the tensing of the jaw, engendered through the use of the mouth as the principal resonator, will

result in such general strain that all the resonance cavities will become distorted.

This constriction of the throat will in some cases cause direct communication with the nose through general false tension of the jaw, palate, etc., so that the tone quality will sound nasal.

Failure to use the throat as the principal resonator makes proper resonance adjustment impossible, and the antagonistic tension on the throat will produce the 'throaty' quality; furthermore this tension will so interfere with adjustment of the larynx that it will be subjected to unusually great strain, and the proper co-ordination of the laryngeal muscles will be unattainable.

Now it is physiologically impossible for a singer to consciously open the throat itself during the act of phonation, since we do not possess voluntary localized muscular control over an isolated part. Thus, to illustrate by means of a similar case, it is impossible to move the larynx volitionally, but it is quite a simple matter to do so when the movement becomes a part of a reflex act—e.g., the act of swallowing. It must follow that directions to the singer with regard to movements of the larynx are futile. The vocal teacher must be perfectly clear as to the physiological possibility of all directions which he gives to the pupil. Many foolish statements about vocal technic are caused by a lack of understanding of *function*. Thus the direction to the pupil that he should open his throat as a voluntary act is impossible, but the suggestion that he should relax the throat as a part of phonation and "get the voice out of it into the head or mouth" will in a sense be possible, since the collapse of the throat is part of the act of forming the vowel in the mouth. Therefore, the teacher who says: "Open the throat, relax it and get the voice into the head" will merely be telling his pupil to form the vowel with the mouth and produce a 'throaty' tone. If he tells the pupil to place 'it' in the nasal cavity he is also giving him a direction which he can follow, in the sense that it is physiologically possible to collapse the throat and tense the palate *during the act of phonation*. The resultant quality will, of course, be 'throaty' and nasal. The pupil will not have placed anything in the head, but he will have engendered a tension of the palate and jaw which has set up vibrations in the front of the face, by reason of this false tension. This sensation of vibration in the 'masque' makes him think that 'something' is in the head or nose. Concentration upon a certain part will often engender

local tension elsewhere, so that concentration on getting 'it' into the head or nose will in time engender excessive tension in the upper pharynx and palate.

Often a singer who has been taught after this fashion will be absolutely certain that his voice is in his head or nose; so certain will he be that in many cases it is impossible to make him realize that the voice is really produced by the larynx, which is situated in the throat. He will, with absolute conviction, assure one that he can actually feel it in the head, or nose, as the case may be.

It will, then, be seen that it is possible for the singer to obtain the sensation of vibration in the "front of the face", or in the nose, and that this is merely an effect of false tension. The result of this excessive transmission of sound waves through the bony 'masque' will be, primarily, a general loss of intensity, since such transmission is far less efficient than would be that from the open mouth. Of course this vibration of the bones of the nose etc., which is in no sense a form of amplification of the tone, or of resonance, merely produces damping. Not only is this true, but in addition there will, in such a case, be definite distortion of the quality, since the bony structure will transmit certain frequencies better than others, resulting in selective damping. Thus the actual effect of the endeavor to "place the voice in the head" will be to reduce the intensity and at the same time distort the quality of the tone. This is accompanied by the far more serious disadvantages attendant upon the excessive tension of the muscles of the soft palate, the jaw, the constrictors of the pharynx, neck etc., which is an unavoidable concomitant of the sensation of placing the voice in the 'head', 'masque' or nose.

Excessive tension of the constrictor muscles of the throat may produce the sensation of something happening in the head, while proper firmness of the pharynx will give a feeling of perfect comfort. Thus the singer whose throat has always been strong and firm will probably assure one that it is relaxed. Strain at the throat is experienced when, as the result of collapse, constriction and interference with the act of phonation are induced.

Let us consider what follows upon relaxing the throat. Firstly, the registers cannot function properly, since a collapsed and constricted throat inhibits proper adjustment of the muscles of the larynx.

When the singer adds the lower to the upper register the intensity will, of necessity, increase. This should necessitate in-

creased throat tension, but with the beginner the tendency will be for the throat to become constricted as the result of excessive action of the neck and jaw muscles. When this constriction occurs, a break is inevitable. If, on the other hand, the throat is kept absolutely firm and unchanged in size and shape, there will be no interference with the laryngeal action. Then, provided that the muscular development of the larynx is complete, the registers will co-ordinate perfectly.

Secondly, the throat is the most important of the resonance cavities and any collapse thereof will inevitably result in the formation of the vowel in the mouth, and the improper resonating of the fundamental at all pitches.

A collapsed throat will leave the mouth and the upper pharynx, which is rather a large cavity, as the principal resonators of the vowel and the fundamental. Since the mouth position will be fixed to determine the vowel, only the fixed position of the upper pharynx is left as the resonator for the fundamental. Such a cavity will be far too long for the upper tones, and as a matter of fact, it will only be possible for it to resonate properly at one frequency for a fixed vowel. Thus, at best, either the vowel must be distorted or the fundamental improperly resonated. Since this fixed frequency at which the upper pharynx will resonate is determined by the vowel and not by the fundamental, it is highly improbable that the resonance conditions will be correct at any pitch. In effect, really, neither the vowel nor the fundamental will be properly resonated and as a general rule the result will be a very thick quality and a badly distorted vowel. This thickness is a most usual fault of a singer whose throat is relaxed.

CHAPTER XI

DEVELOPMENT OF THE PHARYNGEAL MUSCULAR SYSTEM

In the preceding chapter it was shown that the laryngeal pharynx is by far the most important of the resonance cavities, and furthermore, it was emphasized that this cavity should be held absolutely firmly in position during the act of phonation. The physiological reasons for this rigidity have been given and the fact that a resonance cavity must be firm if it is to resonate efficiently is shown in Section III of this book.

It will, then, readily be seen that one of the most important factors in the training of the voice is the development of the muscular system which controls the opening of the pharynx, and the attainment of the ability to accurately adjust these muscles.

Control of the muscles of the laryngeal pharynx, in a very large degree, if not absolutely, influences the entire pharyngeal system. Thus, when the singer has attained complete mastery of these muscles, he will have a real power of adjustment over the whole of the resonance system which should be used for the production of the tone.

Therefore one of the chief phases in the work of the vocal teacher is the development and training of the pupil's throat muscles. As a general rule this control is very limited at the start, and a fundamental problem in vocal training is to make the pupil conscious of the fact that the throat is a vital factor, or in other words, to make him conscious of his throat in the proper sense of the word. This implies a consciousness of the fact that the sound is being resonated in the throat. Such consciousness does not engender any sense of strain.

As has already been pointed out, it is futile to tell the student to open his throat, since such localized control is physiologically impossible. Such directions, however, as: "Go for the throat!" "Form the vowel further back!" "Hold the throat firm!" "Work with the throat!" "Balance the work done in the production of the tone with firmness of the throat!" "Start the tone with the throat!" "Don't let the throat collapse as you ascend the

scale!" "Tense the throat at the moment of attacking the tone!" etc., will, with constant repetition, have quite a definite psychological effect.

The first real sense of the action of the laryngeal pharynx is often engendered by the singing of loud high tones which must be resonated in the throat only, since they cannot be produced at all if the resonance conditions are not approximately correct. A bright, high tone (this means a very high tone, in most cases well above C) is resonated with a short—widely open—throat column only, and is therefore, as has been shown, easier to produce properly than a tone which requires a longer resonance cavity. The fact that the throat is more often "found" in the production of very high, than of middle tones, is also due to the fact that the singer can produce a middle tone incorrectly and not really feel the strain, and also to the fact that quite a lot of sound can be made in the middle of the voice by the use of a resonance column which includes the upper pharynx and does not employ the proper amount of the laryngeal pharynx.

A more definite "throat sense" is, however, attained when the pupil arrives at the stage when he starts trying to add the lower to the upper register without a break. This is impossible of accomplishment if the resonance adjustment is faulty or if the throat is relaxed. Thus, when the latter relaxes during the attempt to co-ordinate the registers, a break will inevitably result. Also the register change occurs in the larynx, and this fact alone may give a sense of something happening in the throat.

The act of adding the lower to the upper register will, then, tend to give the proper sense of throat, and the fact that it must be held firm during this act will tend to develop the muscular system of the pharynx.

Another way of strengthening the throat muscles is to make the pupil sing as good a lower-register tone as possible in the middle or lower part of the voice with a long throat resonance column, and then ascend five degrees of the scale smoothly, keeping the vowel as constant as possible. The intensity will, and must, increase a great deal as the scale is ascended, or the throat, which must be held as rigid as possible, will collapse. In order to prevent any interference with the throat, the jaw and lips may have to be kept absolutely still, since any movement of these members will often, in the early stages, result in a shift or collapse of the throat.

One of the principal difficulties which must be overcome is the interference of the jaw. Generally speaking the beginner

will hold his jaw rigid, since he will probably be forming the vowel, to a large degree, with his mouth. This jaw stiffness is often reflected to the lips, which will be drawn so that in many cases they touch and cover the teeth. The lips and jaw seem to function together to quite a considerable extent so that the direction to the pupil that he should open his lips and show some of the upper—not lower—teeth will often be a very helpful one. A somewhat pouting, open position of the lips for all vowels will in many cases help to prevent a mouth vowel formation and will also, in time, tend to strengthen them and give the singer control over them, thereby improving the articulation.

In getting a bright high tone at the start it is sometimes necessary to make the pupil spread the lips, showing several of the upper—not lower—teeth. This is merely a temporary trick for getting brightness, and many other such devices have to be resorted to, for a time, in overcoming physiological faults. Any definite lip action, which has no reference to vowel formation and is actually contrary to the lip position which would be assumed were the vowel resonated in the mouth, will also have the tendency to stop the pupil from forming the vowel forward. The determination to do something definite with the mouth and lips, which is not helping to form the vowel, often tends to make it difficult for the singer to shape his mouth for the resonating of the tone.

Another device which may be employed is to tell the pupil to form the vowel which is resonated best at the moment (this vowel will vary with different people depending largely upon their faults in speech) and then, keeping the mouth and lips absolutely still, form other vowels without allowing the throat to collapse. Thus, with the well-formed vowel the sensation of 'throat' will be experienced, and this sensation must be retained while the endeavor is being made to form the other vowels in the same area. Another device which may help in the attainment of the concept of forming the vowel back and using the throat as the principal resonator is the singing of a series of tones in scale form, with the jaw well dropped and the corners of the lips rather drawn together but with a few of the upper—not lower—teeth showing. In this exercise the mouth and lip position should be maintained absolutely constant. This position of the jaw and lips may be prepared for before the pupil starts to phonate. In singing scale passages etc. the pupil must try to keep the vowel constant, except in as much as he may have to brighten the quality as he ascends the scale. When the tendency to spread the

corners of the lips for the high tones is strongly manifested, this exercise is often an excellent one, since the chief aim of such exercises is to inhibit any gesture made by the pupil which indicates that he is shaping his mouth or lips for the resonating of the vowel. When the spreading of the lip corners tends to produce a forward vowel formation, the pupil should generally be instructed to narrow them and vice versa. The same sort of thing applies to the dropping of the jaw.

Many of the directions which should be given to a pupil depend upon such natural gestures, which are physical manifestations of the tendency to form the vowel forward and use the mouth as the principal resonator. Thus, when a definite mouth position or contortion is assumed by the pupil, he should generally be directed to make exactly the opposite gesture.

Another device for obtaining the proper technical conditions is the singing of a tone of absolutely constant vowel or quality while the mouth and lips are moved as much as possible.

The proper throat sensation is never actually experienced until the laryngeal development is so far advanced that it has become possible for the singer to carry the lower register over practically the entire range of the voice. It is absolutely impossible to carry up this register unless the throat is held firm. Thus, as the pupil carries the lower register up higher and higher, he becomes more and more conscious of his throat, and he will sense that it must be held firmly in shape since, if it is not so held, the voice will crack. This register which, with a woman in the early stages, may only go to about F on the bottom space, will advance tone by tone, and as this advance occurs the strength of the throat muscles must of necessity become greater.

At first it is uncomfortable and difficult for the pupil to hold his throat firm, but as the muscular strength becomes greater, this sense of discomfort is replaced more and more by one of power, security and confidence.

When the control of the throat reaches a really efficient stage, the singer is in the happy condition of being able to modify the vowel quality to practically any degree he may desire and thus to 'color' his voice at will. Thus, for example, the difference in color between the dark *e* vowel, which is practically the French *u*, and the brightest possible *e* is extremely great. Of course, in a very large degree, this vowel modification is quite spontaneous and is an expression of the emotion the singer is creating.

When real control over the throat is attained, the singer is able to swell the tone as far as he may desire without forcing his voice or losing the quality. The tension on the throat must, as has been pointed out, be sufficient to withstand the work done by the muscular system of the thorax. Thus the act of swelling a tone becomes largely one of holding the throat more and more firmly. The supporting action will usually take place automatically.

Of course a given voice can only develop a certain degree of intensity of sound waves and the maximum for a given tone is fixed by the physical structure of the vocal organs. In other words, the natural power and its maximum are predicated upon the shape and texture of the resonance cavities and by the size of the larynx etc. It is, however, impossible for a singer to force his voice when the muscular system of the throat and larynx is fully developed. When the limit of power is reached, the intensity will not increase and the only effect of further effort will be that the vibrato will become stronger and the emotional stress will be augmented (Chapter XIV).

When the strength of the throat is completely developed, the act of tensing and controlling it becomes absolutely automatic and unconscious, so that ultimately the singer performs the necessary tensing without the slightest sense of effort. The habit of forming the vowel in the pharynx also becomes automatic and he is then in exactly the same condition as is the singer who has been born with what is called a wonderful natural voice. In other words he—or she—becomes quite unconscious of everything physical and the act of phonation becomes an absolutely spontaneous one.

As the technic advances, the problem from the teacher's, and also from the pupil's, viewpoint becomes easier and easier. At first there are a great many things to be thought of. All sorts of tricks which will tend to correct the particular faults of each pupil must be resorted to, and such devices vary a great deal for different pupils. No two pupils have the same faults and therefore the means taken to deal with each different individual vary; indeed, each pupil presents a new problem. Of course the ideal conditions are the same in all cases, but the faults which must be overcome are different for each person. Every advance is marked by the ability on the part of the pupil to stop thinking about a certain phase of the subject, since this phase was marked by some false muscular action which has been overcome and has, therefore, ceased to be a problem.

Another point which must be mentioned is the fact that at some particular stage it is often necessary to give the pupil a certain direction with a definite end in view, as in the case of spreading the lips as mentioned above. Later this direction will have to be eliminated and in many cases reversed. One of the ways in which many teachers err is by using a direction, helpful to a pupil who has certain faults which were indeed lessened by this direction, as the basis of a 'method' and applying it generally to all pupils in all stages as a "golden rule."

There is no royal road to vocal perfection, no "wonderful secret" which will make great singers. There is only one possible way in which the teacher of voice can really train his pupils, and that is by knowing the fundamental laws of vocal technic; or in other words, the correct physiological conditions which are founded upon the physics of sound, and working to attain these conditions. This work, which is indeed difficult for both the teacher and the pupil, entails the elimination of the faults which impede the proper muscular actions and the building up of the muscular system which should be used in the act of phonation.

CHAPTER XII
TONUS AND THE RELAXATION FALLACY

In the actual production of tone, work is performed by the muscular system of the body. The mechanical energy developed is applied to the vocal cords which have to be vibrated, and from them it is taken up by the resonance cavities.

The question with which this chapter is concerned is the proper and most efficient manner in which this 'work' should be performed.

One of the current fallacies in the teaching not only of voice, but also of the technic of many other activities, is the idea that the performer must be in a condition of complete 'relaxation.' It is obvious to anyone who sees a competent artist perform, that he is singing or playing without any apparent strain and that his face is expressive of what he is singing about or of the emotions of the music. There is no sign of struggle. Anyone unfamiliar with the facts of physiology at once attributes such ease of performance to relaxation. If the teacher uses the term 'relaxation', he should endeavor to convey the idea of absence of conscious or voluntary muscle contraction; no part of the body should be held rigid by the act of the singer. However, in most individuals, the muscle relaxed in this sense is in a state of reflex semi-contraction or tonus. The degree of tonus varies in different muscles and in different individuals. This is evident when one grasps the biceps muscle of the arm of various persons. In some, although the arm is relaxed, the muscle seems tense and hard, in others, soft and flabby. We recognize that the firm muscle of the athlete represents a better physiological condition than that of the person whose muscles are soft. These variations in the character of muscle are designated as muscle tonus. The singer must avoid two extremes —on the one hand conscious contraction of groups of muscles tending to keep them stiff and rigid and on the other, the flabby, completely relaxed muscle state. Neither of these allows freedom of use of the muscle. Proper tonus, however, represents a middle stage—it corresponds to the state of the body

of a man 'set' at the mark, ready to spring at the pistol shot. The muscle is in a state of active preparedness. The degree of tonus indicates the relative efficiency of the muscle to respond quickly and effectively to the call for action. A relaxed atonic muscle must contract to a certain extent to "take up the slack" before it can do the work required of it. This delay does not make for speed or accuracy of movement. Consequently, in the whole matter of co-ordinate movements of the body, muscle tonus of the proper degree contributes to smoother, easier and more effective results. It must be emphasized, however, that this tonus is of reflex origin. That is, it is present unconsciously and results from the proper condition of stimulus, originating in the nervous system. Reflex tonus apparently entails little more work on the part of the body than that produced in the flabby, relaxed muscle. Hence the singer's body must always be in this condition of preparedness, and this state must be maintained reflexly even during the interludes of a song, while the orchestra or piano is playing alone. This gives the audience the feeling that the artist is expressive and that this faculty is continuing during the entire progress of the song. No artist allows this function to wane until a few moments after the last note of the song has been played. This art of holding the emotion throughout the entire progress of the composition is one of the great distinctions between the professional and the amateur.

There is no sense of effort or strain in the maintaining of this condition of tonus; on the other hand, it gives the audience the feeling that the singer is free and alert and at the same time, that his performance is interesting and expressive.

To draw a picture of this condition of tonus so necessary for the singer, let us consider some parallels: the great athlete appears to be absolutely free from effort; the great golfer or tennis player will hit the ball with terrific force, apparently without effort but, in very fact, close observation will show that he is actually in a condition of extreme *activity*. He is strung up to the highest pitch of activity, in other words, his body is in the most perfect conceivable degree of tonus. Were he not in this condition, he could not make the fine adjustments which are the vital concomitant of a delicate and properly executed stroke.

In the same way observation of a great singer, actor, pianist etc., will show that his general muscular condition is exactly similar to that of the athlete.

It will, then, be seen that the whole body must, during the act of phonation, be in a state of proper tonus and it is only the muscles actually effective in the production of sound which should have their state of tension increased, i.e., the muscles of the larynx, pharynx and thorax.

The work necessary for the production of the tone is performed more and more efficiently as the condition of tonus of the muscular system of the body improves and the stronger the muscular system which produces the voice becomes, the more effectively may this body energy be utilized.

In dealing with pupils every possible case is found, from the one who is so phlegmatic and relaxed that it is a matter of very great difficulty to make him do any muscular work whatever, to the highly strung neurotic person, who the moment he attempts to sing, over-tenses every possible muscle in his body.

In practice the former case is often the more difficult to deal with, since such a one has, in most cases, no conception of what body activity means.

There seems to be a defir ite connection between temperament and activity of the body. A very temperamental person will usually have a natural tendency to over-tense his body, while the phlegmatic or placid one is apt to maintain a very relaxed condition.

Of course strength and bodily activity are by no means synonymous. The most muscular man is often very 'dead' and even muscle-bound, while a relatively weak girl may be intensely active.

Naturally, one of the most important phases in the training of the voice is the attainment of the proper condition of tonus. Sometimes certain devices may have to be resorted to. The over-tense person will often improve if he is made to sing sitting or even lying down in a comfortable posture, while the over-relaxed one must continually be instructed to work harder with his body, support, etc. In the early stages the work which must be done in order to sing the best possible tone, from the physiological point of view, requires an effort which is very much greater than is necessary for the actual production of the tone itself, since there is a great deal of muscular interference to be overcome. Thus a beginner will have to work very hard, and as he advances, the effort will rapidly become less. This effect is magnified by reason of the fact that the muscles used during the act of phonation are, at the start, very weak, and their co-ordination poorly developed. Effort is, in a sense, a relative matter,

depending upon the strength of the muscle and the number of muscles involved. A weak man will exert tremendous effort in lifting a weight with which a strong one can deal without any apparent trouble. So with the muscles of the voice; when they are weak, the effort seems to be very great, and as they become stronger it appears to diminish. All that is really happening is that the muscles are becoming stronger and the apparent effort is therefore decreasing.

This is why it is sometimes harder to train an over-relaxed than an over-tensed pupil. He must be forced to do the work necessary to overcome interference and to bring weak muscles into relatively vigorous action. The over-tense student will sometimes tend, quite unconsciously, to reduce this false tension as he finds that the act of phonation is becoming easier.

It will be seen that at the start the pupil must work very hard and that this effort decreases as he progresses. Unless this hard work is done, the interfering muscles will continue to predominate and there will be no progress, since the proper muscles will never be vigorously actuated and therefore will not become any stronger. Of course this hard work is extremely dangerous when misdirected, and unless the teacher understands the laws of vocal technic properly, he will inevitably injure a voice irreparably if he makes the pupil sing vigorously and misdirects the effort. If, on the other hand, the teacher does not make the pupil work hard there will be no real progress.

CHAPTER XIII
VOWELS AND CONSONANTS

All that has been said in the preceding chapters has pertained to phonation or in other words, to the production of tone. The phonated sound has a pitch which can be varied by means of changes of adjustment of the muscles of the larynx. Such sounds also possess the property of timbre—are characterized by a certain quality which is determined by the energy distribution in the sound. In brief, then, a phonated sound is composed of a fundamental and a series of overtones.[1]

A tracing may be taken of a tone, as described in Section III of this book, giving a picture of the wave form of the sound which can be analyzed into its component sine curves. These curves show the energy distribution in the tone and determine its timbre. Examination of a great number of such tracings reveals an almost infinite variety of form.

As has already been stated, the energy distribution in a tone produced by the human voice is determined almost, if not entirely, by the vowel sound and the fundamental, which probably have about equal importance.[2] It is, however, impossible for the singer to phonate a definite vowel which is characterized by a frequency lower than the fundamental. Thus the vowel *ee* cannot be sung by a female voice at a pitch higher than about G♯ or A above the staff. (It may be noted here that this pitch is considerably higher than the lower vowel frequency for *ee* given in Chapter V, but we are considering ideal vowels which probably are of higher than average frequencies.) It might be possible for the singer to produce a fundamental in conjunction with a vowel of lower frequency were "difference frequencies" produced of sufficient magnitude to determine the fundamental, but this condition seems to be highly improbable in practice. It is at any rate a fact that above a certain pitch—E above the staff—no true vowel sound can be distinguished.

[1] See Section III.

[2] The better the technic, quality and carrying power the greater is the proportion of fundamental present in the tone.

As has been stated, the expression of emotion etc. is dependent upon the color or timbre of the tone, and the only method by which color variations can be accomplished is by means of vowel modification. Thus the mere vowel 'ah!' may express joy, anger, sorrow, pain, love etc. In practice the artist will merely create the emotion which he intends to express and if his technic is good enough for his voice to respond properly, the desired color will be produced and the emotion will be conveyed to the audience. One of the chief functions of technic is to enable the performer to convey to the audience the emotion and atmosphere of the music and poem.

If tracings are taken of these 'ah's' and analyzed, it is found that for each different color a slightly different vowel is produced. All vowels may be modified in this manner in order that the different emotions may be expressed. It is evident that this vowel modification is accomplished by means of minute changes in the size and shape of the vowel resonating cavities—the pharyngeal cavities.

Such delicate modifications would be, if not impossible, at any rate extremely difficult of accomplishment, were the mouth to be used as an important resonator, since they would entail very definite changes in the position of the jaw and in the shape of the mouth cavity, which would inevitably imply the destruction of the proper resonance conditions for the fundamental. When the pharynx is used as the principal resonator of the vowel, however, the modifications can be accomplished by means of very minute changes in the pharyngeal cavities, without the necessity for any movement of the jaw or shaping of the mouth, and the inter-adjustment between these cavities—the laryngeal, oral and nasal pharynx—makes it possible for the fundamental to be properly resonated irrespective of the vowel.

Such rearrangements of the pharyngeal resonance cavities are far too minute for the singer to find it possible to make them purposefully except within the very broad limits of a definitely dark or bright quality. In the former case, the singer should be conscious that he is using more of the upper pharyngeal cavities and in the latter, less than for a normal color. This is, however, very broad and refinements of color are actually attained, in practice, emotionally.

When a singer has real control of his resonance cavities, a control that has become unconscious or reflex through the proper development and co-ordination of the muscular system of

the pharynx, this expressive function becomes perfectly spontaneous. Thus the emotion which he intends to express will take a definite form in his mind and it will be associated in his subconscious mind with a certain vowel quality. If the physiological mechanism responds properly, this form will be perfectly reproduced by means of the vocal organs. If he does not possess this control, it is impossible for him to really express and he will then be forced to fall back upon inartistic and superficial 'tricks' or in other words, upon cheap affectation, or 'hokum', if he wishes to express anything at all. Such control may be the result of proper training or it may, in a few rare instances, be natural, when the case is one of what is called a "wonderful natural voice."

The possessor of a fine 'natural' voice is fairly safe, provided that he does not allow bad teaching to interfere with his technic and in the hands of a competent coach he may easily become a great artist. A teacher who understands little about the science of vocal technic, but does possess a good ear, may indeed improve a fine voice quite appreciably merely by "trial and error." This is the reason why some really quite incompetent persons are reputed to be great vocal teachers—they were lucky enough to have had some singers with great natural voices pass through their hands. When a teacher who does not properly understand vocal technic has such a pupil, he can easily make a great artist out of him provided that he does not attempt to do anything radical from the technical standpoint, and also provided that he is a competent musician. For this reason it is rather a mistake for anyone to judge a teacher by his successful pupils, since they may have started with fine natural voices. Of course such negative teaching is far better than wrong instruction which will ultimately harm every pupil who is subjected to it, provided that he follows the misguided directions. Some very talented pupils may, however, quite disregard the foolish instructions which the incompetent teacher gives them and they can in this way survive the worst possible teaching for some years, although ultimately they are bound to suffer, since they have nothing to fall back on in an emergency. It is, then, quite possible for a really incompetent teacher to have a very fine pupil who may last for some years. On the other hand, negative teaching will never help anyone very much, and a good ear alone is but a slender reed for the vocal teacher to lean upon.

It has been stated that the vowel sound is always associated with phonation; not so the consonant, which has a natural and

unchangeable period of its own. It is a fixed sound, the pitch and timbre of which cannot be modified.

Mention is sometimes made of 'vowel-consonants.' There is no such thing. The moment a consonant is phonated it must be associated with a vowel and it cannot be considered as a consonant any longer. Thus the consonants *m* and *n* are formed with the lips, and with the tongue against the hard palate respectively. The moment phonation occurs, the consonant has ceased and the singer or speaker is merely humming. It is quite obvious that the prolongation of the 'hum-vowel' which is necessary for the formation of the consonants *m*, *n*, and *l* is merely a form of mispronunciation and is absolutely wrong phonetically. All consonants, except hissing ones such as *s*, *z*, *th* etc. and the rolled *r* are, when properly articulated, instantaneous and must be associated with a vowel in order that the sound may be sustained.

Consonants are formed—with the tongue and lips—in the mouth, and with the exception of the gutturals, in the front of the mouth. Thus it is only possible for the singer or speaker to articulate perfectly when the tone is resonated pharyngeally and the mouth is left free to form the consonants. When the mouth functions as the chief resonator of the vowels, there is serious interference between them and the consonants, since the singer will be trying to use his mouth for articulation when it is being rigidly held in the vowel position, and the two actions will conflict. Thus the singer who uses his mouth as the principal resonator of the vowel cannot possibly articulate and pronounce clearly. This is one of the reasons for the faulty enunciation of so many singers and actors.

The properly formed consonant is produced by means of very rapid, vigorous and at the same time *small* movements of the articulating parts. Consonant practice is, then, a necessary phase of vocal training, and the tongue—principally the tip of the tongue—and the lips, which have to be strengthened and brought under control, must be exercised.

Consonant practice should not be attempted until the resonance conditions are reasonably correct, since the fact that the articulation is in the mouth will tend to bring it into action in the formation of the vowel, unless the use of the pharynx as the principal resonator has been firmly established. When this stage has been reached, however, exercises in articulation are essential, since they will not only strengthen the articulating parts

and improve the diction, but also the independent use of the tip of the tongue will tend to free the back part of this organ, thereby aiding delicate adjustment of the pharyngeal cavity which is quite largely dependent upon the position of the base of the tongue.

Clear articulation is an enormous asset since it is, of course, a vital factor in the pronunciation of words and an artist should be able to make each and every word absolutely clean cut and clearly understandable. One of the tests of technical ability is the capacity for enunciating words perfectly at high speed. Only when the technic is really good can the singer enunciate vowels and consonants at high speed and distinctly without losing the quality. These two factors of voice production—speed and articulation—are rather interdependent and should be studied at about the same stage in the technical development.

The lips must be strengthened by using them neatly and vigorously for articulation, and even by direct exercise. They should never, under any circumstances, be drawn over or touch the teeth during the act of phonation, and therefore the pupil must be taught to open them, thereby displaying a few of his upper—not lower—teeth all the time he is singing. During the course of training the pupil may be directed either to spread or to narrow his lips, but in either case the teeth should never be touched or covered. When the technical development is well advanced it will be found that the lips need never be distorted or spread for any vowel sound in any language. Thus when a singer or speaker uses his voice properly he will never make a spreading gesture with his lips, which will be maintained in practically constant position all the time, except for the vertical dropping and closing of the jaw. This is not only important technically but also, from the standpoint of the appearance which the artist makes, it is quite vital.

The use of a mirror may be permitted for the purpose of allowing the pupil to see whether his lips are open and whether they are moving laterally. Exercises for strengthening the lips by holding them open may be practiced in front of a mirror.

The importance of the facial gestures of the singer or actor has recently been brought, very strikingly, into the limelight by reason of the rise of the talking movies. Lateral gestures of the lips distort the entire face, and with the greatly enlarged image which appears upon the screen in the 'close-up', such grimacing is most distressing.

The voice-user whose technic is correct never makes a facial gesture which has not for its purpose the portrayal of the emotion or meaning of the composition or lines he is singing or reading. This ability, so closely associated with technical training, is one of the first essentials for the aspirant for honors in the field of talking movies.

CHAPTER XIV
THE VIBRATO[1]

In the preceding chapters the question of timbre has been discussed and it has been shown that the quality depends upon the distribution of the energy in the tone, or in other words, upon the overtones and the proportion of these overtones to the fundamental and to each other.

There is, however, another factor quite equally important in the determination of what the ear detects as good quality. This factor is the *vibrato.* A tone without vibrato sounds 'dead' and is lacking in ring, vibrancy and beauty.

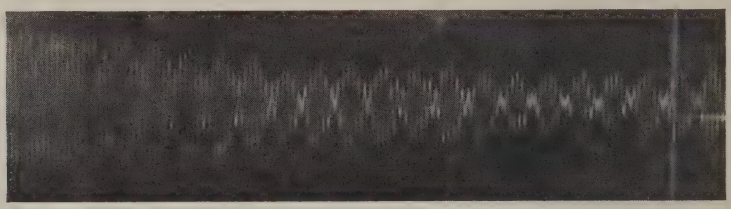


FIG. 16. OSCILLOGRAM OF ONE HALF OF ONE VIBRATO, TAKEN AT HIGH SPEED. NOTE THE WIDE CHANGE IN INTENSITY

The vibrato consists of a periodic swelling and a softening of the tone accompanied by a definite rise and fall of the pitch. This pitch change, however, is practically imperceptible to the ear except at the high intensities, when the vibrato is extremely broad. A proper vibrato[2] must be absolutely regular, must have

[1] The author pointed out the importance and the function of the vibrato in a paper read before the Physical Society in 1924, and in an article published in the *Scientific American,* December, 1924. To the best of his belief, this was the first research to be conducted upon this question.

[2] In order to indicate the nature of an ideal vibrato I will give some results from a test of Caruso's vibrato taken by me at the laboratories of Electrical Research Products, Inc. during a study which I am now carrying on with Mr. S. K. Wolf of that institution.

The tone considered was high B♭ sung forte. All the characteristics were found to be remarkably regular. The vibrato frequency was found to be extremely regular at 6.2 vibratos per second. The high pitch was found to be at the point of high intensity.

High pitch (loud point): 495 vibrations per second;

Low pitch (soft point): 460.9 vibrations per second.

Thus the pitch variation was found to be about one half-step, occuring 6.2 times a second. The audible intensity variation was found to be nearly 100%, or 6.5 decibels.

the correct frequency—about six a second—and must be of the proper amplitude for the intensity of the tone which is being sung (Figs. 8, 9 and 16).

At pianissimo there is no vibrato, but as the tone is swelled the vibrato appears, and as the intensity rises it becomes broader and broader, so that at fortissimo it is extremely pronounced.

The only case in which a tone which is louder than pianissimo may be sung without vibrato is when such emotions as cold, hopeless despair etc., are to be conveyed. Here, of course, a 'dead' quality is desirable.

The vibrato is the result of actuating the voice with *a rhythmic and not a continuous impulse.* Here, then, we have another fundamental principle of first importance: *The production of tone should be accomplished by means of a periodic impulse and not by a continuous effort.* This periodic impulse is applied to the entire muscular system used in the production of tone, or in other words, to the muscles of the thorax, larynx and pharynx. Thus, when producing a tone with the proper vibrato, the singer is actually singing and stopping singing very rapidly. It is evident that the muscular system involved will only have time to relax to a slight degree between the impulses, so that phonation will appear to be continuous but fluctuating in intensity, and in a less degree, in pitch.

The effect, then, is that the intensity rises and falls to quite a considerable extent, especially when the tone is loud. The pitch variation is also quite wide. Examination of tracings of the sounds, phonated by well-produced voices, shows the rise and fall of the vibrato, and also the pitch variations, very clearly. At the point of high intensity the frequency of the fundamental is greater than at the point of low intensity, and both intensity and pitch should change perfectly regularly or rhythmically.

As the fundamental varies, its overtones will also change, so that we have the effect of a constantly fluctuating fundamental and overtones, although the quality will remain practically constant since the resonance conditions for the production of the tone are constant. It is in all probability this fluctuation of pitch and intensity which gives the vibrancy and beauty to a tone which is produced with a proper vibrato. This variation of fundamental and overtones produces in the ear a sense of a wealth of sound and makes the tone appear to be of far greater richness and intensity than does one which lacks vibrato even when such a tone is actually far louder.

When the work done in the production of tone is continuous, the required effort will be very great and the muscular system involved will inevitably become fatigued, but when this effort is a rhythmic one, the periodic cessation will eliminate the fatigue and will, at the same time, enormously reduce the total work done.

Another fact which indicates the vital importance of the vibrato is that it is practically impossible for anyone to hold a tone absolutely true to pitch when the vibrato is lacking. The reason for this is evident, since the continuous application of the nerve impulse to the muscular system of the larynx will soon cause fatigue, the muscles will tend to sag, and the pitch will therefore almost inevitably tend to drop.

As has been stated, the vibrato disappears at pianissimo. In other words, when the vocal cords are actuated entirely by the bowing effect of a stream of air, there is no vibrato, but as soon as the puff method starts coming into play it should appear.

As the intensity is augmented, the difference between the increasingly vigorous impulses and the cessation of impulse becomes greater and greater, and therefore the vibrato becomes more pronounced. When the maximum intensity obtainable from a given vocal apparatus is reached, a further increase in effort results in an augmentation in the amplitude of the vibrato. Thus, beyond the maximum power of a properly produced voice, an increase in effort gives rise to a greater amplitude of the vibrato. This does not strain the vocal apparatus. It does, however, produce the impression of intensified emotion, which is just what the singer is trying to convey.

It must be perfectly clear that there is no similarity whatever between vibrato and tremolo. The tremolo—a serious technical fault—takes the form of either a wobble or a mere quiver of the voice and is the result, not of a periodically applied impulse, but of fluctuating changes in the size and shape of the resonance cavities—probably a fluttering of the epiglottis. In extreme cases the tongue and also the jaw may quiver.

In Chapter IX it was shown that a valuable criticism of the technic of a given voice may be deduced from the breath-intensity and breath-pitch curves. If at the same time vibrato tracings are taken, a complete indication of the quality is obtained. Thus, if the breath curves show the correct shape and the vibrato tracings indicate the proper form and speed of vibrato, the quality is, without any manner of doubt, excellent. If, on the other hand, the vibrato is shown to be too slow,

broad or narrow, the quality is not good, even if the breath curves are of the proper shape. However, this condition does not often occur, since if all the muscular co-ordinations are correct, it is highly probable that the general technical conditions, including the vibrato, are satisfactory. Indeed no case has yet been found where the vibrato tracings were markedly irregular when the breath curves showed the correct form. The inverse is far more probable, since a singer may produce a soft tone incorrectly, thereby showing breath curves of an inverted form, and at the same time have a fairly regular vibrato. It is also a fact that the vibrato is not necessarily entirely destroyed when the muscular co-ordinations and adjustments of the larynx and pharynx are faulty, although it will always be impaired.

In most cases where the pupil has a voice of what is designated as "good natural quality," the vibrato is natural and does not have to be trained. When the vibrato is regular the voice always sounds pleasant, provided that the intonation is fairly true, whereas the quality of a voice which lacks vibrato is never even passably agreeable.

Despite the fact that the vibrato can always be trained when the pupil who lacks it is a hard worker, it is a serious mistake for the teacher to attempt to dwell upon it before a certain degree of technical development has been reached. The result of any such attempt will almost inevitably be to engender a tremolo. When the muscular system of the vocal organs has been developed to the necessary degree, it is, in practically every case, an easy matter for the pupil to conceive the idea of the periodically applied impulse, and in many cases the vibrato will appear spontaneously. In brief, then, the vibrato must not be taught until the pupil has learned to hold his throat firm.

Various devices may be used by the teacher in developing the vibrato when it is lacking. One such device is to endeavor to engender in the pupil's mind the idea of the entire body, as well as the vocal apparatus, throbbing periodically and rhythmically. The periodic movement of the diaphragm may actually be felt and the laryngeal movement may be sensed. The pupil may be instructed to count rhythmically, in his mind, while producing a tone. Such counting must, of course, be absolutely regular. With each count he should be told to sing and stop singing. This application and cessation of effort must be rapid so that, actually, phonation never ceases. While endeavoring to do this he may be allowed to place his hand over his diaphragm in order that he may feel its movement. This device, however,

must not be persisted in too long for fear that a sense of "breath-consciousness" might be engendered. If this movement is too slow at first it does not matter so much, provided that it is regular and of sufficient amplitude, but if it is irregular or too narrow there is serious danger of his merely developing a tremolo. When the movement is of the correct nature but too slow, it will not be found difficult for him to increase its speed as his technic improves.

Another device which sometimes proves effective in the development of the vibrato is to teach the pupil to *shake*.[1] He should be instructed to shake very vigorously with an extremely strong impulse for the upper tone of the shake. The lower tone should be sung with the minimum possible effort. This difference of effort may be exaggerated until he feels that he is singing the upper tone as vigorously as possible and practically stopping for the lower tone. This must be done quickly enough for phonation to be continuous. When he is able to do this properly he may be told to continue the same action but to keep the pitch constant.

Another suggestion which may help to convey the idea of the vibrato is to draw the comparison to a tennis ball which is being batted up with the racquet but which is never actually allowed to touch the ground. Thus the ball is hit up, allowed to drop and hit up again before it can touch the ground. Similarly the impulses for phonation must be applied, stopped and reapplied before it is possible for the sound to cease.

The vital importance of the vibrato in the determination of the quality of the tone is at once apparent. There are, however, many other phases of the technic which are partially or entirely dependent upon the possession of a proper vibrato.

As has been pointed out, the vibrato should be absolutely regular, and when it is perfect it has, indeed, a machine-like regularity. This regular beat, which is going on all the time a singer is phonating, gives a *unit of time*. Thus, when singing an arpeggio, each tone has a certain number of vibratos according to the time and rhythm in which the musical figure is being sung. This allows of absolute perfection of time and rhythm. Such accuracy is quite impossible where there is no unit of measurement—i.e., where the vibrato is irregular or lacking.

Perhaps the most vital factor in artistic and musical singing is the sense of the phrase as the musical unit. Only when the singer has a proper vibrato can he sense this movement over

[1] See Chapter XVII.

a group of notes. Thus the singer who lacks vibrato is only able to sing isolated tones and this means that he cannot really sing at all in the true sense of the word.

Again, the proper singing of runs, scales etc., is, as will be pointed out in Chapter XVI, dependent upon the vibrato action.

Thus, not only quality, but also time, rhythm, speed, phrasing, running scales, etc., feeling and the actual life of the tone itself, are largely dependent upon the vibrato.

In singing a nine-tone scale at high speed, holding the top tone, each tone may have one vibrato while the top tone has nine; the ninth vibrato being an extra vigorous one that will start the voice down the scale to the bottom tone, which has eight vibratos. This process will give an absolutely perfect scale with each tone held exactly the correct integral of time for the required rhythm. Such perfection is absolutely impossible in any other way. This process can, of course, be varied in a very great number of ways to suit any required rhythm, but each movement from tone to tone must be made on *one* vibrato.

Suppose a singer endeavors to run a scale without vibrato: he will have to try to estimate the length of time he holds each tone *without any measure to gauge these time intervals.* The actual result of this will be that the integral of time will inevitably be somewhat irregular, and furthermore, the uncertainty of the exact moment when the pitch should be changed will unavoidably result in a series of more or less pronounced jerks or slurs. This will destroy the smoothness and movement of the voice.

Of course, it is impossible for the singer to move his voice over a musical figure unless he can hear the entire figure in his mind, in the proper time and rhythm, before he starts to sing, but even when the concept is perfect, it is physically impossible for him to encompass the group of tones with his voice if the vibrato is lacking.

It cannot be too emphatically stated that singing, as an art, depends primarily upon this ability to sing groups of tones as single units. Just as a word pronounced in syllables has no true meaning, so a musical figure sung as separate tones has no musical meaning. An artist must sing music fluently and with understanding and meaning, just as an actor must speak his lines with understanding, proper emphasis, continuity and intelligence.

Another point of fundamental importance is that the vibrato action must be taking place *all the time the singer is*

phonating. This also applies to the movement of the voice between tones. Thus, when singing a run, the transition from tone to tone is accomplished on a single vibrato. Under no circumstances should the vibrato stop when the singer slides or runs from tone to tone. It will, then, be readily seen that when a slur down over an interval is indicated, the slur must actually take the form of a series of vibratos, the number of impulses required depending upon the speed at which the 'slur' down should be taken in this particular passage. This will eliminate the 'slurry', or wailing, quality of the slur and will turn it into a rippling run down or in other words, produce a 'pearly' effect.

Thus, when starting to sing a group of tones, the singer should commence the vibrato and this movement must continue with absolute regularity until he stops phonating.

In running the nine-note scale in the rhythm mentioned above, the total number of vibratos required will be thirty-two. The usual rhythm for a tonic triad with the octave repeated will be four beats on each note except the top one which will have eight. Irrespective of whether the number of vibratos on the tones are one, four or eight, the transition from tone to tone consumes exactly the same interval of time, since it is always essential that the singer should be "running on the vibrato" which never ceases and is absolutely regular.

The number of vibratos required for a slur or portamento will vary according to the effect required and to the length of time the upper tone is held. It will always be an exact factor of the rhythm of the composition.

CHAPTER XV
THE SLUR

In the preceding chapter the statement was made that the transition from tone to tone should be made on the vibrato, and that the singer should never slur.

Slurring is so common a fault and so serious an obstacle to good singing that it is necessary to discuss this question further.

Most beginners and practically all inartistic singers slur, despite the fact that one of the first processes in the training of a voice in which this failing is found should be the absolute elimination thereof.

In Section III, the definition of a musical sound is given. It is stated that when the frequency is regular the sound may be defined as a musical tone, whereas when the pitch is irregular the resultant sound is mere noise.

The characteristic of the slur is the constant change of pitch which actually produces the 'slurry' effect. Thus the singer who slurs is not singing—he is making a noise, and a most unpleasant noise too—from the standpoint of the musician.

The slurring attack is shown in Chapter XVI to be the result of a hazy mental concept of the pitch of the tone to be sung.

Slurring is always the result of either a lack of vibrato, a hazy concept of pitch, fear, or a false sense of the artistic.

The correct production of a given tone depends upon the proper adjustment of the vocal cords, or in other words, of the muscles which actuate them, and also upon the accurate 'set' of the resonance cavities for the fundamental and the vowel. Both these adjustments are absolutely dependent psychologically upon a perfectly clear and accurate mental concept of pitch and timbre. Exact adjustment is, in the last analysis, dependent upon the singer's ear in the fullest sense of the word. The motor response of the vocal parts rests upon the clarity of the mental concept.

Let us consider what happens when the singer slurs: Instead of singing a definite pitch of definite quality he starts the tone experimentally, with faulty intonation, and then attempts,

generally by slurring up, to 'find' the proper pitch and quality. Obviously the result of this will be that the sense of pitch and the motor response, which depends upon this sense, become hazy. Psychologically the slurring singer will tend to become more and more bemused. He will constantly be readjusting the tone which he is singing for pitch and quality. The result of this will be that the adjustments necessary for proper tone production become less and less accurate and spontaneous.

The singing of high tones depends, in an even more marked degree, upon the proper tuning of the vocal resonance cavities than does the production of the middle tones which take less support. Thus, when the adjustment is faulty, the high tones cannot be produced at all.

Suppose the pupil slurs up to a high tone: he will be holding the throat adjustment which is, at best, correct for the lower tone. Thus the upper tone will inevitably be improperly resonated. Such slurring may in many cases cut out from five tones to an octave from the top of a given voice.

Of course the beginner is nearly always afraid of the high tones, and at the same time, he is frightened of the amount of sound he will emit under proper technical conditions. Thus slurring is an extremely common fault with beginners. It must be absolutely eliminated before the high tones can be properly sung.

This mental attitude of the student who clings on to the low tone from fear of the upper one and then forces himself to go up with the resultant slur is, after all, a very natural failing for the beginner.

The attainment of the mental freedom which allows the singer to 'let go' and freely 'strike' the centre of the tone is a most important development in the training of the voice.

The elimination of the slur does not mean the stopping of the voice between tones, but it does mean that the voice must move on the vibrato and that the tone just sung must be entirely "left behind" when the next tone is produced.

In as much as the throat is allowed to relax somewhat during the soft part of the vibrato, since the nerve impulse has stopped, the actual movement from tone to tone is accomplished with the throat relatively relaxed. This allows of accurate adjustment for the next tone. Of course the singer need not necessarily think—"relax the throat," he need only realize that he is moving on the vibrato.

Where a slur mark is indicated on the printed page, the voice must move on the vibrato and the result will be a 'pearly' run effect. There are no circumstances under which the pitch of a phonated tone may be progressively changed.

To sum up: the pupil must be made to move from tone to tone on the vibrato, he must hold a perfectly clear mental image of the next tone to be sung before he attempts to sing it, he must sing each tone without hesitancy, fear or uncertainty, he may never vary the pitch of a tone he is singing and he must *never, never slur.*

In singing any group of tones it is absolutely essential that the singer should form in his mind a definite concept of the entire group as one unit in definite time and rhythm. Unless he starts with this fixed concept or mental image it is impossible for him not to slur or jerk. In other words the elimination of slurring depends, in a large measure, upon the ear.

CHAPTER XVI
THE ATTACK

The proper attack or inception of the tone is a most important phase of the singer's technic. A tone may be started with or without a consonant. In either case, however, the conditions for the proper attack are virtually the same, although it is often easier for the beginner to attack with a consonant.

As has been shown, there are two adjustments which must be made in the proper phonation of a tone: the adjustment of the laryngeal muscles, whereby the pitch is determined; and the set of the resonance cavities for the proper resonating of the vowel and the fundamental. These two actions are in a sense reflex, in as much as the singer does not feel the actual muscles which act in the tensing of the vocal cords or in the setting of the resonance cavities. He should, however, have a very clearly defined mental image of the pitch and the vowel-quality he is about to produce, since it is from these concepts that the adjustments are reflexly made, as from a pattern. When the muscles of the larynx and pharynx are properly developed and co-ordinated, these adjustments can be made instantaneously and with extraordinary precision. In the early stages, however, they are not so well under control and herein lies the fundamental difficulty in the proper attack of the tone.

When the attack is faulty it is possible for the singer to readjust somewhat and to slightly improve matters, as for example when he starts under the pitch and afterwards raises it so as to correct the intonation. It is also possible to improve the initial quality somewhat by modifying the set of the resonance cavities, but when he is forced to readjust in this manner the result is never really satisfactory. Exact adjustment is only possible when the mental concepts are absolutely clear and definite, whereas the possibilities of readjustment are, at best, crude.

The proper attack depends, then, upon the exact adjustment of the muscles of the larynx and pharynx at the moment of the inception of the tone; in other words it depends upon a perfect and clear concept of the pitch and the timbre—vowel-quality—and then upon the accurate adjustment of the vibrating

cords and of the resonance cavities at the moment when the breath pressure is applied.

Here, then, is the proper method of attacking a tone: first the singer must obtain a perfectly clear mental image of the vowel sound and the fundamental. Next he must set his resonance cavities properly, holding his throat absolutely firm, and *at the same moment* attack the tone without any hesitancy, explosive effect and—most important—without any shock of the glottis. He must not try to set his resonance cavities first and then attack. The set of the pharyngeal cavities, the stretching of the vocal cords and the attack must be one co-ordinated act. In a little book published under the signature of Enrico Caruso, the suggestion is made that the tone should be attacked "as far back as possible." This is rather a good idea since it suggests that the vowel should be formed pharyngeally and the throat set. It would have been far better, however, if he had said: "Attack the tone with the throat held rigid."

There are many wrong methods of attacking a tone. Among the most common of these are the scooping attack, the coup de glotte and the 'breathy' attack.

When the tone is started with a scoop, the pitch has not been properly sensed. The vocal cords and the resonance cavities have, therefore, been inaccurately and carelessly adjusted and the singer is forced to readjust as well as he can after the inception of the tone. Under such circumstances the resonance conditions are never really correct, and in many instances the intonation will remain faulty even after the readjustment has been completed. The technic of such a tone can never be really good, and in most cases, the resultant quality will be very thick and the vowel sound impure. Sometimes this fault is the result of an ear which is not sufficiently accurate, and under such circumstances the pupil must be made to concentrate extremely intently upon the pitch before attacking. He must never be allowed to sing a tone without having concentrated upon and obtained, as well as he possibly can, a clear mental image of the pitch.

It should be clear that the setting of the resonance cavities for a given vowel and the tensing of the vocal cords for a given pitch are very similar phenomena, since the vowel sound is merely a combination of pitches. The vowel can only be properly resonated when the mental concept of the exact vowel sound is perfect. Some people lack this sense of the vowel

quality and have but a poor concept of the sound of a pure vowel. This sense of "vowel timbre" is far more often faulty than is the mere sense of pitch. The reason for this is not far to seek, since it is only possible for the singer or speaker to produce a pure vowel when he has attained complete control over the principal resonance cavities—the pharyngeal cavities. Thus, while anyone who has sung has probably produced many tones which were true to pitch, and has therefore to some extent developed his sense of pitch, but few people have ever formed really perfect vowels. This sense has, therefore, to be developed in practically every case. No matter how perfect the control over the resonance cavities may be, the vowel cannot be pure unless the concept is correct. Furthermore the proper concept of a pure vowel sound implies a good ear for timbre and this is a further development of ear than is the mere sensing of pitch or in other words, of a pure tone (a single frequency).

The coup de glotte is an attack which starts with a click in the throat and may be one of the faults of the singer whose throat is relaxed and practically closed at the moment the tone is initiated. The vowel formation must therefore, inevitably, be principally with the mouth. The technical conditions under such circumstances are, then, very faulty, and a serious shock to the vocal apparatus will result. The correction of this fault depends upon the inculcation of the idea that the throat must be 'set' and held firm at the moment when phonation starts.

The 'breathy' attack occurs when the singer forces out a great deal of breath at the moment of attacking the tone. This is apt to occur when the throat is constricted and the rush of air is used to force it open to some extent. Here also the vowel formation is principally mouth. This fault may also be the result of a lag in the action of the laryngeal muscles, which come into play a moment after the tone is started. The cure lies in the proper development and co-ordination of the muscles that govern the registers.

A vital phase in the correct attack of the tone lies in the application of the breath pressure at the proper instant. Breath pressure is the result of tension applied to the muscles of the thorax for the production of tone. If these muscles are in tension before the attack is initiated they cannot be used efficiently for the purpose of singing. Thus if the singer takes a deep breath and holds it before attacking, the muscles of the thorax are 'set' and a properly co-ordinated attack is impossible.

A proper attack depends upon the relative relaxation of all muscles used in the act of phonation until the exact amount of starting to sing, when the muscles of the thorax, larynx and pharynx must come into simultaneous, vigorous action. Since all these muscles must be practically at rest until the attack is initiated, no attempt must be made to prepare for the attack beforehand, except from the point of view of preparing the mental image of the pitch and vowel sound.

If the breathing muscles are set before the attack, the breath pressure cannot be properly applied, and if the throat is tensed before starting to sing the result will be mere constriction of the pharyngeal muscles. The laryngeal muscles cannot come into action without the initiation of the act of phonation and the efficiency of their action depends upon proper registration.

The pupil should not be allowed to modify the adjustment after the inception of the tone, since it is only when one fixed pitch and vowel have been phonated, as the result of certain definite adjustments, that definite corrections can be made by the teacher. If the pupil readjusts after the attack the corrections given will be of little value, since they may apply to any part of a varying set of physiological conditions.

The teaching of the attack is one of the first phases in the training of a voice. Discussion of this question has, however, been postponed, since so much of what has been stated here is based upon a proper understanding of the principles formulated in the preceding chapters.

CHAPTER XVII

SPEED, SHAKES, TRILLS, STACCATO

No singer possesses a really good technic unless his voice moves freely and fast up and down the scale and unless he can shake, turn, trill, run all the scales—diatonic major and minor and chromatic—and perform all the ornaments of melody with great speed, flexibility and carrying power and with every tone distinct and perfect. Associated with this phase of the technic is the attainment of a proper vibrato and also the ability to enunciate words clearly and vigorously at high speed. These phases of the singer's technic should not, however, be attempted until quite a high state of development has been reached, or in other words until the resonance conditions, the laryngeal adjustment, and the vibrato are reasonably correct.

The first stage in this phase of the technical training is the study of the shake. At the start, the pupil should be instructed to shake slowly and great pains must be taken to make the movement at the larynx as definite as possible, even if it has to be somewhat jerky. A small, narrow movement or a 'slurry' shake is worthless. When this broad movement has been properly sensed, the pupil may be instructed to increase its speed. Let it be clearly understood that the shake is a consciously controlled action. When this 'trick' has been mastered it should be practiced at various speeds, within certain limits, until it is under perfect control.

When the shake has been thoroughly mastered the trill may be attempted. The student should first shake a few times very vigorously at high speed and then attempt to convert this shake into a trill. The trill is a semi-controlled action, since its speed cannot be consciously regulated. As with the shake, the movement must be broad since, if it is too narrow, the result will be a mere tremolo. The maximum possible movement must be sought and the trill should, at first, be sung vigorously. Later the intensity may be varied. Further suggestions are impractical, since the trill is, in a sense, merely a trick with the larynx which must be learned under the direct guidance of the teacher. Of course the ability to trill is sometimes natural. It is impossible for the singer to trill properly if his throat is relaxed.

As was pointed out in the chapter on vibrato, this movement of the voice is continuous all the time a singer is phonating irrespective of whether he is holding a tone or moving from tone to tone. Thus, the running of all scale passages depends upon the vibrato. If each tone of the scale is worth one vibrato and the transference from tone to tone is done "on the vibrato," it is apparent that the maximum speed at which a singer can run is determined by his maximum speed of vibrato. This speed can, however, be considerably faster than is the normal rate of vibrato. Actually, the maximum speed of vibrato possible with a well trained voice is so great that a scale can be run at what seems to be a terrific velocity with every tone clear cut and pearly. Any attempt to run faster than this maximum speed of vibrato will result in a slurred tremolo run which is quite worthless.

High speed singing should not be attempted until the voice moves properly on the vibrato for the legato. It is, of course, quite futile for the pupil who has not yet attained a proper vibrato to attempt to run scale passages fast.

A light type of voice is usually able to speed up the vibrato better than is a heavy type. However, even a heavy voice should be able to run rapidly.

It is impossible for the singer to run any passage faster than he can conceive it, however good his technic may be. Thus an essential factor in the ability to sing rapid passages is the possession of a *good music mind.*

In teaching the pupil to execute fast runs it is a good plan for the teacher to tell him to hold a tone, speed up the vibrato as much as possible and then run on this high speed vibrato. Often the ability to run properly is first attained for a run down. A run up and down of a five-tone major scale passage is usually the best exercise which can be employed for the first attempts at high speed work.

The vibrato action for running scale passages applies equally to the running of chromatic passages, ornaments of melody etc. As soon as the mind can hold the sound of any passage clearly, at high speed, the pupil can sing the passage, whatever it may be, without any real difficulty, provided that he has learned to run on the vibrato. All singing accomplished in this manner will be clean, clear-cut and crystalline, the pearly effect will always be apparent and the speed will be all that could be desired.

In teaching the chromatic scale it is sometimes a good plan for the pupil to just 'vibrato' up and down a fixed distance,

say an octave, as rapidly and evenly as possible. This often helps him to attain the concept of singing narrow intervals at high speed. When he can do this properly, he may be told to run the chromatic scale on the vibrato. It will usually help him if he counts the number of notes to be sung and makes the proper number of vibratos in the desired rhythm.

The staccato is, of course, absolutely dependent upon the proper attack since it is, in effect, merely an attack which is immediately released. Therefore, the pupil who has mastered the attack will not experience any particular difficulty with the staccato. It should be practised on single tones at first, and later on arpeggios, scales etc., at various speeds.

All these phases of the technic should be practised at the natural power of the voice—***mf***—until they are really mastered, since there is a sort of 'squeaky' tremolo which is often mistaken for a trill, a throat tremble which is supposed to be a shake, a little pinched squeak which is used for the staccato, and a futile, soft, 'throaty', slurry, high-speed run, which is employed by singers whose technic is very bad for running scales etc. Coloratura sopranos who have been badly trained are the worst offenders along these lines. All singers who have been properly trained should be able to perform the coloratura 'tricks' correctly.

Let it be emphasized again that the student must, under no circumstances, be allowed to study these phases of the technic until he has arrived at such a point of development that he will never emit a squeaky or 'throaty' tone.

CHAPTER XVIII
RESPIRATION AND POSTURE

The fact that no attempt should be made to control the rate of expulsion of the breath by means of the respiratory muscles during the act of phonation has been emphasized throughout this book. It has been shown that the singer should inspire properly before starting to phonate and then forget all about the breath. Under no circumstances should he endeavor to influence the rate at which it is being expelled, since this control is properly a function of the laryngeal muscles.

It is, however, most important that the breath should be properly inspired, lest, through false tension and lack of proper tension, the destruction of the correct degree of general tonus should result.

It is by no means a difficult matter for the pupil to learn how to inspire properly. Male singers often breathe in the proper manner naturally. Some people, however, tend to distort their bodies during the act of inspiration. This applies in particular to many women who are not in the habit of filling their lungs when they inspire. Such distortion may be the result of either nervousness or of bad habit.

Faulty inspiration may take the form of excessive inflation of the chest, with corresponding drawing in of the abdominal wall which decreases the amount of air inspired, or of improper bulging of the abdominal wall with consequent loss of chest expansion. In either instance, excessive raising of the chest or protrusion of the abdomen produces tension which seriously interferes with the act of phonation.

So far is the 'breath-control' fallacy carried by some people that they intentionally distort their bodies in the above manner, claiming that excessive diaphragmatic development is a vital function of proper vocal technic. Those who believe this to be so will in many cases define progress by the degree to which the lower part of the body is developed, and they are wont to prescribe exercises which will engender this unsightly and injurious distortion. There are even some who carry this fallacy a stage further and uphold what they call "abdominal breathing." This actually means, in common parlance, protruding the stom-

ach. It need hardly be stated that such distorted forms of inspiration not only destroy the proper degree of tonus of the body, but also reflect direct tension on the muscles of the neck etc. and seriously impede the laryngeal action. Such a "patent-medicine" method is particularly pernicious since the pupil can actually see a physical change and development. Anyone who does not understand the laws of vocal technic may be deeply impressed by such an ocular proof of advancement, despite the fact that the net result is vocally detrimental.

Another school upholds the notion of developing the chest at the expense of the diaphragm, and in this case the upper ribs are thrust out unnaturally, thereby distorting the neck muscles in an even greater degree than does the 'abdominal' method. This form of faulty inspiration is known as the "inter-costal" method of breathing.

It is, of course, obvious that when a pupil has such faults of inspiration as those mentioned above, the proper and natural method must be carefully taught, irrespective of whether such faults are the result of poor instruction or natural to the individual.

A vital factor in the proper inspiration of the breath is the diaphragm, but the inter-costal muscles are also called into action. Thus the work is distributed over as many muscles as possible without overloading any one set and thus distorting the poise and balance of the body. When the breath is inspired properly, the whole of the lungs should be comfortably and evenly filled, but they should never be over-filled. The inspiration of too much is an even worse fault than of too little breath. Thus, a forced inspiration will inevitably destroy the proper degree of muscular contraction necessary for easy posture, which will not then be attained even when the excess of breath has been expelled. The reason for this is that the excess of contraction of the respiratory muscles, continuing over the period of desired expiration, brings about the necessity of exaggerated action of the expiratory muscles to offset the unusual degree of tension of the antagonistic inspiratory muscles. Hence the chest and abdomen remain excessively tensed throughout both phases of respiration, and in this way continue to interfere with free phonation.

In inspiration care should be exercised that both costal and abdominal effort occur practically simultaneously and are evenly balanced.

As the breath is expelled during the act of phonation, no thought should be taken to the loss of air, although attention may have to be given to the maintenance of the proper posture of the body. This should never, under any circumstances, be lost. Such procedure should correct any tendency on the part of the singer to distort his body or allow his chest to collapse as the breath is expelled. When distortion does occur, it may be necessary for the teacher to make a direct correction. This should, however, only be resorted to in bad cases where it is unavoidable.

It may be mentioned here that these ideas regarding proper inspiration are of just the same importance in the performance of any other physical activity as they are in singing. Thus, they are equally essential for the athlete. The tennis player, for instance, who inspires incorrectly will lose the proper degree of tonus of the muscular system of his body and will not be able to execute a well-controlled, accurate stroke. The boxer, the base-ball player, the golfer etc. are all in the same position and they should breathe correctly for *much the same reason* as must the singer.

In some cases the breath may never have to be mentioned and this side of the subject should be avoided by the teacher whenever possible. Under no circumstances should the subject of breath be dwelt upon too much lest, as stated earlier in this book, "breath-consciousness" should result. Many pupils breathe well enough for their faults of breathing to be automatically corrected when they have learned to assume a proper posture during the act of phonation.

The singer's posture is of great moment, not only because the actual appearance which he presents while singing is important and has a very great effect upon the audience, but also because incorrect posture will destroy the proper degree of tonus of the muscular system of the body and will often interfere with the proper adjustment of the vocal apparatus. Of course an artist can sing properly in any position since he is able to maintain the desired degree of tonus under any and all circumstances. This, however, implies great skill and experience. When singing on the concert platform the artist should stand erect and his body should have a forward rather than a backward inclination, although this must not be too pronounced. If his back is arched in, considerable strain will result, so that after singing for a short time he will experience fatigue of the back and abdomen. The body should be comfortably balanced upon

the feet, which should be somewhat separated in order to give a good 'stance'. A sense of balance is as important to the singer as it is to the golfer when he addresses the ball or to the tennis player when he makes a drive (foot-work is one of the most vital phases in the technic of tennis). The "work done" in singing must be performed with the body, or in other words, the muscular system of the entire body must brace the muscles which keep up the breath pressure and actuate the vocal organs. The fundamental condition for this "body work" is the proper degree of tonus of the entire muscular system of the body.

When the singer uses his voice energetically he should brace his body, so that he will have the sensation of "increasing the support." This bracing of the body for the fortissimo or for any big effect (the same thing applies to the pianissimo) is most important; it should not, however, be associated with unnecessary bodily movement. Movements of this sort during the act of phonation are usually of a disturbing nature, since the muscular energy expended in their accomplishment cannot be applied to the production of tone and is, therefore, wasted. Some singers are in the habit of rising upon their toes and elevating their chests when making a vocal effect. Even if this seems to help them to 'support', it is not an advisable thing to do, since all that actually happens is that they expend a great deal of energy in futile and unbecoming movement.

Thus the singer should maintain his body in a state of poise, keeping perfectly balanced on both feet and with all unnecessary movements avoided. When action accompanies singing, the gestures should be made freely and without interference with the poise and tonus of the body.

The idea that the singer should brace his body in order to sing vigorously must under no circumstances be associated with the "breath-control" fallacy. There is no connection whatever betwen the two ideas.

Proper facial expression is of paramount importance in the rendition of a song. In order to sing really expressively, the artist's face must portray every emotion and feeling of the composition. When the technic is faulty, the face is apt to express distress, and worst of all, when the mouth is used as the principal resonator of the vowel, the entire facial expression will, inevitably, be determined by the hideous contortions of the mouth necessary for the accomplishment of this act.

Lateral movements of the mouth are particularly destructive to proper facial expression since not only the mouth but also the upper part of the face will inevitably become distorted. Any desirable expression of the eyes, in particular, is impossible under such conditions. This is very serious, since the expression of the eyes is of paramount importance in portraying emotion.

When the technic is good, the pharynx is the principal resonator of the vowel and the mouth is not shaped, so that the facial muscles are absolutely free to express the required emotions. At the same time, the singer has a feeling of confidence which allows him free rein for these facial expressions, since he is not worried as to whether or not the vocal effects he is trying to make will "come off."

Shakespeare speaks of 'mouthing' actors — 'mouthing' singers are quite as bad, if not worse. It is to be hoped that the development of the talking movies will demonstrate the necessity for proper facial expression on the part of the singer and will give visual proof of the seriously detrimental effect of the idea of mouth vowel formation.

As has been stated, the expression of the eyes is of great importance. They should light up with feeling a moment before the start of the accompaniment; and indicating every passing emotion of the composition, should hold their expressiveness until a moment after the last note has been struck.

It is quite futile for the teacher to mention facial expression until the vowel formation is pharyngeal and the muscles of the larynx are quite well developed and co-ordinated. When the proper stage has been reached, it is most important that the pupil should be made to maintain a becoming facial expression all the time he is singing. This even applies to the performance of technical exercises. At this stage it is, in fact, incumbent upon the teacher to watch carefully and correct the expression of the face and eyes when they are faulty.

As a general rule the assumption of a proper posture may be insisted upon from the outset of the pupil's studies, despite the fact that a fixed position is very injurious and may lead to stiffness. Thus considerable leeway may be permitted. The pupil should not be allowed to move sideways, stand upon his toes or lean against the piano while singing. An incorrect posture, or a fixed one, will inevitably destroy the proper degree of tonus of the muscular system of the body.

Some people whose dramatic faculty is very pronounced will try to put into their singing more dramatic force and ex-

pression than their state of technical development will allow. The result of this may be both incongruous and injurious. This most desirable talent should be utilized to its fullest extent and all individuality must be allowed to have full sway as soon as the voice responds properly, but if it is brought in too soon the result may be vocally harmful. Whenever the pupil can create his own interpretation he should not be checked, provided that he does not distort the music. A personal touch is, in fact, far better and means a great deal more than does one which has been inculcated. The songs given to a pupil who has great dramatic talent, but is not technically very far advanced, should not be of too dramatic a character.

The possession of dramatic ability is invaluable for the singer and anyone who has this gift will usually have great latent possibilities. As the technic of such a one progresses, his improvement will show very clearly in his increased ability to express himself. The greatest care must be taken not to deaden this natural talent, or in any way impair it, during the period when he has perforce to hold himself in check. A competent teacher should, in practically every case, be able to equip the pupil who is talented dramatically with a technic which will respond properly to each and every demand made upon it.

CHAPTER XIX

FAULTS, FALLACIES AND FEELING

The physical process of training a voice is one of eliminating the faults and strengthening and co-ordinating the muscular system which should be functioning in the act of phonation. Technical faults consist of muscular interferences and the false co-ordination of muscles which should not be brought into action for the act of phonation with those which should. Such false muscular co-ordinations will interfere with the development of the muscles which should be employed and also render it impossible for the singer to use and control his voice properly.

A pupil who lacks a sense of musicianship can never be made to sing satisfactorily, no matter how fine his voice may be. A lack of temperament makes it impossible for the singer to render his performance interesting and he will, therefore, never become an artist. Of course musicianship can and must be taught; but, if the student lacks the essential musical talent, the work necessary in order to convert him into a musician is colossal. In other words, musicianship can and must be taught and a sense of music developed, but, when this sense is really lacking, it cannot be actually engendered in anyone. As a general rule, however, a keen desire to sing indicates that the aspirant has, at any rate, latent talent, even if this talent is obscured by a lack of musical knowledge.

There are various ways in which the ear may be faulty: thus the sense of intensity, timbre or pitch may be lacking or uncertain. When the sense of intensity or of timbre is poor, the failing is not so serious as when the sense of pitch is unreliable. Of course these faults may occur in any degree so that, for instance, the sense of pitch may merely be rather uncertain, or the individual may be totally tone deaf. When this failing is not too pronounced it is possible for the teacher to improve matters a great deal, and in some cases it can be absolutely remedied. The process is, however, a difficult one and requires much patience on the part of both teacher and pupil. It may be stated here that singing off key is not necessarily due to a faulty ear, since it is often caused by a poor technic, and in

this case the trouble will be entirely overcome when the voice has been properly trained. Actually, in fact, nearly everyone sings off key to some extent until the technic is quite highly developed, although this false intonation may be so slight as to be imperceptible to any but an extremely sensitive ear.

When the pupil sings off key it is sometimes hard for the teacher to determine whether this is due to a faulty ear or to poor technic. However, in practically every case, a properly conducted test will determine the true reason for the faulty intonation. As a general rule, when any one tone in any part of the voice can be sung true to pitch, the fault is technical and not functional. On the other hand, when every note in the voice is untrue to pitch, the trouble is almost inevitably due to tone deafness and the training of such a voice is impossible.

Another sense which is vital to the singer is that of rhythm. A good sense of rhythm is an enormous asset, and where this faculty is poor, much hard work must be done in order to improve it. Extreme cases may, indeed, be practically incurable. Despite the fact that a fault in time or rhythm is every bit as bad as is the singing of a wrong note, many singers are inexcusably careless about this phase of the subject. To sing in perfect time and rhythm requires a great deal of hard work and study. If this effort is not made, the interpretation of songs is rendered virtually futile. Time and rhythm can, if the sense of rhythm is not altogether lacking, be made absolutely perfect, provided that the student (and the teacher) are willing to do the necessary work. Carelessness in this department is inexcusable.

It may be stated here that it is theoretically possible for any person to develop a really fine voice, provided that the ear is not seriously faulty and that there is no functional disorder of the vocal apparatus. It is evident that when the natural technic is very faulty, there is far more to be done and the work will be much harder than when it is naturally good, or in other words, when the aspirant has what is called a "natural voice." Nevertheless, it does not by any means follow that the pupil who starts with a good technic, relatively, will do any better in the long run than will the one with a poor equipment who works really well. In fact the inverse is only too often true, since many students who start with a fair amount of talent are not willing to work as hard as some who start with far less. In the past it has been supposed that the possession of a 'natural'

voice was the first and most important attribute for the student of singing. In the light of our present knowledge this is now absolutely untrue, since the teacher who really understands how to train a voice can, in many cases, actually "make a voice." The only provisos are that the student must have a normal ear, be a hard worker and must also be intelligent. A sense of musicianship and artistry is a far more essential asset than is the mere possession of a naturally good technic. The true artist is born, not made, since temperament, dramatic ability and a sense of musicianship are truly natural gifts which, despite the fact that they can be trained and developed, cannot be created.

Faulty intonation may be due to a number of causes the chief of which are: (1) faulty technic. This is, of course, corrected when the technic has been rectified.

(2) Faulty mechanism of the external or internal ear. This might be curable by an ear-specialist, but the vocal teacher is quite helpless.

(3) Faulty motor response. In this case there is not much to be done, although hard work and concentration may help, in some instances, where the response is not too faulty.

(4) Mental concept of pitch weak or faulty. Careful ear training will help a great deal, and in some cases may effect an absolute cure.

When the technic is 'throaty', 'thick', 'heady', or 'nasal' the pupil will usually sing rather badly off pitch; since, under such conditions, proper adjustment of the resonance cavities is impossible and false resonance conditions usually cause faulty intonation. All these faults are the result of an atonic (partially relaxed) and practically closed laryngeal pharynx accompanied by false tension on the muscles of the jaw, neck etc. Sound will be transmitted through the members in such a state of tension. Thus, when the muscles of the neck are tensed unduly and tension on the constrictor muscles of the laryngeal pharynx results, the sound will appear to come from the throat and the resultant quality will be what is known as 'throaty'. This is, of course, an absolutely different phenomenon from that of a tone which is being correctly resonated by a firm, open and properly shaped throat. A misunderstanding of this fact results in some people being afraid of the idea that the throat should be tensed in order that the tone may be properly resonated. They erroneously imagine that any tension of the throat will produce 'throatiness'. That this fear is quite unfounded and contrary to the facts of the case has been definitely proven.

A very prevalent fallacy in vocal training is the idea that the mere practice of technical exercises will advance the pupil. Actually it is most injurious for a vocal student to practise technic alone. During the lesson the teacher is forced to make innumerable corrections with a view to obtaining better physiological conditions. Such directions often have little or no direct bearing upon the quality of the tone, since it does not by any means follow, especially in the early stages, that a tone of apparently better quality is technically better. In addition to this fact, as has already been shown, the singer does not really hear the quality of the tone he is producing. For these reasons the corrections a pupil makes for himself will almost inevitably be wrong and he will usually merely be practising his technical faults. Experience has shown that, at any rate in the earlier stages, the pupil who never sings technical exercises except at his lessons will make far better progress than will the one who insists upon practicing technic away from the teacher's guidance. Naturally, then, the rate of progress is dependent upon the number of lessons taken and the shortness of the intervals between the lessons. Thus the pupil who takes three lessons a week will make more progress than will the one who takes the same number of lessons in three weeks. Since all the technical progress which is made is accomplished at the lesson, the pupil is less likely to forget when the intervals between the lessons are short. Furthermore the muscles which have been properly exercised will have time to sag if the interval is too long. It is, of course, rather obvious that, when muscles are being developed and stretched, the exercises by means of which they are being trained should be resorted to at regular, short intervals, and if the interval is too long, all the development which has been accomplished at the lesson will have had time to be lost.

It must also be realized that the development of a good technic depends largely upon the attainment of the proper mental attitude by the pupil. Thus the pupil who listens to his own voice, the one who always tries to make a pleasant quality, the one who is afraid to "let his voice go" etc. must readjust himself psychologically.

The possession of a natural voice depends very largely upon the mental attitude of the singer. Many people are afraid to sing loudly and to "go for it". It is impossible for anyone to sing a tone properly if he is afraid. Inhibition is the singer's worst enemy.

When training a timid pupil the teacher is compelled to work him up into a state of emotional excitement which will allow him to "let go". A great deal of the work of the teacher has to do with the inhibitions of the pupil, who must be *forced* to use his voice in a manner which is often quite foreign to him psychologically. This is very difficult and it is absolutely impossible for the pupil to work himself up, in this way, without the driving impetus of the teacher behind him. These difficulties apply in particular to Anglo-Saxon pupils. Latins are apt to be extremely temperamental and to "go for it" very hard when they sing. Therefore, they are not so apt to hold back and constrict the pharyngeal muscles, thus singing with a 'throaty' technic. This is one of the chief reasons why Italians are so often vocally talented.

The importance of the psychological side of the subject cannot be over-estimated. In the last analysis, technical development depends, primarily, upon the attainment of a mental attitude which permits the singer to give his voice free rein and to allow it to sweep over the phrase.

Bad teaching which engenders in the pupil's mind the idea of listening to the quality of the tone he is singing, or which directs him to make some impossible physical adjustment while singing, or which makes him "breath-conscious" etc. is fatal, not only physically, but also psychologically.

The method of teaching which "builds on the soft" is particularly pernicious from this standpoint, since it engenders in the pupil's mind the idea of restraining his voice and holding back. Actually the first psychological principle of vocal technic, which must be engendered before the pupil can make any real progress, is the concept of freedom—freedom of voice, mind and spirit.

In the previous chapters the quaint notion of "placing the voice" has been discussed. Could anything be more pernicious, from the standpoint of psychological and physical freedom, than the idea of making a physical operation for each tone one sings?

Fear, inhibition and timidity are the worst enemies of the aspiring singer and they must be overcome by the teacher if he is to succeed in developing the pupil's voice. Stolidity comes under the same heading. A stolid pupil, or one who lacks temperamental freedom, must be "worked up".

It is impossible for anyone to sing a single tone of acceptable quality if he is not emotionally excited. This idea of emotional excitement or 'feeling', which must be created and held all the time one is singing, is of fundamental importance. Such

'feeling' should best be abstract, but where the pupil lacks temperament, definite emotions may be suggested to him and he may be instructed to endeavor to hold the idea of great joy, love, anger etc. while singing.

Of course there can be no real life or feeling in a voice which lacks vibrato. This concept of holding emotion or excitement all the time one is singing may, and often does, help to engender the idea of the throb of the vibrato.

The attainment of the proper degree of tonus of the muscular system of the body has been shown to be of fundamental importance in the development of a proper technic.

It is impossible for the pupil who is emotionally 'dead' to attain this condition. There is a definite connection between the creation of atmosphere—the holding of a state of emotional excitement—while singing and the attainment of the proper degree of tonus of the muscular system of the body. For this reason it is physiologically impossible for the pupil to sing even his technical exercises properly if he fails to create emotion while phonating..

Thus it is essential that the singer should definitely *"create atmosphere"* before he attacks a tone and hold this atmosphere all the time he is singing, irrespective of whether he is singing a song or a technical exercise. This act is a vital function in the proper production of the tone. The singer who believes that he can learn to sing mechanically, and who wishes to separate technic and feeling, has no true understanding of the subject. The development of a proper technic is a psychological as well as a physical and physiological problem.

It will, then, be at once apparent that the changing of the mental attitude of the pupil and the engendering of a concept of the vocal art which is psychologically correct is a problem with which the teacher, and the teacher alone, can deal. This is something on which the pupil cannot work without the teacher's aid. In view of the fact that this side of the subject is just as important as is the purely physical side, practice, when away from the teacher, is, from this standpoint also, futile and probably injurious. Furthermore, it is most important, for this reason also, that the intervals between the lessons should not be too great lest the psychological development which has been gained at the lesson should be lost between lessons.

Of course the above statements pertain only to technical development. On the musical side of the subject there is a very great deal of work to be done by the student away from the

teacher. Two lessons a week is about the minimum which should be taken if satisfactory progress is to be expected and the greater the number of lessons taken each week, the faster will be the pupil's advancement.

In the early stages the musical forms, used in working on the technic, should be very simple, since the chief purpose of such exercises is to develop and co-ordinate the muscular system used for phonation and not merely to teach the pupil musical figures. This comes at a later stage. Some methods of teaching endorse the use of books of exercises. Under such a method, the pupil is given a new exercise to learn at each lesson. This is worse than futile, since all that he is doing is to practise vocalizing, with all his technical faults, in order to sing little tunes. The outcome can only be to establish these faults more firmly than ever. *No exercise has any innate technical value.* In fact, since the inspiration of a song and the necessity for pronouncing words are lacking, such vocalizes are apt to be not only futile, but psychologically and technically harmful.

Thus the exercises employed may be simple. The use of single tones is often beneficial in order to obtain certain adjustments, although the concept of singing groups of tones as a unit must be attained as soon as possible. For moving the voice up and down, major triads, groups of five notes of the major scale or the major scale itself may be used. Arpeggios or major tonic triads are easy to learn and may be utilized for moving the voice over a range of an octave or more. For the establishment of the upper register—falsetto—and for the first attempts at co-ordinating it with the lower register, octave jumps may be used. The pronunciation of different vowels, and vowels in conjunction with consonants on one tone, may sometimes be resorted to when endeavoring to inculcate the idea of resonating the vowels pharyngeally. All the above musical forms are so easy that the pupil is able to concentrate upon the physical directions, pertaining to the technic, without having to worry about the tones he is singing. This is all that the exercises are useful for, until the training is so far advanced that the musical forms, ornaments of melody etc., can be taught without impairing the technic. Later in the training, these forms must be studied; thus the pupil must learn the minor scales, the chromatic scale, shakes, turns, trills, triads, intervals etc., but this must not be done until the technic is well advanced.

It is a most unfortunate fact that many people merely train the voice, *as it is*, to do the best it can with the musical forms,

without attempting to really improve the physiological conditions. They simply attempt to obtain the best possible quality with the muscular co-ordinations which are actually being used. This method of teaching may not hurt, and may indeed even help, a singer whose technic is naturally very fine, but in the vast majority of cases it is not only futile but most injurious.

Of course, musical forms may be taught to a beginner, provided that he does not sing but merely plays them upon the piano. It is an excellent plan for every vocal student to study the piano, since he should be able to play reasonably well. Furthermore, he can learn from his piano teacher all the facts about music without fatiguing his voice. When the singer can hear all the musical figures mentally, as he should be able to do if he has practised them on the piano, it is an easy matter for him to sing them when he has attained the necessary technical equipment.

Technical exercises should be used over as wide a range as possible, so that the entire voice is exercised. For this reason the tonic major triad in fundamental position with the root doubled should be used from the outset, since scales are far harder to sing properly and the sweep of this broken chord is sufficient to meet the requirements.

CHAPTER XX
GENERALLY ACCEPTED FALLACIES

Throughout this book a number of the generally accepted tenets of vocal technic have been shown to be fallacious. Among these false concepts are the following:

1. The idea that the breath should be consciously controlled by means of the respiratory muscles during the act of phonation. This fallacy has been so thoroughly dealt with in the preceding chapters that no more need be said about it here.

2. The idea that the throat should be relaxed during the act of phonation. This has also been discussed at some length.

The fact that the laryngeal pharynx should be held rigidly in a definite shape, determined by the vowel and fundamental being resonated, has been definitely proven. To recapitulate somewhat, it may be stated that the muscles of the neck should be relaxed so that there is no visible external sign of tension or strain. This must be very clearly understood, since tension of the neck muscles will affect those of the jaw, which therefore become tense and tend to constrict the throat. When this tension on the muscles of the neck and jaw is great, the throat becomes very constricted and thus held closed, which is the direct inverse from the proper tension which holds it rigidly open.

On being told that the muscles of the throat should be tensed, many people will exclaim: "But that would produce a 'throaty' tone." This contention is, as has been shown, absolutely fallacious since the opposite is actually true. It is, in fact, the constricted throat which engenders this quality. Consciousness of the throat because one has such a reflex control over it that he can shape it properly for the resonating of the vowel and fundamental, is an essential of proper technic and much to be desired. Consciousness of the throat because it is distorted and constricted through interference of the muscles of the neck and jaw is a fatal fault. The direction to conceive the idea of holding the throat firm and forming the vowel 'back' in it will not engender 'throatiness', but the singer who endeavors to relax his throat and form the vowel forward in his mouth, or worse still,

"get his voice out of his throat" and "into his head" (or nose) will inevitably produce a 'throaty' tone.

3. The idea of 'placing' the voice. This curious notion takes various forms. Some say that *'It'*—whatever 'it' may be—should be 'placed' in the head, in the mouth, against the hard palate, in the nasal cavity, etc. It has even been suggested that 'it' should be 'felt' in the 'masque' or front of the face or nose and that the nostrils, the nasal cavity, the lips etc. are important resonators. The quaint statement that the hard palate is the "sounding board" of the voice has also quite often been made.

All such ideas are so unscientific that one would feel ashamed to mention them were it not for the fact that they are very often propounded by so-called 'authorities' upon the subject of vocal technic.

Of course the mere idea of 'placing' the voice anywhere is utterly fallacious and is immediate proof that its advocate is ignorant of what sound, resonance etc. mean physically. When a singer phonates, he sets the air in vibration and the sound emitted is not in the nature of a stream of moving air. The vibrating air has nothing to do with the outgoing breath which has set the vocal cords into vibration. The breath from the lungs which has been used for this purpose has lost much of its energy when it has passed the vocal cords and travels very slowly, whereas sound is transmitted through the air at the rate of about eleven hundred feet a second. This transmission of sound has no connection with a draught or a moving stream of air. Thus the absurd idea that the voice is "vocalized breath" is without meaning.

Now if there is nothing pertaining to the sound which moves other than the *vibration* of the air particles, there is obviously nothing which can be directed or placed. Thus the entire notion of "voice placement" is utterly without any basis in fact.

The idea that the nose or the nasal cavity is *the* resonator of the voice is also totally erroneous, since the post nasal cavity is not only highly damped with loose folds of moist flesh, but also it is not an adjustable cavity. A fixed cavity can resonate at a fixed frequency or frequencies, but it cannot be an important resonator of the voice, consisting as the latter does of vowel sounds and fundamentals which require innumerable and exact resonance adjustments, and inter-adjustments.

When the idea of placing the voice is taken to mean fixed conditions such as getting 'it' into the head, nose etc., the as-

sumption might be that fixed resonance conditions are desired, irrespective of the vowel and fundamental which are being resonated, and this is, of course, absurd. It is to be assumed that anyone who talks about "placing the voice" does not wish to be taken literally, since the literal interpretation of this notion would surely imply the amputation of the larynx and the grafting thereof onto the part designated.

The idea that the upper tones are "head tones" is another form of the same fallacy and is, of course, equally erroneous, since it implies that the resonance column should become longer and larger for the higher tones. This is diametrically opposed to the laws of physics. Those who hold this false theory are, in some instances, quite specific in saying that the "voice should go higher and higher in the head" as the scale is ascended. It is the same fallacy in a more pronounced form.

4. The fallacious idea that the man's falsetto should never be used and is not a true part of the voice, and that a woman's lower register or "chest voice", as it is often designated, should either never be brought into play, or at any rate only be employed for the lower tones (up to F on the bottom space of the staff).

It is indeed difficult to understand these fallacies which are, in effect, contradictory, since the vocal organs of the two sexes are physiologically exactly similar. The larynx and pharynx of both male and female are structurally absolutely similar, except in as much as the male organs are larger, with the result that the average male voice has a natural pitch about one octave lower than the average female. It should surely be obvious that the technical conditions governing the use of the organs of the two sexes cannot vary. Two saxophones may be of vastly different sizes, and therefore have quite different natural pitches, but they function similarily and are played the same, irrespective of their size. The same thing applies to a violin and a viola. Of course, men speak in the lower register, while many women use the upper, and as a result of this, in most cases, the upper register of a man and the lower register of a woman are undeveloped. It is, however, quite transparent that it is the weak register of any voice which most needs development, irrespective of sex. It is also obvious that each register is of equal importance irrespective of sex, so that, while no one would suggest that a man should use the falsetto, or a woman the lower register, only, it

is difficult for one to understand why the inverse contention is so widely held.

Probably the true reason for this fallacy lies in the fact that the teacher who does not understand the science of vocal technic will be unable to co-ordinate or even to develop the registers properly.

Vocal development or progress should be apparent in this manner: the actual voice should seem to become a better and better "natural organ". It may sound rather crude and rough for some time, but it should improve in the sense that the muscles of the larynx, pharynx, and thorax co-ordinate better and the entire vocal apparatus becomes healthier, while the range and power increase a very great deal and the natural quality and power of the actual voice begin to reveal themselves. At the same time, the intonation improves and the sense of strain, effort, constriction and interference are eliminated step by step. What may be called the 'polishing' of the voice is a process which must not be undertaken until the muscular developments and co-ordinations are practically complete.

5. The almost universally accepted fallacy that the mouth should be the vowel forming cavity. This question has been so thoroughly dealt with and the falseness of the contention so clearly proven that no more need be said about it here.

In the above enough has been said to indicate some of the more common ideas which are quite opposed to the actual facts which govern the laws of vocal technic.[1]

Two statements made in the first edition of this book and in my paper *The Science of Voice* read before the Franklin Institute and published in the Journal of that Institute of April 1931 have been widely commented upon in the press all over the United States and by music critics. They are based on certain generally accepted misconceptions about vocal technic.

6. The fallacious idea that the range of the ordinary human voice seldom exceeds two octaves. Many persons, including music critics, have been frankly sceptical about my statement to the effect that the average range of a *properly trained* voice should be at least three octaves.

[1] The author established the fact that the pharyngeal cavities should act as the principal resonators of the voice in the year 1922. This discovery was published in a paper read before the Physical Society in 1924 and later in an article published in the *Scientific American* under the heading "Scientific Tests for Good and Bad Singers" in the issue of December, 1924.

To the best of his belief this discovery was first propounded by the author.

The reason why practically all singers except the great ones have such limited ranges is that they have been trained by persons who are not qualified to teach vocal technic. Those who preach the "head voice" idea automatically eliminate many tones from the top of the voice. The "breath-control" fallacy has the same effect. The lack of understanding of what the function of the registers really is, eliminates a large area at both the top and the bottom of the voice. Voice "placement" is another prevalent cause for curtailment of the range.

True, the beginner can seldom cover more than two octaves and often even less. True also, after the usual sort of training the vocal student receives, the range is still further curtailed. Nevertheless, the process of training the voice should, when properly carried out, result in an enormous extension of the range. If the teaching does not have this effect, the teacher is incompetent.

7. The idea that a great natural voice is an anatomical peculiarity—i.e., that it is due to certain peculiarities in the formation of the vocal organs. My statement that any perfectly used voice can be on a par with the greatest voices of the world in quality, range, control and carrying power, provided that there is no actual physical malformation or disease, has caused nationwide comment.

This fact has been so clearly indicated throughout the pages of this book that no more need be said about it here. True, under the generally accepted methods of training voices the range is usually curtailed, the quality is likely to become worse —not better—the power is most unlikely to develop and the "natural voice" at best remains the same (actually, in practice, it usually deteriorates). Proper methods of training so alter every phase of the technic that a complete transformation often occurs.

8. The misguided notion that the vibrato and the tremolo are one and the same thing. Of course the tremolo is a lamentable fault and is always accompanied by a throaty technic and a poor quality. Without vibrato there is no real singing. The difference has been very clearly shown in this book.

CHAPTER XXI

MISCELLANEOUS FACTS AND FANCIES

There is an amusing and much quoted legend of the old Italian school of singing which runs as follows: A young man who desired to become a great singer went to study with a famous Maestro. He was fired with the highest ambitions and ready to work, if need be, for years in order that he might attain his goal. The Maestro heard him sing and agreed to train his voice. At the first lesson he gave him a single page of exercises and told him to learn them. As lesson succeeded lesson, the routine never changed and for five long, weary years this ambitious young man was never allowed to sing anything but this one page of exercises. (He must have had infinite patience even if his intelligence was not equal to his ambition). In all this time he never sung a song, never changed from the monotonous routine of this single page of exercises. The story does not relate how long this would have continued, but one day he turned to the great Maestro and said: "Master, when will I be ready to learn a song?" "My son", replied his teacher, "go forth and sing; you are the greatest artist in the world."

This absurd anecdote has been quoted time and again by the lazy and ignorant as an excuse for avoiding serious work. The easiest thing for a lazy teacher, who does not understand the laws of vocal technic, to do is to keep his pupils vocalizing exercises. He does not have to do the work necessary in order that they may learn music and interpretation, and they cannot tell whether they are learning anything or not, because they are never put to the test. Since the pupils of such a teacher never sing songs, they cannot perform for their friends, and therefore, they are never subjected to criticism. The catch phrase, "it will come; one day it will come suddenly", is often resorted to in order to keep these unfortunates happy. This sort of thing seems very far fetched, but, unfortunately, a great many cases of vocal students who have been kept on exercises for six months, and even for a year or more, have been found. It need hardly be stated that the sole and only result of such teaching is the destruction of any true sense of singing the pupil may possess. All he ac-

complishes is the firmer establishment of his technical faults. Of course technical work is essential and the singing of exercises necessary, but the other side of the training of a voice—the musical and interpretive side—is no less important. In fact, actual technical development is, in many ways, dependent upon the ability to interpret songs. The greatest voice is absolutely worthless if its possessor cannot really sing. The art of singing does not consist of the mere ability to make pleasant sounds. What it does imply is the capacity for the proper interpretation of music. The correct use of the voice implies, fundamentally, the ability to sing phrases, to enunciate words properly and to express atmosphere and emotion. Mere exercises cannot develop this ability.

The pupil should work on technical exercises until a definite vocal improvement is apparent and this improvement should immediately be applied to the interpretation of songs. In other words, the student should be taught to *utilize* each and every technical improvement. At each lesson, for the first one or two years, about half to three-quarters of the time should be devoted to technic and the remaining part to the interpretation of songs. Generally, for about twelve lessons or so, it may be necessary for the pupil to sing only exercises. In some cases, however, where the technic is very faulty or where the voice has been seriously abused, this period may have to be extended. These cases are, however, rather exceptional.

In most cases the pupil's technic in the singing of exercises is a little ahead of that which he can employ in the rendition of songs. This difference should, however, never be allowed to become too wide, otherwise the vocal development may cease to be reflected into the rendition of songs. Under such conditions his progress will virtually stop, and when he does sing a song, he may tend to impair his technical advancement. Later, as the technical conditions approach perfection, the time given to the singing of exercises may be diminished until, ultimately, a few minutes' work for the mere "limbering up" of the voice is all that will be necessary.

At first, during the period when the student is only singing exercises at the lessons, he should, as has already been stated, never practise at home. As soon as he starts studying songs, however, he will have to learn the words and music, and as the time given over to songs is increased, he will have to do more and more work, away from the teacher, on the musical and inter-

pretive side of the art. The amount of home work will increase as he advances in technical ability and musical knowledge. Nevertheless, there is never any period in the study of voice when the pupil should practise technic away from the teacher. It may be definitely stated that the vocal student who is allowed to practise scales and exercises by the hour is not being properly taught. He is merely wearing out his voice and impairing his technic.

As has been stated, the first song should usually be given after the pupil has taken about twelve lessons, except in cases of extremely faulty technic or where the intonation is poor. However, when false ideas have been firmly engendered by misguided teaching, this time may have to be considerably extended. In cases where the vocal apparatus has actually been impaired (such cases are, unfortunately, by no means rare) it may take many months of careful work before the pupil can be permitted to attempt to sing a song without running the risk of further injury to his vocal apparatus.

There are only too many cases of lost voices, not only among second rate singers, but even among the apparently great artists. It may be definitely stated that nearly every instance is due to actual abuse of the voice and such abuse is, 999 times out of 1000, due to bad teaching. Such cases may be alleviated, but they cannot be cured, by rest or by medical treatment alone. The cause of the trouble is faulty technic, and even if the voice appears to be restored after a period of rest and treatment by a throat specialist, such restoration will inevitably be lost when the patient resumes singing, unless his technic has been radically changed. In most cases mere rest will not help much, and in practically every instance, proper technical exercise is essential in order that the voice may be restored. Where nodules on the vocal cords have formed, a surgical operation is sometimes necessary. When there is considerable inflammation and congestion of the vocal organs, a short period of rest is essential. Most cases of apparent loss of voice are due to faulty co-ordination of the laryngeal muscles, except, of course, where there is actual disease, when the case is one for the physician and not the vocal teacher.

Many women use the upper register only. The inevitable result of this is that they strain the muscles which actuate this register. Probably the upper register is primarily actuated by the arytenoid muscles, which are relatively very small and delicate, and are therefore liable to strain if they are not braced and

aided by the crico-thyroid muscles, the probable actuators of the lower register. Under such circumstances, rest will not help matters at all, permanently, since the moment the singer resumes she will once more strain these delicate muscles and her condition will be worse than ever. If, however, she develops the relatively strong crico-thyroid muscles and co-ordinates them, after they have been developed, with the arytenoids, she will stop straining her voice and a permanent cure will be effected. Actually, as a result of this development, the voice will become infinitely better than ever before. Hence, in many cases where a woman loses her voice, the cure lies primarily in vigorous exercise of the lower register. Soft singing is decidedly the most injurious form of phonation in which she could indulge. Such work will merely accentuate the strain on the arytenoid muscles, and at the same time, distort and injure the larynx through the interference of the throat which will, under these conditions, be in a state of collapse and constriction.

Mixed registration is another cause of loss of voice. Under proper technical conditions the upper register co-ordination of muscles—the arytenoids—should hold the tension of the vocal cords until they are fully loaded, at which point the lower register co-ordination—crico-thyroid—should come in and help, or brace, the upper. Mixed registration occurs when a singer who is 'throaty' uses a little of the upper co-ordination and brings in the lower before the upper is doing its proper share in holding the tension of the cords. Such a technic is always 'throaty'. Under these conditions the laryngeal pharynx, as well as the larynx, is strained and a combination of laryngitis and pharyngitis is apt to result. The cure lies in definitely separating the registers, and then, and not till then, developing and co-ordinating them. Treatment for laryngitis and pharyngitis is, under these circumstances, of little permanent benefit, since the condition will tend to recur, in an even more pronounced form than ever, as soon as singing is resumed. As an actual fact nearly every singer who uses his (or her) voice badly is liable to both these maladies and will find that he is usually "out of voice". Such singers are apt to complain of constant colds and it is indeed a fact that faulty technic does so weaken the vocal parts that they are extremely subject to colds. When the voice is used properly the throat is strengthened and the singer is far less subject to colds than is the average individual.

When a woman singer comes to a teacher and complains that she has lost her voice or that she is suffering from laryngitis

or pharyngitis, he should examine her technic and find out whether she speaks and sings in the upper register only. He should next question her and ascertain whether she has done a lot of soft singing. He should then investigate the manner in which her registers co-ordinate, if there is any sense of registration at all. If the voice is in a really serious condition, he should send her to a throat specialist and obtain a report upon the condition of her larynx, vocal cords etc. Most vocal ills can be cured, provided, of course, that there is no actual disease of the vocal apparatus, through the correction of the technical faults which have caused the trouble.

Loss of voice with men is very often due to a lack of development of the falsetto. When a man sings a high tone with the lower register alone, he is inevitably distorting the proper laryngeal action and strain will result. When this abuse of the vocal apparatus has prevailed for some time, the voice will first become very 'throaty'. Later, loss of voice is apt to ensue. A very 'throaty' singer is actually *mechanically* interfering with the free and proper action of the larynx, which is then definitely distorted, and nodule production may result. Rectification of this condition lies in the establishment and proper development of the falsetto—arytenoid muscles—and then the co-ordination of this register with the lower. High tones should not be sung until this development has been established.

Many tenors use a 'throaty', mixed registration. In this case the cure is the same as with women under similar conditions.

Almost any pronounced technical fault will ultimately result in loss of voice. It is only too sad to observe how many of the great singers lose their voices at a relatively early age. This is, in practically every case, the result of bad training.

Much has been written about vocal hygiene and anything which promotes health is of value to the singer, nevertheless there is no form of abstinence which will help the singer whose technic is faulty. If the technic is really good, moderate smoking, for instance, will not harm anyone in the least degree. Fussing about the voice is, as a matter of fact, very bad for the singer, since it will make him nervous and tense and will undermine his self-confidence—a most important asset. The singer who is always 'saving' his voice and refuses to speak above a whisper all day, when he has to sing in the evening, is utterly ridiculous. This coddling of his voice results in his actually abusing it every time he phonates. Preservation of the voice lies, not in coddling and fussing, but in learning to use it properly.

Some time ago Vitaphone records were being made by two singers. One was a tenor, who sang magnificently, and the other a soprano who used her voice very poorly. While rehearsing with the orchestra, it was interesting to note that the tenor really sang all the time, while the soprano whispered and dropped an octave each time she had to sing a high tone. The voice with the fine technic did not have to be 'saved' while the poorly used one had to be carefully guarded lest it should absolutely disappear. This despite the fact that the tenor was fully old enough to be the father of the soprano.[1]

Now it is not intended that these remarks should mean that a singer can abuse his voice at will when it is properly used. During rehearsal, which is very strenuous work, it is, indeed, often advisable for him to save his voice by singing an octave lower. It does mean, however, that coddling can do no manner of good, and that singing softly for long periods is extremely dangerous.

The really serious singer should have a very extensive repertoire, and should be able to sing every song which he has studied in perfect time and rhythm with proper musicianship and interpretation, word and note perfect. It is desirable for him to sing a composition in the language in which it is written, provided that he can really understand every word he is singing and pronounce the words properly without a false accent. If he is unable to do this it is far better for him to sing a good translation in his native tongue, since there is nothing so absurd as a singer trying to form words which he can neither pronounce nor understand. Even if he has linguistic ability it is a good plan for him to learn the song in his own language first and then study the original text. There are actually very few persons who can really sing a foreign language properly without having resided, for a considerable time, in the country in which it is spoken, although there are a few striking exceptions to this rule.

In the early stages, before the voice has been developed, the pupil should not be allowed to sing for too prolonged a period at one session. As the technic develops, this period may be extended. Part of the skill of the teacher lies in properly gauging the length of the lesson which is proper for a given pupil. Some people imagine that it is bad for the beginner to sing high tones and that even the trained singer should 'save' his high tones. This is by no means the case, since, in reality, it is essential that

[1] This paragraph was written about four years ago—today (1932) the tenor is still singing magnificently. The soprano sings no more! This tenor is probably the only pre-war singer who has really retained his voice—he is the most vigorous living singer!

the entire range of the voice should be exercised at each lesson. Of course it is risky for the beginner to "try out" his very high tones at home, but, under the guidance of a capable teacher, they must be found and used.

When a singer is very talented and has a naturally fine technic, he will sometimes be able to sing apparently extremely well for some years in spite of even the most ignorant teaching. He may have been taught to 'place' his voice and 'control' his breath, and his technical equipment may appear to have been but little impaired. Such a singer may make the most unscientific and even childish statements about vocal technic, which he may really believe to be true. This is one reason why so many foolish misstatements about the voice have been made by some of the greatest artists.

Many of the really great singers have lost their voices at an age when they should have been in their prime. This is not hard to understand since, if a very talented pupil studies with a poor teacher, his natural sense of technic will not permit him to really follow evidently wrong directions. However, if, at some period in his career, he finds himself out of voice, he has only the directions of his teacher to fall back upon. There may have been some slight technical fault which had little effect at first, but later the repeated slight abuse of his voice was certain to tell. It is at this point in the career of even the greatest artist that the crucial moment arrives. If he has been taught such dangerous fallacies as "breath-control", "head resonance", "voice placement", "head tones", or any such physiological absurdity as a direction to move the soft palate, or if he has been told to "get his voice out of his throat" and "relax his throat", he will have but a broken reed to lean upon in the moment of his need, with the inevitable result that his voice will rapidly deteriorate. From these facts it will readily be seen that no teacher can be adjudged as competent because he has pupils who sing even marvelously well. Indeed, if such pupils markedly deteriorate before the age of about sixty, the teacher is, in all probability, to be condemned.

The properly trained voice will last until the singer has started to really fail physically. It should be one of the last, and not one of the first, faculties to deteriorate.

One of the reasons why so few people understand the laws which govern vocal technic is that it seldom occurs to singers, musicians or vocal teachers to associate these laws with the pure sciences—acoustics and physiology. It is really extraordinary how few singers or, indeed, teachers properly understand the

fundamental laws of physics. For this reason many people are always trying to discover some trick or secret whereby the perfect voice may be attained. This is well paralleled by the search of the alchemist of old for the philosopher's stone. His search was, of course, fruitless, whereas today it does seem possible that the transmutation of the baser metals may be accomplished by the application of known laws of physics to this problem. Actually it is absolutely possible for the competent teacher to "make a voice" by the application of the laws of vocal technic which are based, not upon some wonderful and mystic secret, but upon the known and well understood laws of physics and physiology.

A few years ago relatively little was properly understood about the science of sound, but the most wonderful progress has been made recently by physicists, who have been working upon the problems of the telephone, the victrola, the radio and last, and perhaps most advanced of all, the "Public Address System" of the Bell Telephone Laboratories and the talking moving pictures. It is not surprising, then, that our knowledge of the laws governing the technic of singing has also advanced and that it is possible to accomplish today what was utterly impossible for, say, the teacher of the old Italian school of "bel canto". In those days the first requirement of the singer was supposed to be 'voice'; today, as has been shown, this is by no means true.

Not only are meaningless terms used with regard to the voice as, for example, "placing the voice", "controlling the breath", "head tones", "head register" etc., but scientific terms which have a real meaning are, only too often, misused. One of the most abused terms in the entire vernacular is the word *resonance*. Books on singing have been found in which the "resonant bones" and "resonant surfaces" are referred to, and if one asks a singer to state what resonance is, he will usually have a ready answer to the effect that it is what "makes the voice sound full" or "carry" or "ring" or "resound". The reader who studies Section III of this book will readily see how ignorant is this loose idea of what this term means.

Another view which seems to be quite widely held is that a feeling of vibration indicates resonance. Vibration may be felt in many parts of the head or even body, especially if such parts are in a state of tension, during the act of phonation. It is, indeed, a fact that some sound is *transmitted*, not only through the mouth, but also through the bones of the head, from the chest, and probably from the entire bony structure of the body, but this transmission is in no sense a phenomenon of reson-

ance. Furthermore, such transmission of sound is not under the direct control of the singer, except in as much as a state of false tension in a specific part will tend to make that member act as a more efficient transmitter of sound, which is always undesirable.

For many years there was a notion current in England that the hard palate acted as a "sounding board"—this irrespective of the fact that the vocal cords are in no manner attached to, or in intimate contact with, the hard palate.

In closing this chapter, I will indicate about the average ranges over which the different types of voices should extend when they are properly produced:

Ex. 1



CHAPTER XXII
THE SPEAKING VOICE

There are four chief points of difference between the singing and the speaking voice: (1) the phonated sound—vowel—can be far more prolonged in singing than in speech; (2) there should be no vibrato in the speaking voice; (3) the consonants are not as strongly articulated in speech as in singing; (4) the pitch should practically never be changed on one vowel in speech.

Otherwise there is virtually no difference between the laws which govern the speaking and the singing voice.

The requirements for the properly used speaking voice are: (1) good quality; (2) an extensive range; (3) power; (4) a properly produced soft tone which will carry; (5) a properly produced whisper; (6) perfect vowel formation—pharyngeal; (7) clean-cut, clear articulation; (8) smoothness and a proper legato; (9) speed with perfect enunciation; (10) wide range of intensity; (11) wide range of color; (12) the ability to use the voice as vigorously as may be desired for a considerable length of time without fatiguing it or becoming hoarse; (13) correct natural pitch; (14) correct natural quality; (15) correct natural power.

From the natural pitch, quality and power of a given voice, all modifications of pitch, color and intensity are made.

Now it will be perfectly clear to anyone who has read thus far that all these requirements depend upon the same factors as do those for the properly used singing voice: the correct development and co-ordination of the muscles of the thorax, larynx and the pharynx. Thus in speech, as in singing, the pharyngeal cavities should act as the principal resonators of the voice and must be properly shaped for the vowel and fundamental, and the muscles of the larynx should be developed and co-ordinated. The registration should be perfect. This, of course, depends upon the separate development of the registers until the muscles which govern them are fully trained, when they can be co-ordinated—not mixed.

The muscles of the larynx and pharynx must be exercised vigorously if they are to be properly developed. This can only be done through singing, in view of the fact that speech is a relatively mild form of phonation.

Since there is no musical side to the training of the speaking voice, the process is, from this viewpoint, shorter and much easier than is that of the singing voice.

Of course, the possession of a good ear is a great asset. When the pupil is absolutely tone-deaf nothing can be done, since he has no point of contact with the teacher. Nevertheless, a good ear is not as essential for the student of the speaking voice as it is for the one who is learning to sing. Quite remarkable results have, indeed, been attained with speaking voice pupils who had a very poor sense of pitch.

Most people use only one register in speech, so that the unused register will, when found, be extremely weak. One of the immediate results of this is that the normal pitch of most voices is displaced.

Many women use the upper register only, although actresses usually employ an unco-ordinated or mixed lower register. The reason for this is that it is essential for them to make their voices carry in an auditorium. Moreover, they must have power and dramatic force. Obviously, when the upper register alone is used, the voice has neither carrying power nor dramatic force.

The use of the upper register alone produces a quality which is apt to be rather smooth and pleasant, while the unco-ordinated lower register is characterized by a loud, rather coarse quality.

The use of the pure lower register alone usually results in a natural pitch which is too low, although the vowel formation is apt to be fairly well back, even if the quality is rather thick. This technic, despite the fact that the quality is poor, is theoretically better than is the use of the unco-ordinated upper register, since the employment of the strong muscles which govern the lower register—the crico-thyroids—saves the larynx from injury and the better vowel formation does not tend to strain the pharyngeal muscles. Actually this condition is very rare, since a lack of the upper register usually produces mixed registration. Therefore, in practice, it will be found that most faulty voices are pitched too high, since mixed registration usually raises the natural pitch of the voice.

The use of the unco-ordinated upper register is practically always accompanied by a mouth vowel formation, so that, despite the fact that the quality is relatively smooth and pleasant, the actual technical conditions are very bad indeed, since both laryngeal and pharyngeal muscles are subjected to serious strain. When a woman uses this type of technic, and tries to make her voice carry in an auditorium, the result is usually quite disastrous.

For this reason it is not unusual for one to find an actress who has played ingénue roles for some years, in the lamentable condition of having virtually lost her voice. This is particularly unfortunate in view of the fact that she is, as a general rule, only able to play such roles while she is young, and as she becomes older it is necessary for her to graduate to heavier roles which call for dramatic force and vocal power. This is just the time when she is losing or has lost her voice. This technic is, of course, quite worthless for dramatic roles. The excessive employment of the upper register muscles will, ultimately, make her voice chronically husky and hoarse, so that it will sound as if she is always suffering from a cold. The so-called "cigarette voice" is often due to this type of abuse of the laryngeal muscles and not really to an over-indulgence in cigarettes.

Fortunately this condition is quite easily remedied by a competent teacher if taken in time, or in other words, provided that no actual physical injury, such as the development of nodules on the vocal cords, has resulted. The huskiness etc. will become apparent long before serious damage to the vocal apparatus has occurred, so that the voice-user will have ample warning of her danger. The cure lies, of course, in the development of the lower register which must first be found and isolated. When this has been done she is out of danger, although she may, at first, only be able to employ a few low tones with surety. The voice may then be fully trained and the upper register first purified then developed and then, and not till then, co-ordinated. A dozen lessons have, in certain cases, been found to be sufficient for the lower register to be established for a few tones, so that voices which were in a really very bad condition have been brought out of danger in two or three weeks. Of course, if the work is not continued, a relapse to the old methods will inevitably result. All that is implied here is that the danger point may be passed very rapidly.

The most prevalent faults of male voices are somewhat different, since no man uses the falsetto for speech. These faults take the form of some type of 'throatiness', and when the voice is pitched very high—a not uncommon case—of mixed registration. In other words, the chief faults found with men's voices are faulty resonance conditions and improper co-ordination and development of the laryngeal muscles. The result of these faults is that the timbre, power and carrying quality of the voice are poor and also the natural pitch is seriously displaced. At first flush one would imagine that when the upper register—fal-

setto—is undeveloped and unco-ordinated, the natural pitch would be too low. Actually this is seldom the case. When the upper register is undeveloped, mixed registration is apt to occur and this condition produces a natural pitch which is too high. In addition to this, the constricted pharyngeal cavity, which is the direct cause of a 'throaty' quality, will tend to produce a higher than normal pitch. Thus, the general result of both faults will be for the natural pitch of the voice to be too high. This applies particularly to basses and baritones whose voices are sometimes so displaced as to be pitched a whole octave or more too high. Of course, there is no absolute rule as to whether the natural pitch of a voice has been lowered or raised as the result of certain technical faults and many variations are found in practice. Nevertheless, generally, the net result of technical faults, is to raise the natural pitch. However, proper training will, in every case, ultimately disclose the natural calibre and pitch of any given voice. Sometimes, however, it is quite impossible for anyone to tell whether a voice is a tenor, baritone or even bass, until quite a lot of work has been done.

Despite the fact that the discovery of the natural pitch of a given voice depends upon its proper training, each technical improvement is marked by a nearer and nearer approximation to this pitch.

Now, just as in the case of the singing voice, when there is no definite differentiation between the two registers, there is apt to be mixed registration so that no pure register is ever actually used. This is especially true in the case of a man whose falsetto is undefined. Thus, the isolation and development of the falsetto will enable him to produce a pure lower-register tone for the first time. This is another reason why a man's voice generally drops in pitch during the process of training.

The usual procedure in the training of a man's speaking voice is first to isolate and develop the falsetto and then to work out the low tones. This is not, however, an absolutely general law, since, when the voice is a naturally high one, the low tones should not be over-taxed. A true tenor is, however, far rarer than one would suppose, in view of the fact that so many men who seem to have tenor voices are, actually, merely 'throaty' baritones. Indeed most baritone voices sound like tenors when they are very 'throaty'.

There is a very curious belief, even among stage folk, that a high-pitched speaking voice carries better and sounds younger than does a low-pitched one. This is by no means true, since

while it is quite obvious that it is the natural pitch of any given voice which carries best and sounds freshest and youngest, the lower and more sonorous a voice is, the better will it carry. It is a very interesting fact that, in speech, the very low pitched tones seem to carry peculiarly well. Thus, when an actor, or for that matter an actress, uses extremely low pitches, the words are very clearly heard and understood by the audience. Tones which are too low pitched to be of any value in the singing voice carry beautifully in the speaking voice. A possible explanation of this fact may be that the fundamental and the vowel frequencies are more widely separated when the pitch is low and therefore the vowel is more clearly defined. Another explanation of this phenomenon may be that the low tones are usually produced with far less effort than are the higher ones, unless the technic is exceptionally fine. Therefore, the muscles which tend to interfere with the proper adjustment of the pharynx do not become so tensed and the possibility of proper adjustment of the resonance cavities is increased. Whatever the true explanation may be, the fact remains that relatively very low tones carry wonderfully well in an auditorium, while quite loud, high ones, when they are not really well produced, are indistinct and do not even sound loud.

It is quite evident, then, that in the training of the speaking voice the development of the low tones takes on an importance which it does not possess, to nearly the same degree, in the training of the singing voice. This, however, does not mean that the speaking-voice pupil should be made to work excessively on the lower tones of his voice, since the proper working out of these tones depends upon development of the entire vocal apparatus and especially upon the isolation and development of the falsetto.

In working on the speaking, as well as on the singing voice, there are three unknown factors which are only revealed when the training has advanced to quite a high stage. These factors are: the natural pitch, power, and quality. Under no circumstances should the teacher attempt to form any fixed opinion with regard to any of these factors until proper training has revealed them. By the natural pitch of the voice is meant the middle pitch from which it rises and falls. By the natural power is meant the intensity—*mf*—from which the loudness is increased and diminished. By the natural quality is meant the timbre from which color modifications are made. The better the

voice the wider the range of pitch, intensity and color variation at the disposal of the artist.

When the resonance conditions are faulty, the quality will be poor and unnatural, but the resultant sound may have one of many faults. Along general lines it will be either thick or 'white'. Thus, a mouth vowel formation will result in either a partially constricted and closed, or in a highly constricted and even more closed throat. The resultant quality will be either 'throaty', 'thick-throaty', 'nasal-throaty', 'white-nasal', 'white', 'screamy', 'shouty' etc. The so-called English accent is merely a type of 'whiteness' or 'throatiness', while the American nasality is another form of 'throatiness'—'thick-nasal'. Both are technically wrong, but the faults, which lie in the different faulty arrangements of the resonance cavities, are dissimilar. All the various faults of phonation are associated with some type of 'throatiness'.

Occasionally men who possess naturally high pitched voices endeavor to force the general pitch down and assume a false, thick quality. This is injurious since it tends to constrict the throat and produce a mouth vowel formation. At the same time, a more or less fixed distortion of all the vowel sounds is produced. This leads to a most important principle which bears equally upon the technic of both the speaking and the singing voice: quality should never be 'made'. As has already been shown, the tone consists, to all intents and purposes, of the vowel and the fundamental only. Thus, when quality is 'made', a fixed distortion is imposed upon the proper vowel frequencies which can, then, never be pure. The perfect tone consists of a properly resonated fundamental and a perfectly pure vowel. Any attempt to add "a beautiful quality" to these two factors merely produces a thick, distorted tone. Absolute spontaneity is psychologically one of the first essentials of proper technic. In brief, quality of voice is something quite definite and implies perfect resonance adjustment; it is not some strange and inexplicable, physical characteristic of a certain vocal organ.

CHAPTER XXIII
SPECIAL EFFECTS OF SPEAKING VOICE

There is an interesting device for giving the impression of a very telling whisper, which may be used on the stage. This consists in producing the softest possible sound which can be phonated with the vocal cords brought just near enough together in order that they may start to vibrate and initiate tone. The actual sound produced is not really a true whisper, since the vocal cords are brought into play. The resonance cavities must, of course, be properly shaped and the breath, which bows the cords into action, will escape very rapidly. This last point is vital in the proper production of this effect, since, if these conditions are not fulfilled, the resultant sound will be thin, 'throaty' and inaudible. This effect is called a 'stage-whisper'. The true whisper is not a phonated sound.

In singing there are six ways in which the meaning of the text may be brought out: by means of variations of the *pitch, intensity, color, accent, tempo,* and *tune.* The same thing applies to the speaking voice.

Variations of intensity and color, which are accomplished in exactly the same manner in both speech and singing, depend upon the same factors in the text—the ideas and emotions which are to be expressed. The question of pitch variations in speech must, however, be dealt with in some detail.

As has been stated, the properly produced human voice has the characteristic of becoming louder at normal intensity as the pitch rises. From this fact a general law may at once be deduced: the pitch of the voice should rise as the emotion or emphasis rises and vice versa. An exception to this rule is the use of very low, deep, full tones for deep emotions such as love, passion, intense grief etc.

A public speaker, or actor, should always centre his voice around the normal pitch and allow it to rise and fall as the emotion rises and falls. In this way he will be using about his normal pitch and intensity all the time, except when he is making some special effect. This is one of the most important factors in the attainment of the goal of every actor—the ability to sound na-

tural. It will, then, be clear that anyone who uses his voice properly must allow the pitch to centre around his normal pitch, making only relatively narrow pitch changes, as long as the emotion or emphasis does not become very great. Of course, when deep emotions etc., have to be conveyed, the sweep of the voice —the 'tune'—should cover a very extensive range. If the actor's vocal technic is good, the surge of a great emotion will tone up his body and allow him to produce a perfectly free high tone without any special conscious effort. Thus, the voice will never be subjected to strain. It is evident that all color changes are superimposed upon these variations of pitch.

The enunciation of quiet or normal phrases at a pitch that is definitely higher than the normal pitch is one of the most dangerous faults a voice-user can have. This is, unfortunately, only too common a fault with actors, who are, under such conditions, not only straining their voices, but also producing an effect which is both unnatural and indistinct as regards enunciation. For quiet effects either the normal pitch or very low pitches should be used. Really big dramatic effects on high tones should never be attempted unless the technic is very good.

For certain very exceptional effects high soft tones are used. It is, however, absolutely essential that these should be produced properly lest the result should be not only dangerous, but also merely trivial. The technical conditions for the production of such effects are just the same as in singing and their occurrence is about as rare in speech as it is in singing. When these effects are made very sparingly and at just the right moments, the result is most impressive.

Loud, bright, low tones are sometimes used in order to produce a harsh, angry color, but this effect, while it is very striking when used with discretion, will merely give the impression of an ugly quality if employed to excess.

The phrase, and not the single note, or even the musical figure, is the unit in music. The singer who sings note by note conveys absolutely no musical meaning or sense whatever. No one is an artist who does not "think in musical phrases". Exactly the same thing applies to the speaker or actor. *The sentence and not the word is the unit in speech.* This is probably the most important single factor in regard to the reading of lines. The entire sentence must be spoken in one broad sweep of continuous tone, the important words and phrases being emphasized and brought out by means of pitch changes and accents, just as in singing the emphasis is made by the use of effect notes and ac-

cents. Although the possibility of sustaining a tone is far more limited in speech than in singing, this factor is always present in some degree. The singer who picks out a high note, and holds it without reference to the phrase, entirely destroys the musical and artistic effect. In just the same way, if, in speech, certain words are picked out or isolated from the phrase, the effect is merely one of ranting.

When studying a role the words should be memorized and then read sentence by sentence, each phrase being considered as a unit. The rise and fall of the voice and the accent will give the necessary stress to the important words and phrases and convey the proper meaning. In order to determine the points of emphasis, each word of importance in the sentence should be determined and then the number of such words should be reduced to the irreducible minimum. Usually the subject, predicate and object or attribute of a sentence are the words of paramount importance which must be accented. When one or more of these has been brought out in the preceding sentence, its emphasis should be omitted or at any rate greatly reduced. Of course, this rule is by no means arbitrary, since even adjectives may sometimes be of first importance. However any detailed discussion of this question would require the citation of a great number of quotations and would take up too much space for a work of this type.

With reference to the words of lesser importance, the rule is simple and very definite: *they should not be over-emphasized.* Many actors tend to over-emphasize unimportant words such as articles, conjunctions etc., with the idea that each and every word should be clearly understood. In effect the only result of any attempt to do this is that the important words, which should be brought out, lose their emphasis, and all meaning and expression are lost. Although the articulation should be extremely neat, clear, vigorous and clean-cut, it is far better to under- than to over-pronounce all words of lesser importance. The law would better be stated: Each and every word should *not* be brought out in speech—only the important words should be stressed.

As a general rule all color effects are made over the sentence, although there are some special cases where a single word has to be given a very special inflection. In order to determine the proper color effects, the role or poem must be considered as a whole. Then the true meaning of each sentence must be considered, so that every nuance may be brought out and no point

of value lost. All special effects should be definitely determined, and very deliberately made. Sometimes a great deal of practice is required in order that all color effects and special touches may be properly made and produced in a technically correct manner.

When this has been done, the actor or reader must determine each point at which he should pause and take a breath. These places are determined by the import of the text. It is especially important that these stopping places should be predetermined, since one of the most vital components of the proper delivery of lines is the ability to carry the tone of the voice without any break between these places. *The continuity of sound should not be broken in speech, while in singing vowels and consonants should NOT be elided.* Many people break the 'flow' of their voices in speech with the consonants, others may break it with new 'attacks' for each word even if it starts with a vowel.

All consonants must be articulated with the greatest possible rapidity, and it is this rapidity which allows the tone to remain unbroken. Another point of primary importance in this connection is that each consonant must be attached to the *following* vowel sound and not to the vowel which precedes it. This also applies to the final consonant of each word until the pause or breathing place is reached.

This question of the 'flow' of tone in the speaking voice is of extraordinary importance today in view of the ever-increasing popularity of the talking movies. No voice which is broken up can sound even passably beautiful, and furthermore the sense of power and command is lost.

The actors of today, while far better actors, and in many ways far more artistic than most of those of the past generation, are apt to err in this direction. In an endeavor to avoid 'hamminess' they are apt to break up the flow of tone, and for this reason their voices not only lack beauty of tone and sweep, but also the sense of power is lost and they are, only too often, inaudible. This sense of continuous tone does not tend to make the actor sound old fashioned or 'hammy' provided that he does not sustain consonants, mouth his words or change pitch on one vowel.

When the tone or phonation of the speaking voice is continuous, the sound pulses can build up in the ear of the hearer, but when the tone is broken up, this building-up process is always being stopped and re-started. Since this process takes an appreciable fraction of a second, the result is that the sense of

power and command is lost, unless the production of tone is continuous.

Thus, in reading a series of words, where there is no break for breath or dramatic emphasis, the tone must be absolutely continuous, and smoothly elided, and the pitch must rise and fall in a definitely *predetermined* 'tune'. This 'tune', as has already been stated, is dependent upon the meaning of the text, the high tones being used for the words of special importance.

Of course this ability to utter a series of words, without breaking the continuity of the tone, presupposes a pharyngeal vowel formation, since it is absolutely impossible for anyone to accomplish this effect properly if he resonates the vowel sounds with his mouth cavity.

When the tone is broken up the articulation is apt to be slovenly, but where the attempt is made to articulate the consonants vigorously, the effect is explosive, harsh, and in a sense, guttural. In the reproduction of the voice for the talking movies this over-emphasis of the consonants produces a most unpleasant, harsh and distorted sound. On the other hand, when the tone is not continuous and the consonants are not over-emphasized, the diction is blurred and indistinct. It is only when a 'solid' flow of tone is produced that the consonants can be vigorously articulated without explosive effect and distortion.

Before closing this chapter, one last effect—the scream—may be discussed. The scream is merely a very high tone produced in the pure upper register with a very white quality. It is, of course, resonated with the throat only. It is possible for anyone to scream, provided that he or she has an upper register, and this is true even when this register is undeveloped, since the highest tones will always have power. Naturally, anyone who does not possess any upper register cannot scream properly and any attempt to do so is injurious.

CHAPTER XXIV
COMMON FAULTS OF THE SPEAKING VOICE

The art of acting has advanced to an enormous degree in recent years. This improvement has been due to the increased sense of realism and naturalness on the part of the actors and directors of the present generation. Probably the most important factor in the attainment of this end is the possession of a speaking voice which sounds absolutely natural and unaffected and which, at the same time, carries properly.

In the old days the aim and object of many actors was to make mellow tones. They would, therefore, roll their voices, hum, and 'vocalize' with this end in view. Of course all that they really succeeded in doing was to give the impression of extreme affectation and artificiality, while the force and import of the lines were quite lost. The audience merely got the impression of more or less inarticulate 'singing'. This 'singing' effect was due to the fact that many of the vowels were unduly prolonged, the pitch was often changed on a single vowel (an unforgivable offense) and certain consonants such as *m* and *n* and even, in some cases, *l* were sustained and phonated on the added 'hum' vowel.

The question of consonants has been rather lightly touched upon up to this point, despite the fact that it is a most important one. The reason for this is that the production of a consonant is not a phenomenon of phonation. All consonants have this characteristic in common: they cannot be phonated and the characteristic pitch of each one is fixed. During the sounding of a consonant the vocal cords are not brought into action, and all that happens is that an interruption of the outgoing breath is made with the tongue, lips etc.

When the vowel is resonated in the mouth, the movement necessary in order to articulate is relatively very large, since the mouth must be moved from the fixed vowel position into the consonant position before the consonant can be formed. The unavoidable confusion of this double action will inevitably destroy all clearness of articulation. When, however, the vowel formation is pharyngeal the mouth is not set, and is therefore free

for articulation. Thus the consonants can be simply, vigorously and neatly formed *with the minimum possible movement.*

During the act of phonation the lips should be opened and they should virtually never move at all whatever the vowel being resonated may be. This means that they are free to articulate without having to change position from the shape which they would have assumed if they were functioning with the mouth in the formation of the vowel. When the technic is really good, no lateral movement of the lips need ever be made by the speaker or singer.

The undue sustaining of the consonants *m, n,* or *l* is the result of the improper prolongation of the unwritten *vowel* which might be termed a 'hum' and which is necessary for the formation of these consonants. The consonant should be instantaneous and the hum-vowel should always be absolutely as short as possible.

The habit of keeping the lips open and never spreading them for any vowel, strengthens them and allows the voice-user to articulate cleanly, neatly and vigorously without the addition or prolongation of an extra unwritten vowel. Neat, clean-cut consonants are one of the most important factors in making the words understandable both in speech and in song. 'Sung' consonants not only never help audibility in the slightest degree, but actually blur it. The smaller the movement of the tongue or lips for the formation of the consonant, the clearer will be the articulation, provided that such movement is made rapidly and vigorously.

When the tempo is slow and the phrase has to be drawn out, certain vowels must be prolonged. Thus in the case of the double vowel *ī*, which is *ah+ee*, it is the first vowel which must be sustained and the second must be phonated as rapidly as possible. This law applies to both speech and song. The sustaining of the weak part of a compound vowel is rather a common fault which should always be most carefully avoided.

Another rather common fault is the compounding of a simple vowel. For instance, the vowel *oo* as in *you, blue, true, too* etc. is not *ee+oo,* but purely *oo*. When this fault occurs, a mouth vowel formation will usually result. A great deal might be said upon this subject, but, in order to bring it home properly, illustration is necessary.

There is one very curious fault of diction in this country which is rather hard to account for since it is not the result of

any technical difficulty. The fault referred to is the careful rolling of *r's* which should be silent. Perhaps this is the result of an attempt to eliminate or correct the guttural sound which people from the Middle West are apt to make for the vowel sound occurring in such words as *her, girl, there, for, far, bird, fear, near, care, father, mere, fair, fear, poor, were, more, law, clear* etc. The list is very extensive. In all these words the *r* should not be rolled and the guttural should never be heard. There is no case in the English language in which an *r* at the end of a word is rolled, and while there are, of course, guttural consonants such as *k, g* etc., *r* does not come under this heading. The rolling of a silent *r* is a more inexcusable fault than is the production of the guttural sound, which is at any rate natural, whereas the rolled *r* is equally a fault and is, at the same time, a form of affectation. Pharyngeal formation of the vowel sounds makes it an easy matter for the singer or speaker to eliminate this guttural sound which is, after all, merely a form of throatiness.

Another vowel which seems to present a great deal of difficulty in this country, is the *o* as in *hot*. This vowel is often made to sound just like the *a* (*ah*) in *father*. Despite the fact that this vowel can only be correct when formed pharyngeally, technical development will not necessarily help, since *ah* can also be resonated pharyngeally. This is therefore a case where illustration is essential.

The double vowel *ee+oo* as in *new, dew, sue* etc. is often mispronounced. This is a double vowel, the second part of which must be accented and held where desired. The *ee* must always be as short as possible, but it may never be omitted. The correction of mispronunciations of this double vowel demands illustration.

Another vowel which cannot be formed in the mouth without distortion is *ō* as in *low, go, slow, row* etc. For this reason it is very often mispronounced and presents considerable difficulty to anyone whose technic is incorrect. It is, of course, a compound vowel—*oh+oo*—the first part of which may be sustained, while the *oo* must be pronounced as rapidly as possible. Distortion of this vowel may take several forms: it may be pronounced with a 'twang', the second part may be sustained, or the attempt may be made to form both vowels *oh* and *oo* simultaneously. This is of course a physical impossibility, since a resonance cavity cannot be shaped in two positions at one and

the same time. The result is a 'set' of the resonance cavities which produces a very much distorted mouth vowel of extremely ugly quality.

Only a few of the more commonly abused vowels have been mentioned, since in so many cases illustration and imitation must be resorted to in order that the sound of the true vowel may be conveyed. After all, as has been shown, a vowel is merely a tone-quality which must be heard and sensed mentally before it can be produced, irrespective of how good the technic may be.

A most unpleasant fault in speech is 'singing' or in other words, the changing of pitch on one vowel. Offenders who come under this heading will often utilize an upward inflection. This most objectionable method of speaking is usually accompanied by a very pronounced thickness throughout all the vowel sounds and very clumsy and slovenly articulation. The correction of extreme cases of this sort is a colossal task which can only be accomplished if the pupil is taken at an early age, and if possible, removed from the environment in which he constantly hears this type of speech.

One of the most interesting vowels in the English language, and one of the most abused, is the vowel *ee*. This vowel can assume an enormous range of different colors, and shows curves which are more widely dissimilar in their characteristics than are the forms of two curves of other widely different sounding vowels. Thus the bright *ee* is more dissimilar to the dark *ee* than is the vowel *ah* to *ay*.

A very bright *ee* is found in such a word as *fiend* and is sometimes used to express anger. With the exception of this usage, this sound should never be employed in any word in the English language. It should never be used in such words as: *be*autiful, *re*mark, *de*light, *be*low, lad*y*, part*y*, nicel*y*, already, etc.

A dark *ee* is used in such words as *deep, sleep, weep* etc. An overly-bright *ee* vowel is often incorrectly employed in the pronunciation of these words.

An *ee* which is neither dark nor bright appears in such words as *meet, meat, feet, feat, seat* etc.

The two vowels *ee* and *oo* cannot be properly resonated when the jaw is dropped. The reason for this is not far to seek: the lower frequency which characterizes these two vowels is of relatively low pitch, so that the upper pharyngeal cavities have to be added to the laryngeal pharynx in order that

a large enough cavity may act as their resonator. If the jaw is dropped too far down, the opening to the mouth is so large that the upper pharyngeal cavity will not act in conjunction with the laryngeal pharynx to produce the effect of one large cavity. In other words, the jaw cannot be dropped too far when the resonance conditions make it necessary for the upper and lower pharyngeal cavities to act as one cavity.

According to the work of all the most reliable physicists the *ee* vowel is characterized by two frequencies. It is highly probable that when the quality is dark the lower frequency predominates and vice versa. Different combinations of these two frequencies will give all the different color modifications which are possible with this vowel.

Such vowel modification as suggested above is, of course, the basis of all vocal color. The suitable color or timbre of a tone depends not only upon the actual word, but also upon its context. Delicate color modifications are, of course, only possible of accomplishment when the pharyngeal cavities are under very fine control. This most interesting and important phase of our subject cannot be taught until the pupil has arrived at quite an advanced stage in his technical work. It is not a subject which can be adequately dealt with on paper, since fine shades of color modification must be heard and sensed before they can be realized or understood. There is such a thing as general vowel modification throughout the phrase in both singing and speech which gives to the passage a special color. Such color or feeling may have to be held for a section of a song or even for a whole song, recitation or role. Much of this sort of thing may be quite unconscious when the pupil possesses natural dramatic talent, provided that the vocal apparatus is under proper control. Nevertheless, some phases of color modification, at any rate along broad lines, can and must be taught. Any attempt at coloring, when the technic is insufficiently far advanced, is apt to result in mere affectation. It should not, therefore, be indulged in by the pupil until the proper stage of vocal development has been reached.

The type of lines which should best be given varies with each pupil and with his stage of development.

The use of musical monologues is often very beneficial. This type of recitation does not tend to make the pupil 'sing'. On the other hand, it helps to eliminate this fault, since it is the music which is doing the 'singing'. Musical monologues help to engender a sense of rhythm and *tempo* in speech—a most import-

ant phase of the subject. The pupil must be taught to round out each phrase with the music, while under no circumstances should he attempt to enunciate each word with the corresponding note. This may be a little difficult at first, but a relatively small amount of practice will soon overcome any obstacles which may be experienced. This work will help the pupil to develop a proper sense of phrasing and an even flow of words.

Tempo, which is a most important phase in the reading of lines, should be as carefully considered by the reader or actor as by the singer. When the pace of a song is incorrectly conceived the entire effect is spoilt. The same thing is true of the reading of lines, which are often spoken too fast by those who are inexperienced—amateur singers often sing too slowly. In studying lines, one of the first factors to be determined is the tempo—this fact is well understood by every competent actor.

As with the singing voice, a beautiful quality is merely a result of good technic, so that any voice can, theoretically, be made beautiful. The ability to express is dependent upon the natural dramatic talent of the individual and upon his technical equipment. Thus the ability of anyone to speak or sing expressively depends upon his native dramatic ability in combination with his technical control over color, pitch and intensity.

The fact that the quality of a voice is dependent upon the technic, or in other words, upon proper resonance adjustment, is one of inestimable importance. Many people are under the illusion that it is a separate and 'peculiar' result of the physical or structural conditions inherent in the vocal apparatus. So far has this curious belief gone that many attempts have been made to prove that Caruso's vocal apparatus was entirely differently formed from that of an ordinary individual. Various measurements of the size of his vocal cords, the distance from them to his lips, the size of his throat, the expansion of his thorax etc., have been taken and quoted in order to show that he had definite physical peculiarities which accounted for the wonderful quality and power of his voice. One naïve writer even claimed that he had "resonant bones"—whatever this may mean! However, these measurements were of little or no value, since they were not compared with similar measurements of the vocal apparatus of other singers and those of persons who could not sing. Actually many thousands of such measurements would have to be made before any deductions of the least value could be drawn. Even then, it would be surprising if the mere fact of using the voice prac-

tically perfectly for a great many years did not develop the larynx and pharynx and the muscles which actuate them, and at the same time increase the expansion of the thorax.

Of course all this sort of discussion is of little value, in view of the fact that there can be no manner of doubt that the obvious reason why Caruso's voice was the most beautiful in the world was because his technic was as nearly perfect as was humanly possible.

People who imagine that quality is something "weird and wonderful" are apt to try to 'make' quality, or in other words, to make their voices sound beautiful in the abstract. As has already been mentioned, this is a common fault of both singers and speakers. Such a mental attitude is always fatal from both the technical and interpretive standpoints. To recapitulate:

The quality of a tone is simply a function of the overtones and the proportion of each overtone to the fundamental, or in brief, of the energy distribution in the tone. While the fact does remain that the texture and formation of the vocal apparatus has a definite effect in establishing the personal quality of a voice, this factor is so overshadowed by the enormous differences which occur when the resonance cavities are in or out of adjustment, that it need hardly be considered by the singer himself. Moreover, it is not under his control. Any vocal apparatus which is not diseased is, theoretically, capable of producing an extremely beautiful quality when the technic is really good. Of course power is definitely a factor of the size of the apparatus, when the technic is correct, but, even here, the power of a tone emanating from an exceptionally large vocal apparatus which is not properly adjusted is infinitely less than that from a very small voice which is technically well used. A really small squeaky tone is the result of a faulty technic. Every voice, no matter how small it may be, is capable of producing tones of ample size and carrying power.

The endeavor to make quality always results in poor quality, distorted vowels and an absolute inability to color the tone, since the color is already fixed by this abortive attempt at 'quality-making'.

This fault is, even today, far too common among actors and orators, despite the fact that the old school of the 'rolled', 'singing' technic is supposed to be dead. In the opinion of the author this 'quality-making' is every bit as bad and inartistic as was the 'voice-rolling' of the 'ham' actor of yore.

Of course the hall mark of the great artist is his naturalness. It is when we consider the performers of the second and lower grades that we find every form of affectation, including 'quality-making', 'voice-rolling', 'singing', phonated consonants, *r's* rolled in the wrong places, the 'ultra-English' accent etc. This last affectation is most deplorable. It consists, primarily, in the use of the broad *ah* vowel in numerous words in which it is never heard from the lips of educated Englishmen. Some of the words which are abused in this fashion are: *fancy, passage, romance, plan, have* etc. The use of the broad *ah* in these words is absolutely incorrect in any country.

CHAPTER XXV
GENERAL REMARKS

The purpose of this book has been to state the proven laws of vocal technic, and also to give certain general suggestions, as far as possible, regarding the proper method by which the voice may be trained. At the same time it was found necessary to mention and disprove some of the current fallacies propounded by so-called authorities on this subject.

It is perfectly obvious that all the laws which govern the proper technic of voice production are founded upon the two sciences—physics and physiology. Without an understanding of Section III of this book it is quite impossible for anyone to really comprehend this Section. When, however, the import of Section III has been fully digested, it will be quite an easy matter for the reader to follow all that has been stated and proven in the present section.

No definite statement has been made which has not been subjected to proof, and all such statements and deductions were discussed at length with physicists and physiologists before they were propounded. Where absolute proof was not forthcoming this fact has been stated, and the remark has been prefaced by such words as "It is highly probable that," etc. Under this heading come such suggestions as those concerning the actual muscles which predominate for each register. Thus it has been suggested that the upper register is primarily actuated by the arytenoid muscles. While all the indications are in favor of this statement, absolute proof is lacking. Therefore, no definite statement can be made at the present time.

The wonderful progress made of recent years in the realm of physics has rendered it possible for the author of this book to formulate many absolutely definite fundamentals of vocal technic without any serious fear of contradiction from physicists or physiologists. The general acceptance of these fundamentals by teachers of singing all over the world may take a considerable time, since but few people are so broad-minded as to change their ideas as soon as their reason is convinced. The teacher who propounds the theory of 'breath-control', for example, is apt to be-

lieve this theory in just the same spirit as the one in which a man accepts his religion. He has been taught this theory by his teachers, who have, in turn, been taught it by their's etc., until the idea has actually assumed the proportions of a sort of creed. Many of the other fallacies pertaining to our subject are accepted in this blind, but infinitely tenacious, manner, so that it will be no easy matter for the true fundamentals to become generally accepted. However, there can be no manner of doubt that it will only be a matter of time before the true facts are generally recognized.

Despite the fact that much has been accomplished in the investigation of this subject, there is a wide field for research open for the scientific experimenter. Some lines of research which may be suggested are: (1) determination of the ideal vowel-frequencies; (2) determination of the ideal proportion of vowel to fundamental for the theoretically perfect tone; (3) determination of the ideal energy distribution in the tone; (4) a mathematical consideration of the pharyngeal cavities; (5) physiological consideration of the muscular co-ordinations that should occur in the larynx and its surrounding structures.

In each of these researches a very large number of readings must be taken of singers of all calibres, and relative results will have to be considered. It will be absolutely essential that tests are taken from the voices of the greatest singers in the world.

These are, of course, but a few suggestions regarding the lines along which research upon the human voice may be conducted. There are numerous other phases of the subject which lend themselves to investigation by competent scientists.

Despite the fact that the serious investigation of the fundamental conditions which govern the use of the human voice is a practically *new science,* it may confidently be stated that enough has been already accomplished to establish the principal facts which underlie these laws. In fact, the really competent teacher is now able to accomplish an almost unbelievable amount with any serious pupil—an amount which would have been deemed absolutely beyond the region of possibility in the past. It is, in fact, perfectly possible for the pupil who has apparently "no voice" to develop a really great one, provided that he is a good worker, and at the same time has a good ear and a vocal apparatus which is in no way physically incapacitated.

At the present time there are so many teachers of singing who are not qualified for their work that it may be as well to

indicate to the reader how he should select a teacher. Unfortunately, there are no qualifying degrees for vocal teachers. Thus, while one knows that a qualified physician or surgeon is an educated man and not a 'quack,' there is no such safeguard with teachers of vocal technic. Anyone who intends to study voice should, then, ask certain questions of his prospective teacher before making arrangements to work under his guidance. The first qualification of which he should make sure is that the teacher is a college graduate, since an uneducated person is not competent to teach any cultural subject. The next thing to find out is whether he is properly trained in the sciences. It is a good plan to enquire as to his general ideas regarding the fundamental principles of vocal technic and to question him as to the basis for these ideas. If his theories are neither logical nor subject to proof, his work is not only of no value, but is probably extremely dangerous.

Any teacher who has never been associated with pure scientists can have little serious standing. Deductions drawn from teaching in the studio are of negative value if not backed up by scientific understanding. A doctor who does not keep up with the work that is being done by the leaders of his profession is apt to find himself behind the times and to "get into a rut." He will even tend to forget what he has learned at college, as the years elapse. Similarly, the work of a vocal teacher who is not conversant with the latest developments in the physics of sound and in physiology will soon become obsolete and worthless.

Anyone who wishes to study voice should first make sure that his teacher is progressive and competent. If he fails to do this he is running a very serious risk—a risk just as serious as is the one run by a person who is foolish enough to put himself in the hands of a 'quack' doctor. The loss of time and money spent upon the lessons is not the only risk, there is also actual physical danger. Incorrect training may, and generally does, seriously injure the vocal organs.

The next consideration which is of paramount importance for anyone who hopes to become a singer is whether his teacher is a thorough musician. Some vocal teachers are quite ignorant of the facts which govern music and interpretation. Others are most careless in this department of their work. The musical side of the subject is, however, easier to deal with, since the facts of music are well established and not open to argument. There are, indeed, quite a number of capable coaches, although

there are some who, while they profess to teach this branch of singing, are not really competent. A great coach must, perforce, be a fine musician. It is an unfortunate fact that some musicians who are excellent coaches insist upon teaching vocal technic. This, despite the fact that their musical knowledge is in no sense of the word a qualification for teaching a subject which is primarily scientific.

It would be amusing, if it were not pitiful, to examine some of the reasons given by vocal aspirants for studying with certain teachers. The following are some typical examples: "He is (or was) a fine singer", "he composes well", "he accompanies beautifully", "he has a very pleasing personality", or even: "he has a perfectly gorgeous studio and butlers greet you as you enter, so he must be a grand professor!"

All this sort of thing is very sad. It seems almost redundant to emphasize once again that there is one and only one sensible reason for studying with a teacher and that is because he thoroughly understands his subject.

Having come to the end of this section of the book, the reader will see that he can really attain his vocal goal provided that he has a good ear, dramatic and interpretative ability, the capacity for hard work and last, but not least, the right teacher. He has been assured that the attainment of a really fine voice has now been made possible even though the voice, at the time of starting to study, is of apparently poor quality, power and range. This should, then, be a message of wonderful encouragement. On continuing with the next section of the book he will find that real musicianship can be learned if he is ready to study seriously. Nevertheless, he will have been able to deduce that the road which must be traversed in order that he may become an artist is indeed an arduous one. If he is in earnest and has innate talent for, and love of, the art of singing, this will not deter him in the least. In fact, the effect of this realization should be to stimulate him to greater and greater effort. After all, an art which did not imply hard work and study would be of little interest. Indeed, if it were so easy for anyone with a natural voice to become a great singer, the serious study of voice would not be worth while. True art, no matter which branch of art is being considered, is an unending study. The possibilities of development are practically infinite—this is what makes artistic endeavor one of the greatest activities in the universe.

On the other hand, if this book has been read by the dilettante, by the one who believes that there is a wonderful and

inexplicable 'quality' inherent in his voice, irrespective of whether his technic is correct or not; by the one who fancies that interpretation is a 'natural talent' and that hard work and musical study are unnecessary for true artistic interpretation; by the one who is seeking for the "magic secret method" whereby the perfect voice can be magically made; by, in a word, the one who is not *serious* about his art and is not ready to recognize facts and to work and work in order that he may develop and continue to develop, then all that he will feel is a sort of resentment for this plain, unvarnished statement of facts.

But—I do not believe that such a one would have purchased this book in the first place, and if he had, he would not have read it up to this point.

Therefore, I can say to the reader—without fear that he is not with us in our serious study of the human voice: I have shown you the road which you may travel, a road which is, indeed, not an easy or smooth one, not a short cut, but a *royal road*, which will lead to vocal and artistic mastery. I have given you a message full of hope and encouragement.

SECTION II

INTERPRETATION and MUSICIANSHIP

by

ALMA STANLEY, B.A.
(Mrs. Douglas Stanley)

It is absolutely essential that the reader have the following compositions at hand when studying Section II of this book:

LIEDER—
- Brahms:
  - *Der Schmied*
  - *Die Mainacht*
  - *Sapphische Ode*
  - *Sonntag*
  - *Wiegenlied*
  - *Wie Melodien zieht es mir*
- Cornelius:
  - *Ein Ton*
- Franz:
  - *Im Herbst*
- Grieg:
  - *Ein Traum*
  - *Im Kahne*
  - *Mit einer Primula Veris*
- Mendelssohn:
  - *Auf Flügeln des Gesanges*
- Schubert:
  - *Am Meer*
  - *Ave Maria*
  - *Der Erlkönig*
  - *Der Leiermann*
  - *Der Tod und das Mädchen*
  - *Des Mädchens Klage*
  - *Du bist die Ruh'*
  - *Hark! Hark! the Lark!*
  - *Schlummerlied*
  - *Wohin?*
- Schumann:
  - *Die Lotosblume*
  - *Er, der herrlichste von Allen*
  - *Frühlingsnacht*
  - *Ihre Stimme*
  - *Jasminenstrauch*
  - *Lorelei*
  - *Mein altes Ross*
  - *Mondnacht*
  - *Seit ich ihn gesehen*
  - *Volksliedchen*
  - *Widmung*
- von Fielitz:
  - *Eliland Cycle*

FRENCH SONGS—
- Debussy:
  - *Les Cloches*
- Hahn:
  - *Si mes vers avaient des ailes*

RUSSIAN SONGS—
- Moussorgsky:
  - *The Feast*
  - *Le Polisson*

OPERA—
- Bizet:
  - *Carmen*
- Charpentier:
  - *Louise* ("Depuis le jour")
- Gounod:
  - *Faust*
- Handel:
  - *Jephtha* ("Waft Her, Angels")
- Meyerbeer:
  - *Les Huguenots* ("no, caso egual giammai")
- Pergolesi:
  - *Nina*
- Ponchielli:
  - *La Gioconda* ("Suicidio")
- Puccini:
  - *Madame Butterfly*
  - *La Bohéme* ("Che gelida manina")
- Rossini:
  - *Il Barbiere di Siviglia* ("Una voce poco fa")
- Saint-Saëns:
  - *Samson et Dalila* ("Printemps qui commence")
- Wagner:
  - *Lohengrin* ("Elsa's Traum")
  - *Tristan und Isolde*
- Weber:
  - *Der Freischütz* ("Wie nahte mir der Schlummer")
- Verdi:
  - *Aïda*
  - *La Traviata*

FOLK SONGS—
- *All Through the Night*
- *Auld Lang Syne*
- *Comin' Thro' the Rye*
- *Old Folks at Home*
- *Salisbury Plain*

CHAPTER XXVI

MUSICIANSHIP

In the foregoing section of this book the subjects discussed have been treated in some detail. This was essential, since it was necessary that the fundamental principles of vocal technic should be not only clearly understood, but satisfactorily proven scientifically. Such proof was especially necessary in view of the fact that this is the first time that the subject has been considered from a really scientific standpoint. Furthermore, many of the statements made and proven in this treatise are in direct contradiction to the generally accepted ideas held by vocal teachers and singers. Thus it is necessary that a third section dealing with pure physics shall be included so that it will be possible for the reader to understand something of the acoustical principles on which the laws of technic are based.

In this section, however, we are treating with a subject which is well understood by all true musicians, and many excellent books have been written that deal with music in all its phases, so that the reader can obtain detailed information on this phase of our subject without any great difficulty. References are given in the Bibliography.

The musician is, indeed, very often absolutely sound upon his own subject and it is only when he makes statements which should be based upon a knowledge of the sciences that he goes so far astray. It is only too true that, as a general rule, the musician's and the scientist's mind are as far apart as the poles.

Therefore, all that will be attempted in this section will be to indicate what the singer should know about music, and to give the reader some ideas with regard to interpretation.

Let it be perfectly clear, however, that the musical side of singing is of vital importance, and the most wonderful voice is without value unless its possessor is an adequate musician and also has fine interpretive ability. His voice is, after all, merely the instrument upon which the singer 'plays', and the musical and artistic interpretation of songs is the *raison d'être* for learning how to sing.

The attainment of true musical knowledge and feeling calls for much talent, study and hard work. It is, indeed, from this angle that the aspiring singer must, perforce, prove himself to be serious and a real worker. Many pupils are perfectly willing to practise technical exercises for hours without thinking, but when it comes to studying words and working out the musical side and the proper interpretation of a song, they may show themselves to be wanting.

The proper interpretation of a song requires many hours of hard, patient study, and without such work and the ability to think for himself, no one can become an artist.

In the study of technic the teacher may do all the thinking for the pupil so that the ability to advance, on the part of the pupil, depends upon his powers of concentration and upon whether he makes an earnest endeavor to perform the actual physical operations indicated by the teacher. In fact, the pupil must not think for himself at all since, as has been indicated, what he himself hears will inevitably be of negative value as a guide to what he is actually doing. Thus, when studying technic, the pupil must subject himself totally to the teacher and concentrate as hard as possible upon the teacher's directions.

Far different is the nature of the work required of the student in order that he may become an artist. He must work out the music, learn the words, and create the atmosphere and emotions of the song for himself. The teacher can, and must, help and guide him in the attainment of these ends, but in the final analysis he has only himself to depend upon. This means original thought and concentration.

The attainment of a repertoire is a long and arduous process, entailing many hours of very hard work, and this is where the pupil will eventually show his mettle.

As soon as the pupil's technic has progressed to the point where he can attempt a song, songs must be given and the proper attitude towards this phase of the study must be engendered at the earliest possible moment.

It is, of course, futile for a singer to make any serious attempt to perform in public when his technical equipment does not warrant his presumption that he is in the artist class, and the performer who gives recitals on the strength of his 'artistry' alone is extremely ill-advised. No matter how much he may try to express and interpret, no genuine feeling will actually be communicated to the audience. Nevertheless, it is rather cruel to blame such singers, since they are, in ninety-nine out of a hundred

cases, merely the victims of incompetent teaching. Anyone possessing the gift of true artistry could have developed a really fine voice, and been made into a great artist, had he been properly trained. This picture is a very pitiful one—the singer with the soul of an artist, but with an 'instrument' which does not 'work' because he has not been properly taught.

There are teachers who keep their pupils working on technical exercises for many months and even years without ever teaching them to sing songs. Such instruction is quite worthless, even from the standpoint of technic, since it is, in fact, impossible to teach singing without the use of songs. Disregard of the musical and interpretive side of singing is inexcusable, since it is only the result of laziness, or of lack of musical knowledge, on the part of the teacher.

The facts of music are definite and well understood by the competent musician. Time and rhythm are fixed by the composer, as are the expression marks which, especially in the great music, must be followed with the greatest possible precision.

A mistake in time or rhythm is every bit as bad as is the singing of a wrong note; even if it is less obvious to the untrained listener. Incorrect 'tempo' absolutely destroys the value of a song, from the artistic standpoint, as does a disregard of the expression marks.

It is only when the musical facts have become automatically perfect that the singer can let himself go, assert himself as an artist and allow inspiration and imagination to hold full sway.

Thus technic is vital, since it is only possible for the singer with a proper technical equipment to forget his voice and give anything of real value to the audience, however much he may feel. The musical side is equally essential, since only when the music is automatically perfect can he give full sway to his emotions, without worrying about the musical facts. The art of singing is, in the final analysis, merely the art of expressing music, emotion, atmosphere etc., in the most effective manner possible to mankind.

CHAPTER XXVII

SCALES AND KEY CONSCIOUSNESS

It is essential that the singer should develop a sense of key consciousness, since many very beautiful effects are made in music by means of changes in the key, and these changes or "modulations", as they are called, should be understood. Sight singing, also, depends for its success on this knowledge. Many variations in mood and color are indicated by means of modulations to remote keys, or by a change from the major to the minor mode or vice versa.

It is only possible for the singer to give to a song its true musical and emotional import when he understands the music. Knowledge of the musical import of a composition and harmonic analysis are essential for proper interpretation. Some singers, not properly versed in the essential knowledge of the music which they should possess as a fundamental part of their equipment, will say: "I don't want to pull the music apart, all I want to do is to '*feel*' it." Such spurious emotion, divorced from knowledge, merely results in affectation and is worse than worthless. The greater the musical knowledge and insight of the singer, the truer and more real will be his power of bringing out the emotions of the composition and all the moods which the composer has tried to indicate. There is no such thing as spontaneous expression without knowledge, and the suggestion of such an idea is merely an indication of a lack of knowledge as to what music really means.

Key consciousness should be engendered at an early stage of the singer's training. The first step in the attainment of this knowledge is a thorough understanding of scales and their interrelationships. To the student who would sing with real authority, innumerable questions will arise regarding keys, changes of key, the function and meaning of chromatically altered notes, etc., all of which can be answered only by those who thoroughly understand the scales.

The following brief account will indicate the nature of the scales used in music from the time of Bach to the present day.

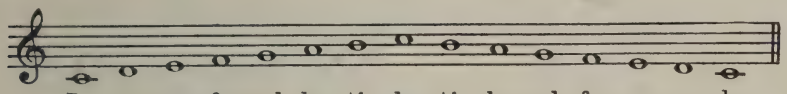
1. The Diatonic Scale

(a) Major.—An adaptation of the old Ionian Mode from the Gregorian system. The formula, or order of whole- and half-steps, is as follows:

Scale Degree:	1	2	3	4	5	6	7	8
Step:	whole	whole	half	whole	whole	whole	half	

In other terms, the half-steps occur between 3 and 4, and 7 and 8. All the other adjacent degrees are separated by whole-steps. In music notation:

Ex. 2

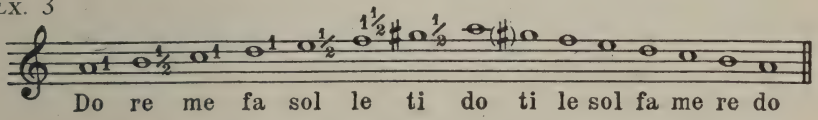


(b) Minor, Harmonic Form.—The formula is:

Scale Degree:	1	2	3	4	5	6	7	8
Step:	whole	half	whole	whole	half	whole+half (aug. 2nd)	half	

As its name implies, the harmonic minor is used chiefly as the basis of minor harmony, though its use in melody is by no means infrequent. Its special characteristic is the step-and-a-half (augmented 2nd) between the sixth and seventh degrees. It has a true leading-tone (degree 7), as have the major scales. Notation:

Ex. 3



(c) Minor, Melodic Form.—Ascending formula:

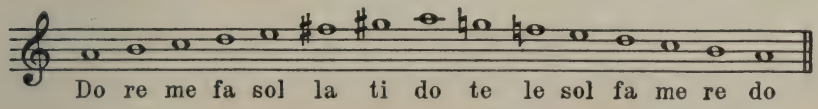
Scale Degree:	1	2	3	4	5	6	7	8
Step:	whole	half	whole	whole	whole	whole	half	

Descending formula:

Scale Degree:	8	7	6	5	4	3	2	1
Step:	whole	whole	half	whole	whole	half	whole	

Notation:

Ex. 4



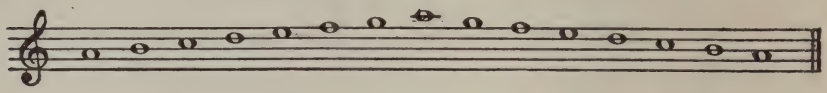
This is the only scale that is different in its ascending and descending forms.

(d) Aeolian Minor.—This scale is also known as the "pure" or "natural" minor. It is a survival of the Aeolian Mode from the Gregorian system. Formula:

Scale Degree:	1	2	3	4	5	6	7	8
Step:		whole	half	whole	whole	half	whole	whole

Notation:

Ex. 5



It will be noticed that this scale and the melodic minor descending have no leading-tone.

Comparing the three forms of the minor scale, two important facts emerge that will greatly facilitate study: (1) The order of whole- and half-steps from degree 1 to degree 5 is the same in all. This is an unchangeable feature of minor scales. (2) the differences are all in the *upper half* of the scale—degrees 5 to 8.

At this point it is necessary to interrupt the discussion of scales by explaining two very important matters.

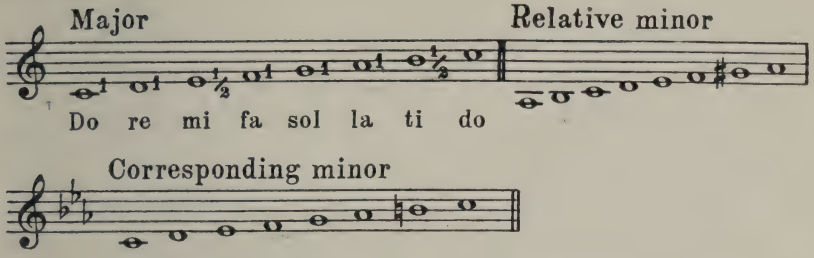
1. Signatures and Keys.—The scale of C major (Ex. 2) required no sharps nor flats, since none were needed in order to make the order of whole- and half-steps agree with the formula. But when a scale is started on any note other than C, one or more sharps or flats are required, since the formula is practically a definition of the major scale, and cannot be changed. The rule for finding other major scales is: For sharp scales, count *up* five steps to find the starting-point of the new scale; for flat scales, count *down* five steps. Then, applying the formula to the new starting-point (hereafter called the "tonic") it will be found that all sharps or flats which may have been previously used are retained, plus one added sharp or flat. The added sharp will always be degree 7 (leading-tone) of the new scale; the added flat always degree 4. This process can be carried on until scales containing as many as twelve sharps or twelve flats have been built. When more than seven of either are used, double-sharps or double-flats occur.

The key-signature is the collection of sharps or flats needed in order to build the scale; it is placed after the clef.

"Key" may be defined as the totality of mental impressions conveyed by the scale and the chords derived from it.

2. Relations Between Major and Minor Scales.—Every major scale has two minor scales dependent upon it. One has the same signature and is known as the Relative minor, while the other has the same key note and is known as the Corresponding minor (See example 6.). The Relative minor is derived from the major scale by counting *down* a step and a half—three semitones. (e.g. the Relative minor of C major is "a" minor which is found a step and a half below C. Like C major it has neither sharps nor flats in the signature.) The signature of the Corresponding minor is found by counting *up* a step and a half. (e.g. the signature of "c" minor is the same as that of E flat major.)

Ex. 6



The foregoing is summarized in the following table, which, however, omits any mention of the corresponding minor as this would make the table too complicated. But this relationship is perfectly easy to find, since a major scale and its corresponding minor have the same tonic, and the signature of every possible scale will be found in the table.

(a) Sharp Scales

Major	C	G	D	A	E	B	F♯	C♯	G♯	D♯	A♯	E♯	B♯
Rel. Minor	a	e	b	f♯	c♯	g♯	d♯	a♯	e♯	b♯	f𝄪	c𝄪	g𝄪
No. of ♯'s in Sig.	0	1	2	3	4	5	6	7	8	9	10	11	12
Last ♯	—	f♯	c♯	g♯	d♯	a♯	e♯	b♯	f𝄪	c𝄪	g𝄪	d𝄪	a𝄪

(b) Flat Scales

Major	C	F	B♭	E♭	A♭	D♭	G♭	C♭	F♭	B♭♭	E♭♭	A♭♭	D♭♭
Rel. Minor	a	d	g	c	f	b♭	e♭	a♭	d♭	g♭	c♭	f♭	b♭♭
No. of ♭'s in Sig.	0	1	2	3	4	5	6	7	8	9	10	11	12
Last ♭	—	b♭	e♭	a♭	d♭	g♭	c♭	f♭	b♭♭	e♭♭	a♭♭	d♭♭	g♭♭

For ease in reading, only signatures from 0 to 7 sharps or flats are used; these appear in the above table to the left of the line. The scales and signatures to the right of the double line (8 to 12 sharps or flats) are encountered as modulations, and in any case have to be included in order to demonstrate the logic of scale construction.

Close study of the above table will yield a number of interesting facts; (1) In the sharp scales each tonic after C is located a perfect fifth (see Chapter XXXII) *above* the preceding tonic; in the flat scales each tonic after C is a perfect fifth *below* the preceding tonic. (2) In the major modes, in going from no sharps up, the added sharp is found to be the *leading tone*. In going from six flats down, the flat which is omitted is also found to be the *leading tone*. In adding flats, the new flat occurs on the fourth degree of the scale. (3) In the minor scales the leading-tone is never found in the signature. (4) In deriving the signatures of the scales from C, all sharps or flats previously used are retained.

As shown in Ex. 3, the harmonic minor scale ascending and descending contains an accidental which never appears in the signature—the all-important leading-tone. It is a vital note in three chords: the Dominant Triad, Dominant Seventh, and Diminished Seventh. The following table summarizes this angle of the matter:

Harmonic Minor	Signature	Leading-Tone
a	No ♯'s or ♭'s	g♯
e	1 sharp	d♯
b	2 sharps	a♯
f♯	3 "	e♯
c♯	4 "	b♯
g♯	5 "	f𝄪
d♯	6 "	c𝄪
a♯	7 "	g𝄪
a♭	7 flats	g𝄫
e♭	6 "	d𝄫
b♭	5 "	a𝄫
f	4 "	e𝄫
c	3 "	b𝄫
g	2 "	f♯
d	1 flat	c♯

2. The Chromatic Scale

It consists of a succession of half-steps, therefore no formula is needed. After four hundred years of use by composers, the notation of the chromatic scale is still in a fluid state.

3. The Pentatonic Scale

As its name implies, this is a scale of five tones. Curiously enough, it is the basis of the folk-music of two such widely separated countries as Scotland and China. Formula:

Scale Degree:	1	2	3	4	5
Step:	whole	whole	whole + half (minor 3rd)	whole	

It is represented by the black keys on the piano. *Auld Lang Syne* is written entirely in this scale, as is *Comin' Thro' the Rye* except for one note.

4. The Whole-Step Scale

This bizarre product of the modern French school is also known as the "whole-tone", or "tonal" scale. It divides the octave into six theoretically equal whole-steps. Uses of it abound in the vocal and instrumental works of Debussy, and Dukas' opera *Arianne et Barbe-bleu* is based almost entirely on it.

5. Other Possibilities

Under this rather indefinite caption must be included the many exotic effects indulged in by composers of the Ultra-Modern school. The singer who attempts the works of contemporary French, German, Italian, and Slavonic writers may expect to encounter music based upon an almost unlimited number of scales. Merely as an indication of the enormous

number of scales possible, it may be mentioned that the late Ferruccio B. Busoni wrote out 111 different diatonic scales starting from the note C. Working on the same idea, a friend of the author's wrote out 256 without duplicating.

However interesting such excursions into strange territory may be, the student of voice may be assured that by far the larger part of his repertoire will consist of music based upon the major and minor scales. Experimentation is still going on, but the standard repertoire of Opera, Oratorio, Lieder, Concert Songs etc. is far past the experimental stage, and it is here that the real foundation of artistic interpretation lies. A knowledge of the scales is absolutely essential; it will involve considerable study on the part of the student, but this work must be done, because unless the scales are perfectly understood, the musical content of a composition will not be properly grasped. Such knowledge is an important factor in enabling the pupil to study the music intelligently for himself, since all music is based on the scales. Lack of this knowledge will reduce him to the level of a contemporary singer who shall be nameless, but who has to depend on cues from the prompter's box at every operatic performance, and who, when singing for the Vitaphone, experienced serious difficulties because the "mike" caught the prompter's cues as well as the tones of the "artist".

CHAPTER XXVIII
TIME, ACCENT, TEMPO

In the preceding chapter the question of the key-signatures was discussed and the reader was given some general information regarding the determination of key and key changes.

The next question to be considered is the time-signature. It is expressed by two figures in the form of a fraction, placed at the beginning of the composition immediately after the key-signature. In the case of 4/4 and 2/2 time the signs 𝐂 or ¢ respectively, are commonly used.[1]

Using the term "beat" in its broad sense, we find that the denominator of the fraction indicates the unit of beat and the numerator the number of these beats in a measure. The numerator is generally 2, 3, or a multiple of either or both. For example, in 2/4 time the unit of beat is a quarter-note, and the value of notes or rests appearing in each measure is equivalent to two quarter-notes. Here we count two to a measure. Again, in 3/4 time the unit of beat is still a quarter-note, but the value of whatever notes or rests appear in a measure is, in this case, equivalent to three, and the number of counts in each measure is three. In 6/8 time the unit of beat is an eighth-note and the number of beats is six.

There are, therefore, two main divisions of time: one in which the numerator is 2 or a multiple of 2, and the other in which it is 3 or a multiple of 3. They are known respectively as Duple Time and Triple Time. To them should be added another of lesser importance, but which is much used in modern music—Mixed Time. Here a numerator of 5, 7, 11, or even 13 may be found. This will be more fully discussed later.

The two main divisions have two subdivisions: Simple and Compound. The following table of the most frequently used time-signatures is arranged under these headings:

Duple		Triple	
Simple	Compound	Simple	Compound
2/2	4/2	3/2	(6/2)
2/4	4/4	3/4	6/4
(2/8)	4/8	3/8	6/8

It will be seen from this table that compound time is practically two measures of simple time combined into one, with the intermediate bar-line omitted. Simple time has one accent: the first beat of each

[1] For a complete explanation of the meaning of these signs, see the articles "Prolation" and "Signature" in Grove's *Dictionary of Music,* or Chapter III, pages 25 and 26, of *Contrapuntal Technique in the Sixteenth Century,* by R. O. Morris (Oxford University Press).

measure. Compound time has two: a primary accent on the first beat, and a secondary accent, which in duple compound occurs on the third beat, and in triple compound on the fourth beat.

The foregoing table omits mention of such time-signatures as 9/4, 9/8, 9/16, 12/8 and 12/16 (Bach even used 24/16). But they are easily explained as extensions of the same principle—the combination of three or four measures of simple time into one large measure of compound. Another way of regarding them—one that is absolutely necessary when the tempo is fast—is to treat them as other kinds of times with the beats divided into triplets. For example, fast 9/8 time is more conveniently treated as 3/4 with each quarter-note divided into triplets; 12/8 time as 4/4 with triplets, etc. Very often fast 6/8 time is found, in which case the same principle applies.

Singers may have to appear as soloists with orchestras, in opera or in oratorio, and they must therefore understand the conductor's beat. Observe that the first beat is always made with a down-stroke, the last beat with an up-stroke.

2/2, 2/4, 2/8; fast 6/4, 6/8 and 6/16:



3/2, 3/4, 3/8; fast 9/4, 9/8 and 9/16:



4/2, 4/4, 4/8; fast 12/8 and 12/16:



Moderate and slow 6/4 and 6/8:



The method of accentuation described is *regular*, but the singer must expect to encounter numerous departures from the rule, or irregular accentuations.

An interesting example of the combination of two time-signatures into one is 5/4. Usually it consists of a measure of 3/4 followed by one of 2/4, with the intermediate bar-line omitted. This would put a principal accent on the first count and a secondary accent on the fourth. It is used by Wagner in the last act of *Tristan und Isolde,* second scene. In order to make his intention perfectly clear, Wagner inserts a dotted bar-line before the secondary accent on the fourth count. Less frequently, 5/4 consists of a measure of 2/4 followed by one of 3/4, with the secondary accent on the third count. An example of this treatment of 5/4 will be found in Moussorgsky's song *Le Polisson.*

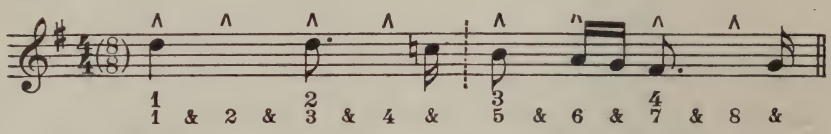
In many songs the time-signature changes. In Brahms' *Sapphische Ode,* for example, 𝄵 is indicated at the beginning, 3/2 in measure 9, back to 𝄵 in measure 10, etc. An extreme instance is found in Moussorgsky's song *The Feast.* The song is 37 measures long, and contains 32 changes of time-signature.

The student must carefully observe such changes and be fully conscious of them when they do occur. If he is not absolutely conversant with them he will sing awkwardly, the flow of the song will be checked and the unfortunate accompanist will have to "drag him along".

In studying a song the singer should, before attempting to learn it, mark the counts or beats with this sign ∧ on the music over each point where the count falls. This is not quite the same thing as the marking of the accents, which will be explained later. The number of these marks in each measure will, of course, be determined by the numerator, irrespective of rests and of the distribution of the notes. Every count should be so indicated throughout the entire composition.

It is often a good plan to consider the time-signature as raised to higher terms when the tempo is slow. This is especially helpful when the metrical figures are complicated or have several components, as in the following example:

Ex. 7

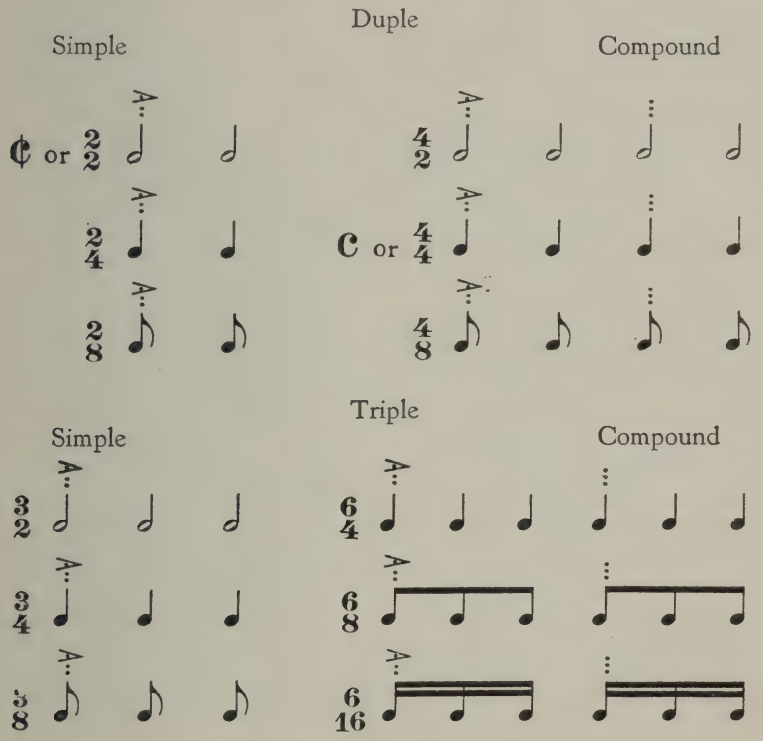


This example is from Handel's *Jephtha*, measure 11 of the tenor aria "Waft Her, Angels". It illustrates the raising of the time-signature for the purpose of finding the exact "time-spot" for each note and dot. 4/4 is raised to 8/8, and by the use of the sign "&" the beat is further subdivided so that the fraction is raised still further to 16/16. The dotted line indicates the middle of the measure.

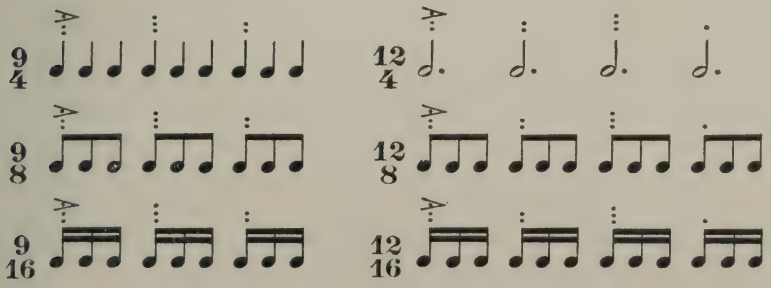
Hence by counting eight and subdividing still more by counting "&" the unit of beat is reduced from a quarter-note to a sixteenth-note. This enables the singer to locate the exact "time-spot" of each note, rest, dot, or double-dot. He can also compare the pulse of a sustained quarter with its equivalent, four sixteenths etc. This sense of division of the beat is essential for the singer, who cannot be too accurate in his feeling for the "time-spot" throughout the entire rendition of a song. While, as will be shown later, the rhythmic wave may be expanded or contracted in many ways, the "time-spot" and the proportion of one note to another in the metrical figure, must always be perfect. This retains the life and movement of the composition and by no means produces a mechanical effect. As a matter of fact nothing so spoils the atmosphere and movement of a song as the distortion of the time. Of all classes of musicians, singers are the worst offenders in this respect, and, since those who aspire to the singing of roles are ever subject to the conductor's beat, it is well for them to master time from the very inception of their studies.

The question of accent in simple and compound time has been briefly touched upon, but the subject is important enough to warrant

further treatment. It was stated that simple time is characterized by one accent—the principal, compound measure by two—the principal and a secondary. This is illustrated in the following table, where the principal accent is marked ^ and the secondary accent ⋮ .



But this is not the whole story, for other accents assert themselves when the measure is still further compounded, as in 9/8, 12/8 etc., and the singer must be conscious of them. They are indicated as follows: first secondary accent ⋮, second secondary accent :, third secondary accent ·.



Many other examples illustrating variations of accent might be cited, but these cases are enough to indicate how much can be done in this field. Of course all the examples given may be subdivided in many combinations.

In addition to the primary and secondary accents the singer must stress to some degree, every beat on which he is singing.

A vocal device for making a very strong accent is a slight holding back, or unwritten pause, before a note. This device is often used in German lieder and may in many cases be exaggerated, especially where the final note of a song—on the first beat of a measure—requires great stress owing to its dramatic import. It is also used in Italian Opera whenever a divided first beat appears, since this figure always indicates an extremely strong stress.

In view of the fact that the emotional, as well as the musical, import of a composition is largely wrapped up with the proper stressing of the accented beats, it is important for the singer to fully understand the correct technical method whereby these accents may be brought out.

Accentuation must be performed *vocally* and not by the prolongation of consonants. Thus the accent takes the form of a press or augmentation of the intensity at the exact point where the accent falls, irrespective of whether it falls on the beginning of a word—which may or may not start with a consonant—or during the sustaining of a note on one vowel.

Proper accentuation is entirely dependent upon the vibrato. Thus, the only method by which the singer is able to stress the accented beats correctly is by means of an increase in the amplitude of the vibrato at the exact point at which the accent falls.

When the consonant is prolonged the vocal stress is not only lost, but the actual effect is one of a diminution of the intensity since, during the prolongation of the consonant, the tone is stopped, except in the case of the absolutely incorrect sustaining of the hum part of *m, n,* or *l.* In this case also the effect is one of diminishing the intensity, since the hum is generally far softer than is a tone produced with the mouth open.

Hence the rule is definite and very simple: Make all accents by means of an augmentation of the vibrato at the exact point at which the accent falls.

While slow sustained articulation destroys the accent, very strong, rapidly articulated consonants are an aid to accentuation (see above). The singer should definitely indicate the beginning of each measure and every beat in the measure.

Tempo is the speed at which a composition is sung. It is established in a general way by the indications in Italian at the beginning of the piece. Some of these are:

Largo, adagio, lento—very slow.
Andante—slow.
Andantino—rather slow.
Moderato—at a moderate pace.
Allegretto—rather fast.
Allegro—fast.
Presto—very fast.

Variations in tempo are indicated by such terms as: *ritenuto, ritardando, rallentando* etc. indicating a gradual decrease in pace, and *accelerando,* indicating a gradual increase in pace, etc.

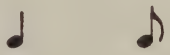
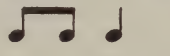
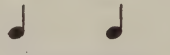
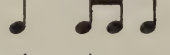
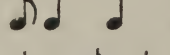
The term *tempo,* in music, actually means *pace* and not *time* as one would suppose from the derivation of the word. Thus the duration of a note is in no way indicated by its value; in other words, a sixteenth-note in slow tempo may be of longer duration than a half-note in fast tempo.

The tempo is sometimes indicated by a metronome mark. Thus in the Handel aria (Ex. 7) the metronome mark is given as 84 to an eighth note. This was added by an editor, but if all composers used this sign it would be a very good thing, since many singers render songs in faulty tempo. The correct tempo is of very great importance. Most amateurs tend to sing too slowly, but, when a song should actually be very sustained and the tempo slow, they are apt to hurry because they lose their breath—this is especially true when they have been taught "breath-control".

CHAPTER XXIX
METER AND RHYTHM

By *Meter* is meant the grouping of the tones in the individual units of beat, and therefore, depends upon the denominator of the time sign. For example: in 4/4 time we may have four quarter notes, or the quarter may be subdivided into two eighths, a dotted eighth followed by a sixteenth, four sixteenths, an eighth followed by two dots followed by a thirty-second etc. Of course we may have two half notes or a whole note, and rests may be employed, etc.

The following are some of the metrical forms or arrangements of the 'feet' in the bar, (this is known as the verse-feet or "metrico-rhythmic theory").

Trochee		Long, short
Iambus		Short, long
Dactyl		Long, short, short
Amphibrach		Short, long, short
Anapest		Short, short, long
Spondee		Long, long
Pyrrhichius		Short, short, short
Ionicus		Long, long, short, short
Choriambus		Long, short, short, long
Molossus		Long, long, long
Antispast		Short, long, long, short
Creticus		Long, short, long
etc.		etc.

A fault in time is every bit as bad as is the singing of a wrong note and is as evident to the musician's ear.

In order that the student may develop a proper sense of meter, he should memorize, feel and know the sound of two, three, four, six, eight to a beat etc. and he should be able to go from one of these metrical figures to another in the same time and tempo. Various methods may be used for developing this sense of time and meter.

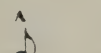
One means of teaching these metrical figures is to direct the pupil to use certain *dummy words* so that the accented syllable or syllables of the word or words employed correspond to the accents of the metrical figure.

This method is of great value in teaching cadenzas, runs and any musical figures where the meter is difficult. It will also indicate the similarity of similar metrical figures. It is very effective for the teaching of scales in various meters etc.

Examples:

Two to a beat..  .....*VE*ry

Three to a beat..  .....*AC*curate

Four to a beat..  ...*IN*ex*PRESS*ive

Six to a beat... 

*IN*oppor*TUNE*
inex*PRESS*ive
in*AC*curate

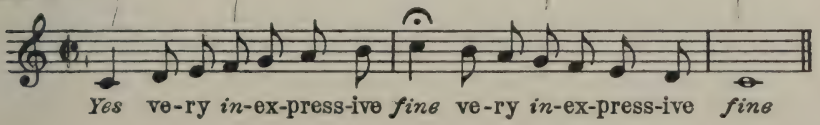
The beat divided by the dot 

YES—in*DEED*
then

(The 'then' represents the dot)

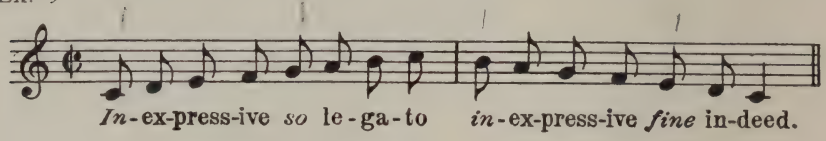
The eight-note scale with the first, top and last notes held:

Ex. 8



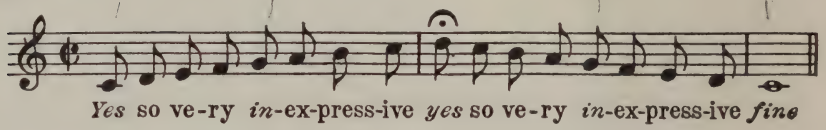
The eight-note scale without holds, to be sung at high speed. *This form may be used for the development of speed in scale work:*

Ex. 9



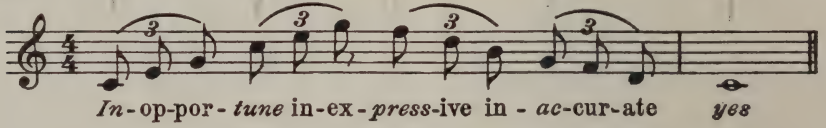
The nine-note scale with the top note held:

Ex. 10



Combination of tonic triad ascending and dominant seventh chord descending in triplet meter:

Ex. 11



The above examples illustrate the use of 'dummy' words as a device for obtaining accurate time and rhythm and engendering the concept of singing in groups rather than note by note.

This device is of great value in developing the ability to sing at high speed with the details of time and rhythm accurate.

The syllables in italics indicate the stressed "time spots".

In Ex. 12 the unit of beat is arbitrarily considered as an eighth-note. The various metrical figures are indicated by the letters A, B, C, D, E and F.

The following table gives an analysis of the metrical figures:

A.—Consists of one eighth-note beamed with four sixteenths; equivalent to one eighth plus two eighths. Hence there are three stressed spots in the metrical figure.

B.—Consists of six sixteenth-notes beamed together, which is equivalent to three groups of two sixteenths or three eighths. Hence there are three stressed spots in the figure.

C.—Consists of two groups of two sixteenth-notes, which is equivalent to two eighths. Hence there are two stressed spots.

Ex. 12—Cadenza from the Cavatina "No, caso egual giammai" from Meyerbeer's *Les Huguenots*



D.—Consists of a quarter-note plus eight thirty-second-notes, which is equivalent to two eighths plus two eighths. Hence there are four stressed spots in the figure.

E.—Consists of eight thirty-seconds, which is equivalent to two eighths. Hence there are two stressed spots in the group.

F.—Consists of five thirty-seconds and is irregular. These five notes must be taken in the time of four, which is equivalent to one eighth-note. Hence there is one stressed spot in the figure.

This cadenza illustrates the use of one, two, four and five notes to a beat. A form of syncopation is also illustrated. Thus in figures A and D the word *then*—below the line—is not sung, since it represents the tied note on which one of the stressed spots falls. The singer should indicate this stress by means of a pressure or accentuated vibrato.

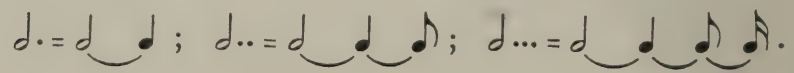
In figure D the quarter note should, by this analysis, be split into two eighths, making three stressed spots come together. One of these is sung and the others indicated by a slight 'press' at the correct moment.

Examples of this use of carefully chosen words could be multiplied, but enough has been said to indicate its usefulness. By this device the mastery of such a relatively difficult cadenza becomes quite a simple matter, and furthermore the idea of singing in groups instead of note by note is engendered.

In scale work the singer should conceive the whole scale as one unit and not as a series of tones. He must always be absolutely governed by the meter and not by his voice. The use of words will help a great deal in the attainment of this conception. Scales may be sung crescendo, diminuendo etc. These dynamic indications should be realized from the outset as referring to the group and not to the single note.

The metronome may be utilized very beneficially during the practice of all musical figures.

In working out the time, the *dot* is, of course, just as important as is the actual value of the note. Many singers are very careless about giving the exact value to the dot. One dot after a note increases its value by one-half; two dots increase its value by three-quarters; three dots increase its value by seven-eighths, thus:



The same thing applies to rests. Thus a rest becomes half as long again when followed by one, three quarters when followed by two and seven eighths when followed by three dots.

The metronome may be used to indicate beats or counts. Thus in 3/4 time it may beat or tick once or three times to a bar. This use of the metronome, for indicating the counts in order that the time spot may be accurately felt, is strongly advocated.

While giving due importance to the principal and secondary accents is the first and most necessary point to be observed in understanding the rhythmic scheme of a composition, the musician will, in the final analysis, think in phrases, and phrases are composed of several measures (with the exception of the monometer which is rare).

In other words the true rhythm is actually determined by the comparison of phrase lengths—the broad unit—which includes the arrangement of the beats in the measure which, in its turn, comprises the metrical value of each beat.

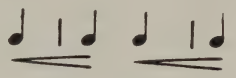
Thus, in studying a composition, we first consider the counts and their arrangements, which correspond to the syllabic arrangement of the words in a poem. Next we consider the accents in the measure, which correspond to the feet in poetry. Then, when the feeling for these two phases of the rhythm has become automatic, we consider the phrase, which corresponds to the line in poetry. Finally we consider the Section (or Part) which in music corresponds to the stanza in poetry. This is rhythm and phrasing in its true sense.

There are various forms of bar rhythm. They can all be classified as either duple or triple. The sense is which these words are here used must not be confused with duple and triple time, which was explained in the preceding chapter. Frequently duple bar rhythm is found with triple time, and vice versa.

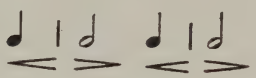
In studying the different forms of rhythm it is always necessary to consider what is taking place between two principal accents.

Sometimes the rhythmic scheme starts before the principal accent and it is therefore necessary that the first mark on the music should be considered, irrespective of whether it is a note or a rest. Many songs start with an apparently incomplete bar. This is known as the anacrusis. The balance of this bar must always be made up, or accounted for, later. When the rhythmic type ends on a weak beat it is called a feminine ending.

The following table gives some of the forms of rhythm in common use:

1.—2 time 

The first note is the anacrusis and the extra beat is made up at the end by the extension into the new measure.

2.—3 time 

If the extension be doubled we have the first form of triple time.

3.—3 time 

Starting on the anacrusis and subdividing the first beat we get this form.

4.—3 time 

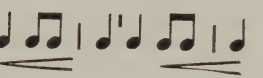
Starting on the second beat of the previous measure we get this form.

5.—2 time 

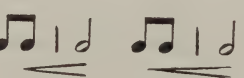
Subdividing the unaccented beat in the previous bar we get this form.

6.—3 time 

Subdividing the third beat of the previous bar and the third beat in the bar we get this form.

7.—3 time 

Starting on the second beat of the previous bar and subdividing both third beats we get this form.

8.—3 time 

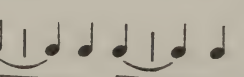
Drawing together one accented beat with the unaccented one we get this form.

9.—3 time 

Starting on the second beat and drawing together both unaccented beats we get this form. This unnatural prolongation of the unaccented beat as opposed to the accented gives rise to an effect similar to syncopation.

10.—2 time 

The tying of the accented beat in the measure with the unaccented beat in the previous measure gives this form which is termed syncopation.

11.—3 time 

Same as above but in triple time.

Other forms may be evolved by combining two or more of these types and by transferring them to values of higher or lower order. Measures containing more than three beats are only compounds of the duple or triple forms shown above.

In order that the reader may properly understand and feel these different types of rhythm, he should tap them out with the metronome. The singer must be able to recognize and feel all these types of rhythm instantaneously. In a syncopated passage the singer must not only feel his part but also that of the accompaniment. If he is to sing on the accented beat and the accompaniment is to play on the unaccented, he must be fully conscious of the accentuation of his own part and of that of the accompaniment, and vice versa.

This is, of course, a general rule: The singer must always be absolutely conscious of all that occurs in the accompaniment. This is not only essential for rhythm but, as will be shown later, for the proper rendition of counter melody etc.

In Brahms' *Sapphische Ode* we find an example of syncopation. Here the vocalist generally sings on the accented part of the beat.

In many of the great songs a beautiful ensemble is obtained when the vocal part and the accompaniment have dissimilar and contrasting rhythms. The time can be counted out, however, by finding the least common multiple of the number of notes to a beat in the accompaniment and in the voice part. For example, if the voice is singing four notes to a beat and the accompaniment is playing six chords or notes, both can be made to fit exactly by counting twelve to a beat. Thus in *Frühlingsnacht,* by Schumann, where the time sign is 2/4, the voice sings four while the accompaniment plays six to a beat.

In *Die Mainacht*—Brahms Op. 43, No. 2—rhythmic contrast is used in a very interesting manner in order to obtain variety. In the first section there is no rhythmic contrast between the voice part and the accompaniment, but when this section is repeated the accompaniment is changed, so that while the voice is singing, as before, in duple subdivision (when subdivision occurs), the accompaniment is changed to triple subdivision. In other words, while the voice is singing two notes to a beat, the accompaniment is playing in triplets.

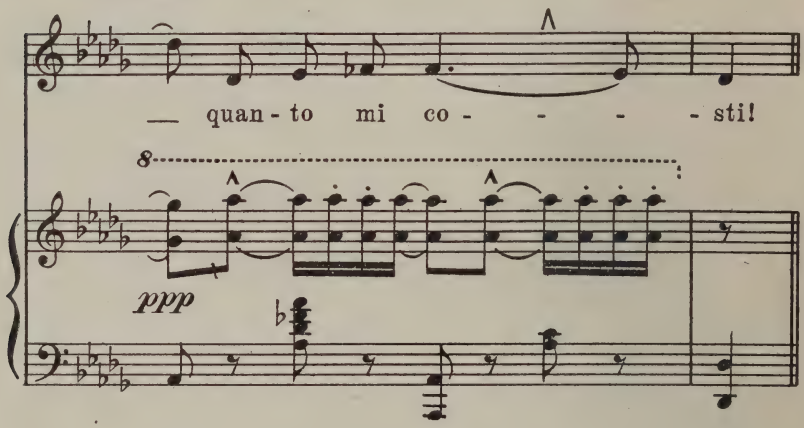
Another means taken by this composer in order to obtain contrast is the shifting of the accent. Thus, in measure seven of this song, the voice has a half note for counts one and two and sings again on three, whereas in a parallel passage, in measure

thirty-seven, the voice has a quarter note on the first count and a half note which it holds for counts two and three.

The question of contrast is an important element in music and is one of the most useful means at the disposal of the composer for obtaining beauty and variety.

A very important dramatic effect, most often found in Italian opera, is wrought by a strong accent or break (an *h*) in a closing cadence at the point where the voice takes the third degree at the same time that the accompaniment plays the dominant seventh chord. Here the time is always drawn out and it is vital that the singer should make the stress, break or sob at exactly the correct moment. Innumerable examples of this may be found in the operatic literature. One is quoted in Ex. 13. Here there is a very strong stress or break at the point indicated.

Ex. 13.—Cadence Break from *Aïda,* Act III; Duet, Aïda and Amonasro



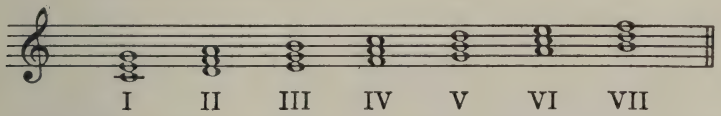
CHAPTER XXX
CHORDS AND CADENCES

Rhythm in the broad sense is based upon the phrase length, and the phrase is determined by the cadence. The latter in turn is a matter of chord formation and resolution. It therefore follows that a knowledge of chords—at least enough for analytical purposes—must be attained before rhythm in its most comprehensive sense can be understood.

A chord is a series of three, four, or five different tones, arranged in intervals of thirds, or in forms that can be reduced to thirds. Three general varieties are recognized: Triads, or chords consisting of three tones; Seventh-chords, consisting of four tones; and Ninth-chords, consisting of five tones. Since what follows is a highly condensed account of chord-formation, the singer who is really ambitious will supplement it by further study. A list of standard works is given in the Bibliography.

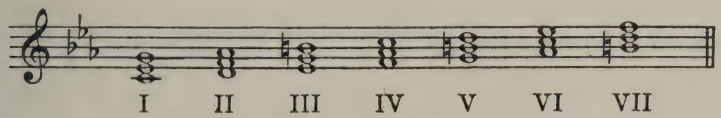
1. Triads may be built on any degree of the major or minor scale. For convenience, they are represented by the Roman numerals I to VII, the numbers indicating not only the chord but the degree of the scale on which it is built. When the triad is arranged in thirds, the note on the bottom is known as the *root*.

Ex. 14.—Triads of the Major Scale



In building triads in minor, the harmonic form of the minor scale is used:

Ex. 15.—Triads of the Minor Scale



It will be observed that in these examples four different constructions of triads are used: Major, Minor, Augmented, Diminished.

See Chapter XXXII, on Sight Singing, for an explanation of these terms.

(a) In the major mode (Ex. 14)—

I, V and IV are major triads, each consisting of a major 3rd and perfect 5th.

II, VI and III are minor triads, each consisting of a minor 3rd and perfect 5th.

VII is a diminished triad, consisting of a minor 3rd and diminished 5th.

(b) In the minor mode (Ex. 15)—

I and IV are minor triads, each consisting of a minor 3rd and perfect 5th.

V and VI are major triads, each consisting of a major 3rd and perfect 5th.

III is an augmented triad, consisting of a major 3rd and augmented 5th.

II and VII are diminished triads, each consisting of a minor 3rd and diminished 5th.

The technical names of these triads are as follows: I, Tonic; II, Supertonic; III, Mediant, IV, Subdominant; V, Dominant; VI, Submediant; VII, Leading-tone Triad.

It is important to note that any major or minor triad can appear in five different keys. For example:

C, E, G— I of C major	C, E♭, G— I of c minor
IV of G major	II of B♭ major
V of F major	III of A♭ major
V of f minor	IV of g minor
VI of e minor	VI of E♭ major

In the preceding examples the triads have been given in the order: bottom note, *root;* middle note, *third;* top note, *fifth.* This is their simplest form. In practice, however, they are found in innumerable modified forms. In order to illustrate the use of these triads, diverse examples will be given from the standard vocal literature.

(a) Whenever a triad has its *root as its lowest note* the chord is said to be in root position (or fundamental form), irrespective of the arrangement of the notes above it. Examples:

VOCAL PART—

The Star Spangled Banner, motive I (Ex. 22, page 202).

Pergolesi, *Nina* (Ex. 27, page 206); first three notes.

ACCOMPANIMENT—

Schubert, *Am Meer;* first chord with voice.

(b) Whenever a triad has its *third as its lowest note* the chord is said to be in its first inversion, irrespective of the arrangement of the notes above it. Examples:

VOCAL PART—

Brahms, *Wie Melodien zieht es mir;* first three notes.

Bizet, *Carmen,* tenor aria, "Air de la Fleur"; first four notes of voice part.

ACCOMPANIMENT—

Schumann, *Widmung;* measure 6, first chord.

(c) Whenever a triad has its fifth as its lowest note, the chord is said to be in its second inversion, irrespective of the arrangement of the notes above it. Examples:

VOCAL PART—

Franz, *Im Herbst* (Ex. 24, page 204); first four notes.

Charpentier, *Louise,* soprano aria, "Depuis le jour"; third measure of voice part, first four notes.

ACCOMPANIMENT—

Schumann, *Die Lotosblume;* measure 1.

3. To each triad (three-tone chord) may be added another note a third higher, whereby a four-tone chord is formed called the chord of the seventh. All triads may be expanded in this manner. There are two seventh chords of outstanding importance.

(a) The Dominant Seventh.—In the keys of C major and c minor it is built upon the dominant (G) and consists of the notes G, B, D, F, or 5, 7, 2 and 4 of the scale. It has three inversions:

1st inv.: B, D, F, G; (7, 2, 4, 5)
2nd inv.: D, F, G, B; (2, 4, 5, 7)
3rd inv.: F, G, B, D; (4, 5, 7, 2)

Like the triads, the inversions are determined by the lowest note, the order of the notes above it being of no importance harmonically.

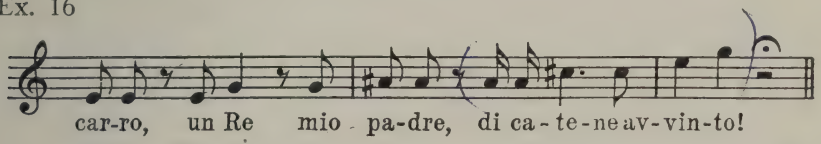
This chord is called the dominant seventh because, in fundamental position, there is an interval of a seventh between the lowest and the highest tones—(G—F). It is also a combination of the two triads common to both the major and the minor scale, which are built upon their fifth and seventh degrees respectively.

This dominant seventh chord can be found in a similar manner in every major and its corresponding minor scale. It is important to note that both have the same leading tone and, since this leading tone occurs in the dominant seventh of both modes, we distinguish the major from the minor by the presence of the accidental in this chord.

The dominant seventh is indicated by the sign V^7.

(b) The Diminished Seventh.—This chord is built upon the leading-tone of any minor scale. For example, in b minor the diminished seventh is built upon A♯, and consists of the notes A♯, C♯, E, G. An example of a passage based upon this diminished seventh is found in the aria "Ritorna vincitor" from *Aïda,* Act I:

Ex. 16



Although no key signature is used the passage is in b minor. The diminished seventh is also found in the major mode as an altered chord.

While a diminished seventh chord may be built upon the seventh degree of every minor scale, there are actually only three different types. They may be designated as follows:

Type I: G♯, B, D, F
Type II: F♯, A, C, E♭
Type III: C♯, E, G, B♭

By merely lowering any one of the component tones a half-step, each diminished seventh leads to eight different keys—four major and four minor. Taking, for example, Type I: G♯, B, D. F:

Lowering F: G♯, B, D, F♭, equivalent to G♯, B, D, E, dominant seventh of A, both major and minor modes.

Lowering D: G♯, B, D♭, F, equivalent to G♯, B, C♯, E♯, dominant seventh of F♯, major and minor.

Lowering B: G♯, B♭, D, F, equivalent to A♭, B♭, D, F, dominant seventh of E♭, major and minor.

Lowering G♯: G♮, B, D, F, dominant seventh of C major and minor.

Similarly Types II and III may be shown to modulate into eight different keys in the same way.

The dominant seventh and diminished seventh chords appear constantly in the works of all composers. In Schubert's *Schlummerlied,* for example, there is not a single measure of the accompaniment which does not contain a V^7 in some form. It is seldom absent from the final (authentic) cadence with which most songs end. It is important to remember that the V^7 of a major scale and the V^7 of its corresponding minor are exactly alike.

Little need be said about the Ninth Chord, or five-tone chord. Only one is used, the V^9, formed by adding another third on top of the V^7. Its existence is questioned by some theorists. Its most convincing use will be found in the works of Wagner.

4. In looking over the songs referred to—or any others, for that matter—the reader cannot have failed to notice many chords containing notes with accidentals that conflict more or less with the key-signature. These are either (a) altered chords or (b) modulations. The difference between an altered chord and a modulation may be briefly summarized by saying that an altered chord does not have the effect of changing the key, while a modulatory chord shifts the key center, establishing a new tonic. For example, in the aria "Depuis le jour" from *Louise,* in the key of G major, measure 21, just before the words "de ton premier", is a diminished seventh chord, Type III; but this and the following measure do not modulate out of the key of G despite the accidentals B♭ and C♯. The accidentals C♯ and A♯ in measure 10, however, on the words "ma destinée" lead to a modulation to the key of b minor.

To go more deeply into this question here is impractical; it forms a large and important part of the study of harmony.

5. Finally, chords in their original form, if continued for too long a period, are apt to become monotonous. Variety is attained by the use of one or more of four methods:

(a) Harmonic figuration, or breaking up of the chords into arpeggio form. Examples:

VOCAL PART—

Rossini, *Il Barbiere di Siviglia;* soprano aria, "Una voce poco fà", third and fourth measures following the interlude.

ACCOMPANIMENT—

Gounod, *Faust;* tenor aria, "Salut! demeure chaste et pure", the entire section marked *Poco più mosso.*

(b) Introduction of auxiliary and passing notes.

VOCAL PART—

Weber, *Der Freischütz;* soprano aria, "Wie nahte mir der Schlummer", Act II. Measures 12 and 13 after *Vivace con fuoco* illustrate auxiliary notes. The next two measures illustrate passing notes.

ACCOMPANIMENT—

Schumann, *Jasminenstrauch.*

(c) Suspensions, or the holding of chords or parts of chords over into the following beats or measures.

VOCAL PART—

Ponchielli, *La Gioconda;* soprano aria, "Suicidio!", last two measures before the second interlude—"del mi-*o* camin".

This device is very frequently found in Italian opera; it is a characteristic effect. Here the note A is suspended. This note is the third of the tonic triad (I), and against it, in the accompaniment, is the dominant (V), really a mixture of two chords at once. The note is tied over the third beat (9/8 time) and on this beat a very strong press or even a break in the voice part must be made. A strong vibrato should be used where a press is desired. Sometimes a sob is made at this point. It is most important that this press should be made at exactly the correct moment, even when the tempo is drawn out.

ACCOMPANIMENT—

Brahms, *Wiegenlied.*

(d) Organ Points, or sustained tones, usually in the bass.

ACCOMPANIMENT—

Saint-Saëns, *Samson et Delilah;* aria "Printemps qui commence", last section marked *poco più lento,* entire section to the end of the aria.

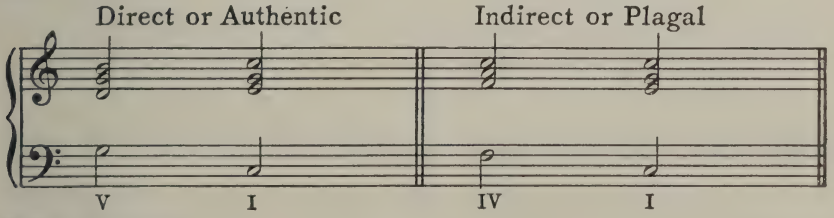
Schubert, *Der Leiermann.* This song is based entirely upon a *double* organ point.

We are now in a position to discuss cadences. The end of a phrase is always marked by a cadence. The most important types of cadences are as follows:

1. The Authentic Cadence: V to I, or V^7 to I. It is found in two forms, Perfect and Imperfect.

(a) Perfect Authentic: V to I or V^7 to I. The V or V^7 must be in root position and the I must have the root in both outer parts. This is illustrated in the first measure of Ex. 17.

Ex. 17



Other examples:

Schubert, *Der Tod und das Mädchen;* end of voice part.

Brahms, *Der Schmied;* measures 12, 13—*und Platz.*

(b) Imperfect Authentic. This is any progression of V or V^7 to I which avoids the strict conditions of the perfect authentic. Although the chords used are themselves suggestive of finality, the imperfect form

of the cadence has the effect of modifying or qualifying this impression of total finality. Examples:

Schubert, *Wohin?; measures* 13, 14—*Rath mir gab.* A modulation to the key of a minor.

Schumann, *Volksliedchen;* measures 3, 4—*grünen Hut.*

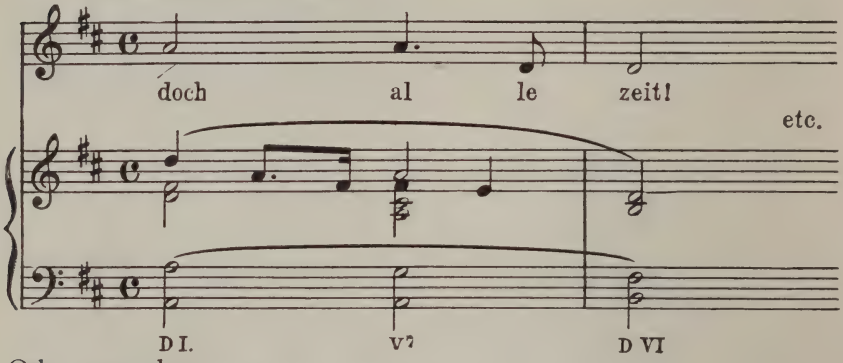
2. The Plagal Cadence, IV to I. This also is found in its perfect and imperfect forms—the conditions are the same as for the two forms of the authentic cadence. It is illustrated in the second measure of Ex. 17. Other examples:

Schumann, *Lorelei;* measure 6 from end—*Gedenke mein!*

Brahms, *Sonntag;* measure 13—*wollte Gott.*

3. The Deceptive Cadence: V or V^7 to VI. It is called deceptive because the chord expected after the V or V^7 is I, not VI.

Ex. 18.—Deceptive Cadence in *Stilles Lied,* from the "Eliland" Cycle, by von Fielitz



Other examples:

Schubert, *Ave Maria;* measure 10.

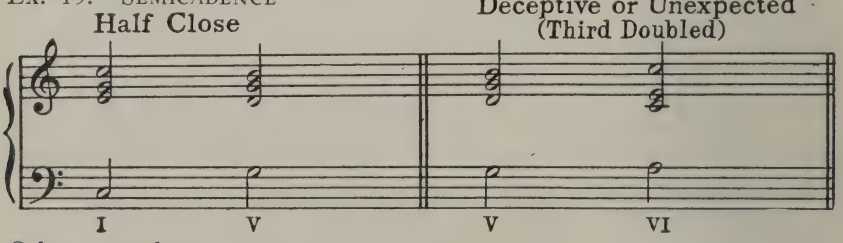
Schumann, *Ihre Stimme;* measures 7 and 8—*Stimme spricht!*

Mein altes Ross; measures 6 and 5 from end—*so weh, so weh!*

Schumann often uses a modification of the deceptive cadence consisting of V or V^7 going to V^7 of the relative minor. This has an even more strongly marked deceptive effect than V^7 to VI. An unusual form of the deceptive cadence—V^7 to the first inversion of IV—is found in *Ihre Stimme,* measures 10 and 9 from the end—*zu gut.*

4. The Half Cadence or Semicadence: usually I to V, but often other chords to V. The characteristic is that the final chord is V.

Ex. 19.—Semicadence



Other examples:

Schumann, *Mondnacht;* measures 12 and 13—*still geküsst.*

Brahms, *Die Mainacht;* measures 25 and 26.

Ex. 20


THESIS
Way down up - on the Swa - nee rib - ber, Far, far a - way,
Half Close
I I I IV I I V V7
ANTITHESIS
Dere's wha my heart is turn - ing eb - ber, Dere's wha de old folks stay.
Perfect Authentic Cadence
I I IV I V7 I

At such points in songs as the ends of stanzas, the ends of sections where the piano has an interlude, and at the final close, the two chords of the perfect cadence are preceded by others that bear certain definite relationships to the cadence chords. The whole group, or "cadence group", has become a sort of standardized formula which has been the common property of every composer since before the time of Bach. The following cadence groups are most often found:

(a) I, IV, II, VI —I, 2nd inv.—V (V⁷)—I

(b) II—IV—V(V⁷)—I

(c) VI, IV —II, 1st inv.—V(V⁷)—I

Sometimes a whole phrase, or even a period of a song, is based Upon one of these cadence groups. The example on page 185 from *Old Folks at Home* shows what is meant.

The harmonic scheme is built on the cadence type (a). The chords used are: I, IV, I (with fifth in the bass), V⁷, I. This refers to measures 5 to 8. Measures 1 to 5 are based upon a similar chord arrangement. In measure 4 we have an example of the half close.

When singing ar playing these eight measures it will be seen that the obvious places at which it is possible to pause are at the end of the fourth measure, where the half close occurs, and at the end of the eighth measure, where the full close occurs. These possible stopping places are definitely fixed by the presence of the cadence as indicated by the table.

Thus the ends of the phrases are determined by the places where the cadences occur.

The importance of a proper understanding of this fact cannot be overestimated since many singers are quite unconscious of what a phrase really is, and moreover, the true unit in music is the phrase. Unless the singer actually feels and knows what a phrase is, he will not be singing the song at all; he will, in effect, be merely making a series of disconnected sounds. This can be paralleled to speech—a series of words are nonsense unless the one who speaks them divides his thought into sentences. The phrase in a song is the sentence, and just as the sentence is the unit of speech, so is the phrase the unit of music. A series of words undivided into sentences are meaningless, and similarly, a series of tones undivided into phrases have no meaning. The singer who sings note by note is singing nonsense. In learning a song it is essential that the student should mark the phrases, which he will be able to do when he knows where the cadences occur.

CHAPTER XXXI

PHRASING AND RHYTHM

It has been shown in the preceding chapter that the phrasing of a song is determined by the presence of the cadences.

There are many kinds of phrases and these are classified according to the number of measures they occupy.

It must be remembered that the ear of the listener senses the phrase from the first tone to the completion of the value of the measure. Thus, when the phrase starts on an anacrusis, the measure must be balanced or made up, by an extension into another measure. This was explained in Chapter XXIX. The different kinds of phrases are:

1.	Monometer	one-measure	phrase.
2.	Dimeter	two- "	"
3.	Trimeter	three- "	"
4.	Tetrameter	four- "	"
5.	Pentameter	five- "	"
6.	Hexameter	six- "	"
7.	Heptameter	seven- "	"
8.	Octameter	eight- "	"
	etc.	etc.	

The most usual forms of phrases in songs are the *Dimeter* and the *Tetrameter.*

The example of *Old Folks at Home*—(Ex. 20)—shows the tetrameter form. Here we have two phrases, the first from measure 1 to 5 and the second from measure 5 to 8.

An interesting example of the dimeter phrase is found in Schubert's song, *Des Mädchens Klage* (in c minor). The first phrase of the voice part starts on an anacrusis which consists of a sixteenth note, and it ends in the second measure with the final sixteenth subdivision for this measure omitted from the phrase. Thus the last beat of this measure, which consists of an eighth note followed by two sixteenths for the voice, has these two sixteenths split, so that the first belongs to the first phrase and the second to the second. The first phrase ends with a half close in c minor and the second with a full close in E flat major. The second phrase also ends one sixteenth note before the end of the measure.

Waltz songs are usually written in octameter phrases. For example, the waltz song "Ainsi que la brise légère"—from Gounod's *Faust* (Act I, No. 6)—illustrates a period containing two eight-measure phrases. The first phrase cadences on the dominant seventh of D major and the second, contrasting phrase cadences on the tonic of A major. This is an example of two phrases similar to each other from the standpoint of melody but ending with contrasting cadences. The presence of the accidental G♯ in the second half of the second phrase is a sign post which indicates A major, since G♯ is the leading tone of this scale. It is interesting to note that the triad, A, C♯, E, is both A major I and D major V. This enables the composer to return to the original key in the following phrase.

In many cases different phrase lengths are combined in the same song. This gives variety and contrast.

An interesting example of varied rhythm is found in Schumann's song *Seit ich ihn gesehen*. After one measure of introduction there is a three-measure phrase. This is followed by another similar phrase, and, in contrast, by four two-measure phrases. This is striking and rather unusual, since the three-measure phrase is not very often found in songs. This contrasting of two and three-measure phrases produces a very beautiful effect.

The question of phrasing and phrase contrast is an extensive one which is only touched upon lightly here. There is a great deal of valuable literature on this subject, although little has been found directly bearing upon the question with reference to songs.

The phrase length has an important bearing upon the tempo of a composition. The general rule is that the tempo is fast when the phrase is long and vice versa.

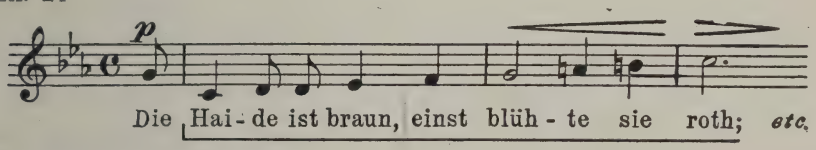
This leads to a most important principle from the point of view of the singer, namely that he should take his breath, wherever possible, after each phrase. It sometimes happens that a phrase is so long that it cannot be sung in one breath, and in this case he must take the extra breath at a caesura, as quickly and unnoticeably as possible, in order not to distort or hold up the musical figure. A caesura marks the rhythmical end-point of the melody, or in other words, the end of a motive or motive member—in the case of a long motive. In regard to the words, a caesura must fall either after a monosyllable or after the last syllable of a word. Under no circumstances may the singer break a motive except by dividing it into its component members at the caesuras.

Of course a breath may always be taken where a rest is indicated, although it is sometimes better not to breathe when it is of very short duration. The general rule is, then, that the breath marks should be indicated at the ends of the phrases, and where an extra breath has to be taken, at a caesura.

Now the statement made above that the tempo has an effect upon the length of the phrase has an important bearing upon this question since, for example, eight measures, taken quickly, may occupy about the same time as would two, taken slowly.

Of course anyone who has become 'breath-conscious' as the result of having been taught 'breath-control', is always worried about his breath, and he will, therefore, tend to split phrases in a most unmusical manner. A properly trained singer should never find himself in this predicament. There are innumerable cases of great compositions which are habitually abused in this way. An interesting case of this is found in the Franz song *Im Herbst* which starts with two similar phrases of three measures each.

Ex. 21



The above example illustrates:

1. A three-measure phrase.
2. An example of a melody based upon the melodic form of the minor mode, c minor, ascending.

These phrases should not, in the author's opinion, be broken, and the beauty of the composition is seriously impaired by the singer who does so in order to inspire, however quickly he may be able to perform this act.

Another example of a phrase which should not be, but which often is, broken by singers is the mounting phrase in Schubert's song *Du bist die Ruh.* The climax of the song is ruined when this is done.

Another consideration may arise in the mind of the reader—he will probably think: "But what about the words: should not the singer breathe and phrase according to the words he is singing?" The answer is, of course, in the affirmative, but in any properly written song there should never be any conflict between the words and the music. In such a song the words and the music are wedded, and far from conflicting, they amplify and help one another. Unless the music is written for the words, and with due regard to their import and rhythm, the song is

valueless. Where the sense of the words gives a pause, the phrase should close, and where there is a slight pause, the music should show a caesura. The rests in the music should coincide with the natural pauses in the poem. Songs which are not properly written should be avoided.

We have, however, another case—that of a translation. The songs of the great composers are, of course, properly written, from this standpoint, in practically every case. These songs have, however, been translated, and such translation is necessary since, at any rate in the opinion of the author, it is far better for a beginner to use his own language than for him to attempt to sing in a foreign tongue which he will probably mispronounce and which he may not even understand.

Now, unfortunately, many translations are very poor. The words not only do not fit the music properly, but also many cases have been found where the music has been distorted, and even the accents interfered with, in order to fit these poor translations. When choosing a translation, it is essential that the singer should read the words with care and definitely reject any edition in which they are unsatisfactory. If a proper translation cannot be found, it is a good plan to try to alter the words written so that they fit the music better. With a little skill and patience many improvements will often suggest themselves. Translations have been found in which an accent in the music falls on the unaccented syllable of a word. The word must then be changed.

Sometimes extra notes are introduced in order that the words of the translation may fit. This is illegitimate and the singer should so alter the words that such extra notes are eliminated, while, at the same time, the sense is retained.

No one should sing an English song in which an accent in the music falls on an unaccented syllable of a word.

Much of the dramatic and poetic value of a poem is lost in translation, as is a great deal of the 'color' of the language which has characterized the words in the composer's mind. Lucky indeed is the singer who can really sing in the original language of the composition, since he can get far more out of the song than can the one who is limited to a translation which is, at best, a makeshift.

We now come to the subject of the broader rhythm which is dependent upon the phrase length. In considering the broad rhythm of a song we must, in the last analysis, think in phrases and not in notes, bars, or even in musical figures. Thus in dimeter phrases we should count two—one beat to the measure—

regardless of the time sign; in trimeter, three; in tetrameter, four etc. In octameter, eight may be counted, but it is sometimes better to count four, twice, for the sake of convenience, although the sense of eight must not be lost sight of. This is similar to the device of counting 'and' in the bar.

The whole song will take shape when the singer thinks of it in terms of this larger unit. Of course all the details must be perfect before he attempts to do this. It is only when this broad sense of the rhythm is attained that the song will be interpreted with its proper swing and 'shape'.

To sum up: The student must first observe the time sign and mark the beats in the measure and the principal and the secondary accents. Then he must find the cadences, and from them, work backwards thus establishing the phrase lengths. From the phrase lengths he can establish the larger rhythm and he will then be able to count once only for each bar, counting one, two, three, four etc. according as the phrase is mono-, di-, tri-, tetrameter etc.

CHAPTER XXXII
SIGHT SINGING

It is, of course, desirable that the singer, no less than the pianist, should be able to read music at sight. A musician should, in fact, be able to read music from the printed page just as fluently as he can read a book. Anyone who can read at sight is able to learn songs, operatic roles etc. in a fraction of the time necessary for the one who cannot do so, since the process of "picking out" the notes, working out the time and learning the melody by ear is a long and tedious one.

It is evident that the faculty of reading music at sight implies not only the ability to read notes and hear mentally the sound of relative pitches and of all possible intervals, but also the capacity for conceiving instantaneously the exact time-spot.

Although it is an asset for the singer to have a sense of absolute pitch, the important essential is rather a sense of *relative* pitch. For this reason the student of sight singing should use the movable, and not the fixed, *do*.

There are many methods of teaching intervals in vogue but, in the opinion of the author, the best way is to base all such teaching upon a knowledge of scales. For this reason the student should know all the scales from the theoretical point of view and should also know the sound of the diatonic major, minor—especially the harmonic form—and the chromatic scale (see Exs. 2 and 3). It is essential that, given the keynote, he should be able to sing any form called for without the slightest hesitation.

All the intervals used in music are based upon the scales, and the student should not attempt to master the intervals until he knows the scales perfectly. The method of teaching intervals by means of steps is a confusing one and has been found to be unsatisfactory in practice.

The various musical forms with which the singer should be conversant are as follows:

1. All the diatonic scales, both major and minor. See Chapter XXVII.

2. All the intervals and their inversions. These intervals are: perfect, major, minor, augmented, diminished.

When given the names of any two notes the *number name* is obtained by counting from the lower to the upper. Thus C-E is a third of some sort, A-F♯ is a sixth etc.

In order to determine the *specific name* of any interval, in other words, whether it be major, minor, augmented etc., the scale of which the lower note of the interval is the keynote, must be considered. Thus in the above examples, considering the interval C-E, it is evident that E is the third in the key of C major, and this interval is, therefore, a *major* third. Had the interval been C-E♭, the E♭ would have been the third in the scale of c minor and the interval would, therefore, have been a *minor* third. Thus the minor third is a half-step less than the major. Had the interval been C-E♯, it would have been a half-step greater than the major third, and this is what is known as an *augmented* third.

It is important to note that this interval should not be considered the same as its enharmonic counterpart C-F, which is a fourth. Thus the interval is determined by its number name. Again, if the interval had been C-E♭♭, it would still have been a third, although the actual interval is less than the minor third by a half-step. This is known as the *diminished* interval.

In order to obtain the number name of an inverted interval in the compass of an octave, the rule is to subtract the number of the given interval from 9. Thus a third inverted becomes a sixth etc. For example: C-E, a third, when inverted becomes E-C, a sixth; C-D, a second, becomes D-C, a seventh; C-F, a fourth, becomes F-C, a fifth etc.

Now C-E is a major third, but its inversion, E-C, is a minor sixth; C-D, a major second, becomes D-C, a minor seventh; but C-F, a "major" fourth, becomes F-C, a "major" fifth in the scale of F. For which reason this interval—the fourth—is known as a *perfect* interval.

The perfect intervals are: primes, fourths, fifths, octaves.

These intervals cannot be classified as major or minor, but they can be diminished or augmented. Thus C-G♯ is an augmented fifth while G♯-C is a diminished fourth.

All seconds, thirds, sixths and sevenths may be classified as major, minor, augmented or diminished.

By using the movable *do*, all possible intervals are known when those in one scale are mastered. The following intervals

are possible from the note C. For practice, similar tables should be made from other notes:

	Perfect	Major	Minor	Augmented	Diminished
Primes:	c-c	—	—	c-c♯	c-c♭
Seconds:	—	c-d	c-d♭	c-d♯	c-d♭♭
Thirds:	—	c-e	c-e♭	c-e♯	c-e♭♭
Fourths:	c-f	—	—	c-f♯	c-f♭
Fifths:	c-g	—	—	c-g♯	c-g♭
Sixths:	—	c-a	c-a♭	c-a♯	c-a♭♭
Sevenths:	—	c-b	c-b♭	c-b♯	c-b♭♭
Octaves:	c-c	—	—	c-c♯	c-c♭

The wider intervals are ninths, tenths etc. A ninth is a second extended, a tenth a third extended etc. The extended form of the interval is found by adding 7, so that the sixth becomes the thirteenth etc.

These intervals should be sung repeatedly using the names of the notes—*do, re, mi,* etc.—or the numbers 1, 2, 3, etc. (thus a major third should be sung either as *do-mi* or as 1-3) until their sound is perfectly familiar to the singer's ear.

3. All the major and minor triads. These were fully discussed in Chapter XXX. They should be sung repeatedly until their sound, and that of their inversions, is learned.

4. The dominant seventh and diminished seventh chords, also discussed in Chapter XXX. Both these chords should be "spelled out", and sung in their fundamental and inverted positions, until their sound is known and firmly established in the student's mind.

5. The chromatic scales and intervals. After the chromatic scale has been thoroughly mastered, chromatic intervals may be learned. The most important of these intervals are the chromatic thirds and sixths.

6. Ornaments of melody. The principal ones are: (a) the long appoggiatura; (b) the short appoggiatura; (c) the double appoggiatura; (d) the turn; (e) the trill; (f) the trill and turn combined; (g) the chain of trills.

All these forms should be learned, practised and recognized at sight. It is essential that the proper note or notes should be accented.

One of the most important phases in the study of sight singing is the development of the ability to conceive and read time and rhythm instantaneously. At first the student will have to mark the counts, but later he will be able to sense where they fall without having to do this and the process will, after some practice, become automatic.

A general idea of the steps which may be taken while learning to read at sight is as follows:

1. Observe time signature.
2. Mark counts.
3. Mark accents.
4. Observe signature and determine *do*.
5. Using the movable *do* name the notes throughout the composition *do, re, mi,* etc. When a definite key change occurs, the *do* must, of course, be moved.

The above process is necessary in the early stages, but later, when the student has acquired sufficient knowledge of the intervals etc., and has had sufficient practice, he will be able to see and read music straight off like a book, without having to make any marks on the printed page.

CHAPTER XXXIII
FORM

Form in music is the balancing of the phrases, periods and sections of a composition. The two kinds of form which are most used by composers of songs are *Binary* and *Ternary*.

A study of folk songs has given much to modern music in regard to form, and many of the great principles upon which our modern songs are built are derived from folk music.

The definition of the term "folk song" is a mooted question. Some authorities hold that a folk song is genuine only when it has grown up among the people, has been handed down from one generation to another, and has finally been written down. Others contend that the origin of a folk song may be known when it has been popular among the people for many generations. In this class would fall such a song as *Old Folks at Home* by Stephen Foster. After all, the folk songs of unknown origin have been harmonized by relatively modern composers and their character, therefore, somewhat changed.

In the chapter on scales, the Aeolian form of the minor mode (Ex. 5) was mentioned. This scale is used in the original version of the English folk song *Salisbury Plain*. Examples of the Phrygian and the Dorian forms of the minor mode are also found in folk music.

Form is actually based upon folk music where we find the principles of symmetry, balance and contrast exemplified.

In Chapter XXXI the question of phrases and phrase length was discussed. Two or three phrases (two are more usual) which balance and contrast with each other form a period. The first phrase is called the thesis and the contrasting phrase the antithesis. Example 20, *Old Folks at Home* shows eight measures or two phrases. Measures one to four, inclusive, embody the thesis which cadences to the dominant, and measures five to eight the antithesis which cadences to the tonic. These two phrases together form a period. Two or more periods form a section of a composition. As with periods, sections must be balanced and contrasted.

For purposes of discussion the first phrase with which the tune begins, or the thesis, will be called A, and the contrasting phrase, or antithesis, B. If there is still a third contrasting phrase it will be called C.

Many songs are based on the principle A—B—A. The first time A occurs it will be marked A^1 and the second time A^2. In this manner the form can be analyzed and the structure of the song classified. For example in the Welsh folk song *All through the Night* there are sixteen measures consisting of four four-measure phrases. The material in this song is divided thus:

A^1,	measures	1 to 4	two phrases
	"	5 to 8	
B,	"	9 to 12	one phrase
A^2,	"	13 to 16	" "

A^1 appears twice to start with, B contrasts with it, and A is repeated again at the close. This is known as ternary form.

This leads to one of the most important phases of song construction: restatement after contrast. A is stated, B contrasts with it, and A is then restated. These sixteen measures can be counted four times four, in order that the larger rhythm may be felt.

An example of a modern art song which follows this form is *Mit einer Primula veris* by Edvard Grieg. It is in 6/8 time and the phrases are four measures long. The song consists of 24 measures altogether, so that there are six four-measure phrases.

A^1	consists	of	two	phrases—	measures	1 to 8,
B	"	"	"	"	"	9 to 16,
A^2	"	"	"	"	"	17 to 24.

This song may be counted six times four when counting in measures.

An example of this type of form in the operatic literature is found in the tenor aria "Celeste Aïda" from Verdi's *Aïda* Considering the aria itself and not the recitative we have:

A^1, 14 measures; B, 10 measures; A^2, same as A^1.

The whole aria is closed with a *coda* which will be explained later.

The composer has carried out the idea of restatement after contrast not only in the music but in the words also, since in A^1 and A^2 Radames speaks of the beauty etc. of Aïda, and in B he tells of his desire to restore her to her country and throne.

One of the best known examples of the binary form is Schubert's *Hark! Hark! the Lark!* After an introduction of eight measures for the piano, the plan is:

A, a phrase of four measures (9-12), repeated (13-16) and extended (17-18). B, a contrasting section consisting of a period with the second phrase repeated and extended to the end of the song. There is no return to the melody heard at first.

The examples considered so far have been of songs based upon the simple folk song pattern and they are beautiful and appealing despite their simplicity of design. Of course many of the compositions of these great composers are of a far more highly evolved type. Wide variation of phrase length is found among their works, although the balance is always maintained.

To the layman this simple folk song form carries the greatest appeal since it is the expected outcome.

Much of the beauty and variety in music, from the musician's standpoint, is gained, however, by the unexpected. In the more complicated songs, beauty and contrast are often attained by variations of phrase length, rhythm etc. Nevertheless, the symmetry is always maintained by the great composers. Thus the principle of unity is retained in spite of variety.

Probably one of the greatest masterpieces in the vocal literature is *Der Erlkönig* by Schubert. The poem is by Goethe. The characters introduced are the father, the child and the Erlking. In this composition the composer departs from the conventional form in a very striking manner. Most of the phrases are cast in the four-measure mould, but the tenseness and dramatic quality of the poem causes the composer to "tighten up" the phrases, as it were, with the result that in several places the phrase length is contracted to three measures (52-54, 70-72, 117-119), to two measures, (146-147), while the little interlude which overlaps measures 19 and 20 can be considered as a one-measure phrase. Considering the song in its original key, g minor, the analysis is as follows:[1]

1. Introduction; 1-15, g.
2. Narrative; 16-32, g, c (21), B♭ (23), g.
   Interlude; 33-36, g.
3. Dialogue; 37-54, g, c (39) f (47), B♭.
   Interlude; 55-57, B♭.
4. Erlking; 58-72, B♭, F (64), B♭ (66).
5. Dialogue; 73-85, c, b (81), e (82), G.

[1] Major keys are indicated by capital letters, minor keys by small letters. The figures refer to the numbers of the measures.

6. Erlking; 86-96, C, a (89), G (91), C (93).
7. Dialogue; 97-112, a, c♯ (106), d (108).
   Interlude; 113-116, d.
8. Erlking; 117-131, E♭, d (120), b♭ (124), g (129).
9. Narrative; 132-148, g, c (139), A♭ (143), g.

The whole of the composition is written in 4/4 time, but the types of rhythm vary a great deal.

At first the rhythm is regular.

For the cries of the child the movement is made more agitated—measures 73-76—by a change of the units in the metrical figure.

The accompaniment consists of contrasting metrical figures of two groups of triplets followed by three quarter-notes. This gives the effect of the horse galloping. Later this same metrical figure is written in octaves as the dramatic import becomes more agitated.

In the section beginning measure 86 and extending to 96 the change of rhythm gives the effect of enticement. This is particularly striking in measures 93—96, where the subdivision of the second and fourth beats in the bass occurs. This gives the effect of dancing and singing. The rhythmical subdivision of the beats in one form or another is maintained throughout the song until the final three measures are reached, when it ceases and chords take its place. This allows the singer to declaim the last phrase which is in recitative form.

This song comes under the type of art ballad of which more will be said later.

The coda has already been mentioned. It is an extension of a part by an adjunct developed from the material used in the body of a song or composition, and it does not affect the form as a whole. Considering the coda in the tenor aria from *Aïda,* mentioned above, the following facts appear: It is added on after A^2 and does not affect the form A^1, B, A^2. It extends from measure 38 through measure 48 of the vocal part. In measures 20-21 in the body of the aria the following metrical figure is found:



This same figure appears in the coda measures 41-43. The recurrence of this motive leads to the dramatic climax in measures 43-44 of the coda.

Another device of interest which sometimes occurs at the end of a song or section of a song is the extension. It has the effect of delaying the final cadence and is generally brought about by the repetition of certain words.

For example in the song *Si mes vers avaient des ailes* by Reynaldo Hahn, the close of the first verse—measures 14 to 17 inclusive—is a four-measure phrase. The parallel passage in the second verse, extending from measure 23 to 28 inclusive, is a six-measure phrase. By repeating the words "Si mes vers avaient des ailes", two measures are added to the second verse. The music would have been complete had he used measures 23, 24, 27 and 28. This delay of the close, and the repetition of the words, is very effective.

A song in which we find A, B and C instead of only A and B is *Les Cloches* by Debussy. Considering this composition in the original key—c sharp minor:

A....Measures 1—10, including two measures of introduction.
B .... " 11—20.
C .... " 21—41, including five measures of postlude.

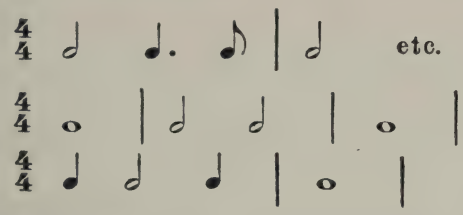
The principle of variety in unity is well exemplified in this song. Three different sorts of material have been used for the vocal part—A, B, C.

The accompaniment carries the principal melodic figure which consists of four tones. This figure is practically unchanged throughout. The voice part consists of a sort of obbligato melody.

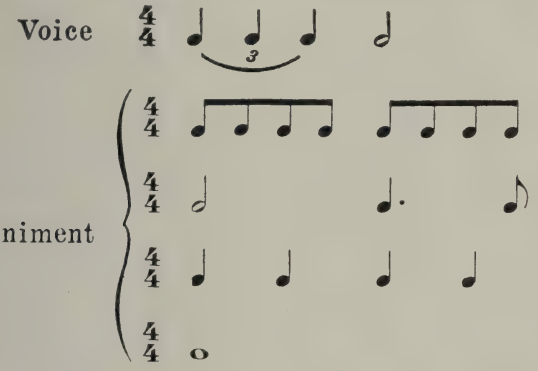
In A and B the tonality is C♯ minor. In C it changes to E major, which is the relative key.

The rhythmical working out of the four tones—C♯, D♯, E, C♯—which comprise the principal melody, is the most interesting feature of the composition. These four notes represent the bells. This rhythmical figure is first found in the left hand part from measures 1 to 6. At measure 6 it is raised to an inner voice, and extends to measure 15. At measure 15 it is taken up by the right hand in an inner voice until measure 21 is reached. At measure 21 it occurs in the upper voice of the treble with augmented rhythm, and this continues to measure 34. It re-appears in measure 37 with the accent shifted, is absent from measure 38, and reappears, for the last time, in measure 39 for one measure only.

The form of this rhythmical figure, which consists of the notes C♯, D♯, E, C♯, is as follows:



In measure 15 five different types of rhythm appear at once thus:



In addition to these factors of the rhythm in this measure, there is the device of 3 against 4.

Of course the singer who hopes to feel and understand such a song properly must conceive all these rhythms simultaneously.

To sum up: the serious student, before attempting to interpret any song, should be able to distinguish the musical figure, the phrase, the period and the construction or form of the composition. In this way only can he really appreciate the balance, the symmetry and the contrasting effects.

The 'ham' actor who merely 'vocalizes' his words is no more ridiculous than is the singer who has not fully grasped the import of the music. No matter how 'beautiful' the voice of an actor may be, his performance is worthless and ineffective if he does not bring out every shade of meaning in his lines. In the same way, no matter how beautiful a singer's voice may be, if he does not fully understand the music his performance is futile.

CHAPTER XXXIV
MUSICAL MOTIVES

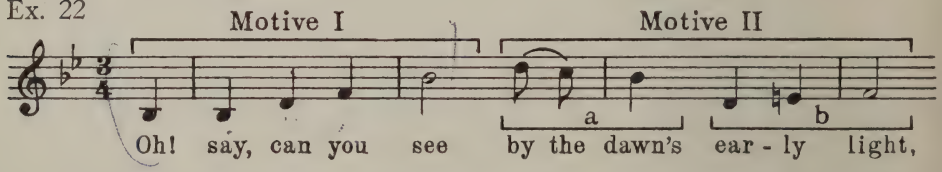
The smallest group of notes which can represent a musical idea is called a musical figure, or motive figure. This is the embryo or seed from which the idea springs. A further development is known as the motive. When this idea is rounded out the resultant group of notes is called a theme.

These definitions are more or less relative, since as few as four notes may, in certain cases, form a theme. An example of this was shown in the Debussy song *Les Cloches*.

At first flush it would seem, to the layman, that the use of many motives in a song would show versatility on the part of the composer and that such prodigality of thematic invention would produce great contrast and beauty. On the contrary, however, a study of the great masters demonstrates the fact that true skill is revealed by the use of but few motives ingeniously contrasted.

In Puccini's opera *Madame Butterfly* the theme of "The Star Spangled Banner" is used to characterize the American hero—Pinkerton.

Ex. 22



Illustrating the theme of the "Star Spangled Banner" divided into its motive members, marked I and II.

Motive II is subdivided into two musical figures marked a and b.

Motive I consists of the broken tonic chord of B flat major in fundamental position.

Motive II contains two musical figures, the first, a, consisting of three notes scalewise downwards, and the second, b, of three notes scalewise upwards.

The passage referred to in the opera *Madame Butterfly* occurs early in the first act.

To introduce the Pinkerton motive the orchestra plays the theme of the *Star Spangled Banner,* transposed to the key of G♭ major, on which this motive is based—Ex. 22. Later, where Pinkerton sings in English, "America forever!" and

Sharpless answers him with the same words, both sing this motive.

The first motive of the *Star Spangled Banner*—the Pinkerton theme—consists of the tonic chord broken, and the second motive of two short musical figures, one of which has three notes scalewise descending and the other three notes scalewise ascending (Ex. 22). For convenience we may designate these motives thus: I for the first and II for the second motive and IIa for the first and IIb for the second figure of this motive.

In the above mentioned phrase in which both Pinkerton and Sharpless sing "America forever!", motive I, in G♭ major, is started by the orchestra and taken up by Pinkerton, who sings on the third note of the tonic triad, proceeds to sing motive IIa and the first note of motive IIb, which motive is completed by Sharpless who then sings motive IIa.

There are many ways of varying a motive in order to make it interesting. One of the principal methods is by means of transposition. In Pinkerton's aria from *Butterfly*—"Amore o grillo"—we find the first motive of the aria consists of the tonic chord of B♭ major, but here the second inversion is used. Later on in the aria—measures 30-32—the same inversion of the tonic chord transposed to D♭ major is used.

Considering the second part of the first phrase of this aria, measures 1-4, we find motive IIa (Ex. 22) and this motive is immediately repeated. The same construction occurs again in the transposed passage mentioned above.

The whole phrase, then, seems to be derived from the theme of the *Star Spangled Banner*. Motive I of both is a tonic triad, although in the aria the second inversion is used. Motive IIa is similar in both.

Further consideration of the score will reveal many similar uses of this theme and the various motives which comprise it.

This discussion of *Madam Butterfly* has shown the way in which a motive can be elaborated. There are several methods by which the composer may accomplish this end. The following table indicates the chief means at his disposal: (1) transposition; (2) sequence; (3) interval expansion; (4) interval contraction; (5) rhythmic augmentation; (6) rhythmic diminution; (7) variation; (8) exact repetition.

1. An example of transposition from the aria for Pinkerton from *Madam Butterfly* has been mentioned. This is merely a case of transposing the motive into a different key.

2. When such transposition occurs in series, a sequence is found. Such repetition is always in regular order.

This device is often employed by the composers of Italian opera, and, if not carried to extremes, is very effective. A good example is found in the aria "Suicidio" from *Gioconda* by Ponchielli—measures 27-29.

Ex. 23



An example illustrating Sequence. Note the upward trend of the melodic line.

Notice that the motive begins on the note A, the first time, on B, the second, and on D, the third. These repetitions include all the features of the original motive.

3. In the case of interval expansion the compass of the motive as a whole is extended, by the expansion of an interval.

In the following example from *Im Herbst* by Franz—

Ex. 24



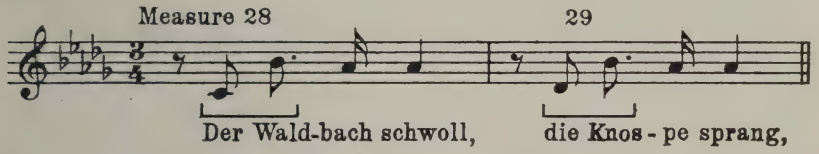
the compass of the motive in measure 38 is an octave, and when it appears again in measures 41-42, at the dramatic climax, it is expanded to nine notes. The rhythmical figure remains the same in both cases, but the accent is shifted. The first time the motive begins on the principal and the second time

on the secondary accent. In this way the strong accent is moved from the first and lowest note of the motive to the highest note, and thus, this, the climax note of the song, is brought out with the maximum possible strength.

4. By interval contraction is meant the inverse of interval expansion.

The song *Ein Traum* of Grieg in measures 28-29 illustrates interval contraction:—

Ex. 25

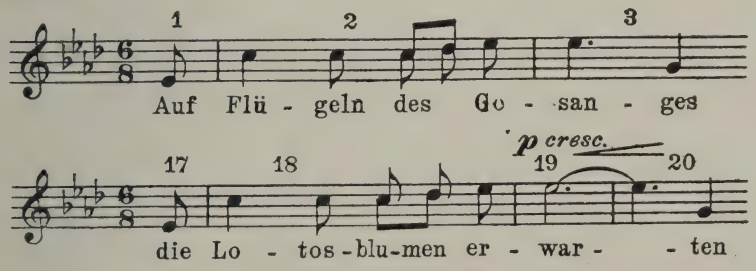


The compass of the interval is reduced from a seventh to a sixth, also in measures 33-34 the motive appears transposed and a similar contraction of the interval occurs.

5. In rhythmic augmentation the musical motive is repeated in an augmented form so that it occupies more measures. This device for the elaboration of the motive is very often found in vocal music. It is most effective since it gives the impression of a rallentando.

An example of this may be found in Mendelssohn's song *Auf Flügeln des Gesanges* in measures 19-20, as compared with measure 3 where the motive appears for the first time.

Ex. 26



In measure 3 the high E♭ is a dotted quarter and when it is repeated in measures 19 and 20 it becomes a dotted half tied to a dotted quarter.

6. Rhythmic diminution is the inverse of rhythmic augmentation, but it is less frequently found in the works of song composers. An example will be found in Schumann's song *Er, der herrlichste von Allen,* measures 2 and 10.

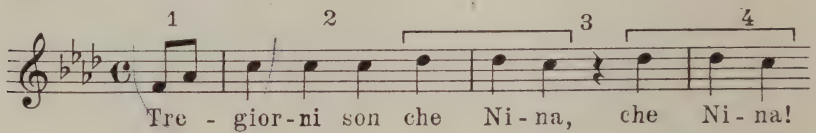
7. Variation of motive is a means of elaborating the motive by representing notes in it of greater value by figures of two or more notes of less value, in such a way that the original motive is still recognizable and intact. An example of this appears in the aria "Un bel di Vedremo" from Puccini's *Madame Butterfly*—see measures 5 and 53.

The A♭ starting on the first beat of measure 5 is a quarter note tied to an eighth; its counterpart in measure 53 is subdivided into four sixteenths followed by an eighth.

8. A motive or a motive member may be repeated exactly with regard to notes, metrical accent, rhythm etc.

As an example of this, the old Italian aria *Nina* by Pergolesi may be quoted.

Ex. 27



Here in measures 2-3 and 3 (second part)-4, the group of three notes occuring on the fourth, first and second beats are exactly repeated.

The above methods of varying the motive are among the most important, although there are, of course, other means of accomplishing this end.

Further consideration of what has been written will serve to illustrate how a singer will be able to interpret the music intelligently and properly when, and only when, he understands the meaning of what the composer has done.

Speaking generally, positive movement of the motive produces a definite emotional effect. Thus a rise of pitch, such as is found in transposition and sequence, in cases where the figure is carried up, represents such emotions as longing, yearning, striving, ecstasy, passion etc. The inverse (a fall of the pitch of the motive), such as is found in transposition and sequence downward and in interval contraction, produces the emotional effect of renunciation, faint-heartedness, introspection, sorrow etc.

The physical structure of the human voice is in excellent keeping with this fact since the natural intensity of a properly used voice increases as the pitch rises. This does not apply to the extreme limits, but the properly trained singer will have so extensive a range that these limits are never employed. Thus a

tenor or soprano who is properly trained will sing with increasing intensity up to about high C, a contralto up to about high B♭, a baritone up to about G or A and a bass up to about F. Each of these classes of voices should be able to sing several tones above these pitches, and thus the limits of range are never actually employed. The great German songs seldom go above A above the staff for soprano or tenor, and even arias are seldom written above high C, except for a coloratura, who should sing up to about double high C, so that even the F above high C is by no means her "top note". A coloratura's most powerful tone may be about F above high C.[1]

Of course a badly trained singer with a 'placed' voice, or one who has his upper tones "in the head", possesses so limited a range, and uses such faulty resonance conditions, that he will start shutting off and "fading out" just at that part of his voice where he should be singing with the greatest power.

Thus rising effects will naturally produce the impression of an increase of intensity when the artist is actually singing at the natural power of his voice. This brings the human voice beautifully in line with the musical facts, and is one of the reasons why the voice, when really properly used, is such an extraordinarily expressive instrument, quite apart from its unlimited possibilities of variation of timbre. This also indicates why the performance of a singer whose technic is faulty is so very unsatisfactory.

Except in rare cases where a very special effect is required, the music will be found to rise when the emotion rises, and this is especially true of the works of the great composers. An exception to this rule is found in some of the compositions of the modern French school where examples of the inversion of this idea are of only too frequent occurrence. For this reason the singing of these songs to excess is very apt to lead to 'throatiness'. A 'throaty' singer fades on his high tones. Such a one cannot sing full high tones of good quality and is, therefore, apt to have a strong predilection for songs of this school. The songs of the modern French school are very interesting and at times quite beautiful. They should, indeed, form a part of the repertoire of every artist, but they are not "teaching pieces". It is obviously most harmful for the singer whose pianissimo is not properly produced, to attempt to sing songs where this effect is used very often on the high notes, and, as has been shown, the attainment of a perfect pianissimo is one of the last phases of technical development. A further consideration of the examples quoted

[1] Review text on page 118, paragraph 6, see also Ex. 1, page 128.

in this chapter will indicate clearly the emotional effects produced by the elaboration of the motive.

1. Considering the Pinkerton aria from *Madame Butterfly,* the singer portrays at the beginning of the aria a rather lighthearted mood, but when the same motive is found in the transposed position—higher—he shows, for the first time, his passion for Madame Butterfly.

The idea of the aria is a mounting one and indicates happiness and insouciance. Only at the point mentioned, and at the end, where the real climax occurs, should any passion be expressed. In each case where the emotion rises the music mounts.

2. In the case of the aria from *Gioconda*—"Suicidio" (Ex. 23)—the emotion indicated is desperation, and since the motive is transposed up and used in sequence, the singer must portray an ever-rising feeling of despair. The passage is marked *cresc. con passione,* so that each mounting figure should be sung with increasing volume. All this is clearly indicated by the composer.

3. The example of interval expansion given in the Franz song *Im Herbst* (Ex. 24) portrays, in a wonderful manner, the final cry of despair at the futility of disappointed passion.

Notice that these three examples illustrate different means taken by these composers to portray much the same type of emotion. Thus the composer has at his disposal many means of conveying similar emotions, and in this way he is able to avoid monotony.

4. In *Ein Traum* of Grieg (Ex. 25) from which the example of interval contraction is given, the feeling attained is the holding in abeyance of the emotional effect before a mounting phrase in which the emotion rises.

5. In the Mendelssohn song *Auf Flügeln des Gesanges* (Ex. 26) the rhythmic augmentation produces a quiet, calm effect. The drawing out of the rhythm and the holding off of the close produce a sense of peace and restfulness.

6. Rhythmic diminution, as already stated is very rarely found in songs. The effect it produces is the opposite to that of rhythmic augmentation.

7. An example of variation of motive is found in the soprano aria "Un bel di Vedremo" from *Madam Butterfly*—see measures 5 and 53. The emotional effect of this variation is very striking and interesting. The breadth of line as it appears in the opening measures of the aria is made diminutive as Madame Butterfly relates how Pinkerton treats her like a child. On the

lines "Piccina mogliettina olezzo di verbena" one seems actually to hear the mincing steps of the Japanese child-wife. This gives a very charming touch of realism of which the singer must be conscious.

8. Exact repetition intensifies the emotion in some degree by the mere repetition of what has been said or expressed by the composer.

Thus in the example given of *Nina* by Pergolesi (Ex. 27) no great emotional effect is indicated, and as a matter of fact the whole composition is calm, but the repetition of the motive indicates slight emphasis on the call "che Nina" when it is repeated. The following figure rises in pitch and thus indicates a distinct and definite rise in the inflection.

Design is a factor of all arts. Design in music is largely dependent upon the appropriate use of the musical motive. Elaboration, variation, repetition and contrast of the motive provide the composer with his principal means of conveying his emotional, intellectual and aesthetic design or plan.

CHAPTER XXXV

MELODY AND COUNTER-MELODY

The melodic progression, or melody, is the result of tones of varying pitches which are regulated by a rhythmic pattern. There are various melodic outlines, among which the following distinctions can be made: (1) arpeggio, or harp-like, outline; (2) scale-wise outline; (3) chromatic outline; (4) horizontal outline.

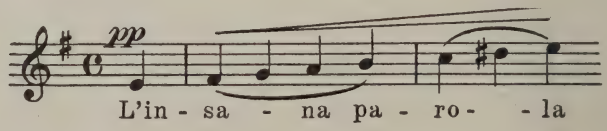
1. In the case of the arpeggio outline the progression of tones in the melody forms triads or chords. The accompaniment of the waltz—Act 1, No. 6, from *Faust*—carries a melody which is based on the tonic triad of the key of D major. Notice that the melody consists of D, F♯ and A for the first five measures and no other note is introduced.

Another very interesting example of this is found in the Brahms song *Der Schmied*—in the key of A♭ major—where two notes (C and E♭) on the triad of the tonic are employed for the first four measures. The accompaniment during these measures is sounding the tonic triad in various positions.

2. In the case of the scale-wise outline the melodic progression is based upon a scale.

An example based on the harmonic form of the minor scale is found in the soprano aria "Ritorna Vincitor" from *Aïda*—

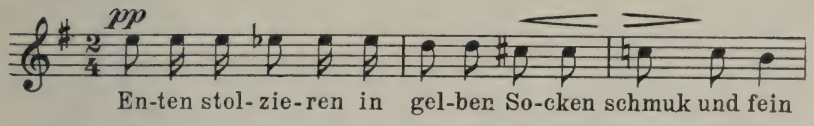
Ex. 28



Another example is found in the Franz song *Im Herbst* in which the opening phrase consists of the melodic form of the minor mode of c ascending (Ex. 21).

3. In the case of melody based on chromatic outline the progression moves in chromatic steps. An example of this is found in Grieg's song *Im Kahne,* measures 13-14-15 etc.

Ex. 29



This produces a weird atmosphere.

In many cases these chromatic effects are used to denote the howling of a storm. An example of this appears many times in Wagner's *Der fliegende Holländer.*

4. In the case of horizontal outline the progressions wind closely around a single tone.

An example of this is found in the tenor aria from *Boheme*—"Che gelida manina"—the closing measures of which centre around a single tone, E♭.

This occurs directly after the dramatic climax and produces a soothing and quiet effect.

A melodic outline which closely resembles this horizontal form is the monotone. Some special and interesting effects are attained by the use of this form, an example of which appears in the *Aïda* aria "Celeste Aïda", where a monotone passage is used in the coda just before the dramatic climax. This device heightens the passion of the climax through contrast.

Of course different melodic outlines are usually found combined in one song.

The general statements made in the last chapter with regard to a rise in intensity where the pitch of a theme rises is beautifully exemplified in Brahms' song *Die Mainacht,* measures 27-31. Here the intensity very definitely rises as the pitch rises, and falls as it falls. This is indicated by means of the crescendo and decrescendo signs.

We will now consider the question of counter-melody. Very often more than one melodic progression is being enunciated at the same time, and when the accompanying melodies are so constituted that they stand out clear and distinct from the principal melody, the effect is contrapuntal. Thus counterpoint is the art of combining two or more melodies or themes. We may call these counter-melodies.

The principal melody may appear in the voice part or it may be announced in one of the "voices" of the accompaniment. This melody may then be taken from the voice part to the accompaniment or vice versa. The effect produced is that of one voice answering the other.

The following examples give some of the ways in which melodies and counter-melodies may be used:

1. The accompaniment may announce a complete motive and this motive may be answered by the voice with an exactly similar one. This is the principle of imitation by exact repetition in another guise. An example of this may be found in the aria "Suicidio" from *Gioconda:*

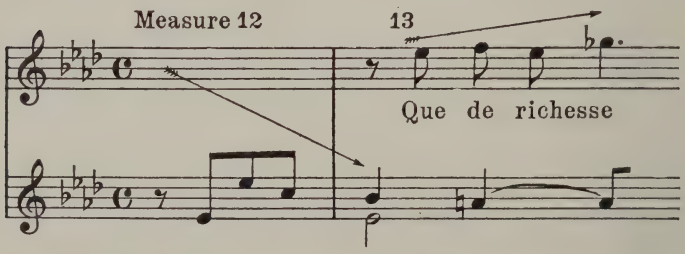
Ex. 30



2. The accompaniment may announce a melody, by announcing a motive, and this may be answered by a similar motive for the voice which is, in some manner, contrasted with the first motive while they proceed together. This gives an effect of balance.

An example of this is found in the aria "Salut! Demeure" from Gounod's *Faust*.

Ex. 31



Observe that the motive has a tendency to turn down when announced in measure 12, by the accompaniment, and in the answer (measure 13—first half), sung by the voice, it turns up. In measure 13 the motives in the voice part and the accompaniment proceed together forming a melodic contrast. This is immediately followed by a similar device.

3. The inverse case of this is where the voice announces the melody and the accompaniment answers, both proceeding with contrasting melodies. An example of this is found in the

"Bijou Song" from Gounod's *Faust,* measures 26—29. Here the voice sings a scale passage on the words "c'est la fille d'un roi" and drops down to two sustained notes, while the orchestra answers with similar scale passage. This is repeated immediately in the same form.

4. The voice may sing an obbligato or counter-melody to the principal melody in the accompaniment. A very striking example of this is found in the song *Ein Ton* by Peter Cornelius, where the voice part consists of a monotone only, and the entire melody throughout is in the accompaniment. Another example is found in *Ergebung,* the tenth song of the "Eliland" cycle by Fielitz. During the first interlude the principal melody is announced by the accompaniment, which continues with this melody while the voice sings a counter-melody. The melody in the accompaniment rises while that in the vocal part drops. This gives contrast.

All that has been said tends to show very definitely that the singer and the accompaniment together must form a perfect ensemble and that, from the standpoint of the music, both are of equal importance. The voice may be considered as one instrument in the orchestra when the singer is performing to an orchestral accompaniment, and although it is often the solo, or outstanding instrument, it merely forms a part of the whole.

The voice should not always stand out, since sometimes the accompaniment carries the principal melody, when it should predominate while the vocalist sings the accompaniment. For the proper interpretation of a song, the ensemble must be perfect and both must be musically accurate, neither conflicting with the other, and neither being compelled to distort the music for the benefit of the other.

Only too often is the accompanist expected to modify the music to fit in with the singer's musical distortions, and when this happens the result is inevitably the destruction of the musical ensemble.

Thus the ensemble between the accompanist and the singer must be perfect. The accompanist must know and feel the singer's part, while the singer should know the accompaniment and feel what the accompanist is playing. The singer must be fully conscious of the counter-melodies in the accompaniment; he must know when it has the principal melody and he must realize that he is singing the accompaniment during this phase of the song. Under no circumstances may the one or the other drop out of the picture for even a fraction of a second.

During the interludes the singer must feel what the accompaniment is doing and he must hold the 'atmosphere', despite the fact that he is not singing. If the vocalist does drop out of the picture, even for a moment, whether he is singing at the time or not, the audience will immediately be conscious of a break in the atmosphere or emotion, and the effect will be ruined. This applies equally to a postlude. The singer must hold the atmosphere *until after the last note of the song has been played.* In the case of a cycle, the atmosphere must be held until after the last note of the entire cycle has been played. The case sometimes arises where the accompaniment has to finish a melody started by the singer. Here the vocalist must realize what is happening so that he will exactly meet the accompaniment. Where he has to take up a melody started by the accompaniment, he must feel what it is playing, so that he can come in at exactly the correct moment and take his cue as if he were actually continuing what the accompaniment has started. If he fails to do this the melody will be distorted and therefore destroyed.

CHAPTER XXXVI
INTERPRETATION

From the standpoint of interpretation, vocal music might be classified under the following headings:

1. Classical School. Oratorio. Folk Songs.
2. "Bel Canto" Opera.
3. Modern Opera.
4. Lieder.
5. Modern Art Songs.
5. English Ballads, Operetta, etc.

1. The Classical School calls primarily for *beautiful tone* in the abstract sense. Vocal color is not called for and would, indeed, be out of place in the interpretation of this type of music. The singer must be meticulously accurate and precise from the musical standpoint and he should pay strict attention to all the dynamic effects indicated on the printed page. His attitude must be one of detachment and aloofness. He may not, under any circumstances, display the slightest sign of sentimentality and a rather cold and, to beg the term, "classical" atmosphere should be created. This school represents a very high type of pure music and must be interpreted with a high, impersonal and abstract emotion.

2. The "Bel Canto" Opera is essentially of the old Italian school, since Mozart should be classed under the heading of classical composers. The greatest factor in the interpretation of such music is beauty of tone. The emotions expressed are rather elementary and the music is generally trite. In contrast to the Classical School, the emotions to be conveyed are essentially sentimental. The only true virtue of such music is that it gives the singer an opportunity to display the beauty of his voice. The slender accompaniments make *mere* beauty of tone still more essential on the part of the singer.

The singers of this school of music are called upon to vocalize florid passages, and the sopranos, and even the tenors, have to sing long coloratura passages. Such 'vocalization' must be very brilliant; and speed, in combination with tonal beauty, is essential. All the different types of voice are called

upon to trill, shake, run etc. Technically such singing is rather difficult in a merely mechanical sense. The use of this music during the course of training is of value from the technical standpoint, since every singer should be able to perform all the 'tricks'. It is very easy artistically and interpretively and marks an elementary, and not an advanced, stage in the development of the vocal art. Beautiful high tones are essential, and from this standpoint also, such singing is very useful during the process of training. No other type of music can be used which will do so much for the development of tonal beauty in the abstract, and the singer must, of course, be capable of producing beautiful tones at will.

Actually it is far more difficult, from the technical standpoint, for the singer to interpret the simplest of Schubert's songs *properly* than for him to perform the most difficult 'tricks' demanded by composers of the old Italian operas, and, to any one who has a proper control of color, this "Bel Canto" school is really very elementary.

Musically this school of singing is simple, although the time etc. must be accurate. Many liberties may, however, be taken with regard to the holding of high notes etc. The coloratura passages, in particular, must be accurately sung, usually at very high speed.

C. Hubert H. Parry in his book *The Evolution of the Art of Music,* says: "The human voice is for use and not only for ornament. People must no doubt learn to sing in a special way in order to do justice to the beautiful old-world artistic creations; and art would be very much the poorer if the power to give them due effect were lost. But the expression of things that are worth uttering because they express something humanly interesting is much more difficult, and implies a much higher aim. Both objects require a great deal of education, but the old-fashioned singer's education was limited chiefly to the development of mechanical powers; the singer of the genuine music of Bach, Schubert, Schumann, Brahms and Wagner requires the old-fashioned singer's education and the education of the mind as well."

In these few sentences this writer clearly indicates the enormous advance which has been made in the singer's art since the days of the old Italian school of "Bel Canto".

3. When we come to the singing of Modern Opera, the demands made upon the singer are indeed of an infinitely higher order. Despite the fact that the artists of today often sing rather crudely, there is no question but that all the beauty and technical

ability of the "Bel Canto" school of singing should be at their disposal.

Wagner, for instance, wrote many passages which should, of course, be beautifully sung, since they are exquisite examples of lyric melody. Of course Wagner makes the highest demands upon the singer of any composer, since not only should the Wagnerian singer have a perfect command of color, but also he must be a really fine musician. It is indeed impossible for anyone to fully understand and appreciate this music unless he recognizes the motives and understands their meaning. When Wagner's music is properly understood, the appeal is so overwhelming, the meaning so deep, the atmosphere so marvelously created, and the illusion so complete, that the listener is inevitably carried away, not only by the sweep of supremely glorious harmony, but also by the actual meaning so perfectly conveyed by this great master. Not only is Wagner so great a master of dramatic effect, color, meaning, atmosphere and harmony, but also his works are full of the most glorious melody. When the dramatic action calls for simple beauty of melodic outline, as in the case of the "Prize Song" from *Die Meistersinger,* he writes themes of a beauty unsurpassed in the works of any other composer for the voice. It is unfortunate that, in most instances, the music of the great master is shouted and 'barked'.

The modern opera requires the following attributes on the part of the singer: fine musicianship, musical understanding, color, interpretive ability (in the highest sense of the word) and beauty of tone—*plus* all that the old Italian school demands. Thus the art of the modern opera singer is on a far higher plane than was that of the singer of the old Italian school. There should never be the slightest trace of sentimentality, and the cheap effects which sometimes characterize the Italian singer must be entirely eliminated. In addition to this high standard of musicianship and vocal artistry, the operatic singer of today should be a really fine actor.

For the proper interpretation of such music, the artist should have studied Lieder.

It is, indeed, most unfortunate that the German school of singers who are good enough musicians and artists to sing the best modern operas from the musical and emotional standpoints are, as a general rule, poor vocally and dramatically, while the Italian school of singers, who are often born with beautiful natural voices, are usually not good enough musicians to sing such compositions, and their acting is, in many cases, far worse

than is that of the German school. The French singers are often lacking vocally but their acting is generally far better than is that of the Germans or Italians. The English and American singers who are, on the average, far the best histrionically, are in most cases lacking in vocal and musical ability, although they are generally better than the Italians from the latter standpoint.

The cause of such a deplorable state of affairs is not far to seek. The teaching of voice, instead of being a universal science, falls into schools, and these schools are usually founded, in the most curious fashion, upon the *faults* of the singers of each country. To show what is meant, in a little further detail, let us consider what are the natural faults of the singers of the different countries: the German, whose language is guttural, will usually tend to sing with a very 'thick', 'shouty' technic. What do we find of the German teachers of singing? They teach the "up and over" or "head voice" idea and in addition to this, as a rule, they make their pupils sing very energetically. What is the result? The tone is indeed loud, but it is generally 'noisy' and the 'head' idea for the upper tones tends to make the singer use too long a cavity. This, of course, makes such tones 'thick', 'shouty' and crude. In other words, the ideas which have been thus briefly indicated will, in effect, serve to magnify the natural tendency of these German singers to produce a 'thick', 'shouty' and noisy tone.

Little need be said about the Italian school in this connection, since the Italian 'Maestros' are generally the most negative of all teachers. Primarily they teach by imitation and by 'ear'. Thus, although they seldom improve any voice radically, in the true sense of the word, they do, in some slight measure, help a voice which is naturally well produced. The non-elided language and the beautiful climate of Italy produce more naturally well-used voices than are heard from any other country and therefore we find many Italian singers whose voices sound beautiful. It may, however, be mentioned that the effect of Italian training upon singers of other nations is often negative. The chief saying of the Italian school is: "Open the throat!". This is, of course, a quite futile direction from the standpoint of physiology, although it is not exactly wrong.

The French language is an essentially nasal one, and for this reason the French singers naturally tend to sing nasally. What do we find the French teachers saying? They tell their pupils to sing forward "in the masque". This is a perfectly meaningless phrase, but it does indicate to them that they should sing more

nasally than ever. These teachers often talk of "breath control", but not nearly so emphatically as do the American, and in a slightly less degree, the English teachers. Thus, again, in the French school we find a tendency to increase the natural fault—thin nasality—of the singers of that country.

Now let us consider the American school of singing. The American has a natural tendency to speak and sing with a 'throaty-nasal' technic. This is a 'thick', 'throaty' nasality in contrast to that of the French singer which is thin and nasal without being especially 'throaty'. What do many of the American teachers say? They tell their pupils to direct the voice into the head and more especially the nose. So far does this absurdity go that one well-known writer expressed himself as follows: "The singer's best friend is his nose." Moreover many of these teachers preach "breath control" with the most tremendous enthusiasm, and of course the only result of any attempt to control the breath is the development of 'throatiness'. In this way the two chief sayings of these teachers directly tend to develop the natural faults of the American singer.

This whole line of thought is an interesting one and could be followed out in great detail with regard to each and every country. Thus, for example, a consideration of the English school discloses the fact that British teachers tell all their pupils to "bring the tone 'forward' " and often, "to the lips" or "to the hard palate" thereby exaggerating the natural tendency on the part of the English singer to produce his voice in such a manner that it sounds 'thin', 'throaty' and 'white'.

A possible explanation of this state of affairs is that teachers get used to the sound of the natural, national faults and come, in time, to really like the resultant sound. Some day we will have the science of vocal technic standardized, and no one will be allowed to teach who has not passed a very comprehensive examination in physics and physiology before a board of examiners who are recognized authorities on these subjects. The teacher of voice will then have to qualify, just as does the physician, before he is allowed to practise. When this day does at last dawn, we will find that not units, or even hundreds, but actually thousands of singers will be produced who can sing as well as the best Italians, are as musical as the German artists, and can act as well as the actors of the legitimate stage of America and England.

Can you conceive how overwhelming a production of the *Ring* would be under such circumstances? Just imagine the

glorious music of Wagner really sung by singers whose voices rang with the true glory of which the human voice is actually capable when properly produced! How stirring would be the grand drama of this cycle if it were to be acted with the art and finesse of the great actors and actresses of the Anglo-Saxon stage! How splendid would be the message of the music were it rendered with true musicianship by singers with fine voices who could really act. True, the German singers do sing with the most commendable musical accuracy as a rule, but they tend to shout. So true is this that many Wagnerian singers practically lose their voices after singing for about ten to fifteen years. It cannot be too emphatically stated that this is solely and only the result of faulty technic, and when a voice of dramatic timbre is properly used, the singer finds little difficulty in making it carry over the orchestra. This is particularly true since the orchestra is only loud when the singer's part is forte, and for the quiet passages it is always subdued by Wagner, who must have fully understood the characteristics of the properly used human voice.

Of course there are today some very fine singers in the world, but they are so few and far between that the combination of qualities required for the satisfactory operatic singer is seldom found. Thus the singer who is lucky enough to have a naturally fine technic is seldom a good musician and still less often a good actor. Even then, when these three requirements are met, the personal appearance must be considered. A Madam Butterfly who weighs 200 pounds or more does not satisfactorily create the illusion of Puccini's heroine, who should be "almost transparently fragile and slender". If all the talented singers in the world—and they may be numbered in thousands—were properly taught, there would be plenty of singers to choose from and it would be possible to find many artists with all the necessary requirements and attributes.

Since the singing of modern opera depends so largely upon both the proper interpretation of the old form of opera and also of lieder, it is not necessary to say any more here about this side of interpretation. It is, of course, an essential part of the repertoire of all singers.

4. The interpretation of Lieder is probably the highest form of the vocal art, since the singer and his accompanist are alone, and there is no stage setting or orchestral accompaniment to help them. Moreover, these songs represent, at their best, the very finest in vocal music.

The requirements for the lieder singer are: perfect musicianship, voice, color, dramatic ability etc. With neither gesture nor any other outside help whatever, the lieder singer must be able to convey every conceivable emotion, color and atmosphere. This, of course, requires a perfect technic without which the resultant effect is merely inanity or affectation. In this type of singing the effects are made by means of color rather than by mere voice and we do not find the brilliant high notes and gaudy effects called for in opera. The really great lieder singer should, however, be able to make such effects if he so desires and therefore, in the opinion of the author, it is essential that he should have had training in the operatic school. There is little excuse for the lieder singer who "has no voice" but sings intelligently and musically.

The prejudice against operatic stars who sing lieder would indeed be very foolish were these singers good musicians, but as a rule they are *not*.

Thus this school of music is an essential part of the training of the singer. It is indeed a most vital part since only through the proper interpretation of these great songs can he learn the true meaning of the word 'color' and attain a proper feeling for great music.

Thus during the course of training the pupil should study Italian opera in order that he may learn to make purely vocal effects, hold high tones, make dramatic effects and sing with intense dramatic vigor. Many of the French operas come under the same heading. The student should not study Wagner until he is an accomplished lieder singer; the same applies to the Russian school of opera and some of the French. The lieder of the great masters must be studied intensively in order that the pupil may develop a sense of vocal color, nuance, the creation of atmosphere and the interpretation of the delicate shades of emotion.

Both these types of music should be taught as soon as possible, so that a proper sense of values may be attained at an early stage while, at the same time, the pupil's repertoire is being built up. It is not advisable for the serious vocal student to learn a great many ballads until he has a real foundation of operatic music and lieder, when he will have at his disposal every means of expression which may be needed for the most perfect interpretation of such songs. In studying a great composition, the student is learning a song which will last him all his life, and, at the same time, he is mastering something of the prin-

ciples of interpretation. When, on the other hand, he studies an ordinary ballad, he is merely learning something which will soon be dead, and these songs do not really teach him much about music or interpretation.

One of the reasons why operetta and the lighter forms of music are, as a rule, so badly sung, is because the singers of this class of music have never had proper training in the great music. Such singers do not hesitate to break phrases and they will even breathe in the middle of a musical figure. It is most interesting to notice how striking is the effect attained by a singer who has been properly trained, from the musical and interpretive standpoints, when such a one does sing operetta or ballads.

The extraordinary success of many famous singers has been due largely to the fact that they have been very good musicians and have had a fine sense of interpretation derived from a proper knowledge of great music. It is undoubtedly because of this background that they have been able to do so very much with songs of a lighter character.

5. The Modern Art Song is chiefly characterized by atmosphere and realism. There is a tendency on the part of the composers of this school to pay less attention to melody than do the composers of lieder, and as a rule the more human emotions are not prevalent. Although an essential part of the vocal student's repertoire, these songs must be used by the teacher with great caution, since many soft and peculiar effects are called for which will often prove detrimental to the pupil's voice until he is technically very far advanced. The singing of pianissimo high tones, so often called for in songs of the modern French school, is extremely dangerous if they are incorrectly produced.

The great value of this school of music is the engendering of the idea of atmosphere in its most subtle form, and for this phase of interpretation they are invaluable. Here 'color', which is of primary importance, is more essential than is mere beauty of tone. This is, of course, true to a great extent of lieder also, but in the interpretation of modern art songs, color overwhelms every other factor. It is interesting to note that, while beauty of tone is a necessary concomitant of all good singing, as music advanced it became less and less the one ultimate aim of the artist. It is essential for the singer of modern music to be able to produce both appropriately ugly and beautiful sounds. As the art of singing has progressed, the demands made upon the singer have also advanced, so that today he should be able to produce any and every quality he may desire.

It is always annoying to hear people talk of the "lost art of 'Bel Canto' ". From the musician's standpoint the old Italian singer of this school would today be quite childish and of as little artistic merit as is the 'ham' actor of the old school who merely rolls his voice. Just as the 'vocal' actor is, today, a thing of comedy, and just as acting has developed from a mere trick of rolling the voice and trying to make it sound 'nice' into a fine art of realistic interpretation, so has singing advanced, from a mere faculty for making pretty sounds and performing technical 'tricks', into an expressive and interpretive art. Faulty as is the singing of today, it is, without doubt, so far ahead of the singing of the old Italian school that it may be called a new art. It was, in fact, only from the time of Schubert that it became a true art at all. A good flutist can perform all the tricks of the coloratura soprano better than she can. The infinite possibilities for expressing color, feeling, emotion and atmosphere with the human voice surpass those of any mechanical instrument which could ever be devised by the skill of man. In the opinion of the author, singing can be the highest form of interpretive art, whereas the old school of 'Bel Canto' was absolutely without real artistic value. One reason why the human voice is more effective than a mechanical instrument is that it can, under proper conditions, express and create atmosphere and emotion better. Outside these functions, a mechanical instrument far surpasses anything the voice can do, since such an instrument can be perfectly constructed, whereas a human being can never attain absolute mechanical perfection. The true art of singing, then, rests on the ability of the singer to make any quality he may desire for the proper interpretation of a song. Even when singing a technical exercise the pupil should feel emotion, since any tone without some feeling in it will not only be 'dead' and inexpressive, but it cannot even be technically good, in view of the fact that only when the singer is expressive can he have attained the proper degree of muscle tone so vital for good technic. Let it be stated then that the greatness of a singer is measured, in a large degree, by his skill in varying the quality. Of course the singer who has a wide range of color can make a beautiful quality whenever he so desires. The scope for color variation is practically unlimited, since the possibilities of vowel modification, which is in actual fact color, are virtually infinite.

The thought has probably passed through the mind of the reader that the only too prevalent notion of "placing the voice" is absolute death to the idea of color, since a perfectly 'placed'

voice would imply a fixed quality. There is real comedy in the theory of a certain great singer, who also taught voice, that tones of different pitches should come out of various parts of the head. In her book, she has a picture of a head, in which a series of lines is drawn straight out from the palate, the first one coming out through the upper teeth and the last out of the top of the head. Each line has a note on the end of it. This is the idea of 'placing' brought to its highest—or shall we say lowest—terms. Such fancies eliminate the idea of color, yet this writer, who displays such complete scientific ignorance, was in her time one of the greatest singers in the world. It is a very curious fact that many people will study with a teacher because he or she has a wonderful voice. The same people would never be so foolish as to go to a dentist because he had good teeth or to a doctor because he was 'fit'.

6. Rendition of the Lighter Music is indeed a simple matter for the properly taught vocal student since, from his study of the best in music, he will have at his command every form of expression necessary for the most perfect interpretation of such songs. The effective interpretation of a simple song, whether it be an English ballad or a number in a musical comedy, operetta or comic opera, is merely a matter of proper application of some of the dramatic, musical and atmospheric effects at his disposal, which he has acquired from the study of operatic arias, lieder etc. The dramatic effects should be slightly modified and the atmospheric and color effects slightly exaggerated, and then he will have at hand all that he could ever need for the best possible interpretation of such music. Particular attention should always be paid to the proper reading of the words, but this, of course, applies to every type of song. For light music it is imperative. Every word must be perfectly pronounced and clearly audible, since even an unmusical audience can hear and understand the meaning of the words.

To sum up:—From the Classical School the vocal student learns to sing with absolute musical precision, beautiful tone and impersonal expression.

From the 'Bel Canto' school he learns to perform all the 'tricks' and to make beautiful and sometimes dramatic effects.

From Modern Opera he learns to interpret with great intensity and emotion, to sustain fine, full high tones and to sing as effectively as possible.

From Lieder he learns to sing with real musical feeling and to express all the shades of emotion and atmosphere by means of vocal color.

From the Modern Art Song he learns to create atmosphere in its purest form.

Light Music teaches him nothing new, but it does enable him to apply what he has learned from the great compositions to the music of lesser worth—the music which appeals to the masses. Of course no mention is made of popular music in the accepted sense of the word, since it does not come under the heading of real music at all.

CHAPTER XXXVII

HOW TO STUDY A SONG

The contents of the preceding chapters have already indicated the proper manner in which a song should be studied, so that the following remarks are, in a large measure, a résumé of what has gone before.

The first step in studying a new song is to obtain a general idea of the composition as a whole. Whenever possible it is an excellent plan to hear a record of the song interpreted by a great artist, and of course it is still better if the pupil can hear a great singer actually render the song either at a recital or, in the case of an aria, at the opera. The student should have the score or a copy of the song with him at the performance.

If the vocal student is a good pianist, he should next play over the composition several times himself, and if he is unable to do this, he should have an accompanist do so.

When a general idea of the song has been obtained in this manner, the process of really learning it consists of two distinct phases:

(a) The study of the composition *away from the piano.*

(b) Learning the music *at the piano.*

The following steps should be taken, away from the piano:

1. Learn the words perfectly without reference to the music.

The words should first be memorized and then recited with the proper significance and value of every word and sentence brought out. Of course the phrase is the unit in recitation just as the musical phrase is the unit in music. Thus the poem should be recited phrase by phrase and the significant words should be properly accentuated. The unimportant words should not be too greatly emphasized. The declamatory, interrogative, exclamatory passages etc., should be carefully noted. In all great songs these effects are brought out in the music. Thus in a declamatory passage the emphasis in the music corresponds to that of the words, and the notes on which the stressed words fall are musically emphasized by the composer.

Considering the aria "Elsa's Dream" from *Lohengrin,* it is evident that a reader would stress the word *he* in the sentence "he will my champion be"—(the German is *Er soll mein Streiter sein* which is literally translated)—and Wagner stresses the note on which this word falls in the music. Furthermore he repeats the phrase and prolongs the note on which this word falls the second time in order to give it still greater stress and also to further emphasize the sentence which is a climax of the aria.

In the case of an interrogative passage, the inflection rises on the question, and therefore one would expect to find a rising motive in the music: i.e. the melodic line should "turn up" on a question. Schubert's *Erlkönig* (first phrase) illustrates this point. Here the highest point in the melodic line falls on the question.

As an example of an exclamatory passage, the first phrase of the recitative preceding the soprano aria "Ah, Fors' è Lui" from Verdi's *Traviata* may be cited. In declaiming the words "È strano!" it is evident that the accent or emphasis should fall upon the syllable *stra* and repetition of the phrase gives still greater emphasis, since the strong syllable is still more stressed the second time it appears. Similarily in the music the composer brings out the note on which this syllable is sung by making it fall on the secondary accent the first time it appears, and he increases the emphasis the second time by making it fall on the principal accent. There is a crowned pause in the music between the two exclamations and another similar pause after the repetition, which still further accentuates the exclamatory nature of the words. Such crowned pauses, which are most important from the dramatic point of view, should be made very deliberately by the singer.

Examples of the intimate nature of the relation of the words to the music in the compositions of the great composers could, of course, be multiplied indefinitely.

In passing it should be noted that the repetition of a phrase in music serves for emphasis, and just as the reader should never repeat a phrase with the same inflection twice, so should the singer never repeat a musical phrase without varying the color.

The words should be perfectly mastered before any further step in the study of a composition is undertaken, since it is only possible for the student to concentrate properly on one phase of a song at a time. The same thing applies to each step which must be taken in the study of a song until the singer has become an adequate musician.

2. Observe the time sign and note any changes of this sign which may appear during the progress of the song.

Note the emotional import of such changes.

Mark the counts and the grammatical accents. Such marks should be made throughout the entire composition including the places where the accompaniment plays alone.

3. Determine the pace of the song by the direction over the opening measure, or by the metronome mark when this indication is given.

Observe all changes of pace indicated by other directions during the course of the composition.

A list of the terms used to indicate pace are given in Chapter XXVIII. Other terms which modify the tempo are:

Meno mosso.....less rapid.
Più mosso.....more rapid.
Rallentando and *ritardando*.....growing slower.
Accelerando.....growing faster.
A tempo.....return to original pace.
etc. etc.

4. Observe the signature and note whether the key indicated is major or minor. Also note any key changes which may occur during the course of the composition.

Note the emotional reasons for the major or minor modes and for any key changes which may occur.

5. Note all cadences throughout the entire composition in both vocal part and accompaniment. This will determine the phrasing of the song and the bar rhythm which are dependent upon the cadences.

Mark the ends of the phrases with a large breath-mark thus: √

Count the number of measures comprising each phrase.

Classify the cadences and name the chords.

6. Find and mark any caesuras which may occur. Mark these caesuras with small breath-marks.

7. Note all musical motives in both vocal part and accompaniment.

Follow all the devices employed in order to elaborate the motives and note their effect upon the melodic outline. Note the emotional effects of these elaborations in both voice part and accompaniment.

8. Note the thematic outline and form of the composition as a whole.

9. Find the climax of the song, and note how it is brought about musically and dramatically. Notice what precedes and what follows it.

10. Determine the school of music to which the song belongs. From this will be deduced the *type* of emotion which should be conveyed in the rendition of the composition.

11. Determine the general emotion to be conveyed; whether it be subjective or objective.

Determine, phrase by phrase, the emotions and colors appropriate.

Determine all transitions of color and emotion.

The above applies to both voice part and accompaniment.

12. Notice every expression mark on the music. Every such mark is of paramount importance, should be meticulously followed, and eventually worked into the rendition of the song.

All the foregoing processes in the study of a given song are to be worked out away from the piano.

The following steps should then be taken, one by one, at the piano:

1. Play the scale in which the song is written. This engenders key consciousness.

Play the scale or scales of any key or keys into which the composer modulates.

Play all cadences which have, as stated above, already been marked.

2. Play through the voice part many times in exact time and at the proper pace, without paying any attention to the expression marks etc. This should be done with the metronome which must, of course, be beating through all the interludes, rests etc. so that the pulse is never lost.

Sing the melody through many times, in perfect time with the metronome.

3. Fit the words to the music and sing through many times with the words, in perfect time and rhythm, without regard to the expression marks.

4. Take out and practise until perfect, any passage or passages which present difficulties in either the intervals to be sung or in the time.

Practise with an accompanist any passages in which the accompaniment is against the voice part, until they are so perfectly blended that the ensemble is complete.

5. Practise the whole song, phrase by phrase, with the accompaniment, in mechanically perfect time until it is thoroughly memorized.

Sing through the whole song, with an accompanist, standing away from the piano, in other words, without any reference to the music. Make quite sure that all cues are properly taken up. Do this many times until the song is perfectly mastered as a whole in mechanically exact time and rhythm. All the singing referred to above (2-5) should be performed an octave lower in order to save the voice.

And now comes the process of working out the expression marks!

6. Consider carefully all indications of variation in tempo, by noticing such marks as *rallentando, accelerando* etc. Also consider all *tenuto* and *fermata* marks etc.

All variations of tempo must be made *over the phrase*, so that the holding of a high note, for instance, is, under no circumstances, applied to the single note, but is prepared for and applied to the phrase. Thus, when a note is to be held, the rhythm of the phrase must be properly "shaped" for this hold so that the sense of the rhythm is never lost. From this it will be seen that the actual length of time any note may be held is quite definite, since it is dependent upon the *shaping of the phrase* by the singer. In other words the rhythm may be drawn out to the held note and narrowed from it and this expansion and contraction may be performed according to the singer's musical taste and judgment, provided that the sense of rhythm is never lost.

The mere holding of a high note, irrespective of this sense of rhythm, is the mark of the amateur or of the unmusical singer.

The concept of phrasing and rhythm, in both its broad and narrow sense, must be so complete throughout the rendition of the entire song that it is perfectly conveyed to the audience, who then, and only then, experience the 'feel' of the proper shape of the composition.

7. Work in the dynamic effects. These effects are indicated by such directions as *cresc. dim.* etc. the swell marks and the signs ***p, mf, f*** etc. Although dynamic effects are usually made over the phrase, a sudden loud or soft note is called for when indicated by a very definite expression mark such as ***pp, ff, fz*** etc. placed immediately above it. Such effects should be made most deliberately, since they are written by the composer for some very definite purpose.

8. Work in the articulation. As already explained, articulation must not be confused with phrasing.

The principal directions which indicate the articulation are: *legato, staccato, portamento, leggiero,* slur marks, etc.

10. Work up the chief climax of the song, and so grade the dynamic effects throughout that this climax is rendered with the maximum possible effectiveness.

Work up to the climactic points of each individual phrase, giving to each its proper relative value and intensity balance.

11. Work in the color and the atmospheric effects.

First consider the school of music to which the composition belongs, and then create the suitable color, emotion and atmosphere of the song as a whole.

In building a program it is usual for the recitalist to start with a group of songs of the Classical period, wherein he has to portray abstract and impersonal emotion. The next group is usually of the Romantic period where the emotion to be created is concrete and personal, and the third group usually consists of compositions of the Modern School where the effect which must be produced is mainly one of atmosphere and realism.

Next consider and work in the color, mood, and atmosphere of the sections of the composition. Key changes often indicate transitions which should be made very deliberately. Thus, for example, in the ternary form of song where we have A^1, B, A^2, the singer has to contrast B with A^1 and A^2 from the standpoint of color and, while A^1 and A^2 are in a large degree similar, they too must be contrasted.

Modulation to a foreign key always indicates a definite change of color. The general trend of the song is often indicated by the mode, and modulation from major to minor or vice versa denotes a very definite change of color or mood.

Next consider and work in the color effects, atmosphere and emotion of each phrase. Among the many factors which determine these effects are the dramatic import of the words, the expression marks and the dynamic effects indicated on the music for the phrase, the melodic outline of the phrase, the length of the phrase, and variations in the lengths of the phrases, and a knowledge of the cadences. The semicadence gives a feeling of suspension or expectation, and sometimes implies a question or an interrogative mood. The deceptive cadence (Ex. 19) also gives the idea of suspension or expectation, but with an added element of mystery. The plagal cadence suggests an abstract emotion, a feeling of resignation etc. and this cadence is often found in

church music or in music which deals with religious subjects. The perfect, authentic cadence gives a sense of finality; it is used in virile passages where breadth of idea is portrayed.

The smallest units into which the color and the emotional effects can be worked are the motives and the motive members. Just as in a beautiful piece of embroidery or a mosaic the pattern is brought out by the interweaving of the colors, so, in the case of music, the motives or motive members must be conceived and colored in order that they may stand out distinctly from each other and at the same time blend as a colorful whole.

Such devices as transposition and sequence of the musical motive, while mechanical in themselves, have a definite emotional effect. When the melodic line of these devices has an upward trend, they express yearning, longing, ecstasy, etc. The singer must sense the emotions so indicated and must grade the sequence, dynamically and emotionally, so that the climax is reached at the high point. For example in the passage from the aria "Suicidio" from *Gioconda* given in Ex. 23 the motive is continually mounting. The emotion must also rise in proper proportion as the motive mounts to the apex, or the entire value and effect of the passage is lost.

The singer should realize the dynamic possibilities of his voice and grade his emotional effects properly, within the range of intensities of which his vocal organs are capable of functioning. All effects are made by contrast of both emotion and intensity, and, unless restraint is used, all climatic effects will be spoiled. Thus a big climax is made by means of the greatest possible contrast of intensity, and if the singer is using his fortissimo too much the true climax will never be sufficiently telling. Mere loud singing gives the impression of shouting and not of emotion. A singer who starts a dramatic phrase too loudly, and with too much emotion, will inevitably become inarticulate at the climax where he should have risen to his greatest heights. Exactly the same thing applies to the overuse of the pianissimo, and while some singers tend to overuse the fortissimo, many others err in the other direction and depend far too much upon pianissimo effects. An occasional pianissimo is extraordinarily telling when properly graded, but the excessive use of this effect merely results in weakness, insipidity and mawkishness.

Let it be very clear, then, that true emotion, from the dynamic standpoint, is dependent upon the proper grading of the dynamic effects and not upon the actual intensity. Of course the

greater the range of intensities and color effects at the disposal of the singer, the wider will be his expressive possibilities; but a relatively small voice, artistically used, can produce an infinitely greater effect than a big one, crudely used.

Repression and quiet effects—not pianissimo, which is a very special effect—are often indicated by the devices of transposition or sequence downwards. These devices may be used to indicate such emotions as sorrow, renunciation, introspection etc. In the interpretation of such passages the singer should, of course, exercise repression and hold himself in check.

A shifting of the accent from the low to the high note, and the expansion of an interval in a motive are both means of heightening the emotional effect. A fine example of this is shown in Ex. 24 of the song *Im Herbst* by Franz. The emotional effect indicated in this manner must be wrought by the singer with seeming spontaneity. It must be so prepared for by him that the high note on which the shifted accent occurs, and which is actually the emotional apex, not only of the motive, but also of the whole song, becomes a spontaneous cry of anguish. This climax must be properly prepared for in the preceding passages, and so carefully graded that it does, indeed, stand out as the big climax of the song. The beginning of the phrase must be sung with great restraint so that this climax rings out with the maximum possible effectiveness by reason of dynamic and emotional growth. It is still further heightened by what follows, since the next note drops a thirteenth and this, the final passage, should be sung quietly and with great repression.

Every device employed in the elaboration of the motive has its emotional aspect, and such effects must be worked out in detail for all the songs and arias which the pupil may study if the interpretation is to be of real musical value.

The type of melody is also an indication of the emotional effect to be conveyed by the singer. Thus a melody based upon the diminished-seventh chord portrays horror, terror, stress, restlessness, storm etc. The passage quoted from *Aïda* (Ex. 16) is a good illustration of this.

A melody based upon a major triad gives an effect of strength, virility etc. How beautifully Brahms uses this form to characterize *Der Schmied!*

The weird, the oriental, the mysterious, the sprite-like, etc., are often indicated by a chromatic outline. Grieg's *Im Kahne* (Ex. 29) is a good illustration of this. This chromatic effect must not be confused with a melody which is the outcome of

a series of diminished-seventh progressions used chromatically, where the atmosphere created is generally one of storm etc.

The singer must sense the atmosphere which is induced by the different types of melody and then, becoming imbued with this atmosphere, he must create the desired emotional effect. As with every other phase of interpretation he must sense what is coming, and as the melodic outline changes he must be absolutely ready, so that he can change his emotion at the exact moment indicated by the change in melody.

Only when the music of a composition is perfectly understood, from the intellectual standpoint, can the emotional and color effects be properly interpreted. Thus, not until the technical sides of both the vocal and the musical phases of a composition are absolutely mastered, can the singer be said to be 'living' the song. He must know a song so perfectly, from every angle, that he can, at last, forget everything and 'live' in the emotion and atmosphere which he wishes to convey.

All effects from the standpoint of music and of color, as well as technical mastery of the voice, must be so thoroughly practised, phrase by phrase, that the singer can exactly repeat his own performance. Thus one phrase may have to be sung hundreds of times before the desired effect has been attained and so perfectly mastered that it has become, in a sense, automatic.

The creation of emotion is virtually a quite definite 'act' and the atmosphere desired has to be "worked out", just as have the music and the mechanics of the voice. The singer must be able to reproduce these emotional effects just as surely as he can reproduce the proper notes etc.

One mark of the artist is the ability to re-sing a song many times with the same effects.

The varying emotions, colors and atmospheres of a composition must be felt and held from the first to the last note, irrespective of whether the artist is singing or not. He must sense the musical and emotional import of the composition just as strongly when the accompaniment is playing alone as when he is singing, since, if he fails to do this, even for a fraction of a second, the audience will inevitably feel the emotional drop.

Actually the artist should start to create the proper atmosphere a few seconds before the music begins, and he should hold it until *after* the last note has been played.

It may be as well to indicate how some of the atmospheric effects may be made from the technical standpoint.

Very bright effects are produced by using vowels so modified that only a short cavity—where possible the laryngeal pharynx per se—is used. For this color which is expressive of ecstasy, passion, anger, hatred etc. the upper pharyngeal cavities —nasal and oral pharynx—must, as far as possible, be eliminated as resonators. Thus for a very bright color the general rule is to use the shortest possible 'throat' column per se.

For very dark effects expressive of misery, despair, pleading, the weird and supernatural, fear, etc., the upper pharyngeal cavities must be used to the maximum possible extent, and where the pitch is too high for the use of these cavities, an extra long 'throat' column must be used. Where the upper cavities can be used, the minimum possible amount of the laryngeal pharynx, compatible with a 'non-throaty' tone, must be brought into play. It need hardly be stated that some 'throat' resonance must always be present or the tone would be 'throaty'. In order to go from a bright to a dark color on one tone, the process is to start with the shortest possible 'throat' column and to slowly add more 'throat', and then, where the pitch is low enough, add the upper pharyngeal cavities, until the limit for the particular pitch is reached.

An extremely wide range of combinations and inter-adjustments of the resonance cavities is possible with any given vowel, since every vowel is subject to wide modification. The color is darkened by a modification which alters the bands of frequencies which characterize the particular tone being phonated. Such darkening or brightening of the vowel sound, or in other words, change in the energy distribution or the sound spectrum, is accomplished by the modification of the length, size and shape of the resonance cavities.

A very beautiful, mellow color on a high tone is produced by the use of the maximum possible amount of 'throat' resonance for the given pitch without any addition of the upper cavities. This color is expressive of intense ardor, grandeur, deep love etc. In other words, in order to produce this color the singer must use more than the normal amount of the resonance of the laryngeal pharynx. This effect must, under no circumstances, be attempted until the technic is very far advanced, or the resultant quality will be 'throaty'.

A very striking effect can be produced by starting a high tone with this adjustment and slowly brightening and swelling at the same time. In this case the length of the 'throat' column is slowly shortened while this cavity is held more

and more firmly. The result is that of a tone which becomes increasingly brilliant and dramatic as it is swelled. Caruso often used this device.

Another very interesting effect which can be used in order to sing a soft tone with a cold, despairing, or impersonal color is produced when the vibrato is eliminated, the breath expulsion is high and a great deal of the upper pharyngeal cavities is used.

A very weird or eerie color can be produced by the use of a high breath expulsion and a resonance adjustment wherein an excessive amount of the upper pharngeal cavities is brought into play. This is similar to the last effect mentioned, but the vibrato need not be entirely eliminated, and even more of the upper pharynx, at the expense of the laryngeal pharynx, is used.

Of course a practically unlimited range of color effects is possible by means of various combinations of the resonance cavities, but it is only practical to give a few hints here, since the actual case must, in practice, be considered and worked out. These few paragraphs will, however, indicate, along very general lines, what are the physical means at the disposal of the properly trained singer for varying the color or timbre of his voice. Once more let it be emphasized, however, that all variations of timbre are merely vowel modifications, and that the vowel itself is the determining factor of the timbre. Ultimately the singer whose voice is under proper control makes all these delicate inter-adjustments of the resonance cavities quite unconsciously. Thus all he has to do is to feel the words and music properly, and he will, quite instinctively, make the desired vowel modifications. In fact it is only possible for the artist to make all the infinite variations of timbre or color when he does so emotionally.

It is an unfortunate fact that great artists who are born with practically perfect natural voices are, physically, quite unconscious of what they are actually doing, since, when the technic is good, there is no definite sensation whatever, because such sensation is merely the outcome of false tension. This is why so much emotional and 'spiritual' nonsense is written on the subject of vocal technic. It may indeed be quite effective for the vocal teacher or coach to talk about "merely expressing", "spiritual development" etc. when the technic responds perfectly and unconsciously, but it is worse than futile to mention this angle of the subject to anyone whose technic is faulty.

12. Having, then, studied, worked out and practised until perfect every phase of the song, the singer's final process is to sing it through many times in succession, reproducing his own

performance, in every detail, each time. This should be done several times daily for many weeks and then, and only then, can he be said to have 'mastered' the composition.

All the foregoing steps, which must be taken one by one by the student in order that he may learn a given song properly, are not, of course, necessary for the fully trained artist. When the pupil has at last reached the artist class, most of these processes will have become quite automatic, and all he will need to do is to glance through the music and read at sight everything which the composer has written, without having to take each step separately. He will then merely pick out any passages which present difficulties and practise them.

Of course difficulties will confront even a great artist in almost any composition. Thus his process in learning a song will be to memorize and dramatize the words, study the music away from the piano, pick out any difficulties which may occur and work them out, and then practise with an accompanist, working out as he does so every detail of interpretation, color etc. with the infinite care which is the concomitant of true genius.

SECTION III

PHYSICAL PRINCIPLES

by

STANLEY WATKINS
A.C.G.I., B.Sc., A.M.I.E.E.

CHAPTER XXXVIII
INTRODUCTORY

All the knowledge which we possess of the world outside of ourselves is revealed to us through the medium of our senses.

During early childhood all of the senses—sight, hearing, touch, taste and smell—are being actively employed in educating the brain, during its formative period, to interpret the innumerable impressions which are being conveyed to it from the surrounding universe.

While animals, and, to a lesser degree, the savage races of mankind, retain this active use of all the senses throughout life, the more civilized human being practically dispenses, in maturity, with the use of taste and smell, except to a very limited degree. He still uses the sense of touch in almost all of his activities, but mainly in making unconscious adjustments to his environment. The senses of sight and hearing have, in the meantime, grown in importance to the extent that nearly all the information which the individual receives from the world about him is conveyed to his consciousness through one or other of these two senses. In order to realize the truth of this statement, one has only to consider how little a cold, which can deprive one temporarily of the faculties of taste and smell, interferes, through that deprivation, with the normal activities of life.

In view of the superior development of the senses of sight and hearing it is not surprising that the higher arts—sculpture, painting, music, the drama—address themselves exclusively to these two senses; or in other words, gain access to our consciousness solely through the eye or the ear.

In what follows we shall be concerned only with the vocal arts, singing and speaking, and more particularly with the former. First, however, let us glance at the processes by which any artistic conception is conveyed from the artist's mind to that of the persons who look upon or listen to the product of his art. The avenues of approach to the brain of the recipient are the eye and the ear. The only way in which the artistic idea or emotion can be conveyed is, therefore, by means of light falling upon the retina of the eye or sound striking upon the drum of the ear.

The light pattern which the eye receives from a painting by Turner is very complex, and complex also is the sound pattern which the ear receives during the playing of a Beethoven symphony. It is nevertheless true that a complete and accurate description of the light vibrations in the one case or the sound vibrations in the other would include everything which the observer can receive from the picture or the listener from the orchestral performance.

Scientific research has built up an exact knowledge of the nature of light and sound vibrations and has provided the means of utilizing this knowledge in ways which, not so many years ago, would have been thought impossible. The light vibrations from a drawing or photograph can now be trapped and conveyed, in the form of electric currents, over a telephone wire, to be released at the farther end, again in the form of light, where they may convey the image of the picture to any number of people far distant from the original. The sound vibrations given out by a symphony orchestra can be transmitted, in like manner, to audiences thousands of miles distant, or they may be made to write themselves on wax and form a permanent record by means of which the musical performance may be enjoyed not only at distant places but after the lapse of years, or centuries.

The principal difference, from a scientific point of view, between a painting and a musical symphony is that the one is conveyed by light vibrations and the other by sound vibrations. But there is a further difference. In the case of the painting the complex system of light vibrations, which is to convey the artist's idea to the eye of the beholder, is fixed once and for all by the nature and arrangement of the colors which the artist lays on the canvas. In the case of the orchestral performance, on the other hand, the sound vibrations are created, each time the symphony is played, by the agency of musical instruments manipulated by musicians, who follow the instructions provided by the composer. It is necessary, therefore, that the musical instruments be correctly designed and built to produce the desired musical tones. They are to the composer what the pigments on his palette are to the painter.

Through the knowledge of the nature of sound vibrations, arrived at by scientific research, it has been possible to bring about great improvements in the construction of musical instruments and to give greater scope to the genius of the composer. As an example of this, take the piano, which has been developed from the simple forms which existed in the eighteenth century

to the modern concert instrument. This has been accomplished by careful study and experiment on the form and materials of construction of the strings and sounding board, the placing of the hammers and dampers with relation to the strings, the effect of different kinds of materials for the striking surfaces of the hammers, and countless other details; every step in the development being assisted and tested by the application of precise scientific knowledge.

Let us consider, for a moment, the parts played by the pianist and his piano during a recital. We have the performer, skilled in the manipulation of the instrument and using it as a means of sending out to the audience a complex system of sound vibrations. This system of vibrations is predetermined, to a great extent, by the specification which has been written by the composer, but is subject to modification according to the performer's interpretation of the composer's idea, and his technical ability. But what the audience hears is the piano, not the performer (except in some rare and eccentric cases), and, however great a genius the pianist may be, the effects he produces are obtained by his control, within the limits of the instrument, of the nature of the sound vibrations which it sends out. The quality of the tone is limited by the instrument and depends, ultimately, upon its scientific designers and its skilled manufacturers and tuners. The emotional and intellectual effect upon the audience is obtained by the pianist through the medium of the vibrating strings and sounding board of the piano.

But suppose that, instead of a piano recital, we are concerned with a vocal performance. Here, again, we have a performer interpreting the work of a composer and reaching the ears of his audience through the medium of a complex system of sound vibrations. But, in this case, the instrument upon which the performer plays is his own vocal apparatus and he plays upon it with the muscles which must be developed for that purpose, just as the muscles of the fingers and arms etc. of a pianist must be developed and co-ordinated for playing upon the piano. The human vocal apparatus is a musical instrument, and from the scientific point of view, differs only in detail from any other wind instrument. It is capable of a much greater range of tone quality than any of the manufactured instruments but it is, none the less, a device by means of which sound vibrations can be produced, and the scientific principles governing sound vibrations are applicable to it no less than to any other sound producing instrument.

Scientific investigators have long since unravelled the principles which govern the transmission of sound and made familiar the characteristics of sound waves, so that once created their behavior can be predicted with great accuracy; and a great deal is known about the manner in which the ear acts in receiving the sound waves and interpreting them. The manufactured musical instruments have been exhaustively studied and their action is, in almost all cases, well known and controllable.

In the past much work has been done towards explaining the production of the vowel and consonant sounds of speech, but the conclusions have been drawn from data of a statistical nature, with the result that while something has been learned of the general principles of voice production with regard to the average man or woman, the work has not led to the knowledge of what factors determine the differences between well produced and poorly produced voices, and that is the information of most importance to the teacher of vocal technic.

In order to make any progress along such lines the physical scientists must proceed hand in hand with the vocal expert. There is no more excuse for the singing teacher being uninstructed in the principles of the acoustic science underlying his art than there is for the manufacturer of a musical instrument not understanding the mechanical and acoustic properties of the materials used in his product, or for a practising physician not having a thorough acquaintance with the latest advances of medical research.

In the chapters immediately following, the physical principles of sound are sketched briefly with a view to providing those readers whose training and habits of thought have not been along scientific lines with the least amount of technical equipment necessary to follow the arguments advanced in Section I.

CHAPTER XXXIX
THE NATURE OF SOUND

In order to understand the nature of sound let us consider a particular case. The sketch in Fig. 17 shows, in simplified form, a once popular toy known as a pop-gun. It consists of a cylindrical tube in one end of which is tightly fitted a cork. Into

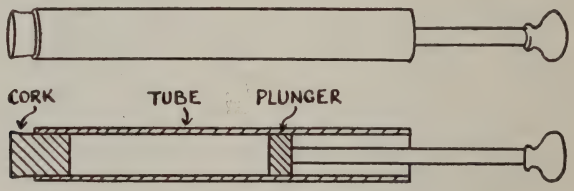


FIG. 17.—THE POP-GUN

the other end is thrust a piston, or plunger. If the plunger is pushed into the tube the air inside is compressed more and more until the air pressure becomes sufficiently great to overcome the friction betwen the cork and the sides of the tube. The cork then flies violently out, with the accompaniment of a loud 'pop.'

It is the 'pop' with which we are concerned at the present moment. The air inside the tube is, as we have seen, compressed by the plunger. When the cork flies out, the compressed air follows it and compresses, in turn, the air in the immediate neighborhood of the opening at the end of the tube. This layer of air, in its turn, compresses the next layer away from the opening and so on, with the result that a pulse of pressure travels outward from the end of the tube. If we are within hearing distance of the pop-gun, the pressure pulse eventually reaches our ear drums and, by its action on them, conveys to us a sensation which we recognize as the sound known as a 'pop'. The air, or any gaseous matter, may be regarded as consisting of minute particles which are continually bumping against one another. When the gas is under compression the particles are forced into closer intimacy and the jostling becomes more violent. It is this bumping which results in the wave of pressure which radiates from the gun when the cork is expelled. As each par-

ticle takes a certain amount of time, though exceedingly little, to reach and bump its neighbor, so it takes a measurable amount of time for the sound pulse to be transmitted through the air from the gun to our ears.

The rate at which sound travels has been accurately ascertained and is found to depend upon the nature of the substance through which it is travelling, or in other words, upon the characteristics of the particles of which the substance is composed. In air the rate is about 1100 feet per second, or ten times as fast as an express train. Sound will travel through substances other than air and the speed of transmission will depend upon the substance. In the case of liquids and solids the speed is much greater. As an example of this, consider what happens when a distant explosion occurs. We first see the flash, since light travels much faster than sound and reaches us almost instantaneously. Then, a little later, we hear the sound of the explosion transmitted to us through the air. If, with a stop watch, we have been able to measure the time interval between the flash and the sound, we can calculate how far away the explosion is. If we had placed our ear against the ground, we should have heard the sound of the explosion through the ground before we heard it through the air, since the speed of transmission through the solid rocks of the earth is greater than the speed of transmission through air.

It is important to realize that the air particles in the neighborhood of the pop-gun do not travel with the sound pulse all the way to the hearer's ear. Each layer of air merely moves forward a very short distance, and having done its work in passing on the pressure pulse to the next layer of air, returns to its original place and resumes its normal condition of pressure. That this is so will be made clear by considering what happens when a sound reaches us through an atmosphere charged with visible layers of cigar smoke. The sound passes unobstructed through the wisps of smoke without the smoke being carried along with it. The forward and backward motions of the air particles are shared by the particles of smoke but are too small and rapid for the eye to observe.

Now let us imagine a pop-gun constructed so that a series of repeated pops can be made. Starting with these occuring at the rate of one or two a second, let us increase the rapidity with which they are repeated. As they get faster a point will be reached when separate pops are no longer heard, but only a con-

tinuous *tone*. This will occur when the repetitions are about twenty a second. The state of affairs is then similar to that which exists in the case of an aeroplane motor which gives a distinct note actually consisting of rapidly repeated explosions. The same phenomenon may be observed by making use of a small toothed wheel arranged so that it can be made to revolve at various speeds. If a small card be held against the toothed edge of the wheel while it is revolving, the card will be pushed aside by each tooth and will spring back into place when the tooth has passed it. As it does this the air at the surface of the card is momentarily compressed and a sound pulse sent out. This happens every time a tooth passes the card and as the speed of the wheel is increased the individual taps become merged into a musical tone.

Consider, for a moment, what is happening to the air which transmits the sound from the card or pop-gun to the listener. The air in the immediate neighborhood of the source of sound is momentarily compressed. This compression is handed on to the next layer of air which, in turn, passes it on to the layer beyond it and so on, until it reaches the listener's ear. When these compressions follow in rapid succession a train of pressure pulses is sent out from the source, the pulses following closely on one another's heels. While the air in each pulse is at higher pressure than normal, the air in between the pulses is at lower than normal pressure. In other words, what is being transmitted through the air is a series of alternating compressions and rarefactions.

One way of producing a continuous and smooth series of sound pulses is by means of a tuning fork. As the prong of the fork moves backwards and forwards it produces alternating compressions and rarefactions in its immediate neighborhood, and these are sent out into the air and form a train of sound waves. It is the same phenomenon as that which occurs when the card is held against the revolving wheel, except that the motion of the tuning fork is smooth, while that of the card takes place in a series of jerks. It will be helpful to look a little more closely into what happens to the air when the tuning fork is in vibration. The diagrams in Fig. 18 show the sequence of events as though it were possible to photograph the air layers by means of a motion picture camera.

(1) shows the state of affairs when the fork is at rest. Of course the air is not actually divided into separate layers, but is so indicated in

order that we can concentrate our attention on what is happening at each point.

(2), (3) show how, as the fork spreads, the layers nearest to it are crowded together and start crowding those next to them, starting a pressure pulse moving.

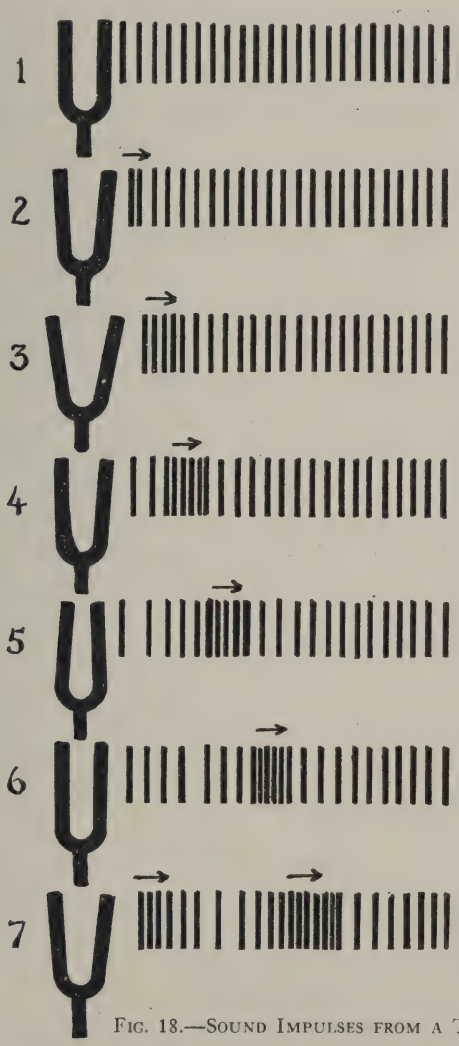


FIG. 18.—SOUND IMPULSES FROM A TUNING FORK

In (4), (5) the fork swings inwards and the air layers next to it move apart to form a rarefaction. In the meantime the region of pressure has moved farther away.

In (6), (7) the fork again spreads, sending out a second pressure pulse.

The wheel and card device provides a simple way of illustrating a most important relation. Suppose we have a wheel with fifty teeth, and suppose it to be revolving at the rate of three hundred revolutions a minute, or five revolutions a second. The card will move backwards and forwards two hundred and fifty times per second and it will be noticed that the tone produced is somewhere near middle C on the piano. If it is tuned to C by changing the speed of the wheel it will be found that the number of motions of the card are two hundred and fifty-six per second. By changing the speed, the tone may be matched to any desired note, and it is found that each note corresponds to a definite number of vibrations of the card per second. In other words the pitch of the tone is determined by the number of sound pulses or sound waves per second. The term *frequency* is used to denote the number of repetitions per second of any periodic occurrence; for example the number of vibrations per second of a tuning fork, or the number of pulses per second in a sound. What has been said above can, therefore, be expressed by stating that the pitch of a tone is determined by the frequency of the sound waves, and that the frequency of the tone known as middle C is 256.

By means of the wheel and card we can demonstrate another interesting relation, namely that which the frequencies of two tones must bear to one another in order that they may form a consonant musical interval. Starting with any pitch, i.e., with any speed of the wheel as a basis, it is found that doubling the speed raises the tone one octave. A speed of three times the original gives the fifth above the octave. If, in this manner, we pick out each of the intervals of the musical scale which form consonances we find that the relation between their frequencies is as follows:

Octave	1 : 2
Fifth	2 : 3
Fourth	3 : 4
Major Third	4 : 5
Minor Third	5 : 6

This relation holds true, no matter what pitch we have adopted as our starting point.

Sounds may be divided into those which can be said to have a definite pitch and those which have not. For the purpose of this book we shall refer to the former as "musical tones." I am aware that the definition is open to some objection from a

musical point of view, but it should be borne in mind that it is not intended to define a tone which is 'good' musically but only to differentiate between musical sounds and noises, the latter term being used for those sounds which consist of an irregular succession of pulses of no definable pitch.

The alternating compressions and rarefactions which are conveyed through the air and effect the transmission of a sound may be considered as 'waves' of sound. The length of a 'wave' is the distance from one point of compression to the next. If there are 256 compressions per second and the sound being in air is travelling at the rate of 1100 feet per second, there must be at the same instant 256 waves in each 1100 feet along the path of the sound. The length of each wave is therefore $1100 \div 256$ or 4.3 feet, or about 4 feet 4 inches. This is the wave length for a sound whose pitch is that of middle C on the piano. A sound one octave higher, having twice as many waves per second and travelling at the same speed through the air, will therefore have a wave length of half that of middle C, or 2 feet 2 inches. The longest audible sound wave has a length of about 50 feet and the shortest of about $\frac{1}{2}$ inch. That is to say, the limits of pitch audible to the human ear correspond to about 20 compressions a second at one extreme and something between 20,000 and 30,000 per second at the other. Some ears can hear tones above 30,000 but this is very rare. Below 20 vibrations per second the sound, when sufficiently intense, makes itself felt as a series of separate pressure impulses. Above the upper limit of pitch the sound, although inaudible, has been known to cause a feeling of distress when sustained for long periods of time.

In the tuning fork we have a very accurate standard of pitch, as the frequency of a given fork is very little affected by surrounding conditions, such as temperature. It is possible, and highly instructive, to make a tuning fork draw a picture of its own vibrations. If we set up a tuning fork as shown in Fig. 19, fitted with a small metal pointer, in such a way that the pointer is made to touch lightly on the surface of a moving strip of paper which has been coated with a thin covering of soot; as the paper is drawn past the point the latter will trace a straight line. If, on the other hand, the paper is kept motionless and the tuning fork made to vibrate, a straight line will result which is at right angles to the former line. If the paper is set in motion while the tuning fork is vibrating, the result will be a wavy line. A similar result can be obtained by attaching to the tuning fork a

small mirror from which is reflected a spot of light, the light spot falling upon a photographic plate as in Fig. 20. By causing the plate to move in the direction at right angles to the motion

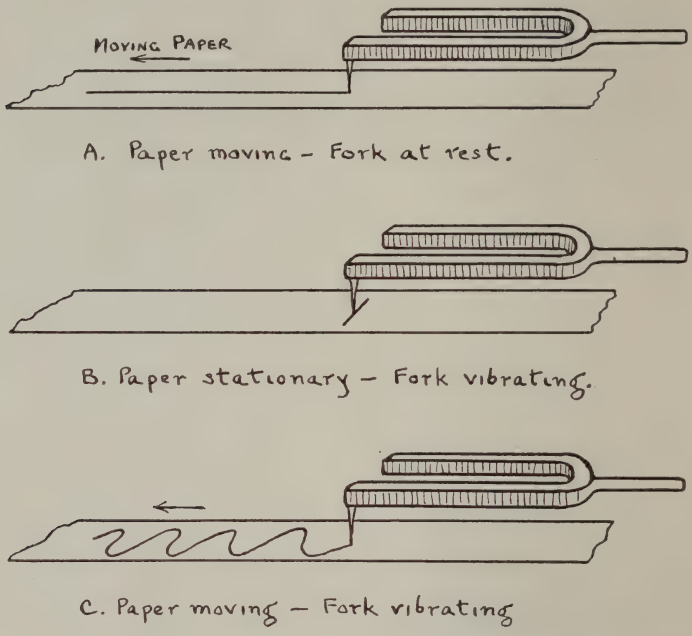


Fig. 19

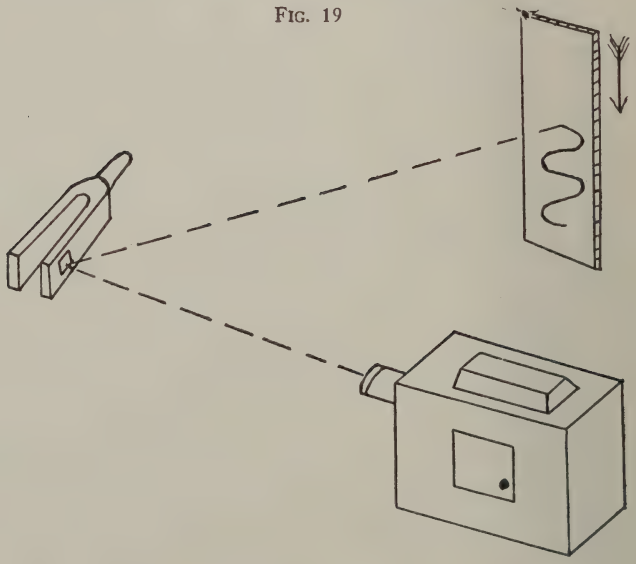


Fig. 20

of the light spot a wavy line is obtained similar to that traced on the moving paper in the previous experiment.

Let us consider the meaning of the curved line obtained by one or other of these pieces of apparatus. The line swings backwards and forwards across the straight line which would be drawn if the tuning fork were motionless. In order to study the curve it is helpful to take a small piece of card with a long, narrow slot cut in it and lay it across the curve in the manner shown in Fig. 21. As we move the curve from right to left, keeping the slotted card stationary, a very small portion of the curve shows through the slot and is seen to move up and down,

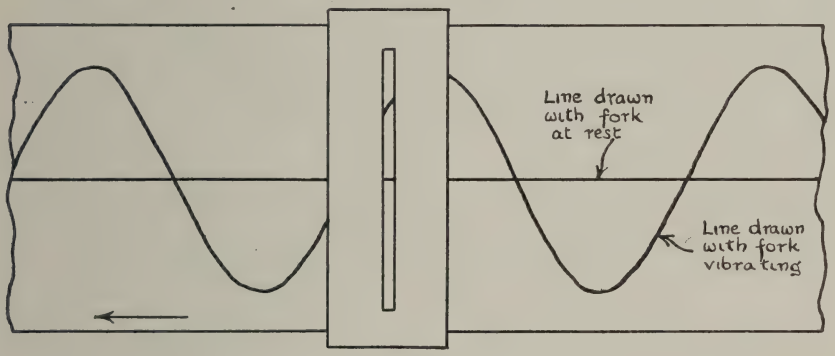


FIG. 21

crossing and recrossing the horizontal straight line. The motion of this small element of the curve is reproducing the motion of the part of the tuning fork where the mirror or pointer was attached. The up and down movements of the point correspond to the backward and forward motions of the prong of the tuning fork, and as the compressions and rarefactions of the air in the neighborhood of the tuning fork are produced by these motions, they also are indicated. Thus it is possible, by means of a curve of this nature, to get some idea of the motions of the particles of air which are being agitated by the tuning fork.

It will be seen that the curve traced out by the tuning fork has a resemblance to a series of waves, and, when the speed of the photographic plate or the blackened paper has been accurately measured, we can tell by counting the number of waves on a given length of paper how many vibrations per second were being made by the tuning fork, or in other words, we can determine the pitch of the tone which it was producing. It will be found moreover that the more violently the tuning fork is

vibrating the farther will the curve extend on each side of the straight line, so that we have in the curve, as well as a means of measuring the pitch, a method of measuring the magnitude of the vibrations. The greater the swings of the tuning fork the louder will be the sound, but, for a given tuning fork, the pitch of the note, or the number of vibrations per second, is the same no matter what the intensity or loudness of the sound may be. This is illustrated in Fig. 22.

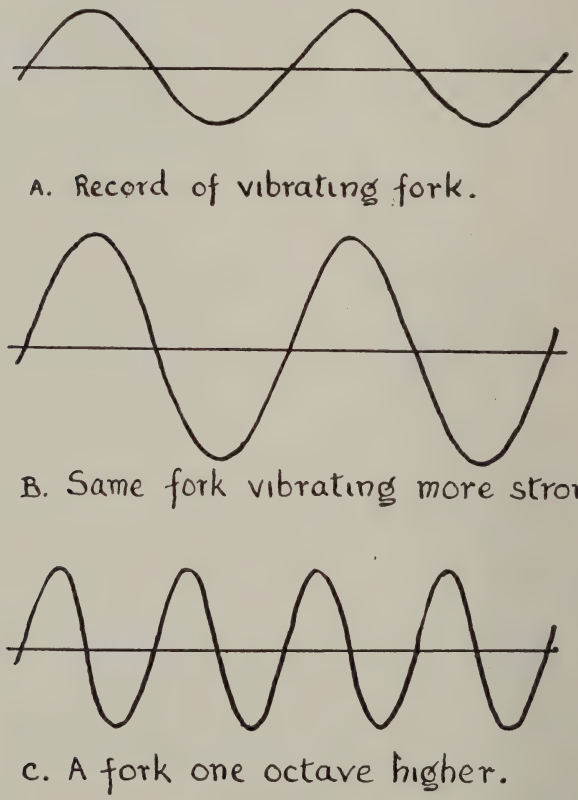


FIG. 22

We see, then, that there are two definite and measurable properties of a train of sound waves: the number of waves per second which determines the pitch of the tone, and the magnitude of each wave which determines the loudness. There is, however, another property of sound waves which we have not yet considered. If tones are produced from a tuning fork and from a violin, both having the same pitch and the same loudness, they

are, nevertheless, distinct and we can immediately recognize which instrument is which. The difference is referred to as the quality of the tone, and we have next to consider what characteristic of sound waves it is which determines quality, otherwise known as timbre or color.

CHAPTER XL
QUALITY

How it is that two instruments, though they may give a tone of the same pitch and loudness, are entirely recognizable one from the other, or in other words, produce sounds which are different in quality?

You will remember, from what was said in the last chapter, that the amplitude or magnitude of the air vibrations determines the loudness of the sound, while the frequency of the vibrations, or their number per second, settles the pitch. It follows that the quality of the sound must depend upon the only other factor, which is the individual nature of each vibration or sound wave.

It was shown how the motion of a tuning fork could be recorded on a strip of paper in the form of a wave curve. In order to study the nature of sound waves in the air it is necessary to obtain a similar record of the vibrations of the air itself. This can be done by making use of the fact that an extremely light body will move with the air when the latter is in vibration. Fig. 23 shows a diaphragm or sheet of extremely thin material to

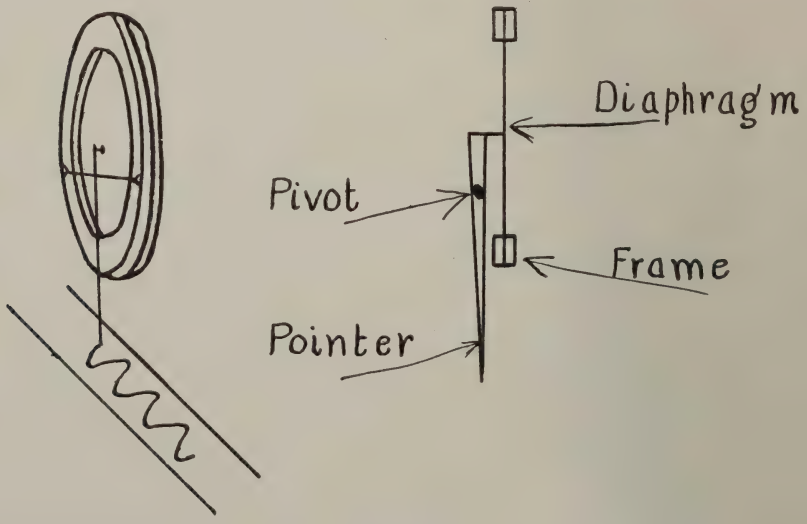


Fig. 23

which is attached a pointer of very small weight. If this diaphragm be placed so that the air vibrations strike upon it, it will follow these vibrations and impart its motion to the pointer, so that the movements can be traced upon a piece of moving paper in the same manner as the vibrations of the tuning fork were traced by the apparatus described in the previous chapter. In this case also, a small mirror may be attached to the diaphragm, as shown in Fig. 24, and the vibrations recorded on a moving

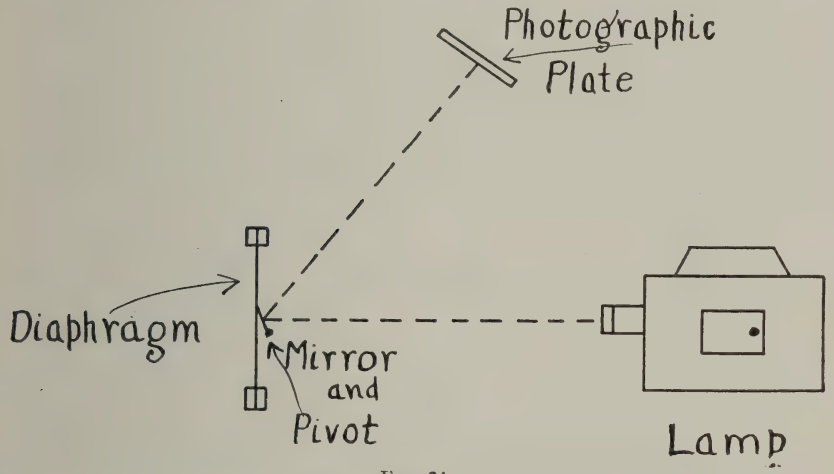
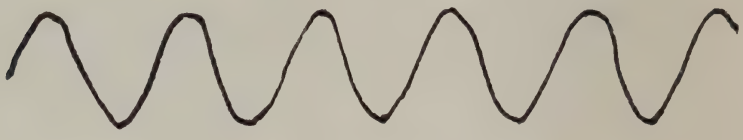


FIG. 24

photographic plate. The wave curve so obtained will reveal the form of the sound waves with an accuracy depending upon the faithfulness with which the diaphragm follows the air vibrations. The device as shown in these figures is rather a crude one and not sufficiently accurate for studying fine differences in the forms of various sound waves. A much more accurate and delicate apparatus will be described in a later chapter, but the principle on which it acts is similar.

In Fig. 25 are shown the records of several different types of sound waves obtained by means of the apparatus referred to above. The first of these shows the sound wave produced by a tuning fork. It will be seen that a smooth and symmetrical curve is obtained. This has a characteristic shape which is representative of what is known as a 'pure' tone. Such tones are obtained only from a very limited class of sound-producing instruments. The next example is the sound wave given by a violin. In this case it is easy to explain the peculiar shape of the curve. As the bow is drawn across the string the latter is dragged

aside until it slips and springs back into place. This occurs repeatedly and results in the saw-tooth shaped motion of the string which is reproduced in the sound waves given out by the



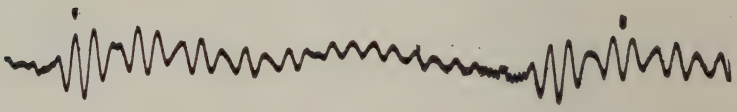
TUNING FORK



VIOLIN



VOWEL *Ah*



VOWEL *Ee*

FIG. 25.—TYPES OF SOUND WAVES

instrument, the rising slope of each wave corresponding to the drawing aside of the string by the bow, and the sudden downward drop of the wave corresponding to the springing back of the string.

The wave shapes corresponding to the vowels produced by the human voice are seen to be complex in shape but it will be found that their complexity can be explained when we have examined carefully the mechanism by means of which these vowels are produced.

The first and obvious effect produced on our ear by a musical tone from an instrument or the singing voice is the recognition of a certain individual quality which we have seen must depend upon the shape of the sound waves. Now it is possible, by concentrated attention, for the ear to distinguish, in addition to

the one musical tone whose pitch is determined by the number of waves per second, a whole series of higher tones present in the sound. It is found moreover that these higher tones, which are known as 'overtones' or 'harmonics', bear fixed relationships to the main tone as regards their musical intervals. The overtones include only tones contained in the following series:

The octave above the main tone;
The fifth above the octave;
The second higher octave;
The major third above the second octave;
The fifth above the second octave;

and continuing on by smaller and smaller intervals. From what has been said in Chapter XXXIX about the relations between musical intervals, it will be seen that the above series of overtones have the following relations to the main or fundamental tone:

Octave	2 : 1
Fifth above	3 : 1
Second octave	4 : 1
Third above	5 : 1
Fifth above	6 : 1

Similarly it is found that the higher overtones include those having 7, 8, 9 etc., times as many vibrations per second as the fundamental. The questions then arise: are these higher tones, heard as harmonics of the fundamental, actually present in the tone in the form of sound vibrations of the corresponding frequencies? How do they affect the quality of the tone? The answer to the first question is that not only are the harmonics present in the sound wave, but that any periodic wave, of whatever shape, can be built up by combining a fundamental wave, and harmonics of that fundamental, in the required proportions.

Let us examine a little more carefully what this means. Suppose we set up, as shown in Fig. 26, a series of tuning forks, the first of which gives a tone corresponding in pitch to any key on the piano say, for example, an octave below middle C, that is to say the sound wave given out by this tuning fork will have a frequency of 128 per second. Let the second fork give the octave above this tone or 256 per second, the third fork a fifth higher or 384, and so on, the series of forks providing as many harmonics of the fundamental tone of 128 as we may desire. If all these forks are sounded at the same time, the result will not be a pure tone such as would be given by a single tuning fork,

but a compound tone, whose pitch will be recognized as that of the fork of lowest frequency, and in which harmonics corresponding to the other tuning forks can be recognized.

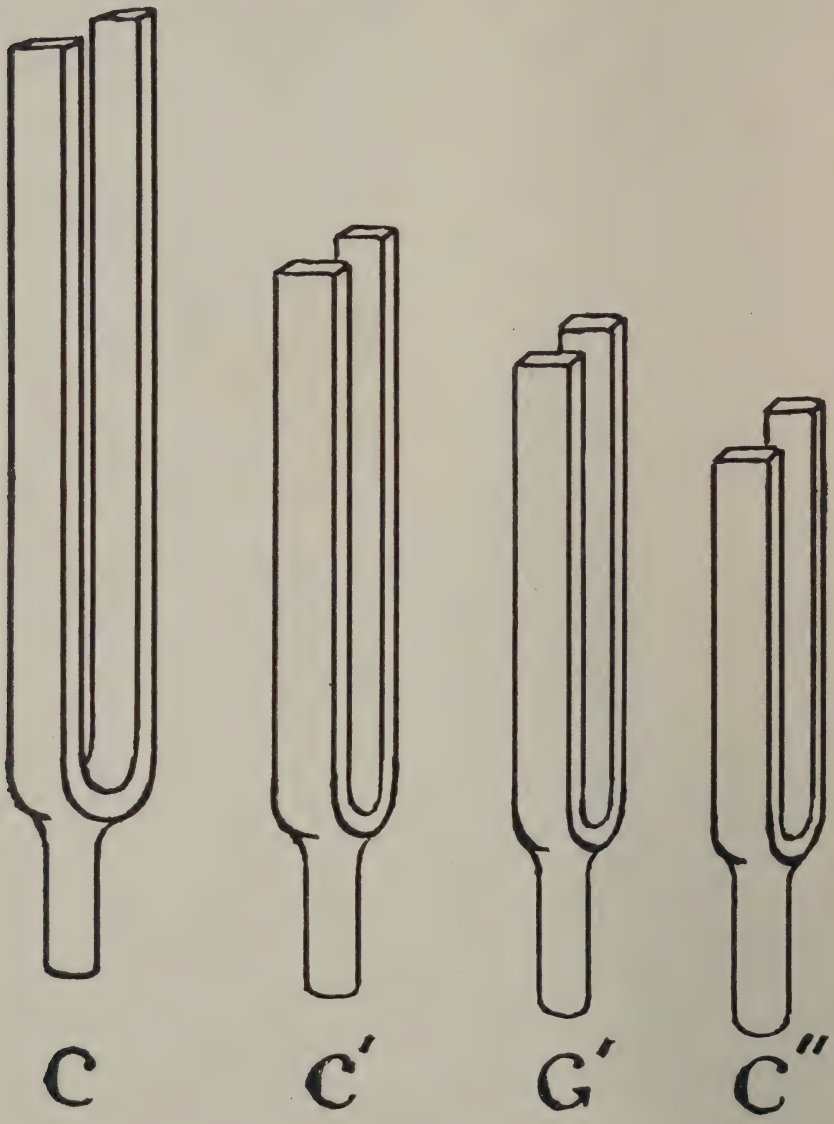


Fig. 26

This apparatus will give us the means for producing tones containing, in addition to the fundamental, any desired combination of harmonics, in any relative proportions, if we have the power to control the loudness of the sound emitted by each individual fork. The way in which this can be done will be discussed a little later, but in the meantime let us assume that we have that power. Now if we set the fundamental fork in vibration by itself and make a picture of the sound wave by means of the apparatus described in the last chapter, we shall get the wave shown in the top diagram in Fig. 27. If we now stop the fundamental fork and set the one corresponding to the octave above in vibration, we shall get the sound wave shown in the second diagram. The shape of the wave will be similar to that given by the fundamental fork, but there will be twice as many vibrations per second, so that for every half-wave in the first diagram, there will be a complete wave in the second. Now, if both these forks are sounded at the same time, the result will be that the air particles will be caused to vibrate by fork No. 1 as in the first diagram and by fork No. 2 as in the second diagram, and the resultant motion of the air particles will correspond to a wave obtained by adding, at every instant, the two motions determined by the two forks. If therefore we add to the curve in the first diagram the higher frequency curve of the second diagram, we shall obtain the result shown in the third diagram, always remembering to add the heights of the two curves when they are on the same side of the horizontal lines and to subtract one from the other when they are on opposite sides. This process will be clear from the way in which the third diagram is drawn. As we add more and more forks and the tone becomes more and more complex, the above process has merely to be carried farther, the wave for each fork being added on and the resultant wave becoming more and more uneven in its shape as more and more harmonics are added.

Now the sound waves which strike the ear are made up of a combination of the vibrations produced by the individual forks, and it is obvious that the ear has no means of telling whether the sound is coming from a number of separate forks vibrating at the same time, or from one sound producing instrument giving a complex sound wave of the same shape as that produced by the group of forks.

In drawing the diagrams in Fig. 27 the waves have been placed in such a way as to indicate that they all started at iden-

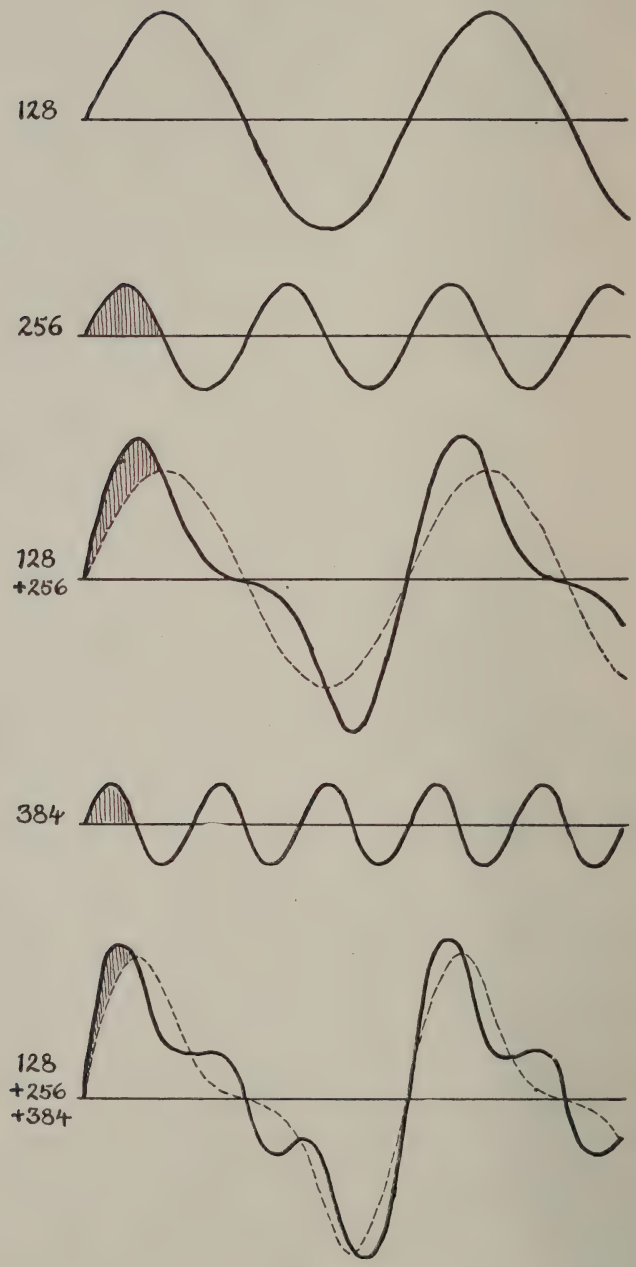


FIG. 27.—FUNDAMENTAL AND HARMONICS

tically the same instant. Any one of them could have been shifted to the right or to the left. It is an interesting and very important fact that it does not matter at what instant any one of the waves starts with relation to any of the others, as the quality of the tone will not be affected. The shape of the resultant complex wave will, it is true, depend not only upon the number and magnitude of the harmonics but also upon their relative positions; but the quality of the resultant tone depends only upon the harmonics present and their relative magnitudes. It is a very fortunate thing that this is the case, since otherwise the quality of the sound produced by an orchestra would be quite uncontrollable unless all the instruments could be made to start giving out their tones at precisely the same instant.

It was mentioned above that in order to obtain any desired quality from a multiple arrangement of tuning forks, it would be necessary to control independently the loudness of each individual fork. A method by means of which this can be done will be discussed in the next chapter.

CHAPTER XLI
RESONANCE

Suppose we have a boy seated in a swing. By giving him a series of small pushes, properly timed, we can cause him to execute very large swings to and fro. At first his motion will be very slight, but, as we continue our periodic pushes, he will swing through a wider and wider angle until he is moving backwards and forwards several feet, and it will require very much less effort on our part than if we had attempted to lift him backwards and forwards through the distance to which our small pushes caused him to swing. Note, however, that the pushes which we give him must be timed correctly, or instead of causing him to swing further and further we shall impede the motion and interfere with his swinging instead of helping it. We can only make him swing a certain definite number of times in a minute, and this will be fixed no matter whether he is swinging backwards and forwards a few inches or several feet. The number of swings which he makes in a certain fixed time is called his "natural frequency."

Now a tuning fork is, in reality, nothing but a swing with a very high natural frequency, making a large number of swings in a second instead of a few in a minute, and, just as we were able to cause the boy to swing, so is it possible to make a tuning fork vibrate, by means of slight, but properly timed, impulses. If any sound of exactly the same pitch as that of the fork is sustained, the tuning fork will respond to it because each pressure pulse of the sound will strike the fork at just the right instant, and the combined pushes, though exceedingly delicate, are sufficient to build up vibrations in the tuning fork. The tuning fork may then be said to be in sympathetic resonance with the sound. If two tuning forks of the same pitch be placed near each other and one is sounded by striking or plucking it, the other also will vibrate. If the first fork is stopped or withdrawn the second fork will continue to give out its tone for a short time, just as a swing will continue to oscillate after we have ceased to push it.

The upper diagram in Fig. 28 illustrates a tuning fork—frequency 256—in vibration, producing a sound wave in the air (a progressive

wave) which is to advance indefinitely to the right. The right prong of the fork, starting from its position of rest, A, has swung to B and back again.

The motion of the thin layers, or strata, of air at constant intervals is represented by the heavy black lines, while their undisturbed positions are shown by the dotted lines. The arrows represent the direction of motion and the velocities of the various air strata.

The air stratum to the right at a distance of 2 feet 2 inches (a half wave-length) represents the position of the condensation. Thus, while the fork of frequency 256 vibrations per second has oscillated from A to B and back again, the condensation has travelled 2 feet 2 inches.

Notice that while both the rarefaction and the condensation travel with the sound wave, the displacement of the air molecules at the center of a rarefaction and a condensation is zero, and the direction of motion of the particles in the rarefaction is opposite to the direction of the wave propagation.

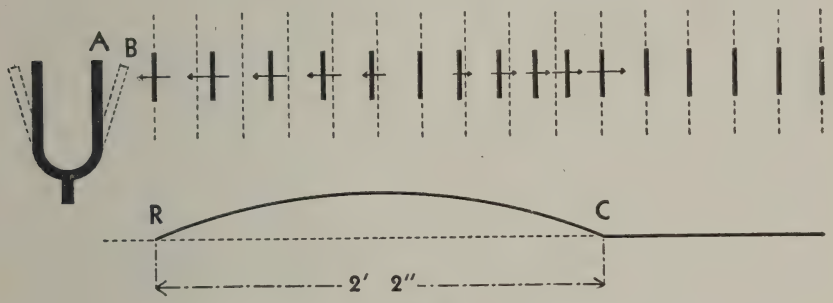


FIG. 28

The lower diagram shows the transverse representation of a sound wave. It is often made use of because it is easy to draw.

The method employed is to choose the positions of the undisturbed air strata along the horizontal axis as the points from which the displacements of air strata are reckoned, and then to rotate the displacements about these reference points 90 degrees.

The letter R indicates the point at which the rarefaction, and the letter C the point at which the condensation, starts.

In the same way, if we lift the damper from one of the strings of the piano and sing a tone corresponding in pitch to that particular string, it will be found that when we stop singing, the string will be in vibration and will give out its tone by sympathetic resonance with the voice.

The objects which respond to others most readily by sympathetic resonance are those whose mass is small, since it takes a great deal longer to set a heavy body swinging by gentle impulses than a light one. A tuning fork is actually one of the

most difficult objects to set in vibration by resonance, because it is made of heavy metal and is very stiff, so that it requires a great many accurately timed impulses to give it much motion. In addition to having small mass, a resonating body must be so constituted that it can vibrate, or in other words, it must be elastic. One of the lightest elastic substances is air.

Let us consider how a confined body of air may be made to vibrate in sympathetic resonance with a tuning fork or other source of sound. Fig. 28 illustrates a tuning fork vibrating at 256 per second. This corresponds to a sound whose wave-length is 4 feet 4 inches. In one complete vibration the fork produces a period of compression and a period of expansion of the air particles. Thus in traveling from A to B and back again the fork has gone through one half cycle and the pressure pulse has travelled one half wave-length, or 2 feet 2 inches.

If the tuning fork is set into vibration in front of a tube (Fig. 29) which is closed at one end, forced vibrations are set up in the tube. These forced vibrations will reinforce the sound produced by the fork if the natural period of the air column is the same as that of the fork. This form of resonance is a special case of forced vibration.

In Fig. 29 the tuning fork which has been placed near the open end of the tube is assumed to have been in vibration long enough to establish steady conditions of vibration in the tube.

A shows the strata of vibrating air at the instant of time when in their undisturbed positions and moving to the right with maximum velocity. The fork is shown in its position of maximum displacement to the right.

This particular phase relation of 90 degrees between the two vibrating bodies is assumed for the purpose of discussion only; a more technical treatment of the problem of phase relations would involve the introduction of a great deal of higher mathematics and is beyond the scope of a work of this kind. There are also certain end corrections which are not considered in the diagrams.

B shows the state of affairs an eighth of a period later. The right prong of the fork is shown swinging to the left, while the various strata of air which have been displaced the amount indicated are slowing down in velocity. Notice that the amplitude of vibration of the air becomes less as the closed end of the tube is reached, at which end there is no displacement. A point of no displacement is called a *node (N)*. At the open end of the tube

there is maximum freedom of movement of the air particles. Thus the maximum displacement is at or near the open end of the tube. This point is called an anti-node, or *loop (L)*.

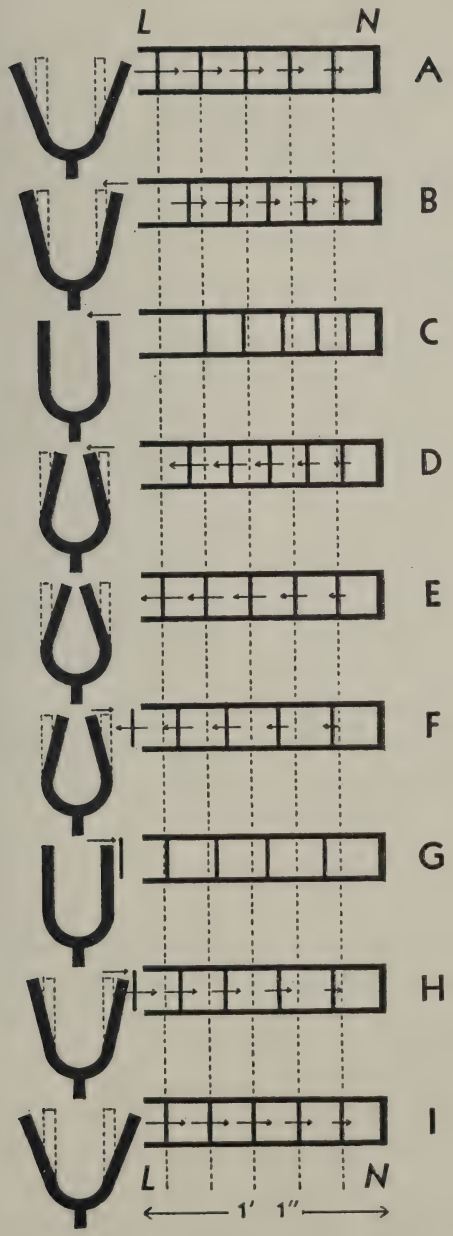


Fig. 29

C shows the state of affairs two-eighths of a period later than A. D, E etc. are similarly drawn to indicate what is taking place one-eighth of a period later than the preceding one.

From our definition of wave-length, the distance between a maximum displacement and no displacement of a vibrating medium is a quarter of a wave-length. A tube closed at one end which has a node at the closed end and a loop at the open end, and no other nodes or loops within the tube, is said to be resonating its fundamental frequency, i.e., its lowest frequency tone. Thus the tube in Fig. 29 must have a length of 1 foot 1 inch for the frequency of 256 vibrations per second except for a slight open-end correction.

A tube closed at one end will resonate for the same fork at lengths of three, five, seven, etc. times the length required for the resonating of its fundamental. The distribution of nodes and loops for a tube three times the length necessary to resonate its fundamental is shown in Fig. 30. The phase of air displacements in X is the same as in C, Fig. 29, while that of Y is the same as G, Fig. 29.

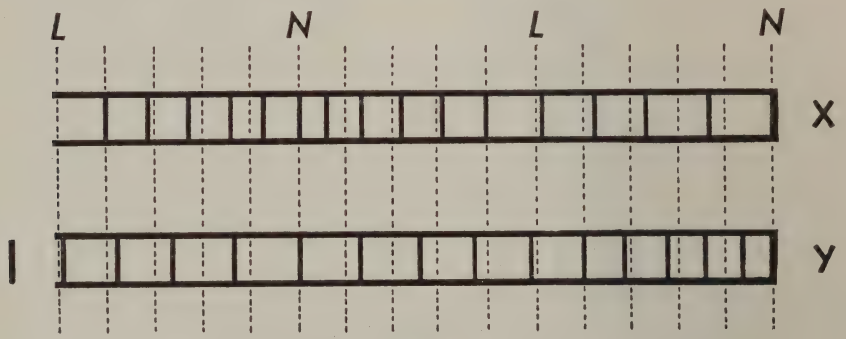


FIG. 30

The length of a tube open at both ends is one half wave-length for the fundamental resonance tone. This is twice the length required for a tube closed at one end if the end corrections are neglected. An open tube will resonate for the same frequency at lengths of two, three, four etc. times its length for the fundamental.

To get the best resonating effect the tube must be held very close to the fork and so by approaching and withdrawing the tube the amount of resonance and therefore the volume of the tone may be controlled. If we apply this principle to our series of forks shown in Fig. 26, giving each fork a resonating tube of

the length corresponding to the pitch of the particular fork, we can thus pick out and increase the magnitude of any one or several of the harmonics, and in this way control the quality of the sound produced by the apparatus.

Now if we have an instrument which gives out a composite tone i.e., one with a wave shape not like that of a tuning fork but containing harmonics, what will happen if we apply resonating tubes to it? Suppose we use a tube whose length can be varied, say by means of a piston which can be moved backwards and forwards inside the tube. Let us start with a tube longer than that required to resonate the fundamental pitch of the tone. For instance, if the instrument is producing middle C which has a fundamental of 256 per second, as we gradually shorten the tube we shall get a resonance of the fundamental when the length is 1 foot, 1 inch. Then, if we continue to shorten the tube, there will be another resonant point at a length of 6½ inches, in which case the first overtone, which is an octave above the fundamental, will be accentuated. At about 4⅓ inches, the next overtone, which is a musical fifth higher, will be brought out, and so on. Similarly, if we arranged up against the instrument a series of such tubes of lengths proportioned accurately to resonate the various harmonics, by approaching or withdrawing the tubes any arrangement of harmonics could be accentuated and the quality of the tone varied at will.

In order to construct an instrument with which we can obtain a tone rich in harmonics and to which can be applied resonators to accentuate one or more of the harmonics, we may employ a rubber 'squawker' made by stretching thin strips of rubber over the end of a tube so that they form two lips lying together as shown in Fig. 31. If we attach the tube to a supply of air under pressure such as a bellows, the air pressure will force the lips out slightly and some air will escape producing a puff. The elasticity of the lips will cause them to spring back as soon as the puff is released. This process will then be repeated and so a series of puffs will be caused, the frequency of repetition of which will depend upon the tightness with which the lips are stretched, and the result will be a continuous tone of a shrill and harsh nature containing a very large number of harmonics. The harmonics present and their relative proportions will depend upon the manner in which the rubber lips vibrate as they allow the puffs of air to pass between them. If the rubber strips are adjusted so as to be slightly separated, so that they do not strike

together, the tone will be relatively smooth and there will be a considerable escape of air, since the air will be continually flowing out and the lips will vibrate by a kind of bowing action produced by the air passing between them, similar in some respects to the action produced by a violin bow as it passes over a string. This produces a periodic increase and decrease in the flow of air without any complete stoppage. If the lips are adjusted so as to be in actual contact when at rest, the air current will be completely stopped between the puffs and the result will be a harsher

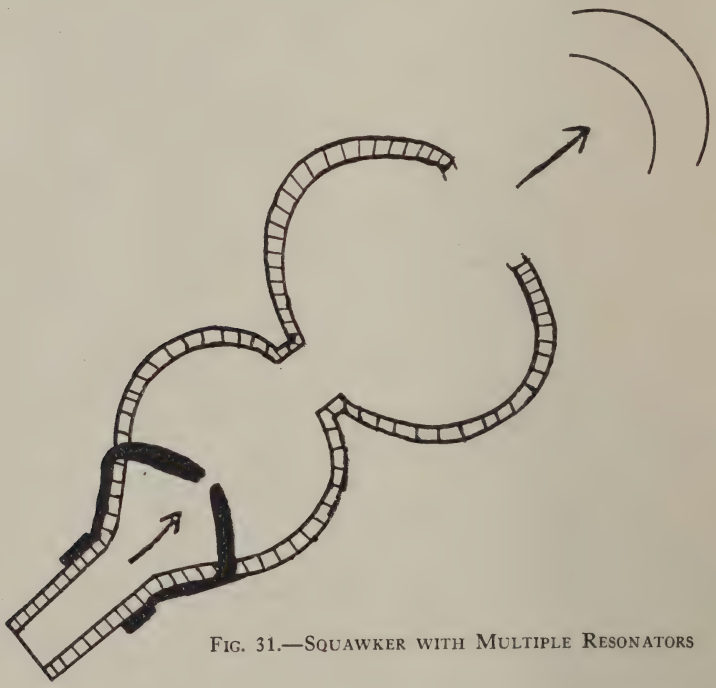


FIG. 31.—SQUAWKER WITH MULTIPLE RESONATORS

tone, i. e., one containing a greater proportion of the harmonics of higher frequency. There will also be less flow of air out of the system.

Now if we apply to the 'squawker' a resonator consisting of a tube adjusted to resonate with one of the harmonics present in the tone, that harmonic will be accentuated, and, by using a number of resonators, the quality of the tone may be controlled by picking any desired harmonics and accentuating them above those whose presence in the tone is not desired.

The only type of resonator so far considered has been a cylindrical tube with one end closed. There are, however, other

produced by the passage of the air across the edges of the cords in much the way that motion is imparted to a violin string as the bow is drawn across it. The muscular system of the vocal cords is also capable of determining, to some extent, the proportions of the harmonics present by controlling the segmentation of the cords. That is to say, in addition to the vibration of the cords from end to end, as a whole, there will be a superimposed vibration of each half of the cords separately producing the harmonic which is an octave above the fundamental. The cords will also have a vibration in which their length is divided into three parts giving a harmonic of three times the pitch of the fundamental, and so on up the scale of harmonics.

The vocal cords should control the rate at which air flows out of the lungs during singing and indirectly have an effect upon the air pressure. When they are separated the air pressure may be relatively low but a great deal of air will escape. The tone will be of low intensity and cannot be long sustained. When the cords are held close together, great air pressure can be built up behind them and a loud tone can be given out and sustained for a relatively long time.

The principal cavities, which form the third element of the system and provide the resonance of the fundamental tone and of such of the harmonics as are being selected, are made up of the laryngeal, oral and nasal pharynx, and probably to some extent, the passages below the vocal cords including the trachea and bronchial tubes (see Section I, Chapters III, IV, V).

A resonance cavity will be most efficient when its walls are hard and firmly held. The pharyngeal cavities fulfill these requirements and by means of muscles may be adjusted so that a wide range of variation of size and shape can be secured.

CHAPTER XLII
THE VOCAL SOUNDS

The sounds emitted during the act of singing are divided broadly into two classes, the consonants and the vowels.

The consonants contain a very small amount of energy and are short in duration. Since they are not phonated they cannot be said to have any definite fundamental.

The vowels contain most of the energy of speaking or singing sounds. They can be sustained more or less steadily and are periodic in their nature, that is to say they consist of a series of sound waves substantially constant in shape during the phonation of a given vowel. We may regard singing as the production of a number of more or less sustained vowels separated by consonants or by pauses. Before going a little deeper into the nature of the vowels let us return for a few minutes to the consideration of resonators.

When a tuning fork is brought into sympathetic resonance by sounding another fork of the same pitch in its neighborhood, it is found that the pitches of the forks have to be very accurately alike in order that the one will resound to the other. If the natural pitch of one is changed to a very slight degree, say by sticking a small piece of wax on the end of each prong, the forks will not resound to one another at all. A tuning fork is therefore said to have very sharp resonance.

When an air pipe is made to resonate to a tuning fork it is not necessary for the pipe to be tuned with extreme accuracy for some degree of resonance to result. There will be one particular length of pipe for which maximum resonance is obtained, but the pipe may be slightly longer or slightly shorter and there will still be resonance but in a lesser degree. In other words, a resonance pipe of a certain fixed length will respond strongly to the pitch, or frequency, which is exactly equal to its own resonance frequency, but frequencies in the immediate neighborhood of this value will be accentuated to some extent. The pipe does not resonate as sharply as a tuning fork. Other types of resonators may be even less sharp in their resonance characteristics. This is true of air cavities in which the walls are not perfectly

rigid or are covered with soft, sound-absorbent material. In the case of multiple resonance chambers connected by comparatively narrow passages, this effect is very pronounced, particularly when the communicating passages are lined with absorbent material.

Consider what the effect of resonators of different degrees of sharpness of tuning will be when they are applied to sound producers which are rich in harmonics. Suppose that we have a vibrator giving a tone of which the fundamental pitch is one hundred vibrations per second and which contains all the harmonics of the fundamental up to, say, the eleventh or twelfth. We shall represent this in diagram form by drawing a horizontal line, A—Fig. 33, the distance along which represents vibrations

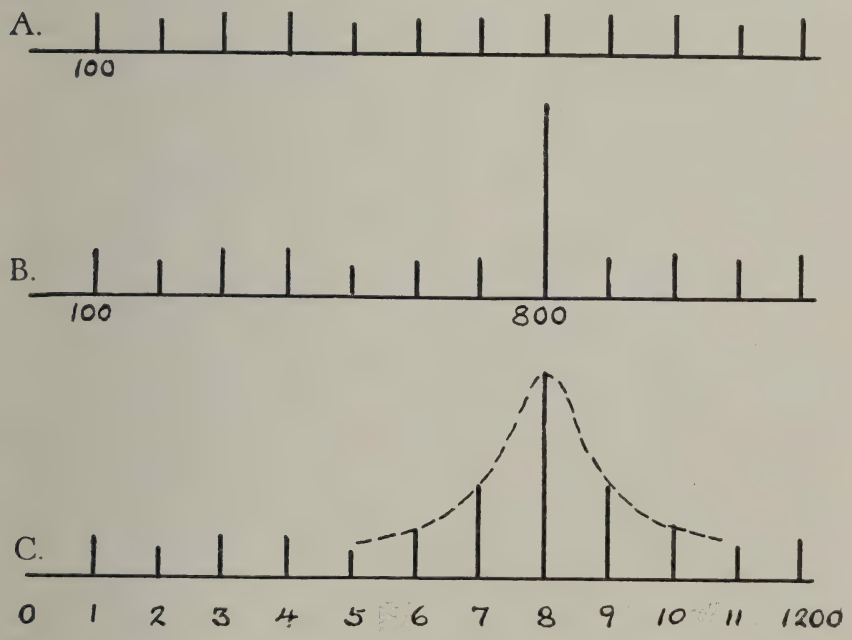


FIG. 33.—EFFECT OF SHARPLY TUNED RESONATOR

per second as shown by the numbered scale, and by erecting at the points corresponding to the various harmonics vertical lines whose height represents the loudness of the harmonics. We have shown them all of about the same loudness, for the sake of simplicity, although this would not often be true in an actual case. Since we have assumed that there are no harmonics missing, there will be a vertical line at 100 representing the fundamental and lines at 200, 300, 400 etc. representing the harmonics.

Now what will be the effect of applying to this source of sound a sharply tuned resonator whose natural period of vibration is 800 per second? The harmonic whose pitch is 800 vibrations per second will be strongly accentuated so that the vertical line corresponding to it must be made considerably higher than the others, as shown in B—Fig. 33. The resonator being sharply tuned, it will have no effect upon the other harmonics.

Now suppose that a resonator of natural pitch 800, but not as sharply tuned as the previous one, be used. The harmonic at 800 will again be strongly accentuated but, on account of the character of the resonator, the harmonics in the immediate neighborhood will be somewhat affected. Those at 700 and 900 will be magnified but to a lesser degree and those at 600 and 1,000 may be affected though very slightly. The state of affairs may then be represented as at C—Fig. 33. In this case a *band* of frequencies is said to be resonated, the band in this case extending from 600 to 1,000 vibrations per second.

We have assumed so far that the fundamental pitch of the tone is such that one of the harmonics falls exactly at the resonant pitch of the resonator. Let us see what will happen if the pitch of the tone is varied keeping the same resonator throughout. Fig. 34 shows four conditions corresponding to fundamental pitches of 100, 150, 200 and 250. In the case of the tone whose fundamental is 100 there is a harmonic at every hundred period and, as we have seen above, those at 600, 700, 800, 900 and 1,000 will be accentuated. When the pitch of the fundamental is 150 the harmonics will occur at 300, 450, 600, 750, 900, 1,050 etc. Those within the frequency band of the resonator will be accentuated and we shall have the condition shown in B—Fig. 34. The dotted line indicates the amount of magnification which the resonator can give to any particular harmonic, and as this dotted line depends only upon the resonator, it determines which harmonics will be affected and to what extent. By drawing out the diagram of harmonics for tones with fundamentals of 200 and 250 as in C and D—Fig. 34, it will be seen that, no matter what the pitch of the fundamental may be, there will be an accentuation of the harmonics which happen to fall in the neighborhood of the pitch of the resonator so that in each case the frequency band in which resonance occurs will be the same.

If we carry this illustration a little further and use two resonators at the same time, tuned to two different pitches, we

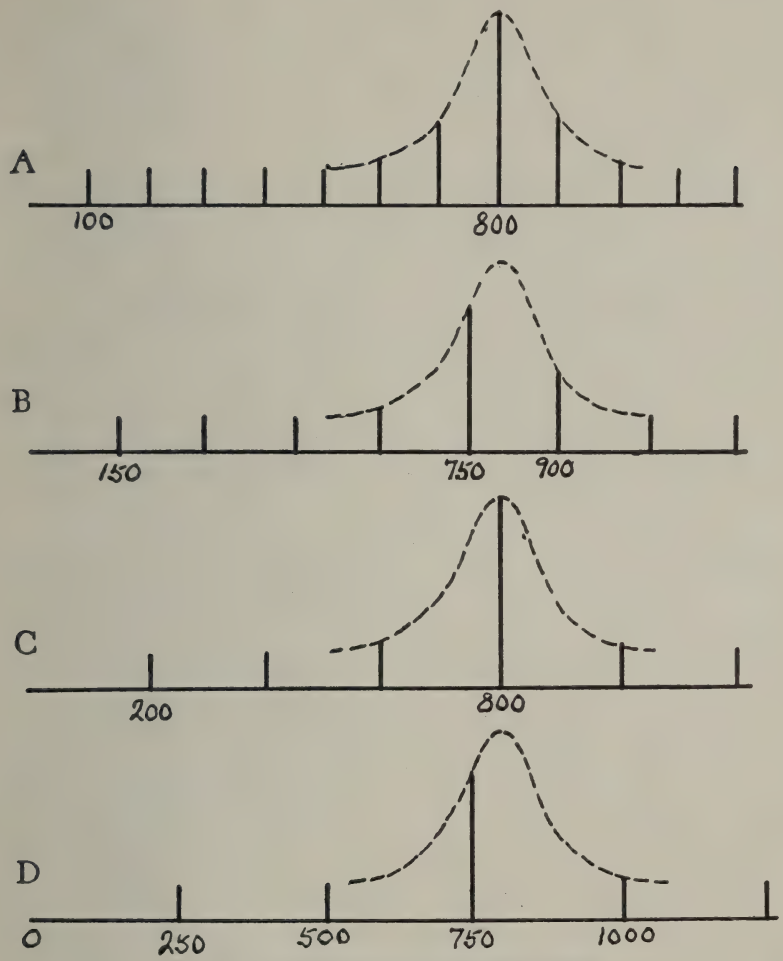


FIG. 34.—EFFECT OF TUNED RESONATOR

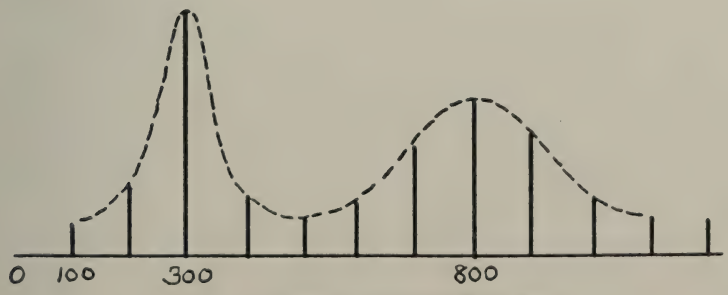


FIG. 35.—EFFECT OF TWO RESONATORS

shall get two bands of resonance. In Fig. 35 is shown the result of using two resonators tuned respectively to 300 and 800 vibrations per second, one having a sharper resonance than the other. The fundamental pitch of the tone in this case is assumed to be 100.

Thus it is possible to resonate one, two or more bands of harmonics, and as would be expected, each different arrangement will result in a characteristic quality of sound. Herein lies the basis of the formation of the vowel sounds. Analyses of the sound waves constituting the vowels show each vowel to be characterized by definite frequency bands peculiar to it. A vowel is formed from the sound given out by the vocal cords by the action of the resonance cavities, which are adjusted to accentuate the bands of frequencies characteristic of that vowel. The frequency bands for any given vowel are independent of the fundamental pitch of the tone, and therefore it is possible to sing the same vowel at different pitches.

It should be noted, however, that in order that the tone may have harmonics falling within each of the frequency bands for a given vowel, it is necessary that the pitch of the fundamental be below the lowest frequency band. If the fundamental lies above the lowest band the vowel cannot be sung at such a high pitch. This explains why there are certain vowels which cannot be sung at the top range of a woman's voice.

In Fig. 36 are shown the resonance curves for some of the vowel sounds of speech. These curves were obtained in the Bell Telephone Laboratories by means of the apparatus which will be described in the next chapter. It will be noticed that in all cases there seem to be at least two resonant regions, and in some cases three or four. This is not surprising considering the internal structure of the vocal cavities which would admit of several different resonators being in action at the same time.

The curves shown in Fig. 36 are for spoken vowels. The research work which has been done on vowel sounds has heretofore been mainly based upon the speaking voice and usually upon observations of untrained voices. These curves may not be, and probably are not, representative of what would be obtained with properly produced voices. Unfortunately we have not yet available a set of such curves made from the voices of great singers.

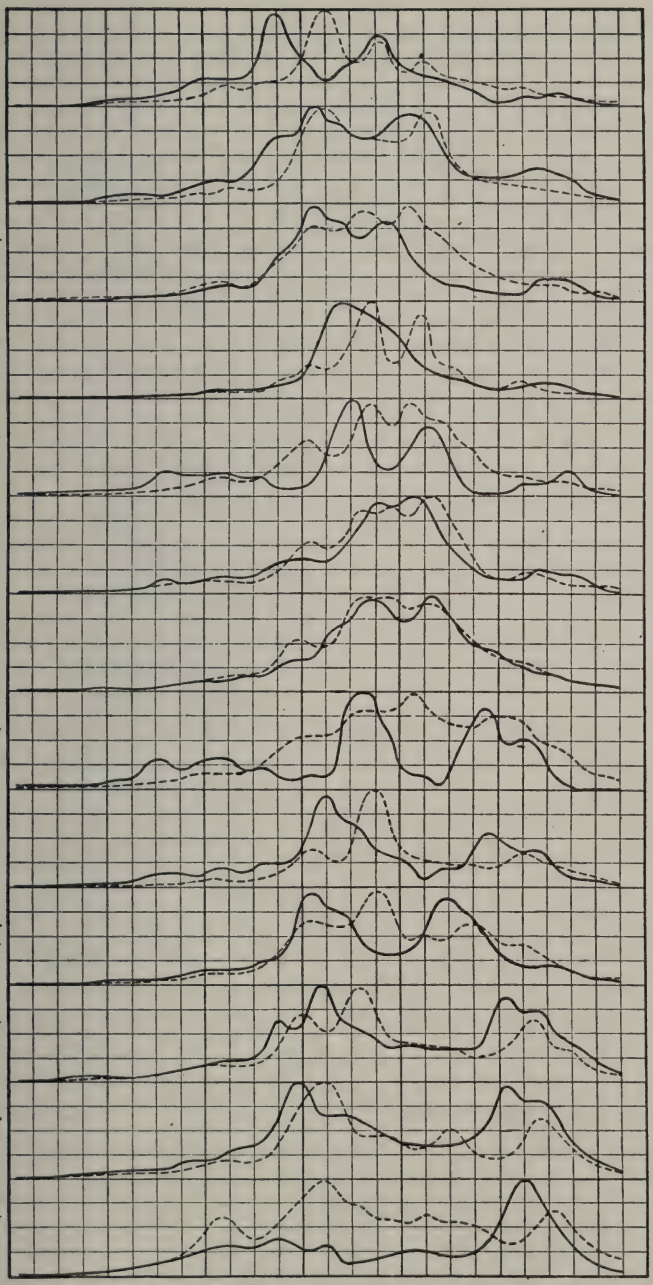


FIG. 36.—ANALYSIS OF VOWEL SOUNDS. RELATIVE IMPORTANCE OF THE AMPLITUDES AT DIFFERENT FREQUENCIES TAKING INTO ACCOUNT THE SENSITIVENESS OF THE EAR

From "The Sounds of Speech," by Irving B. Crandall; Bell System Technical Journal, October, 1925

CHAPTER XLIII
SOUND RECORDING AND REPRODUCTION

In Chapter XL mention was made of apparatus by means of which sound waves could be picked out of the air and their form faithfully recorded.

One example of such apparatus is shown in simplified form in Fig. 37. This is pictured and described in greater detail in the

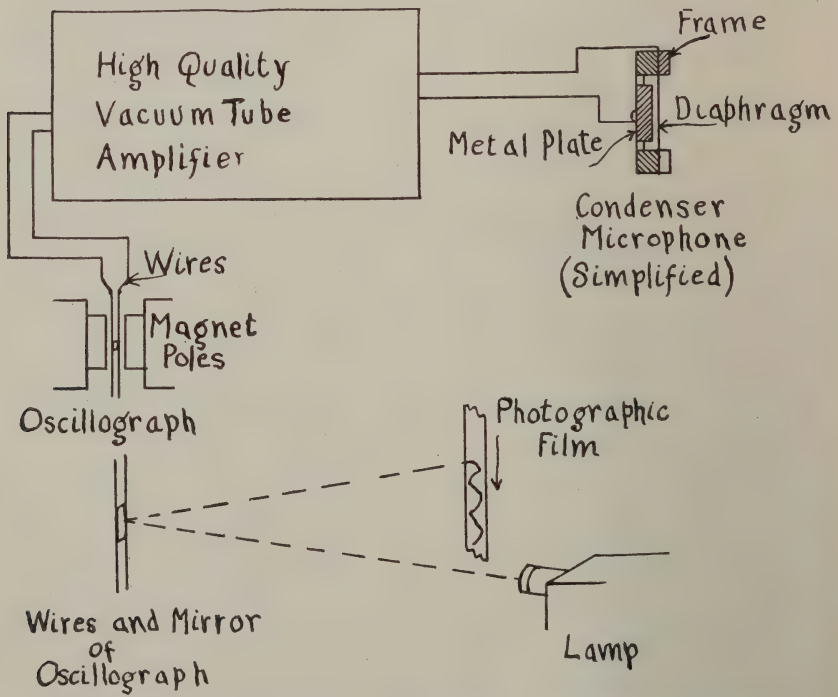


FIG. 37.—DIAGRAMMATIC SKETCH OF OSCILLOGRAPH, AMPLIFIER AND MICROPHONE

October, 1925 number of the *Bell System Technical Journal,* in an article by Irving B. Crandall entitled "The Sounds of Speech," and consists of three elements developed in the Bell Telephone Laboratories in the course of the very extensive investigations which have been carried on in those laboratories on

the nature of speech, and the requirements of the instruments and transmission lines through which speech is conveyed in the telephone system.

The first element is a microphone, by means of which the sound waves in the air are picked up and converted into electrical vibrations. The microphone contains a stretched metal diaphragm about a thousandth of an inch in thickness, close to which is mounted a metal plate. The two form the plates of a charged electrical condenser, and when sound waves fall on the diaphragm, causing it to vibrate, the consequent changes in the distance between the diaphragm and the plate produce corresponding changes in the capacity of the condenser. The condenser is connected in an electrical circuit in such a way that the changes of capacity are accompanied by the production of electrical vibrations, very feeble, but copying with great accuracy the form of the sound waves which fall on the diaphragm of the microphone.

These feeble electrical vibrations are passed on to the second element which is a vacuum tube amplifier similar in principle to the amplifier of a radio set but specially designed to increase the power of the electrical vibrations with practically no distortion of their form.

From the amplifier the electrical vibrations are led to the final element of the system, a specially built 'oscillograph' (see frontispiece). The oscillograph consists essentially of a pair of fine wires stretched side by side in the field of a powerful electromagnet. Across the middle of the wires is fastened a very small mirror. The passage of the vibrating electrical currents through the wires causes them to move back and forth, one advancing as the other retires, and thereby deflect the mirror. By means of a beam of light, reflected from the mirror onto a moving photographic film, the vibrations of the wires are registered. They correspond to the vibrating currents flowing through the wires, which in turn correspond to the air waves falling on the microphone diaphragm.

It was with apparatus of this nature that the records of sound waves pictured in Fig. 25, Chapter XL, were obtained, and the curves of vowel resonance given in Fig. 36, Chapter XLII, were derived from an analysis of such sound records.

It may be asked to what extent we are certain that the records so obtained truly represent the form of the original sound waves. Scientific measurements, in order to be unassailable, must

be checked in order that assurance may be felt that the theory upon which they are based is true and has been correctly applied. In this case a most satisfactory proof is available, since the recorded waves can be converted back into sound waves and these compared with the original sounds. The process of recording sounds and subsequently reproducing them from the record has, in fact, been employed for many years in the phonograph. The most recent and best methods of phonograph recording employ a system which is substantially the same as that just described. The speech or music to be recorded is picked up by microphones and the resulting electrical vibrations, after being amplified, are made to operate an electrical recording instrument. In the commercial phonograph industry the recorder, instead of being an oscillograph producing a record on a photographic film, is an electromagnetic device which engraves, by means of a sharp sapphire point, a fine groove on a revolving wax disc. As the point vibrates from side to side, following the electrical vibrations, the groove forms a sinuous track, which, upon examination with a magnifying glass, is seen to resemble the wave curve produced on the photographic film by means of the oscillograph. As the wax disc revolves the recorder is caused to move slowly and steadily across its surface, so that the groove is cut in a spiral, gradually covering the surface of the wax with its sinuous track.

Upon the grooved surface of the wax disc is then deposited, by electroplating, a copper sheet which, when removed from the wax, has embossed upon it a raised spiral corresponding to the groove.

From this metal plate the commercial phonograph 'record' can now be made. The material of which records are formed is hard and brittle when at ordinary temperatures but becomes softer and more yielding when heated. The metal plate is placed in a press with a slab of the heated record material. When the pressure is applied, the impression formed on the slab of record material is a copy of the face of the original wax disc; that is to say the finished record carries a sinuous groove representing the form of the original sound waves.

The sound may now be reproduced by employing a system which is, to all intents and purposes, the reverse of the system used in recording it. An electrical 'reproducer', consisting of an electromagnetic device similar in principle to the 'recorder', carries a needle which is placed in the beginning of the groove of

the record. As the latter revolves the needle vibrates to and fro, following the sinuosities of the groove, and induces feeble electrical vibrations in the reproducer. These are passed through a vacuum tube amplifier and conducted to a sound projector or loud speaker, which is another electromagnetic device carrying a diaphragm of one form or another. The business of the sound projector is to cause the diaphragm to vibrate in conformity with the electrical vibrations and to produce, in the air, sound vibrations. When care has been exercised in the design of all the various elements which make up the recording and reproducing systems, it is found that the final sounds obtained reproduce, with remarkable faithfulness, the original sounds recorded.

This process of recording and reproducing sound may be carried out by the agency of photographic film instead of by the use of wax disc records. In this case a form of oscillograph is used and a photographic sound record made on the film. The reproducing system in this case makes use, in the place of the electromagnetic reproducer, of a photoelectric cell, a device which develops electrical vibrations under the action of light. A beam of light is passed through the photographic film to the photoelectric cell, and as the intensity of the light is varied by means of the sound record on the film, the photoelectric cell produces electrical vibrations corresponding to the recorded sounds. These electrical vibrations are passed, as before, through amplifiers to an electromagnetic sound projector.

Both of these methods of sound recording and reproducing are now being applied commercially to the production of motion pictures accompanied by sound: the so-called "talking movies."

One of the contributions to musical art made by the scientific study of sound which is of particular interest to singers, is the advance which has taken place in the understanding of the acoustics of buildings. It is the common experience of speakers and singers that some halls have good acoustics and are easy to sing or speak in, while others are very trying to the performer, and to the audience. This is due to the fact that the sounds produced by the performer reach the members of the audience not only by the direct path from the performer's mouth, but also by reflection from the ceiling and walls of the building. The effects produced may be of several kinds. If the hall be a large one, reflection from distant surfaces of the building may produce echoes. Even if the hall is not sufficiently large for distinct echoes to be heard, each sound, after it leaves the per-

former's mouth, will be reflected back and forth between the walls and other bounding surfaces of the hall and will, therefore, persist for a certain length of time. At each reflection the sound will lose some of its power, on account of the absorbent properties of the surfaces with which it comes into contact, until finally it dies down to a point where it is inaudible. In a hall with extensive walls of hard material, this persistence of the sound may last for several seconds, so that each sound issuing from the singer or speaker is mixed up with the 'overhang' from the sound before, and the result is a confusion which makes it difficult for the audience to understand the words of the performer. If the sound strikes against surfaces which are highly absorbent, such as carpets and heavy draperies, a greater proportion will be absorbed at each reflection and the sound will die out much more rapidly. The clothes of the audience itself are highly absorbent, for which reason a hall which is very reverberant when empty, may have good acoustics when full of people.

Very frequently a hall, if it be decorated with heavy carpets and much heavy draping and upholstery, will have practically no reverberation, in which case a singer will suffer a feeling of oppression and may tend to force his voice, while musical instruments played in such a hall will sound 'lifeless'. There is an optimum condition of reverberation in a hall of any particular size, and this can usually be secured by adjusting the amount of absorbent material used in the decorations and placing it in suitable parts of the hall.

Many other examples could be given to show how the intelligent application of scientific principles may be made to serve the ends of art. Section I of this book is a very striking example of the application of such principles to a subject which has hitherto been neglected by scientists.

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THE SCIENCE OF VOICE

APPENDIX ONE



Illustration 1
HIGHLY DAMPED STUDIO
FOR VOICE TESTS

CHAPTER I

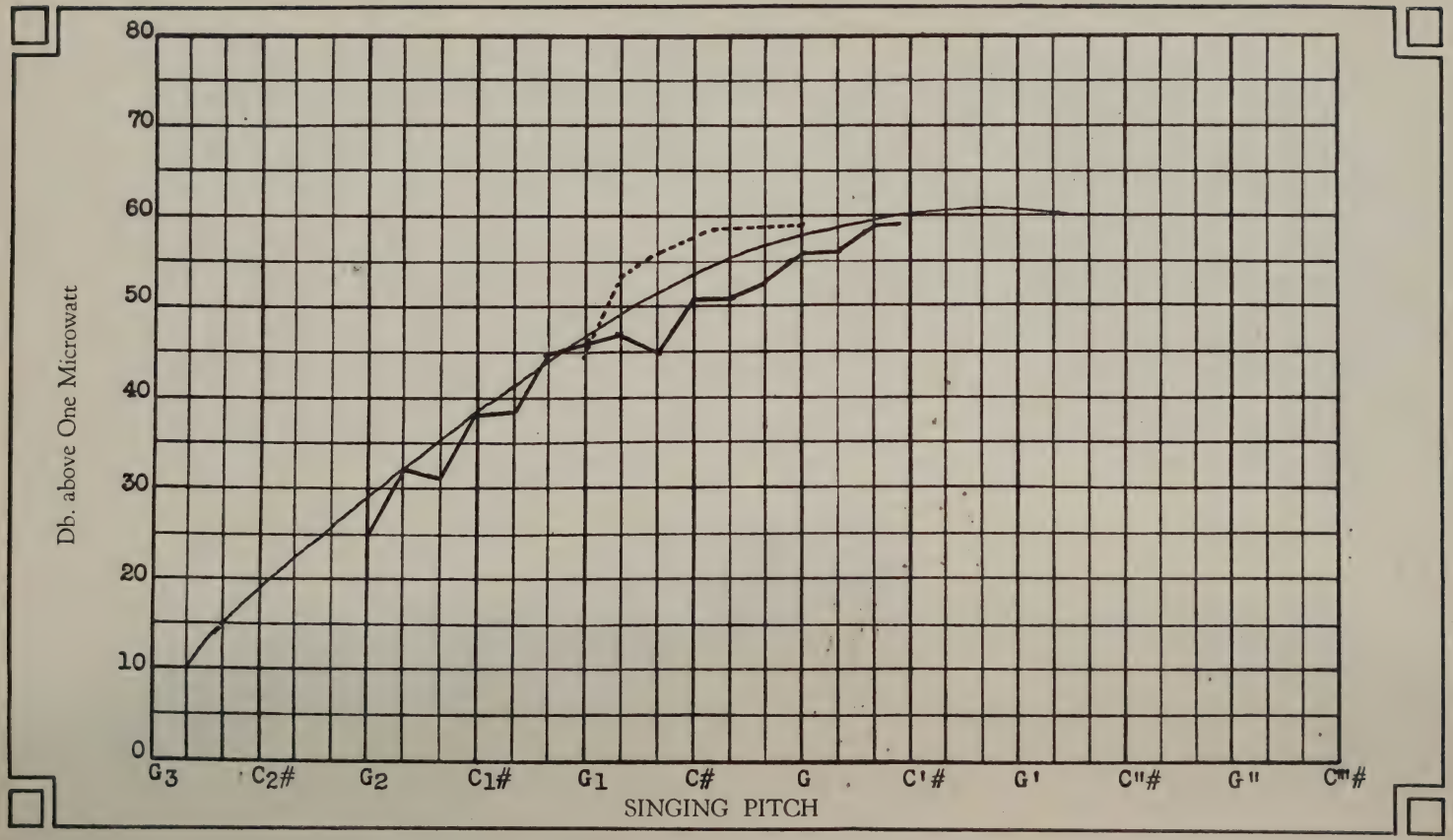
In the year 1931, a group of scientists and engineers from Electrical Research Products, Inc. (the branch of the American Telephone and Telegraph Company which deals with all matters pertaining to the moving picture industry) approached me with a view to my carrying on my researches on voice in the laboratories of this institution and devising scientific tests for singers.

I accepted their offer with great pleasure, since I was now able to continue my investigations with the aid of many invaluable "tools" designed by the engineers of the Bell Telephone Laboratories.

I started the research in November, 1931, and continued until May, 1935. Some of the results of this work were published in the paper reproduced in Appendix Two, with the permission of the editor of the Journal of the Acoustical Society of America.

We first designed a highly damped studio. (See Illustration 1.). It was essential for all tests to be made in such a studio, since readings of intensity, quality, vibrato or tremolo taken in a "live" place are without value.

Our equipment included a Western Electric oscillograph which we used for some preliminary readings but afterwards abandoned, since the work entailed in analyzing tracings in sufficient number to be able to obtain any information of value, would have been colossal. Hundreds or even thousands of tones would have had to have been recorded, and from about fifteen to four hundred sound waves analyzed for each tone. It takes a man nearly a day to make an analysis of one wave! Fortunately other means of sound analysis were available. While I was doing this work, an Acoustic Spectrometer was designed and built in the Bell Telephone Laboratories (see Illustration 2). This instrument gave a qualitative and, in some degree, a quantitative reading of the sound spectrum. (A tone consists of a fundamental and a series of overtones in varying proportions to one another. The distribution of energy in the tones between the fundamental and its overtones constitutes the sound spectrum.)



Cut 1

PITCH-INTENSITY CURVE OF LAURITZ MELCHOIR

Perhaps the most useful tool with which we had to work was the High Speed Level Recorder (see Illustration 3). This instrument traces, on a piece of moving paper, every slight change in intensity at high speed and with great accuracy. In connection with this instrument we also used the Crystal Analyzer (see Illustration 4) which, by means of a moving pair of band-pass filters, gives an accurate quantitative reading of the sound spectrum. Despite the fact that the tone had to be sustained for from six to ten seconds, which was hard for some of the singers, we were able to obtain valuable data.

In the paper reprinted in Appendix Two, we show that, by means of pitch-intensity readings, we were able to give a reliable analysis of the singer's technic and of his progress under training.

After we had published this paper, we took tests of two of the leading tenors of the Metropolitan Opera Company—Giovanni Martinelli and Lauritz Melchior (see Cut 1). It was interesting to note that they both gave curves similar to the form indicated as desirable by our findings. In fact, Melchior's reading was very near the reference curve for about two-thirds of his voice. This provided an interesting check-back on our results. The small section of a curve, dotted in (see Cut 1), indicates the intensities of tones sung in the climax of a dramatic aria ("Lohengrin's Narrative"). It is interesting to note that Mr. Melchior produced fuller tones here than he did when singing single tones at full voice. The explanation for this lies in the fact that the emotional urge engendered in the interpretation of this passage freed up his voice and made him actually produce more efficient and better tones. The artist is apt to "do" more when he performs than when he vocalizes. The student seldom exceeds his technical efficiency. I might suggest that this type of test could be used as the basis for a worth-while psychological test of the artist's dramatic and musical ability.

One result of interest brought out in this investigation was to show that the maximum loudness obtainable from any well-produced voice varies but little from that of any other voice. Light, high voices show a few very high tones as loud as the loudest produced by more powerful ones which do not reach such high pitches. The better voices, and the more powerful ones, show high intensity readings over a wider range. The most powerful tone measured was sung by a coloratura soprano at G above high C. Melchior's high A was the next most

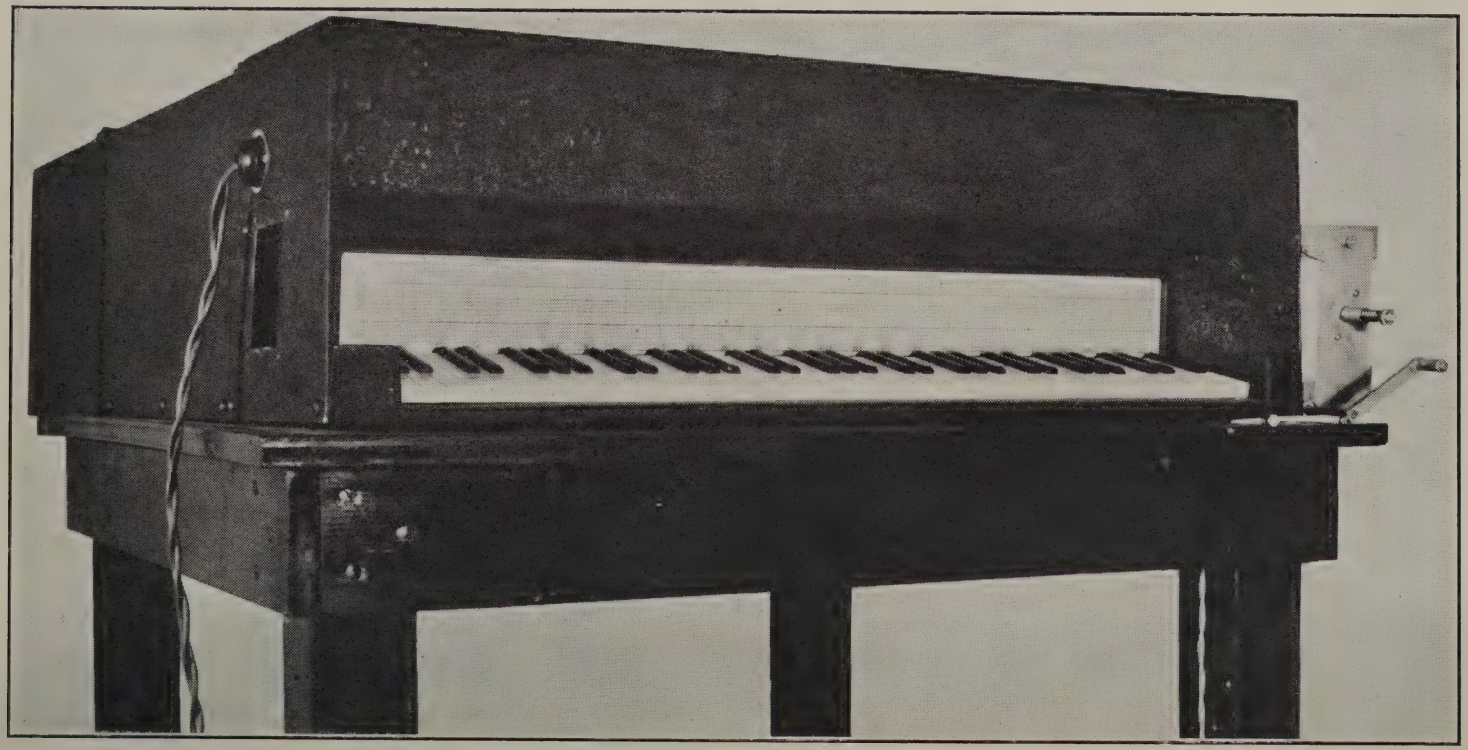


Illustration 2

ACOUSTIC SPECTROMETER

powerful, although one student gave nearly as high a reading. However, the superiority of Melchior's voice was indicated by the fact that he was able to produce powerful tones over a far wider range than was the student. With reference to this student, it is most interesting to note that he started with a very light, thin voice, and between two tests, taken nine months apart, had increased the intensity through the middle of his voice nearly a thousand-fold, and through the upper range, more than a hundred-fold.

The vital importance of the lower register in women's voices was clearly indicated, since those singers who used the falsetto only, were able to produce a few loud, high tones and then "faded out" through the middle and lower ranges of their voices. A properly trained coloratura soprano showed considerably more power through the middle of her voice than did an operatic contralto who sang falsetto only. Furthermore, a smooth curve, with a steady rise in intensity as the pitch rises, was obtained only when both registers were used.

The Decibel (d.b.) is a unit used in the measurement of the loudness of sound. A change of ten d.b. represents a power ratio of ten to one; an increase of twenty d.b., one hundred to one; thirty d.b., one thousand to one etc. An increase of nine d.b. doubles the apparent loudness, as heard by the listener, and an increase of eighteen d.b. doubles it again etc. Thus a singer whose voice is thirty d.b. louder than that of another singer will balance with a thousand such singers. This is why a singer with a full, free voice can top the orchestra and chorus in an opera. Our tests showed that the voice of a typical radio singer is down over twenty d.b. below the reference curve. Therefore it would take at least a hundred such voices to balance with one legitimate singer. As a result of these intensity readings, we found that a properly-produced voice rises evenly and slowly in intensity as the pitch rises. In other words, an "even" scale is one in which the intensity rises steadily as the pitch rises, and shows about ten to fifteen d.b. increase in loudness for an octave. Thus the intensity range throughout the range of the voice is about forty to fifty d.b. All tones were sung full voice and as free as possible. The loudest tone which can be produced is from ten- to a hundred-thousand times louder than the softest. However, vocal music, except in a few rare instances, is written to cover a range of two octaves at the most. Thus the actual intensity range utilized is only from twenty to thirty d.b. This

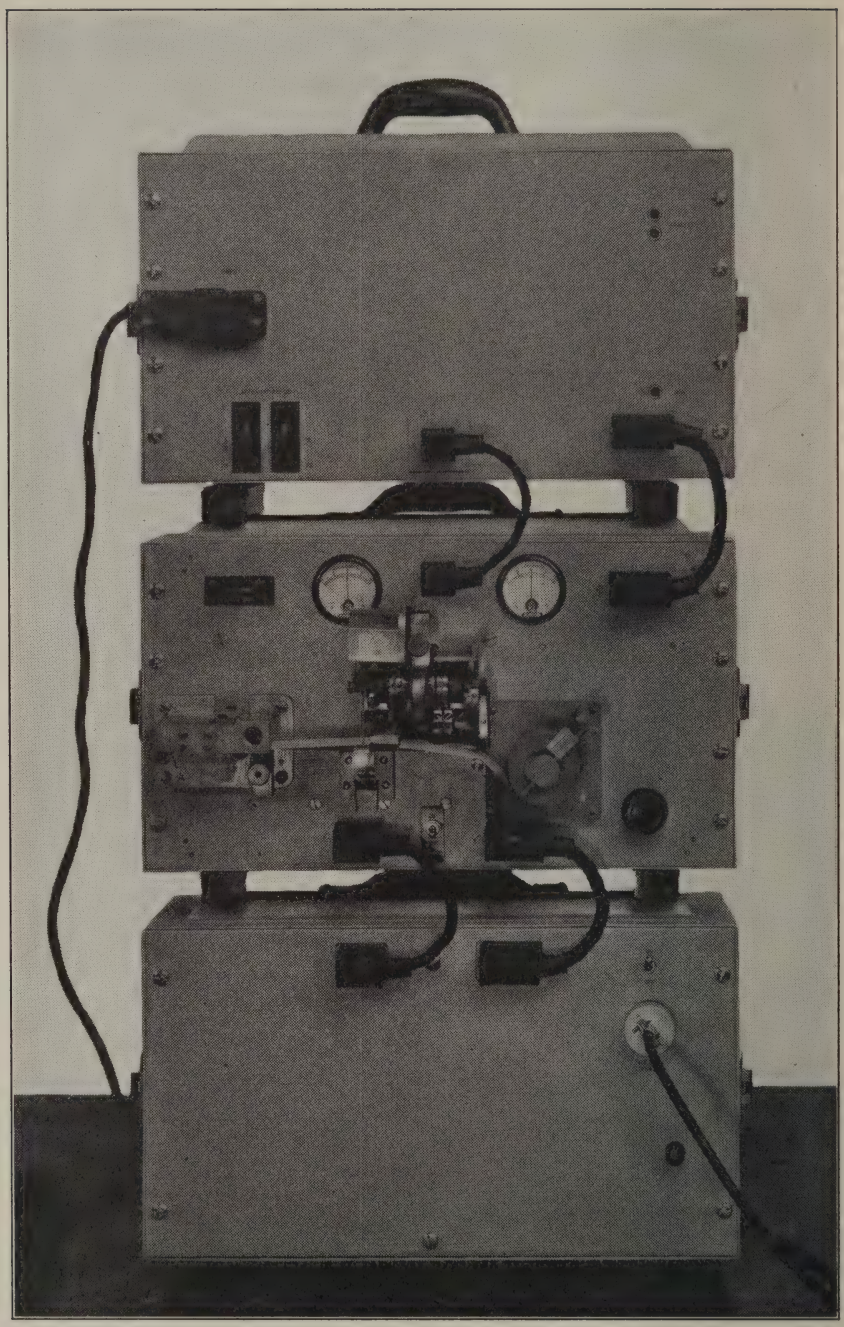


Illustration 3

HIGH SPEED LEVEL RECORDER

is within the broadcasting range. The woman who uses no lower register has a few loud high tones and then drops very rapidly through the middle of her voice. For this reason her intensity range over the two octaves may be as much as fifty d.b. This means that her voice cannot be recorded or broadcast without considerable difficulty, since her relatively loud high tones must be monitored. The crooner who never produces a loud tone never has to be monitored. Therefore, in broadcasting and recording, only a singer with a well-produced voice, or a crooner who doesn't really sing at all, can be handled easily.

Perhaps our most startling finding occurred when we investigated sound spectra. We examined thousands of spectrograms from at least two hundred voices of all calibres and classified them in every possible way. No order appeared. One day a young man whose voice had been very badly trained came in for the test. His voice was white, shrill, throaty and nasal—it was, in fact, one of the most unpleasant voices I have ever heard. His spectrum on the high G was almost exactly similar to that of a tenor whose quality was very beautiful, especially in this range of his voice. Again, we obtained two exactly similar spectrograms from a bass and a tenor on middle C. And then another angle of the question occurred to me: A Caruso record sounds grand. The voice sounds infinitely more beautiful than anything that we ever hear today, but, the old recordings cut down the frequency range so that instead of reproducing from fifteen to fifteen thousand cycles, they only reproduced from two hundred and fifty to twenty-five hundred cycles. Furthermore, the quality of reproduction was very poor, since the reproducing system peaked at various frequencies and considerably distorted the spectrum. The deduction was obvious—the spectrum does not determine whether the voice sounds pleasant or unpleasant. There are, in fact, two sorts of quality:-

(a) The spectrum.
(b) The characteristics of the sound which make it pleasant or unpleasant to the ear.

What we found was that the spectrum merely determined the vowel and the vowel color. The fundamental is strong if it happens to fall in one of the vowel bands—otherwise it is weak. A strong fundamental has nothing to do with pleasant quality, any more than does a predominance of harmonics in any particular band of the spectrum. What is it then that determines what

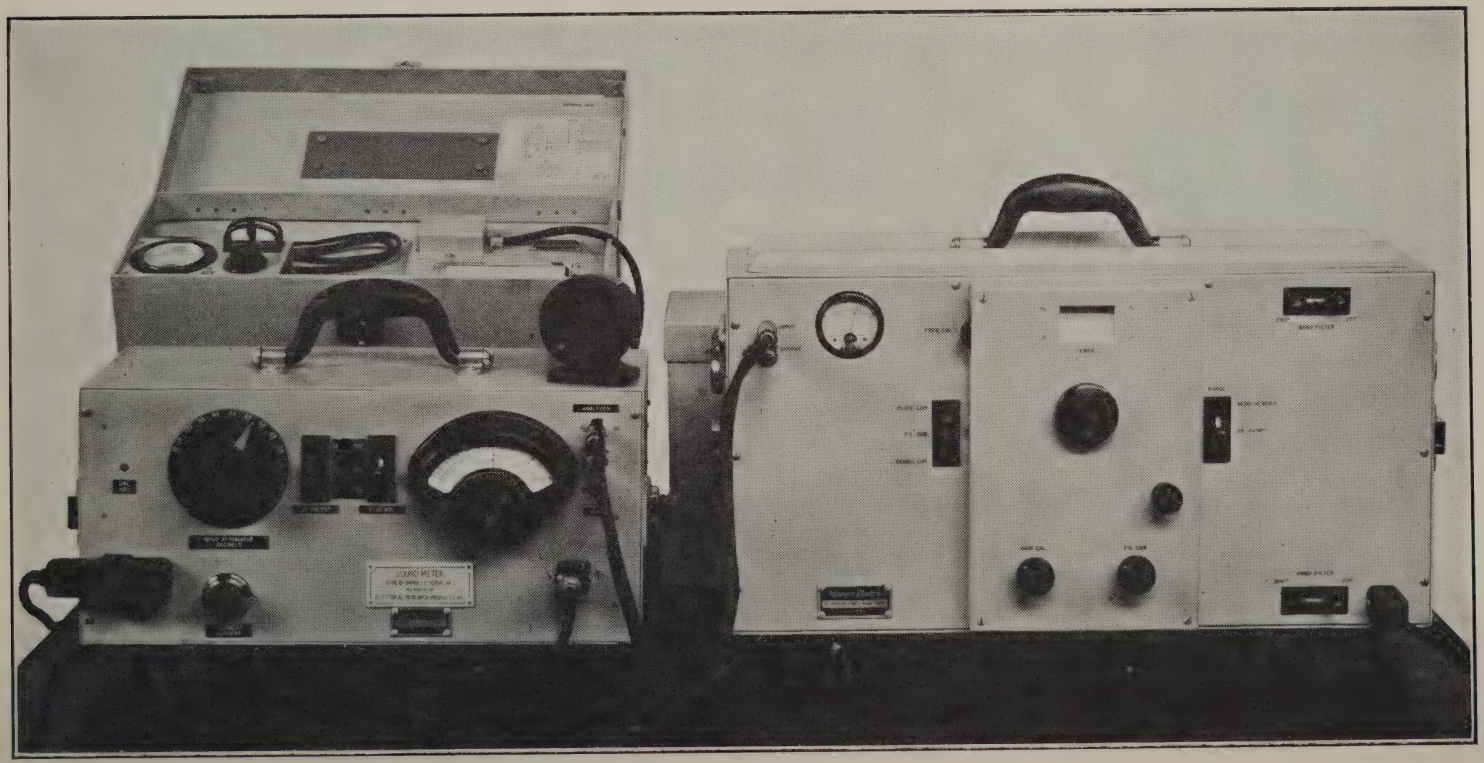


Illustration 4

CRYSTAL ANALYZER

we hear as a pleasant or unpleasant voice? The answer, although complex, is not far to seek: It lies, not in the form of a single wave, but in the changes of pitch, loudness and spectrum in time: i.e. in the nature of the vibrato or tremolo movement. Thus, while the tone is being sustained, the pitch, intensity and spectrum are fluctuating. Good or bad quality, from the listener's standpoint, depends upon the nature of these fluctuations.

We showed the following characteristics to be of paramount importance in determining good quality:

(a) An even fluctuation of pitch.
(b) An even fluctuation of intensity.
(c) A fluctuation of not less than five and not more than six and a half a second, ideally of six.
(d) A centering of the middle pitch of the vibrato with the pitch being sung. If this middle pitch wavers, the quality is unpleasant.
(e) A sufficient, but not excessive, pitch fluctuation for the loudness of the tone being sung.

The pitch fluctuation at normal intensity should be a semi-tone; at pianissimo it is slight, and at fortissimo it may be as much as a whole tone.

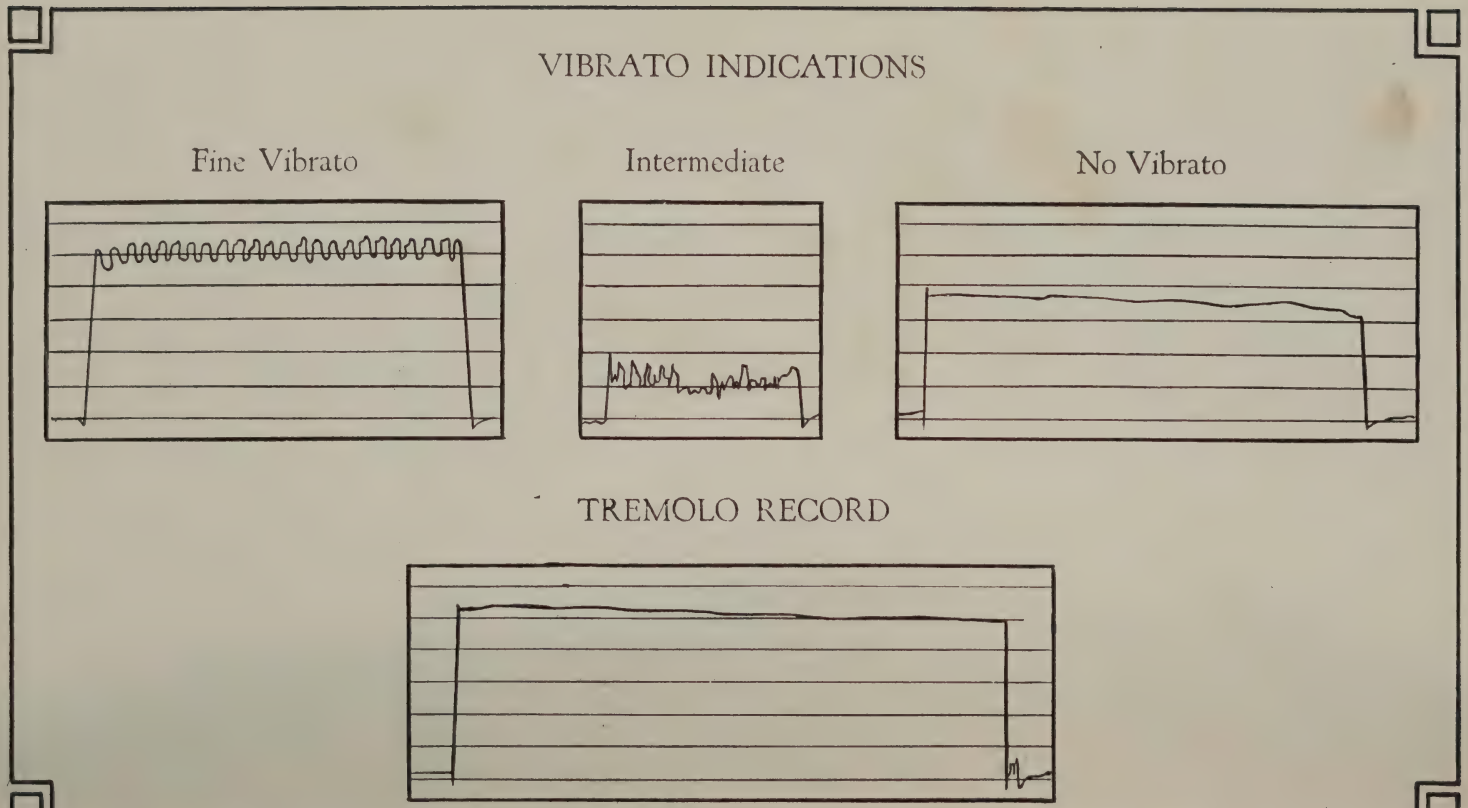
(f) A sufficient, but not excessive, intensity fluctuation for the loudness of the tone being sung.

This fluctuation should go from zero at pianissimo to as much as ten d.b. at fortissimo. The ideal fluctuation at mezzo forte is from three to five d.b.

These statements about the vibrato movement are the best which can be obtained from the singers of today. At the present time, unfortunately, there are no really great singers such as Caruso, Destinn or Sammarco. Readings taken from records made in a reverberant studio are of limited value.

I have, however, taken readings from the best recorded tones of some of the great singers, and the vibrato frequency and pitch fluctuations seem to be as indicated. Any reading of intensity fluctuation taken from records is valueless.

There are still two other factors to be investigated, but they demand the development of an instrument which will follow pitch changes as the level recorder follows intensity changes. Such an investigation could be carried out through the analyses



Cut 2

VIBRATO AND TREMOLO RECORDS

of oscillograms, but this, as I have already pointed out, would entail a terrific amount of work. The first of these factors entails an investigation of the manner in which the pitch is changing during the vibrato cycle, and the second an investigation of the spectrum changes in the vibrato cycle.

The true vibrato consists of an "on" and "off" impulse applied to all the muscles used in the act of phonation, i.e., the muscles of the thorax (inspiratory and expiratory), the muscles of the larynx and the opening muscles of the laryngeal pharynx. The vibrato can only occur when the opening muscles of the laryngeal pharynx are at all times in tension.

The absolute tremolo does not involve the muscles of the thorax—it is actuated by a tetanic flutter of the constrictor muscles of the laryngeal pharynx, which may, in bad cases, be communicated to the tongue and jaw. The constrictor muscles of the throat are at all times in tension.

Between the absolute vibrato and the absolute tremolo, we find the "vibrato-tremolo" and the "tremolo-vibrato", in which cases the walls of the pharynx are fluttering between opening and constrictor tension, with the balance of tension on the opening side in the former case, and on the constrictor side in the latter.

The absolute vibrato cannot be slower than five a second or faster than six and a half. The absolute tremolo can be very fast. Fluctuations up to eleven a second have been recorded.

There is a definite intensity fluctuation with the vibrato and none with the absolute tremolo (see Cut 2). However, a violent vibrato-tremolo or tremolo-vibrato may slow down to the vibrato frequency, or even considerably below it. A slow, unpleasant wabble is then heard as the result of the violent fluttering of the walls of the laryngeal pharynx. This produces an intensity change, and sometimes an extremely wide one. For this reason our level recorder readings do not always distinguish between the vibrato and the vibrato-tremolo or tremolo-vibrato. They do indicate the absolute tremolo (see Cut 2).

The relatively slight movement of the throat, in opening tension, which occurs with the true vibrato, must produce far smaller changes in the spectrum than would a violent fluttering of its walls between the constrictor and opening tension which occurs for the tremolo-vibrato and the vibrato-tremolo. It is probable that the unpleasant quality of these violent movements, and the sense of ill-defined pitch which they produce, are pri-

marily due to excessive changes in the spectrum during their cycle.

To sum up, then, there are two sorts of quality: Spectrum (or vowel) and pleasant or unpleasant quality, determined by the changes in time.

While all that I have said in my previous writings with regard to registration has been most emphatically borne out by further experience and investigation, I have never been completely satisfied with the muscular theory which was presented in both my books.

There is still no entirely reliable method of examining the co-ordinate action of muscles in tension for a given act. Any muscular theory must therefore remain merely a theory. However, consideration of the action of each muscle separately and of what happens when certain pairs or groups of muscles tense in coordination, in conjunction with a general knowledge of the technic of the particular activity under investigation, can produce fruitful results.

Books on vocal technic are unreliable and, as a general rule, merely attempt to prove a more or less silly theory based upon some acoustically unsound notion.

We have already progressed a long way in the working out of the muscular theory of registration, although there still remains much to be done in order to absolutely prove this theory scientifically.

The following ideas are therefore presented as a theory, but I feel that they give an extremely satisfactory picture of how the laryngeal muscles function in the act of phonation.

The vital principle to be observed, when considering the function of the voice producing organs, is that the act of phonation always involves a question of "holding" and not of movement. When this angle of the subject is kept in mind, many obscure problems become clear. "Holding" involves tension on two groups of antagonistic muscles; movement, necessitates the relaxation of one of the groups. This question of "holding" is dealt with at length in the subsequent pages, and it remains the key note of this discussion.

In what follows, I will endeavor to keep my terminology as simple and uninvolved as possible.

The vocal cords are brought together, tensed and held in tension by means of the following muscles:

(1) The arytenoideus muscle (See figs. 1 and 2, pp.

7 and 8.). This muscle, when contracted, draws the arytenoid cartilages (See fig. 4, p. 19.) together and closes the glottis.

(2) The posterior crico-arytenoid muscles (See figs. 1 and 2, pp. 7 and 8.). These muscles, when contracted, draw the arytenoid cartilages backwards and inwards.

(3) The lateral crico-arytenoid muscles (See fig. 2, p. 8.). These muscles, when contracted, draw the artenoid cartilages forwards and downwards.

The posterior and lateral crico-arytenoid muscles act in antagonism, and, in coordination, hold the arytenoid cartilages firmly to the cricoid cartilage.

(4) The thyro-arytenoid muscles (See fig. 2, p. 8.). These muscles lie in the vocal cords themselves and their fibers lie in diverse directions. They therefore serve a double purpose: Firstly they are antagonistic to the crico-thyroid muscles, in as much as they act to relax the vocal cords; secondly, they serve to modify the elasticity and consistency of the vocal cords themselves, thereby regulating the area which is in vibration. In other words, either the edges of the vocal cords, or their entire surfaces may vibrate according to the degree of tension on these muscle fibers.

(5) The crico-thyroid muscles (See fig. 5, p. 20.). These muscles draw together the cricoid and thyroid cartilages (See fig. 5, p. 20.) thereby stretching the vocal cords.

When the thyro-arytenoid and crico-thyroid muscles act in coordination, they hold the thyroid cartilage firmly in position and maintain the vocal cords at constant tension, provided that the arytenoid cartilages do not give.

It will then be seen that the entire structure of the larynx is held firm by means of four groups of muscles, i.e., the posterior and lateral crico-arytenoid muscles which, acting in coordination, hold the arytenoid cartilages firmly to the cricoid cartilage; and the crico-thyroid and thyro-arytenoid muscles which, acting in coordination, hold the thyroid cartilage firmly in constant position with regard to the cricoid and the arytenoid cartilages.

A distinction must be made between the muscular action which holds the vocal cords in tension for the pitch, and the increasing muscular tension which holds this tension against the breath pressure (i.e. under load) for an increasing intensity. This is the function of the registration action.

For the higher pitches the vocal cords are held in greater tension than for the lower, while at the lower pitches they vibrate at a wider amplitude than at the higher. It will then be seen that, as the pitch rises, the holding firm of the arytenoid cartilages becomes more and more important, since the increasing tension on the vocal cords will tend more and more to make them give. This means that the action of the posterior and lateral crico-arytenoid muscles becomes increasingly important as the pitch rises—i.e., the falsetto action becomes increasingly prominent.

Inversely, as the pitch drops, the holding firm of the thyroid cartilage with regard to the cricoid (the crico-thyroid, thyro-arytenoid action) must become more and more important in order that the tension on the cords may be maintained constant for an increasing amplitude of vibration—i.e., the lower register action becomes increasingly prominent.

At the moment of attack, all the laryngeal muscles come into tension in order to stretch the vocal cords to the necessary length and tension for the pitch. Considering a crescendo from pianissimo to fortissimo, the tension on the cords is held against the increase in breath pressure, and the increase in amplitude of their vibration, by means of added tension on the muscles which hold the tension. The additional "hold" is first taken up by the arytenoid muscles (posterior and lateral crico-arytenoid muscles) and at a certain point of tension, beyond which these muscles cannot go, the added tension is taken up by the thyroid muscles (crico-thyroid and thyro-arytenoid muscles). As long as the added tension is being taken up by the arytenoid muscles, the singer is using the falsetto register and as soon as the thyroid muscles start to take up the added tension, the singer is using the lower register.

The fact that high speed moving pictures of the vocal cords in action show that only the edges of the cords vibrate for the falsetto and that the entire cord vibrates for the lower register, seems to prove this contention. The edges of the cords alone could not vibrate if the thyro-arytenoid muscles were to be in tension and the entire cord must vibrate when they are in a high

degree of tension. This proves that the thyroid muscles take on the additional tension for the lower register.

Since the pitch would waver and be uncertain if the arytenoid cartilages were to give; and since the arytenoid muscles (posterior and lateral crico-arytenoids acting together) hold the arytenoid cartilages firmly to the cricoid; and also since it is the falsetto action which gives to the voice a pleasant quality and a well defined pitch, the action of these muscles for the falsetto register is also indicated.

Inasmuch as the crico-arytenoid muscles predominate for the falsetto, and their action becomes more prominent as the pitch rises, the falsetto should become fuller and louder as the pitch rises, provided that these muscles are developed. This is borne out in practice and is in accord with the muscular theory I have previously propounded. The inverse also seems to be true with regard to the lower register, which becomes more promient—but not louder—as the scale is descended.

In view of the fact that the crico-thyroid and the thyro-arytenoid muscles are relatively very powerful, there is virtually no limit to their increase in tension, within the limitations of the particular vocal apparatus, provided that they are fully developed. Hence the lower register can be swelled to fortissimo without straining the laryngeal muscles.

It is apparent that, where the crico-arytenoid muscles are weak, the arytenoid cartilages must give, and legitimate high tones cannot be produced. There will then either be a gap, or break, between the registers, since the degree of tension at which the lower register action (increase of crico-thyroid, thyro-arytenoid tension) should occur, cannot be reached; or mixed registration may occur. In this case, the crico-thyroid, thyro-arytenoid muscles will start to take on added tension at too low an intensity —i.e., before the tension on the posterior and lateral crico-arytenoid muscles, which is necessary in order to hold the arytenoid cartilages firmly to the cricoid, has been reached.

This condition of instability of the arytenoid cartilages allows the tension on the vocal cords to fluctuate and produces a tone of uncertain and wavering pitch which is characteristic of mixed registration.

The fact that "giving", or pulling forward, of the arytenoid cartilages accompanies mixed registration is clearly indicated in practice, since whenever this phenomenon occurs the larynx can be seen to tilt and a dent appears just underneath the thyroid

cartilage. This dent must be caused by the "giving" of the arytenoid cartilages when the muscles which should hold them firmly to the cricoid cartilage are not sufficiently developed to perform this function against the crico-thyroid pull. Such an unbalanced pull must have the effect of allowing the thyroid cartilage to rotate forward and of forcing the cricoid cartilage to rotate backward—hence the dent.

Nevertheless this question of mixed registration is further complicated by the fact that it is always accompanied by a high degree of throatiness, so that the opening muscles of the laryngeal pharynx, in particular the tongue muscles, are also involved. Thus the suspension of the larynx, which is attached to the tongue through the hyoid bone, seems to be involved in the laryngeal action.

The explanation for the break between the registers when the laryngeal muscles are undeveloped is simple. The arytenoid muscles will only hold up to a certain point of tension and there is a gap between this point and the point at which the thyroid tension should augment. At this point, then, the arytenoid cartilages will suddenly give and a break, or crack, will occur.

Whenever mixed registration occurs there is a lack of development of both sets of muscles. As soon as the registers have been separated, it is found that they are both weak and undeveloped. Both the mixed falsetto and the mixed lower register resolve into a weak lower register and a very weak falsetto. It would, therefore, seem that, in both cases, the arytenoid cartilages "give". The precise difference between mixed falsetto and mixed lower register is difficult to define. Perhaps in the former case the posterior and lateral crico-arytenoid muscles are very weak, while, in the latter case, the thyro-arytenoid muscles are also very weak.

Practically every pupil starts with some degree of mixed registration. In the case of the male voice the falsetto muscles are undeveloped and the lower register is more or less mixed. In the case of the female voice, the lower register muscles are usually undeveloped and the falsetto register is therefore mixed. In both cases, then, we find a condition of mixed registration. This results in a "giving" of the arytenoid cartilages. If pressure is applied to the laryngeal muscles after these cartilages have "given" the effect is only to injure and not to develop the voice.

As soon as pure registration has been established, the weak falsetto muscles can be carefully developed, provided that the register is always kept pure, and they are not overloaded.

Since the lower tones in the lower register do not demand very much strength in the arytenoid muscles, they can be sung vigorously in the pure register with beneficial results.

In working with both registers it is, of course, essential that throatiness should be reduced and the opening tension of the tongue muscles brought into action. The base of the tongue must be drawn down (thus dropping the larynx), and away from the posterior wall of the laryngeal pharynx, while the muscles which attach to the hyoid bone from the palate, chin and neck, together with the intrinsic constrictor muscles of the laryngeal pharynx, must be relaxed.

The reader must bear in mind the following facts:

a. There are two distinct and separate registers in every human voice, even when they are obscured by perfect coordination or mixed registration.

b. Except where perfect coordination occurs, both registers are relatively weak in a greater or less degree.

c. Except in cases of extreme abuse of the vocal organs the registers can always be isolated and purified.

d. The purified registers can always be developed.

e. Purified, fully developed registers coordinate without any difficulty whatever.

f. Mixed registration is always accompanied by a high degree of throatiness, while undeveloped registration is generally accompanied by some degree of throatiness.

g. The quality is always impaired when the registration is faulty.

h. The intensity is always reduced by faulty registration, and where the registration is very faulty, to an enormous extent.

The fact that the training of the voice depends primarily upon the registration action is then apparent, and the muscular theory I have presented bears out this fact and provides a muscular explanation for the importance of this phase of the work.

CHAPTER II

I have said a great deal in this book about breathing and the "breath-control" fallacy. I would now like to present this subject from a somewhat different standpoint. Whenever we perform any physical action, we bring into tension diverse groups of muscles in coordination. These muscles come into tension because of a memory-picture in the brain. When a coordinate act has been performed a large number of times, it becomes reflex or unconscious. If, then, one group of muscles, which is used for a certain act in coordination with other groups, tenses, these other groups also tense, since they coordinate automatically. The "breathing-act" constitutes two phases, inspiration and expiration. During the act of inspiration, the inspiratory muscles tense, the expiratory muscles relax and the glottis (the slit between the vocal cords), which must be closed for the act of phonation, opens. Inversely, for the act of expiration, the expiratory muscles tense, the inspiratory muscles relax and the glottis opens. If the glottis did not open during the acts of inspiration and expiration, the individual would suffocate, since the breath could not be drawn in and out. Since one has performed the breathing act millions of times, the opening of the glottis always coordinates with the muscles of the thorax when they are tensed for the breathing act. THE ACT OF PHONATION IS NOT THE ACT OF RESPIRATION, SINCE THE GLOTTIS MUST BE CLOSED FOR THE FORMER AND OPEN FOR THE LATTER.

There are four combinations which may occur with the breathing muscles:

(a) The inspiratory muscles may tense while the expiratory are relaxed.

(b) The expiratory muscles may tense while the inspiratory are relaxed.

(c) Both inspiratory and expiratory muscles may relax.

(d) Both inspiratory and expiratory muscles may tense.

The first two cases cannot occur for the act of phonation, because, under these circumstances, they are being tensed in the coordination used for the breathing act, and the glottis therefore opens. The third condition cannot occur, because work is being done during the act of phonation, and relaxed muscles cannot do work. The fourth condition must then prevail. For the act of phonation, both inspiratory and expiratory muscles must be tensed, which tension must be maintained at all times, since if at any time either group of muscles is relaxed, the act of respiration is initiated, the glottis opens and the act of phonation destroyed.

Nevertheless, sound can be produced on an expiratory blast. This method of sound production is known as "crooning" when performed softly, or "throaty" singing when performed loudly.

For the legitimate act of phonation, both inspiratory and expiratory groups of muscles are in tension and build up the breath pressure against the closure of the glottis*. The larynx is dropped. The throat is in opening tension and shaped for the resonation of the vowel. The mouth and jaw are out of action. In order that the larynx may be dropped, the base of the tongue, to which the larynx is attached through the hyoid bone, must be depressed (This can never occur when the tongue is grooved and pressed against the lower teeth.).

Now let us see what happens when the act of expiration is initiated: i.e., when the inspiratory muscles are relaxed and a stream of air is blown out. Under these conditions the glottis is open and it would seem impossible for the individual to produce sound. Nevertheless it is a very simple matter for him to do so. All that has to occur is for the larynx to be drawn up into the throat and for the base of the tongue and the walls of the laryngeal pharynx to constrict on it, thereby squeezing the vocal cords into approximation. Under these circumstances, the throat closes the glottis and becomes a sort of breath valve. It cannot then perform its proper function as a resonator, which function is taken up by the oral cavity (mouth).

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* It is important to mention here that the closure of the glottis is a function of the laryngeal muscles, and is therefore dependent upon registration. It is impossible for any singer who has not gone through a process of training involving the isolation, separate development and proper coordination of the registers to produce anything other than a throaty tone, unless his voice was naturally properly produced at the start—a most unlikely contingency.

This method of producing sound alters the function of practically all the muscles used in the act of phonation, so that —not to draw too fine a point—the throaty singer is really not singing at all. Throaty singing is harmful, since the squeezing of the larynx cannot fail, sooner or later, to injure the delicate laryngeal muscles and the vocal cords themselves. "Breath-control" implies the deliberate blowing of a "controlled" stream of air. The exponent of "breath-control" is performing the breathing act and always produces absolutely throaty tones.

To sum up in tabular form:

	CORRECT TECHNIC	INCORRECT TECHNIC
BREATHING MUSCLES	Inspiratory muscles tense.	Inspiratory muscles relax.
	Expiratory muscles tense.	Expiratory muscles tense.
	Breathing act ceases, and breath pressure built up against glotteal closure.	Act of expiration initiated.
	Vibrato action—breathing muscles involved.	Tremolo action — breathing muscles not involved.
LARYNX	Dropped.	Raised.
GLOTTIS	Closed by intrinsic laryngeal muscles.	Closed by constriction of the throat.
LARYNGEAL PHARYNX (throat)	Held open.	Constricted in order to close glottis.
	Shaped for resonation of tone.	Not used as resonator, but as breath valve.
MOUTH	Out of action.	Used as resonator of tone.
JAW	Relaxed.	Tensed.

The vibrato action rests primarily upon the changes in the degrees of tension between the inspiratory and expiratory muscles and, therefore, cannot occur when the expiratory muscles only are in tension. The utter impossibility of a proper coordination of the laryngeal muscles, when an important factor in their function is being performed externally by means of a constriction of the muscles of the throat, is apparent.

The work done in singing is a question of "hold" or "grip". As soon as the inspiratory muscles are relaxed, all effort becomes mere "pushing" or forcing of a breath-blast against a constriction of the throat. The difference between "going after it" or singing vigorously, and pushing or forcing the voice is then apparent.

In the first case, a "grip" or "hold" occurs on both the inspiratory and expiratory muscles. As long as this "hold" persists, it is impossible for the singer to force his voice. The

amount of tension required, depends upon the pitch and loudness of the tone. The tension increases as the pitch rises and as the intensity is increased above or decreased below mezzo forte. In singing a rising musical figure, the singer must gauge the right amount of tension for the first tone, and then ADD the necessary tensions for each subsequent higher tone without releasing the tension between the tones. Much of the skill in singing lies in the proper "timing" of these tensions. The soft tone is produced with a slightly opened glottis and, therefore, the tension required on the breathing muscles, in order to maintain the breath pressure against this opening, must be augmented. This is why more work must be done in order to sing softly than loudly.

In the second case, the breath is forced through a constricted throat. Therefore the throaty singer has to increase the "push" in order to swell the tone. For this reason it is far easier to sing softly than loudly. It is impossible for anyone to sing softly without constriction unless the pharyngeal and laryngeal muscular systems have been completely developed and properly coordinated. Soft singing before this stage has been reached always leads to throatiness. The throaty singer is always forcing his voice, and the louder he sings, the more he forces.

The reader will want to know how it is possible for the singer to bring into action both inspiratory and expiratory groups of muscles for the act of phonation. This is not so very difficult of accomplishment: Before starting to phonate, he must inspire his breath, with the minimum possible tension, by expanding his lower ribs and his diaphragm. Then, at the moment of the attack, he must continue this "out" (inspiratory) gesture and take the tension smoothly, without jerking. As the tone is established, he must hold this tension which must be "timed" to occur at the moment of attack—not too soon and not too late. Since he has attacked the tone on the inspiratory gesture, he has established the necessary inspiratory tension. Under no circumstances may he collapse the ribs or the diaphragm at the moment of the attack or subsequently. This presents some difficulty, since the pupil generally "gives" somewhere until he has become very skillful. The ribs may "give" and he may lean over backwards. The diaphragmatic muscle may "give". He may transfer the tension up into his chest, or down into his abdomen. He may collapse his chest or jerk

his shoulders etc. All such movements must be definitely eliminated. During the act of inspiration, the shoulders and the chest should not be raised.

I want to emphasize here that no form of exercise other than singing is of very much avail. To the best of my belief the breathing muscles are not used in a similar function for any other act. If these muscles are developed in a gymnasium, or by means of breathing exercises, their function in the act of phonation is more apt to be interfered with than helped. The prize fighter, with his tremendous diaphragmatic musculature, has, as a rule, a little, throaty, high-pitched voice because of this unbalanced development. The rib muscles and the diaphragmatic muscle are in a sense antagonistic, since a collapse of the former renders inoperative the tension on the latter, and vice versa.

CHAPTER III

The act of phonation is a single coordinated act involving the coordinate tension of the muscles of the pharynx, larynx and thorax. This coordination cannot be broken up. The separate groups of muscles involved in this act are not subject to conscious control during the act of phonation.

The muscles come into tension because of sound memory-pictures in the brain. It is the will to produce sound which brings the muscles into tension. The conscious tensing of muscles cannot of itself produce sound. In other words, the psychological process cannot be inverted or replaced by a physical process.

In addition to the tension applied to the groups of muscles used in the act of phonation, the pupil tenses other groups of muscles. These muscular tensions, which should not be involved in the act of phonation, come under two headings:

(a) THE BRINGING INTO ACTION OF MUSCLES IN AN UNDESIRABLE FUNCTION—i.e. FOR THE PRODUCTION OF A THROATY TONE. This case is exemplified in the tensing of the muscles of the jaw which occurs when the mouth cavity "sets" for a resonance adjustment.

All directions under this heading for breaking down such muscular tensions are physically difficult of accomplishment. The pupil must be made to force the gesture indicated. Thus, when the jaw "sets" it cannot be dropped down all the way easily. It has "set" for the mouth-vowel position and this "set" is often tremendously strong. Intense concentrated effort is necessary in order to break down such incorrect muscular co-ordinations, which function in the production of throaty tones. Not only are the jaw directions difficult of accomplishment, but so also are the directions with regard to the "giving" of the muscles of the thorax.

Directions with regard to the lips do not require so great a physical effort, but they are by no means easy of accomplishment. The upper, lower, or both lips may be spread or pursed up. A double triangular formation may occur. The corners

of the lips may be drawn down and the lower lip forced out. There are a great many possible combinations which occur in practice. Lip, as well as jaw "sets" must be broken. I have said in this book that the upper not the lower teeth should show. When the tone is properly produced, the lips do not touch the teeth, and the upper teeth are generally showing. However, there is no correct mouth or lip position. The teacher's purpose is to break down any mouth or lip "set". He must observe the mouth positions which occur for throaty tones and then proceed to break them down. Having replaced a wrong "set" with a new one which helps, he must not allow this new position to become "set". The teacher must, therefore, give his directions merely with a view to breaking the mouth "set" and must be at all times on the alert in order to avoid "setting" a new position.

(b) CONDITIONED REFLEXES, OR IN OTHER WORDS, COORDINATION WITH THE ACT OF PHONATION OF GROUPS OF MUSCLES NOT DIRECTLY INVOLVED IN THE ACT.

If two actions are made simultaneously a great many times, the performance of one of these actions will cause the other to occur reflexly. This is what happens when the breathing muscles function for respiration—tension on the inspiratory muscles with relaxation on the expiratory, and vice versa—and the glottis opens reflexly.

In the process of producing sound, the pupil has inevitably engendered many of these conditioned reflexes. An apparently harmless gesture, or even mannerism, may have become coordinated with the production of throaty tones, slurring etc. Such gestures would have no effect whatever upon the singer who had not so coordinated them. Nevertheless, the mere raising of the eyebrows or dilating of the nostrils—to quote two apparently harmless gestures—may have become so coordinated. Every one of these conditioned reflexes must be observed, recognized and broken down by the teacher. If this is not done, the pupil will go throaty or slur etc., every time he makes the gesture, however well he may sing otherwise.

All directions given by the teacher under this heading are physically easy of accomplishment by the pupil, since they do not actually take part in the production of sound. They must, however, be watched carefully, since they constitute habit com-

plexes and constant care and concentration must be exerted in order to break down such complexes.

All directions given by the teacher to the pupil fall under two headings:

(a) POSITIVE DIRECTIONS.

All positive directions are of a psychological nature. They deal with the pitch, vowel, color, loudness and duration of the tone, plus connected sequence memory-pictures of groups of tones in their time, tempo, rhythmic and melodic forms, and also with the breaking down of inhibitions and the building up of energy as applied to the production of sound.

(b) NEGATIVE DIRECTIONS.

All physical directions are negative. They deal with the forced breaking down of incorrect muscular coordinations and with the elimination of conditioned reflexes.

There are many devices which may be employed in order to eliminate throatiness. Here I will consider some of the physical manifestations of throatiness, many of which give "leads" to the teacher with regard to the procedure which he should adopt.

The singer who uses his voice really well produces it with apparent ease. He never strains, forces or pushes his voice. However, the crooner and the extremely throaty singer also sing "easily". There is a difference which must not be confused. The one with the good technic is "working" all the time he is singing, but this "work" is done efficiently. Furthermore, his face and neck are not distorted and he can move freely in the action of a performance. Strain and effort—as distinguished from the proper work necessary—are not apparent at any intensity. The throaty singer does not seem to "work" or to exert effort when he is singing softly, but if he tries to swell the tone, the strain immediately becomes manifest. At his loudest intensity his whole body is apt to quiver, his neck becomes horribly distorted, he grimaces, his head sticks out, his chest heaves, his abdomen tenses etc., in fact, every part of his body except the proper muscles (especially the inspiratory muscles which hold the ribs and diaphragm patent) seems to become tensed and involved in the act of phonation. The strain on the larynx is indicated by distortion of the neck, which occurs when he is singing at any intensity. In bad cases, the larynx tilts and a dent appears in the middle of the front of his neck below the

thyroid cartilage. This dent (which I have already discussed in Chapter I. of this appendix) is a sign of mixed registration. It very often appears with women singers who force the falsetto and fail to use the lower register. It becomes more pronounced as the tone is pushed and swelled and is a very real danger signal.

In the process of "opening up" his voice, a pupil may have to make what seems like a very great effort, in order to accomplish this end. Thus, in the intermediate stages, the pupil must work very hard. Ultimately, however, this effort is virtually eliminated. The necessary drive must not be confused with the strain to which the throaty singer is subject, nor compared with the apparent ease of production of the entirely throaty tone of the crooner.

Now, it is possible for the teacher to approach incorrect muscular coordinations directly. I have discussed the various mouth positions and movements of the jaw and lips for "detuning" the mouth cavity. The head should at all times be set squarely on the shoulders and it should never be thrust out. When the singer phonates, the muscles at the sides of the base of the neck, which hold the head in position, should not be allowed to relax. Thus, when the throat is held open, the base of the neck swells somewhat, while, when a throaty tone is produced, it contracts. (This "bracing" of the muscles at the base of the neck is similar to the bracing of the legs when "going after" the tone hard.)

Any "giving" of the ribs which causes the pupil to sway over backwards and often to tense and distend his abdomen, may be subject to direct correction. A break at the hips can also be inhibited.

All physical directions must be followed a hundred per-cent or they are of little value. Thus the direction to the pupil to force down his jaw as far as it will go, must be followed absolutely. A partial movement helps but little, if at all.

The thrusting out of the head may be coordinated with throatiness, with slurring, or with both—this gesture must be eliminated. Swaying over backwards, moving the shoulders, tensing the abdomen, giving at the hips, nodding the head backwards or forwards, and many other gestures, may have been coordinated with throatiness, slurring etc. Each of these and any other such gestures must be eliminated by the teacher, who is relatively safe if he assumes that each one of them is coordinated with technical faults. If these physical manifestations

of technical faults are not eliminated, radical technical progress is impossible.

The work necessary, for both the pupil and the teacher, in the elimination of wrong muscular coordinations is sometimes very great. The worse the technic, the more difficult and necessary will be the elimination of these coordinations. Nevertheless, if the pupil is a real worker and can concentrate hard, he can practically always be made to sing really well.

I have devised certain physical controls or manipulations which often help, especially in bad cases. These controls deal with the lips and jaw, and with the head and body. Since such manipulations are made by the teacher and are drastic, their usefulness is somewhat limited, and when the external control is omitted, the pupil generally relapses into the old habits in a greater or less degree. Sometimes, however, they may prove very useful.

After the directions with regard to the jaw and lips for the detuning of the mouth cavity, by far the most useful physical control I have yet devised, lies in the manipulation of the tongue. This manipulation serves a double purpose: It inhibits the pulling up of the larynx and, at the same time, draws the base of the tongue away from the posterior wall of the laryngeal pharynx, thereby inhibiting the constriction of the throat. The pupil performs this manipulation with his own fingers. I will not describe any of these manipulations here, since, if they are not done correctly, they may prove injurious. The written word can only convey so much, and the description of a manipulation might be confusing and do harm.

When a singer who produces his voice properly is told to "go after" a tone hard, his procedure is first to relax, limber up, and then to breathe, and just before the inspiration is completed, take the tension for the tone which has been clearly defined in his mind. He then holds and does not "give" as he establishes and sustains it. The taking of tension at the moment of attack predominates over any thought about inspiration.

The reader should bear in mind the fact that it is the will to produce a defined sound which causes the muscles to come into tension. Sound cannot be produced mechanically by the conscious tensing of muscles. All devices are of an inhibitory nature, and even where a device may seem to imply a direct control, this is not the case. The mouth adjustments, for example, break the mouth positions, but do not open the throat.

It is, in fact, the attack, which depends upon an uninhibited initiation of a defined sound, which accomplishes this end. All the directions I have given with regard to posture and the action of the breathing muscles are to inhibit the blowing (i.e. breathing) act. It is the proper attack and sustaining of the tone which makes the "hold" possible. Even the tongue device serves only to interfere with the production of a throaty tone. It does not drop the larynx, or open the throat if the tone is not attacked firmly in the center of the pitch with a defined vowel and intensity.

If a throaty singer is told to attack a high tone vigorously, he immediately tenses his inspiratory muscles. The harder he intends to "go after" the tone, the more he tenses. Then, at the moment of the attack, he throws this tension violently into reverse. The harder he intends to push, the greater is this pre-tension. Since his method of producing tone is based upon blowing and not holding, and because he has to go into inspiratory tension in order to swing into the reverse blowing action, it becomes necessary for him to stop blowing, take inspiratory tension, and then blow again each time he changes pitch. This renders it absolutely impossible for him to sing a continuous musical figure as a single unit. He has to stop, jerk and slur each time he changes the pitch. In singing a major triad he has, therefore, to make ten physical gestures with a stop and slur between each tone.

The singer who produces his voice properly makes one gesture only. He attacks, takes hold of the first tone, increases the tension—in the space of one vibrato—for the next tone without giving etc. He is then able to sing the entire musical figure on one impulse—the vibrato action eliminating the slurs, and the skillful regulation of the degrees of tension establishing the pitches. In this connection, let me add that the tension should not, and need not, be released during the inevitable interruptions of the consonants. The throaty singer has to stop and start again each time a consonant occurs, so that he is slurring up and down all the time and is not, in the true sense of the word, singing music at all.

The singer who produces his voice properly has a mind like a piano keyboard. His pitch concepts are absolutely defined and move in semi-tone steps. The throaty singer conceives principally slurs.

When I stated that the throat should be held rigidly, in opening tension, several people expressed the fear that such a teaching would lead to throatiness. I can only say that I must assume that the teacher knows something about his job or he should not be teaching. Of course, if he tells a throaty singer to hold his throat firm or rigid, he will merely increase the throatiness. The process of training is in two stages. In the first, throatiness—constrictor tension—is being reduced. In other words, the muscles of the throat must be relaxed. In the second stage, when the opening tension of the laryngeal pharynx has been established, all increases in tension mark improvement. Thus, the direction "go for the throat" often helps the pupil who is not throaty, but always makes the throaty one worse.

When the voice is steady or has an absolute tremolo, the engendering of a tremolo-vibrato, or wabble, may start the opening process, since, in this more violent movement, the throat is brought momentarily into opening tension. This movement must later be steadied into a vibrato-tremolo. Finally the true vibrato must be engendered.

CHAPTER IV

In regard to the treatment of the registers, a principle of fundamental importance has revealed itself. This principle applies primarily to women's voices,* and is an invaluable guide to the teacher: THE PUPIL CAN PRODUCE A FALSETTO TONE EXACTLY CORRESPONDING TO THE LOWER REGISTER TONE ONE OCTAVE BELOW. NO MORE! NO LESS! The highest tone she can sing, with a fully opened throat in the lower register, reflects as a similar falsetto tone exactly one octave above. Where the lower register continues up with a partial opening, partially open falsetto tones can be produced one octave higher. The pupil should never, under any circumstances, be allowed to practice "squeak" tones more than an octave above the highest tones she can reach in the lower register. Careful, intensive work in purifying and opening the lower register is automatically reflected into the falsetto, one octave higher. It is far more important for the pupil to be able to produce a good, free, open high A in the falsetto, derived from the octave below in the lower register, than for her to be able to scream or squeak extremely high tones. Very occasionally these squeak tones, which are immediately released when the lower register has been established, may be used in order to engender a "pull" on the arytenoid muscles. But this "pull" is at the expense of injurious constrictor tension on the throat. Thus, more than an occasional essay of these very high pitches does harm—not good.

More than one teacher who has read my books has discovered this high squeak-voice, has become immensely pleased with it, and has harmed his pupils' voices by using it to excess. Ultimately, when the lower register has been worked out and carried right up, very high tones can be sung legitimately.

I have pointed out that the pleasing or displeasing quality of the voice is not dependent upon the sound spectrum. Nevertheless, as indicated in Appendix Two, there is a degree of darkness or whiteness beyond which the singer cannot go without destroying the possibility of pharyngeal resonance adjustment,

* I never allow a man to sing very high falsetto tones, which are at such high tension that they tend to become throaty. The pure falsetto is found, in the singing range, at about F above middle C.

and thereby spoiling the quality of the tone. Extreme darkness, whiteness, nasality, or throatiness are always based on a mouth resonance adjustment, and are, therefore, throaty and of unpleasant quality. There is another point about quality which may surprise the reader. When a voice is properly produced, it does not have what is known as a characteristic bass, baritone, tenor, contralto or soprano quality. In fact, if we were to take a group of voices of all calibres, from the lowest bass to the highest coloratura, and tell them to sing up the scale on an "ah" vowel of the same color, and if we were then to level the loudness into one continuous, even scale, the result would sound very much like one voice of extremely wide range. When Caruso and Sammarco sang a duet, it was at times difficult to distinguish which one was singing; on the lower tones, Sammarco's voice was bigger, and on the higher ones, Caruso's. Through quite a wide area, they sounded very much alike. The distinctive baritone and tenor qualities we hear so much about today are simply a thick throatiness in the former case and a white, nasal throatiness in the latter. Similarly, the so-called contralto quality is simply a thick, throaty mixed register sound while the typical soprano quality is a relatively shrill and white or insipid one. A well-produced voice is categorized, not by its particular type of throatiness, but by its power, by the number of tones which are powerful, and by the area in which these tones lie.

In this connection it is interesting to note that any properly produced voice singing up the scale at mezzo forte will be singing falsetto at about E flat on the top space. This is irrespective of the type of voice or whether it be male or female. Of course, the lower register goes higher when a greater intensity is used. This point is particularly interesting in view of the fact that in this respect the man's voice is exactly the same as the woman's. He goes into falsetto on the same note—not an octave below. In other words, the E flat above high C in a man's voice is legitimately falsetto when sung mezzo forte. This assumes a properly-produced, fully-developed voice.

I have dwelt many times in my writings on the harmful effect of listening to one's own voice. I will discuss this question from a different angle. There are two sorts of ear:

(a) The physical ear itself, the purpose of which is to receive sound impressions from the outside—not to motivate the voice.

(b) The memory centers in the brain, from which the act of phonation is initiated.

The memory-picture of sound in all its phases: pitch, vowel and vowel color, intensity, rhythm, time, time spot, and sequence-pictures of these phenomena, are received through the ears and stored up in the brain. IT IS FROM THESE MEMORY-PICTURES THAT THE SINGER PHONATES. If he attempts to use his "listening apparatus" for this purpose, he is inverting the psychological process and destroying the function of the ear (memory centers in the brain). The moment the singer uses his listening mechanism as a guide, he starts to break down these memory-pictures which are his most vital asset.

What will the process of the self-listener be when he wants to sing a given pitch? He proceeds to make a noise of undetermined pitch and then shift it around, slurring up and sometimes down, until he has arrived at the pitch which his ear tells him is the desired one. However, by the time he has finally arrived, he has heard a slurred sound, and has, in some degree, forgotten the pitch of the tone he should have sung. If this process is indulged in over any considerable period of time, he will more or less completely lose his sense of accurate intonation. I have, in fact, heard several singers with excellent ears, who, because they listened to themselves, sang badly, and often continuously, off key. THE SINGER CANNOT ACCURATELY CHECK THE PITCH OF THE NOTE HE IS SINGING BY LISTENING TO IT. As far as vowel and quality, and even loudness are concerned, he will, if he uses his listening faculty and inverts the psychological process, obtain an entirely distorted picture. The throaty tone, especially the thick, throaty one, is communicated directly to the inner ear because of the constrictor tension on the laryngeal pharynx, and the throatier and thicker it is, the better does it sound to the singer himself. The most conceited singers are always the throatiest. The great "battle" in teaching voice, is the fight in which the teacher must engage in order to force the pupil to stop making throaty sounds which seem so beautiful to himself. I have eliminated the throatiness and increased the power of pupils' voices out of all recognition and had them tell me that it didn't sound any louder to them than it used to. This battle is particularly insidious with baritones, who sing with a throaty tremolo-vibrato which sounds so rich, mellow and virile to their own ears. It is often

easier to teach such pupils how to sing good high tones than middle ones, which are actually far less difficult to produce. Every time a singer listens to his own voice, he inevitably slurs and produces throaty tones.

One device for stopping the pupil from listening to his own voice, and for teaching him to intone properly, is to force him to respond, with extreme precision, to cues given by the teacher on the piano. So long as his ear is really focused on the pitch of the tone produced by the piano, it will not be focused on his own voice. When I tell a pupil to sing a major triad, I strike a chord to establish the key, and then cue him in with the first note of the triad. I then play the second and third notes in a definite tempo. He must be forced to respond immediately to these cues, without hesitating, slurring, jerking or "giving" between the notes. He must also be made to mount the intensity in exactly the right proportion. This is, in many cases, amazingly difficult. If he listens to his own voice, he will dodge the cue again and again. He may try to look at my hands to see me strike the key. He may try to guess when I am going to play the note. He then keeps jerking and scooping against the cue. The teacher must overcome all such complexes.

There are two great deterrents against learning to sing:

The first is an inhibition against producing a free, loud tone. This inhibition has been built up from childhood. One's earliest recollection is probably one of mother saying, "Sh! dear: Don't make so much noise". This inhibition, which leads to absolute throatiness, is generally further engendered at school, where the children are only too often made to sing very softly.

The second is the listening complex which inverts the psychological process and leads to faulty intonation, distorted vowels, and, above all, to throatiness.

It is quite easy to "work out" a voice from a relatively crude, loud tone. A throaty, mellow, soft one must be forced open before anything can be accomplished.

In the early stages, the teacher must associate, in the pupil's mind, loudness, with a "grip" or "hold" on the muscles of the thorax, because it is impossible for him to "hold" if he is singing softly. Since the glottis opens slightly for a soft tone, and the necessary grip is therefore increased, the ability to "hold", instead of "giving", will obviously only be possible, at first, under the most advantageous circumstances: i.e., in the phonation of a full, loud tone. Later, when full, free singing has been estab-

lished, increasing "hold" on the muscles of the thorax must be associated with the decrescendo, and the maximum "hold" or tension, with pianissimo. The teacher must always bear in mind the fact that properly produced tones are tremendously louder than the throaty ones which practically every pupil produces in the early stages.

Vocal improvement implies an extension of range, an increase in power over a wide range and improved quality plus an improved movement and better control. An increase in intensity always occurs as the technic progresses. Nevertheless, this desirable increase in intensity does not imply that the pupil should shout or scream. It must be accompanied by an improvement in quality. One test of the proper development is whether the increase in intensity is for a few tones or over a wide range.

One of the throatiest voices (a baritone) which I tested at the laboratories, gave the loudest reading for one tone—high F—but the intensity dropped very rapidly from this pitch down and the lower tones were very weak. He could not go any higher. Where real improvement occurred, the increase in intensity was over a wide range.

The more advanced the technic becomes, the more accurate must be the adjustments. When the voice is really "opened up", the precision of attack and intonation must be very fine, and the "timing" of the tensions required must be performed with consummate skill. The singer with an "open", free voice can produce every tone with extraordinary ease if the pitch is perfectly centered and the timing is accurate. If he slurs into the tone, all the adjustments are incorrect and the effort is increased to an enormous degree. Listen to a Caruso record with this matter of the attack and the pitch and intensity precision in mind, and you will see what I mean.

The work done in singing is performed by means of tension on the muscles of the ribs and the diaphragmatic muscle. The rib muscles must at all times be held absolutely firm, while the increases and decreases in tension for the higher and lower pitches seem to be looked after by changes in the degrees of tension on the diaphragmatic muscle.

In singing a musical figure in a given tempo, it is not enough for the singer to meet each note at its exact time spot, since, in addition to this factor, we also have to consider the question of the duration of each note. If there is any slur between the tones, the time occupied in the slur is subtracted from the

duration of the tones in the particular tempo and time pattern. This question of duration is of great importance.

Some voices "carry" in an auditorium, others which may sound louder in a room, seem to fade away and disappear. "Carrying quality" is not a mysterious characteristic of tone, as some people imagine, but a question of pitch centering, vibrato and duration. When the tone is sustained in an auditorium, the sense of power is greatly diminished if the pitch wavers, or in other words, if the vibrato is not properly centered on a given pitch. A changing sound pattern is built up in an auditorium and this sound pattern should be definitely centered. However, most of the tones sung are of short duration. It may take half a second before the listener in the middle of a large auditorium has received the full power of the tone which has been built up by reflection from the walls, floor and ceiling. When the singer slurs or breaks off for the consonants, he cuts down the duration of all these short tones which are, therefore, never built up to their maximum loudness. Such a voice sounds much less powerful than it would be if the pitch were properly centered. This is also true of speech. It is interesting to note that the distance at which a microphone should be placed away from the singer depends upon the amplitude of the vibrato, not upon the intensity of the tone. A relatively steady tone demands a close pick-up and vice versa. A good vibrato, more than any other factor, gives a sense of power to the listener and, where this is coupled with accurate intonation, a voice of medium power may sound remarkably full.

Wealth of tone is considerably curtailed when the consonants are prolonged. The consonant is merely a noise which interrupts the tone. It is not sung. Mr. Watkins (author of Section Three of this book) is showing the Voder at the World's Fairs of 1939 in New York and San Francisco, for the American Telephone and Telegraph Company.* This instrument is of great interest since the principles on which it is based are the same as those on which my findings are based. In other words, we do know what speech and singing are. We can synthesize them from their elements. The vowels are derived from a musical tone, the pitch of which can be varied, while the consonants are derived from a hissing noise (see Appendix 3). Surely this instrument should spell the death warrant of those who teach and propound such alchemistic ideas as "voice placement", "sing-

* See Appendix Three.

ing in the masque", "placing the voice in the head", "head tones", "vocalized breath", "focusing the voice" etc.

It is not an easy matter for the pupil to learn how to attack a tone in the center of pitch, vowel and intensity, or how to connect two tones without slurring, jerking or both. He must not be allowed to proceed until the attack of the first tone has, in some degree, been improved, however many tries this may take. The tension on the muscles of the thorax should occur at the moment of the attack. Pupils pre-tense, or tense too late. The "timing" of the tension is vital and must be worked out with meticulous care. The pupil must really be made to relax before, and take tension at, the moment of the attack. This is difficult since it calls for physical skill and mental concentration.

In singing a triad, the intensity must mount for each ascending tone. The pupil must be forced to "work" in order to attack the first tone, and to increase this work, without "giving" between the tones and with properly timed precision, in order to "go up". The mere fact that he must make a real effort often presents a definite difficulty, since many pupils have extremely sluggish physical and mental responses and they are also often very inhibited. When they are so constituted, they must be driven. This is hard work—it tires the teacher even more than it does the pupil. The details of "giving", or relaxation, at the moment of attack and between the tones, must be worked out and the faults overcome. Now, all this sort of thing is rather straightforward and a great deal can be accomplished by means of direct, hard, intensive work on the part of both the teacher and the pupil—nevertheless, I have never had a new pupil who could attack in the center of the pitch or connect even two tones properly. I have never had one who had been taught to realize the importance of pitch precision.

Again, loudness is just as important as pitch precision. This phase of the work also has been disregarded. An ill-defined ("slurred") intensity is as bad, technically, as slurred intonation. Correct muscular coordination depends upon the loudness as much as upon the pitch of the tone. A soft tone has the same adjustment between the thyroid and the arytenoid muscles as does a far higher tone sung loudly. When the intensity is not properly defined, the laryngeal muscles cannot coordinate properly. Furthermore, a mounting musical figure cannot be sung legato unless the proportion of loudness between the tones is correct.

CHAPTER V

In working out the resonance adjustment, purifying the registers and eliminating throatiness, one of the teacher's most important weapons is the control of the vowel color. I have already described this phenomenon. Let me point out again that there are two bands of frequencies which determine the vowels. When the lower band predominates over the upper, the color is dark, and vice versa. In Cut 3, there are shown spectrograms of a dark, normal and white "E" vowel. As a general rule, the beginner's voice is far too white, especially in the falsetto—he is apt to produce white, mouth vowels. As I have already pointed out, the first opening process generally depends upon the engendering of the concept of darkness. In other words, the pupil must be forced to open his throat through the use of dark vowels. The white vowels, in nearly every case, lead to increased throatiness. As will be seen from Cut 3, the vowel color can be read from a spectrogram; but looking at a spectrogram does not convey the sound impression of darkness or whiteness. This can only be done by ear. It is virtually a pitch phenomenon. True, the pitches involved are overtones, but this does not alter the fact that vowel and vowel color are just as much pitch phenomena as fundamental pitch itself. The pupil must receive the mental picture of darkness from the teacher, who should strike the piano key in order to convey the pitch, and sound the vowel in order to convey the vowel quality. It stands to reason that the teacher must be able to produce the vowel sounds he wishes to convey to the pupil. This is not teaching by imitation. It is merely conveying vowel qualities. Such vowels may, in fact, be spoken or sung at very low pitches by the teacher, if he so desires.

Of course, the pupil must not be allowed to make mouth positions for the vowels. If he purses up his lips and covers his teeth in order to darken, he will merely be producing a "throaty-dark," or thick sound which is no better than a "throaty-white" sound. It is vitally important for the teacher to be able to distinguish between a relatively open dark tone and a throaty one.

A Good Singer Produces Three Tones of the Same Pitch—All on the Vowel "ee"

"Bright" or "White" *ee*



"Average" *ee*



"Dark" *ee*



Cut 3
VOWEL COLOR

This period of very dark singing will often have to be continued for quite a long time, and by virtue of this process in conjunction with various other directions given by the teacher, the pupil may improve out of recognition. Nevertheless, it is only one stage in the training process and there will come a time at which he will start to go backwards and "shut off" again unless the quality is modified, and, if necessary, whitened, in order to "fit" the "opening" which has occurred. When going into the whiter stage, the voice actually becomes a good deal more powerful, but the elimination of darkness often conveys the impression to the pupil that he is producing a softer tone and that the quality is less rich and mellow. He is, therefore, quite apt to resist this stage of development. He must be forced to make the necessary changes for each stage in his vocal progress at the command of the teacher.

I have said a great deal about holding tension. If at any time the tension on the thorax "gives", it is translated into movement. Tension so translated is not only lost, but reversed and thereby changed into muscular interference. The pupil who jerks, "gives" each time he does so. Thus, a series of jerks between tones becomes a series of progressive "gives". In other words, each successive tone becomes progressively more throaty. The pupil can never recover once he has "given". He is forced to push harder and harder. Hence, as soon as he has jerked or "given", he must be made to stop singing and start again.

When a "give" occurs, it entails the entire muscular system used in the act of phonation. In other words, when the inspiratory muscles "give", the opening muscles of the laryngeal pharynx also "give", the glottis opens and the larynx is drawn up. The "give" must, therefore, be considered as a whole. Nevertheless, various directions designed to stop the body "gives" may be employed by the teacher, or, provided that his technic is not definitely throaty, the pupil may be told to hold at the throat. (This direction is often especially helpful if he has been the victim of a "forward, voice-placement", "singing in the masque", "nasal resonance" etc., teacher, since it will have a psychological effect and tend to nullify such teachings, which engender throatiness). The teacher must try out various directions and see which ones work best at the moment. "Give" is often due to inhibition, which makes the pupil "feel into" the tone instead of meeting it squarely in the center of the pitch,

vowel and loudness. The positive psychological directions must always be given.

The pupil should never, at any time or for any reason, be allowed to correct himself or in any way endeavor, of his own volition, to improve either the quality or intensity of the tone he is singing or the method by which he is producing it. He must put himself entirely in the teacher's hands. If for one moment he usurps the teacher's prerogative, and endeavors to direct himself, the lesson becomes a farce. The good pupil is one who tries, with the utmost concentration and energy, to follow exactly what he is directed to do. He must not at any time attempt to analyze what he is doing while he is singing. If he does this, he inevitably releases and every tone he produces is entirely throaty. In other words, he must be absolutely subject to the teacher and must never for a moment become analytical of himself. The intelligent pupil asks the teacher hundreds of questions. He always wants to know why. If the teacher is properly informed, he is able to answer these questions and welcomes them. The teacher who refuses to answer questions is, transparently, ignorant.

When the pupil is told to "hold" or "go after it harder", he is not trying or working if he jerks more vigorously and pushes harder. He must distinguish between trying hard and making abortive physical efforts.

I have indicated a number of physical and psychological devices which the teacher can employ, but the mere giving of directions such as I have indicated does no manner of good unless it is backed up by the necessary knowledge and understanding. A mouth or jaw direction which helps one pupil in a given stage may harm another pupil, or the same pupil in a later stage. The teacher must be able to detect not merely the difference between a throaty and a free tone, but also the minute differences between slightly less throaty and slightly more open tones, etc. The pupil progresses by gradual stages. He doesn't suddenly go from a throaty to a perfect tone. Again, mixed registration is not suddenly eliminated. The pupil separates and purifies the registers by slow degrees. The teacher must be able to detect slight differences in the purity of registration. The directions he gives are for the purpose of purifying the registers, eliminating constriction and increasing the opening tension on the throat and attaining a better resonance adjustment, bringing movement into a steady voice and gradually changing

tremolo movements into the vibrato which must be properly regulated. All the directions given must have these ends in view. The devices I have indicated are perfectly futile and often very injurious if they are not applied intelligently.

Each pupil presents a personal problem and must be dealt with accordingly. Some are emotionally very dead and phlegmatic. They must be driven and worked up, as must the physically lazy ones. Others are highly strung, neurotic and overemotional. They must be directed carefully and treated less rigorously. A given fault may occur from a number of different causes. For example: The pupil may slur because his memory-pictures of pitch are ill-defined, or because he listens to his own voice, or because he "gives", jerks and pushes, or because his sense of time and rhythm are bad (so that he cannot conceive the exact moment at which to move the pitch), or again, he may be inhibited against singing high tones or singing loudly enough, or his vibrato movement may be faulty or lacking, etc. Whatever the cause or causes may be, the fault must be eliminated by the teacher, who must be able to diagnose the physical and psychological causes of each fault. If he is not skilled in the making of such diagnoses, he is not competent.

During the process of training, the pupil may progress steadily, in slow stages, or, if he is highly strung and vigorous, he may go through a series of sudden "openings". The latter type is more apt than the former to develop a really fine voice, but he goes through periods during which he has difficulty in performing. If the energy is applied spasmodically the opening occurs, but is not held onto, since the maintenance of the given stage of opening demands sustained and controlled energy. This type of pupil must be held under rigid discipline by the teacher and taught how to use and control his energy. He may sometimes be "chasing" his own voice for a very long time and then, just as he has caught up, he may go into another opening. When a sudden opening first occurs, a state of unbalance of the pharyngeal and laryngeal muscles results. This gives rise to vocal instability or apparent hoarseness, which must not be confused with the hoarseness engendered by bad singing. While such hoarse periods are sometimes inevitable, they need not occur provided the pupil can be made to "get hold" of the "opening" as soon as it occurs. This type of pupil may have rather a bad time until he has really "got hold" of his voice. In the long run, however, he is apt to develop a far better voice than the one

who progresses slowly and is always able to give a smooth and slowly improving performance.

Emotional freedom is an extremely important factor, especially in the higher stages of development. In many cases the vocal equipment develops a good deal faster than do the emotional and musical capacities. After all, the reason for singing a full, free, sweeping melodic line is the expression of emotion. If the true emotional and musical urges are lacking, the singer will merely sound as if he is forcing himself to make a loud noise. The work in developing this side of the pupil's make-up is difficult and subtle, and, since it is extremely personal, there is little one can say about it in print.

The ridiculous, so-called, mezza voce singing we hear so much in recital, is merely a throaty, mixed falsetto. It conveys no true emotional message, nor does it portray the musical intent of the composer. Emotion and mood are not conveyed with any degree of sincerity by mere loud or soft singing. They are properly expressed by means of color. The dynamic effects are generally looked after by the composer to a very large degree, since he keeps in the lower part of the singer's range for quiet effects and goes up for a climax. Sometimes special loud or soft effects are desired and where such effects are indicated by the composer, they must be encompassed legitimately by the singer. If, as often happens in the modern French school of music, the high tone is marked pianissimo, it must be separated from the musical phrase and sung as a unit in itself, since it is impossible for the human voice to mount on a continuous diminuendo line without going throaty. This "picking out" of a high note for a special dynamic effect, gives it a peculiar force and does not detract from its musical or emotional import. In fact, it makes a poignant climax of a pianissimo tone. It is impossible for the singer with a properly-produced voice to sing through entire compositions pianissimo. The tension is so great that he inevitably slips into throatiness. Every singer who goes through the body of a program mezza voce is merely throaty and inane. There is no exception to this law. It is only too sad to realize how many great voices have been ruined by this attempt to encompass a false form of artistry.

One of the questions I am so often asked is: "How long will it take me to learn how to sing?" This question cannot be answered. Some pupils progress with almost uncanny rapidity. Others are very slow. Furthermore, the apparently more

talented pupil may progress far slower than the seemingly less talented one who is able to concentrate and work hard. My general guess is about two years for a reasonably talented pupil, but the real answer is from naught to infinity, since it is possible for a pupil to start with a perfect voice, and some pupils can never be made to sing. Of course, if the ear is really faulty, nothing can be done, but the absolute self-listener may also be untrainable, as may be the one whose registration is completely mixed. For example, I worked with one girl, who had studied for seven years with incompetent teachers, for two seasons, and completely failed to establish either register. This is, to be sure, an exceptional case, but really bad teaching can completely eliminate a voice forever. Some years ago there came to me a young man who had been a successful radio singer. He had a typical radio voice—small, white-throaty and nasal. He was, in fact, a diction singer. His "modesty" was remarkable! He pointed out to me, that with his glorious quality and superb artistry and musicianship, all he had to do was to extend his range four tones higher in order to be the greatest tenor in the world. It was really a very nasty little voice and he could just squeeze out an A flat. Well, I was to be permitted to do anything I liked provided that I did not change the "quality" of his voice. Since this quality was, essentially, throaty-nasality, I need hardly point out that, in order to do anything with him, I would have had to eliminate it. After what seemed like a very long period of hard work on both our parts, mine consisting of trying to change his voice, and his of trying to stop me from doing any such thing, he quit. The voice was still throaty-nasal and he could still just squeeze out an A flat. Then he went to Europe to study. At the end of two years, he returned—his voice was still throaty-nasal and he could still just squeeze out an A flat. Of course, such pupils are absolutely untrainable.

On the other hand, some of the best voices I have developed have started with little or no "natural voice".

Artistry, dramatic ability and musicianship are of first importance if the pupil is ever to become a real singer. These phases of his art may be developed and, to a considerable degree, improved, but if they are lacking or are of low order there is very little the teacher can do. The development of a fine voice is far easier and takes far less time than does the development of an artist.

I have often been asked to say something about children's voices. I, myself, have not done much work with children, but it is perfectly obvious that the child's voice is no different from the adult voice, except that it is smaller. It has the same muscles, the same cartilages, the same anatomy and the same physiology. The child's voice should be trained exactly like the adult's. The unfortunate thing is that boy sopranos and little girls are generally made to sing falsetto only. This is horribly injurious and eliminates thousands of voices before the age of puberty is reached. It is still more vicious when the choir-boy, whose voice is beginning to develop and drop, is forced to thicken his falsetto and sing "alto". If the registration action were to be properly worked out, and the growth of the vocal organs met with the necessary increases in intensity of both of the properly isolated and resonated registers, there would be no sudden change or "break". The lower register should at all times be used in speech. It should be used in singing, where it belongs. I am confident that a child's voice could start to undergo training at a very early age, and that this training could be continued, without any interval at the age of puberty. After all, the break in the boy's voice is primarily a register change and this would not occur if the registration action had been properly established. For many years, most of the children in the public school system of New York have been told to sing softly, and, I am afraid, to shape their lips for the vowels, and to use nasal resonance. I wonder how many latent singers have been eliminated by this abuse. A group of untrained children generally sing badly off key unless they are allowed to sing out loudly. In working with a group of children it is a good plan to let them sing low and loudly and thereby establish the lower register, and then, when this is established, let them sing the high part in the falsetto. Of course, groups cannot really be trained technically, since this is a matter of individual work, but the sort of procedure I have indicated, might do the youngsters good rather than harm, if they were not inhibited and were allowed to sing full voice and with freedom.

CHAPTER VI

Since the publication of the first and second editions of this book and of my other book—"The Voice, Its Production and Reproduction"—I have been very gratified at the wide interest shown in my work by singers and teachers in this and other countries. I have received letters from all over the world and many teachers as well as students have come to work with me and study my methods of procedure. My desire is to succeed in teaching others how the principles I have laid down may be applied to the training of the voice. Some of these teachers have been the finest type men and women one could desire. They have studied themselves, listened to lessons and returned time and again in order to increase their knowledge of the procedure and of the devices which can be employed. Others, I am afraid, have been less sincere. These have come to me with the idea that they could learn some "trick", "stunt" or "magic secret" in a few lessons and then pose as "scientific" teachers. While I never refuse to help anyone, I do wish it to be understood that I want to be associated only with serious, sincere teachers. The "breath-control", "singing in the masque" teacher could write all he knows about technic on one sheet of paper, and one lesson should suffice for the pupil to assimilate it. Serious scientific teaching is not easy—it is hard work which demands meticulous attention to detail. It is simple enough, for example, to break the registers, but the engendering of pure, properly resonated registration is often a long, arduous process. The registers can indeed be brought together, and the break eliminated, at a premature stage, but when this is done the result is mixed registration and throatiness. The teachings I have propounded do not constitute a patent method—they indicate a procedure. Each case calls for individual treatment. The competent teacher must not only understand the theory, but he must also have a special talent for his profession.

Before I laid down these principles, it was impossible for anyone really to improve or change a voice, since this cannot be done unless the process of isolation and proper development of the two registers has been accomplished. But pure registration is impossible without pharyngeal resonance adjustment and

the proper action of the breathing muscles, plus the correct regulation of the vibrato. Anyone who accepts one or more of the fundamental principles I have laid down and rejects others vilifies the entire subject. The fundamentals I have stated constitute a single entity.

I have indicated the general educational requirements for anyone who wishes to take up the teaching of voice as a profession. In addition to this, as I have shown in the preceding pages, the teacher must have a finely attuned ear, in order that he may be able to detect slight differences in tone, and sense small changes in the physical adjustments. Furthermore, he must be able to exercise ingenuity in the use of the proper devices which should be employed for each particular case with which he is working. He must also have a sympathetic understanding of each pupil's psychological difficulties and make-up. Patience is also necessary, since he must be prepared to work out every minute detail with meticulous care. He must never let anything of a deleterious nature pass.

Vocal teachers come under a great many categories, but one of the most dangerous is the one who is quite uninformed with regard to the scientific principles on which the training of the voice is based, but is in some sort of key position whereby he can obtain the ear of successful singers and the general public. Most artists have "been the rounds", and they seem to be willing to take a chance on anyone who has a certain status in the musical world. When their voices have deteriorated to a noticeable degree, they change teachers and, in many cases, go to another teacher who is just as ill-informed and talks the same sort of unscientific jargon as their former ones. Each of the teachers with whom they study shines with a sort of reflected glory, and young singers go to him because he is the "teacher of so and so". These students do not stop to consider whether the specific teacher has helped or harmed the artist—they do not observe the very patent fact that most of the successful singers are deteriorating and many of them lose their voices when they should be in their prime. Most singers do not confess to themselves that their voices are deteriorating until it is too late, and then they very often fail to lay the blame at the door of the teacher or teachers who are responsible. Some years ago I heard a Wagnerian soprano whose voice was one of the finest I had ever heard in the German roles. A few years later I heard

her again—her voice had been absolutely ruined. What do you think she said to me? "I am out of voice because I have dust in my nose."

Teachers in this category have nothing of value to tell their pupils, but they have to say something. Therefore, they make up some wild story or "magic secret". In many cases they clothe this story in esoteric language, in order to make it sound "interesting". These unscientific notions always do harm.

I have in mind, for example, the case of a young man whom we will call "Little Willie". He now has a baritone voice of enormous power, with a range of about three octaves, and he can sing a high B natural. When he came to me, he had a tiny, white voice which sounded like a throaty, light tenor, but he could only go as high as middle E flat. "Little Willie" had been studying under just such a teacher.

In "The Voice, Its Production and Reproduction", I quoted various passages from the books which had been written by so-called authorities. These were quotations of so unscientific and ridiculous a nature that, when I read some of them at the Franklin Institute in Philadelphia, I had a group of serious scientists roaring with laughter as if I were a vaudeville comedian.

The unwritten nonsense about voice is still more extraordinary. Take, for example, "Little Willie's" late teacher. His fundamental idea was to "smooth out" a voice. When "Little Willie" started studying, he had a fine, big, crude voice and he could make a high G. When he stopped, no one would have dreamed that he had ever been able to sing a single note. The parting remark of this teacher was, "Well, if we have succeeded in nothing else, we have succeeded in toning your voice down".

This is his theory of vocal technic: "Everything has a positive and a negative pole. In singing, the negative pole is the throat which must be relaxed; so you must nod your head when you are going to sing a tone and thereby relax it." (Of course, any movement, such as nodding the head, tenses the muscles of the neck.) "The positive pole is the buttocks which must be tensed. Most important in singing is the 'breath clutch'. Blow out all the air, relax for ten seconds, rolling the head, then distend the diaphragm and then pull it in and tense. Now sing softly." So "Little Willie" stood up, tensed his buttocks, blew

out his breath, counted ten while he rolled his head, inhaled and stuck out his diaphragm, pulled it in (this raised and tensed his chest and neck and stuck his head out), tensed hard and then tried to squeeze out a little, soft, throaty white tone. Can you imagine the pitiful, effeminate squawk which this unfortunate young man was forced to make? Poor "Little Willie"! He is a he-man, six feet-two inches tall and large in proportion! I need not dwell upon the results of pre-tensing the breathing muscles, which inhibits their coordination with the act of phonation, and, if carried to its logical conclusion, would make it impossible for the pupil to produce any sound at all, but I wish I could describe the look on our "Little Willie's" face the first time he sang for me: Picture him standing there with his buttocks very tense, his abdomen pulled in, his chest raised and as tense as a board, his head thrust out, his neck distorted, his jaw locked and his eyes starting out of his head with an expression of fear, surprise and distress in them. Of course, this pre-tensing process is exactly what I would propound if I wished to obtain the throatiest possible tone.

The "toning down" or "smoothing out" process which is, in reality, merely one eliminating the voice, is probably the key to the entire situation which arises as a result of this injurious school of teaching. In the early stages a pupil's voice is apt to be quite crude. A young man who uses the lower register only, has a shouty element in his voice at all times. This element becomes very pronounced at about C sharp, and at E flat or E he is apt to produce a definitely unpleasant shout. If he can go any higher, he does so by sheer forcing. In order to eliminate this fault, make the quality pleasing and reach the high tones, the falsetto action must be coordinated. When the throat is open, the vocal cords must be able to generate the necessary sound energy in order to actuate a properly tuned, and acoustically coupled, resonance system which delivers a considerable volume of tone. If the falsetto action is lacking, the arytenoid cartilages "give" when a wide swing is demanded of the vocal cords. The pupil is then only able to reach the high tones by shouting. When the two registers are pharyngeally resonated and coordinated, the voice goes up without a quality change over a range of at least three octaves. This is the only legitimate way in which the singer can cover a wide range. There is, however, another method: He can go deliberately throaty and aug-

ment this throatiness as the pitch ascends. Such throaty tones, which are relatively soft, can be produced without laryngeal development.

Now, consider the case of a teacher who understands nothing of registration and resonance adjustment. The pupil comes to him unable to go up, and producing rather ugly, shouty tones. He cannot permit him just to shout. So about the only thing he can do is to "smooth out" the pupil's voice by making him "shut off" and deliberately constrict his throat. He therefore teaches him to "cover", "place in the head", "sing in the masque", "use nasal resonance", etc. at about E flat. While these words actually mean nothing, they do indicate to the pupil the idea of deliberately going throaty and producing a mixed register tone. This technic, while it is relatively smooth and enables him to sing higher tones, lacks volume, sounds more or less effeminate and is definitely injurious because the throat is constricted and the registration mixed. Furthermore, these faults are cumulative—he becomes throatier and throatier and the registration becomes more and more mixed as time goes on. Therefore, his singing career lasts only a few years, after which period his voice shuts off completely. In the meantime he is able to give an apparently smooth performance and he learns to admire and consider as a virtue the effeminate, little, throaty, mixed-register, "mezza voce" tones which he can produce. When his voice has shut off so that he cannot sing any more, he teaches, and hands down the tradition of this injurious and effeminate form of singing. Many recitalists use this form of technic in performance. I do not consider it singing at all, since it lacks color and fails to communicate any sincere emotional or musical message whatever. The singer who uses the mezza voce technic can also shout, but he has nothing between the mezza voce and the shout—he cannot swell the tone legitimately. A pupil, trained under this system, who is still able to go through a program, often fails to realize that his natural, virile voice has been destroyed.

In the case of a woman, matters are still worse. Practically every woman uses falsetto only. Now, while the falsetto, when pure and properly resonated, gives the pleasing quality to the voice (male or female) the lower register gives the strength, endurance and power. Without the use of the lower register, the voice is at all times subject to strain, especially for the lower tones, which are very weak in the pure falsetto, but can be made

louder if they are mixed and forced. Furthermore, as I have shown, the purification and freeing of the falsetto action depends entirely upon the isolation and development of the lower register. In the early stages of training there is a rather unpleasant break between the registers, but it is because of this break that the pupil can produce good quality and high falsetto tones. If the lower register action is lacking, it is absolutely impossible for her to do anything but scream her high tones, or squeak them with a terribly constricted throat. Both are harmful, and unpleasant to the trained ear. Nevertheless, we hear practically nothing else today, since nearly every woman sings falsetto only. The great singers of the past used the lower register over a very wide range and the very great ones used coordinated registration, which meant that they could swell through every intensity without impairing the quality. Destinn's high C, for example, was a thing of indescribable glory at all intensities. No living singer can produce a really good high C today, but Destinn had perfectly coordinated registration and was using the lower register most of the time, except for the soft effects. Her throat was open at all intensities—just as much for pianissimo as for fortissimo. She did not emit a throaty squeak for a soft tone or a scream for a loud one.

During the early stages of training the break is apparent and one does not have to be an authority in order to detect it. It is easy for anyone, who knows nothing about technic, to criticize the singer for this transition, despite the fact that it is because of it that good high tones can be produced. As the technic develops, the break becomes less and less apparent. Soon it is hardly noticeable. The period during which the break is apparent cannot be avoided—it is a necessary concomitant of vocal improvement.

One of the most ridiculous contentions one hears today is the claim that certain great singers lost their voices because they used the lower register, or "chest voice". Every great voice which has been lost was destroyed because of the deliberate elimination of the lower register. There are innumerable cases. When the artist's voice was great she used the lower register. Her teacher stopped her from using it, and, as soon as he had accomplished this end, her voice started to deteriorate. In a few years it had virtually disappeared. She sang before the lower register was eliminated and lost her voice later. To claim that the use of the lower register destroyed

her voice is absurb. The inverse proves itself. Singers who lose their voices undergo an "untraining process". They traverse, in the inverse direction, the stages which I would go through in "making a voice".

The properly coordinated voice shows no audible sign of registration. When a teacher lightens the lower part of the voice, the lower register action commences to disappear and a lack of balance between the thyroid and the arytenoid muscles becomes apparent. At this stage a break appears. The uninformed teacher believes that it is the loud lower register tones under the break that are doing the damage. He therefore proceeds to eliminate these tones and thereby accelerates the destructive process. With the absolute elimination of the lower register, the singer, who still possesses her dramatic and musical talent, inevitably forces her lower tones to a disastrous extent, and her ultimate destruction proceeds at an ever increasing pace. Observe, she goes through the stages of:

(a) Coordinated registration.

(b) The use of two registers with a break between them. (She is still able to sing high tones.)

(c) The elimination of the lower register. (The high tones degenerate into screams and disappear one by one, the lower tones are lost, and the power of the voice drops rapidly.

The uninformed teacher mistakes the injurious, forced, thick, mixed falsetto, which does destroy the voice, for the beneficial lower register.

A lack of scientific knowledge is bad enough among private teachers who do not have to be qualified in any way for their profession, but what do we find in the big conservatories and colleges?

Some years ago a young man and his wife came to work with me. They had been studying music (majoring in voice) at one of America's biggest universities, which boasts of a music department of very large proportions. The young man had graduated and was prepared to teach and hand down to future generations of students what he had learned. His wife couldn't graduate, because she couldn't sing through one page of any song in any key. I freed her up sufficiently for her to be able to struggle through a program, although her voice was still quite throaty and had a most unpleasant tremolo. She then received her degree and was foisted upon the world as a graduate

vocal teacher. What had they learned at college? They had studied the "card and handkerchief" method. No, this is not a conjuring trick! It is a "method" of teaching singing. The victim puts a visiting card in front of his lips and tries to make it vibrate. The more it vibrates, the better he is supposed to sing. He then takes a lady's handkerchief, folds it up, puts it in his mouth against his hard palate, pulls his upper lip down over his teeth and then endeavors to sing. The result is the throatiest possible squeak. The more efficient the protagonist becomes, the squeakier and throatier grows his voice. Well! The young man was big and strong and was just able to squeeze out those throaty tones through a program; his wife's voice was completely ruined.

An attractive young lady who had studied for seven years and graduated with a teacher's diploma from one of the biggest conservatories in the country, after a four year course, came to work with me. She had started with a good voice. When she sang for me the highest tone she could reach was F on the top line. Every tone was a pitiful squeak and her face and neck were so distorted that she looked like a wizened old woman. She could not sing and would not teach, since she was conscientious and realized that she had learned nothing about vocal teaching.

Still another case—During one of my lecture tours, I visited one of the most pretentious out-of-town conservatories. After my lecture, one of the vocal teachers invited me to dinner. In the course of the conversation she blithely said to me: "Of course, we do not produce artists, our object is to train teachers, not to make the students sing." In other words, their methods, taught to prospective teachers, failed, in every case, to make anybody sing.

I have had innumerable cases of impaired and ruined voices brought to my attention. The formation of nodules, for example, as a result of vocal abuse, is only too common. I have cured two such cases only recently. In one of them, a young girl of eighteen was unable to speak through an entire sentence without her voice catching and stopping. She was one of the many victims of a radio-technic teacher in New York. The other case was the victim of a Philadelphia teacher.

Fortunately, nodule cases are relatively easy to cure, since the establishment of the lower register opens the throat and thus releases the constriction which has caused the nodule.

Since the squeezing action of the throat has weakened the arytenoideous action, the vocal cords do not come into close approximation. The pupil is then able to sing, although the breath expulsion is high, and by the time the necessary degree of laryngeal development has been attained, the nodules have disappeared.

Matters are, today, no better in other countries—I have also been in contact with hundreds of singers whose voices have been ruined as a result of European training.

The really competent teacher must work out the procedure for himself—along the lines I have indicated, but according to the specific case he is handling. There are no set rules or physical gestures which will avail him anything. Without knowledge, his ear benefits him but little, but without ear, his knowledge is just so much dross.

Many people have asked the question: "Why is the Golden Age of Song past?" The answer is "Bad teaching". When I was a young man, I studied with a number of teachers in Europe, among them Emmanuel Garcia. He was typical of the old school. He didn't really teach technic at all. He couldn't do anything to improve my voice radically, or those of his other pupils, but he did not interfere with a naturally good technic. He encouraged his pupils to sing full voice and he emphasized the attack. His corrections took a form of "No! not like that; like this," and he would sing a remarkably free tone for so old a man. He used to say—"I can place a book on the piano, so! But you cannot place your voice!" Each lesson I had to know a new Concone exercise and he taught me how to sing songs. He had the picture of power and freedom—he knew that a voice should ring out over the orchestra and fill an opera house. He never hurt a pupil's voice. He didn't "place" it in the nose, or "in the masque", and he didn't teach "breath control". Thus, if a pupil with a great voice went to study with him, he kept it, and a great singer was allowed to appear.

Today most of the best voices in this country are given free scholarships. These students start with fine voices. They have the sort of voice which I too would choose. At the end of a course of four years' study, their natural voices have disappeared. They have lost all their natural power and freedom and have become throaty and nasal. At this stage they would no longer be eligible for the scholarship which was given them when they started. This is true in hundreds or even thousands of cases.

The most talented pupils have the greatest natural "drive", and the more certainly are their voices ruined. If Caruso had been given the type of training these students receive he would never have appeared in public.

There are only about two singers at the Metropolitan who are able, more or less consistently, to top the orchestra, and they are not in a class with Enrico Caruso, Emmy Destinn, Mario Sammarco, Kirkby Lunn, Marcel Journet etc. Of the others, there is not one who is not absolutely mediocre; and many of them might have been great artists.

Any reader who is too young to have heard any really great singer may say: "I enjoy so and so's singing; I think that his voice is wonderful". Let me point out to him that if Caruso, Destinn, Melba, Sammarco, or any one of the really great singers were to come back and appear at the Metropolitan today, the audience would immediately recognize the enormous difference and go wild with enthusiasm.

Perhaps the evil had its first big impetus in Paris, where Jean De Reszke started the "singing in the masque" idea which has done such inestimable harm; although the fantastic imaginings of Lillie Lehman have borne much evil fruit. One of the troubles lies in the fact that people are apt to look to the ex-great singer in order to learn how to sing; but he is an ex-singer —he has lost his voice or he would still be singing, and he has lost his voice because he has abused it. He always does harm, since he teaches the very tricks which have destroyed his own voice. A procedure which can destroy a great voice must indeed be bad. After all, when the voice functions properly, no definite sensations can be observed by the singer himself. It is only when it starts to deteriorate that he is able to observe diverse sensations. These sensations arise because of muscular interferences, and the worse he sings, the more clearly defined do these sensations become. When he sang really well, he just didn't know how he did it. As each degree of throatiness became more pronounced, the accompanying sensations also became more apparent. Take Jean De Reszke: the natural fault of a French singer, who is losing his voice, is nasality. The throatier he becomes, the more apparent is this sensation of nasality, or of something occurring in the front of his face. This undesirable transmission of sound waves through the masque is directly communicated by tension on the jaw and constriction

of the throat. This is the source of Jean De Reszke's idea of "singing in the masque".

As the voice becomes throatier and throatier, the action of the muscles of the thorax becomes more and more of a blowing process, hence the idea of "breath control". Need I develop further? Each school of singing has been derived from the sensations of ex-great singers who have lost their voices. Their theories are always one hundred percent wrong.

Since the publication of my books, relatively few other works on this subject have appeared. One or two of these have propounded the same old theories of "voice placement", "breath control" etc., which I have discussed and condemned in my writings. Several others have contained more or less extensive quotations from my works. Some of the authors have given full credit and acknowledgement, others have paraphrased many of the statements I have made without acknowledgement. However, I am glad to know that my findings are beginning to take root.

There is only one method of obtaining reliable information about any subject, and that is through serious, unbiased, scientific research. Findings based upon scientific research are true, and must be so, since science consists of the marshalling of the known facts, and of properly checked research based upon this data. An approach from any one angle is not scientific. Thus, findings with regard to the voice based upon acoustics or anatomy or physiology or psychology or artistry alone are of little value. They must be based upon a composite understanding of all we know and can discover in each of these realms of art and science. If any phase of the subject is not taken into account the deductions drawn are of little value.

In spite of my researches and those of certain other scientists working in this and allied fields, many of the widely accepted ideas about technic still present an extraordinary anachronism. These ideas are of so unscientific a nature as to leave one incredulous that they can exist. They bring to mind the wild imaginings of the alchemist and the witch doctor. The fact that they can exist in 1939 when science has advanced to a point at which the "talkies", the radio, the telephone etc., and finally the Voder, were developed is quite incredible.

Even as late as 1938 a book written by Pierre Key appeared. In this book he makes such statements as: "It should be borne constantly in mind that one should do one's singing mainly

from the upper teeth up.—Nevertheless the heart of our singing power-house is to be found in that portion which constitutes the region of the hard palate and extends forward and upward." And again: "The sensation of feeling the throat to be a sort of open space, and of the tone as something that is issuing forth as though pouring from a faucet, is one of indescribable delight." This book is full of such absolutely meaningless and unscientific notions. Perhaps Mr. Key was joking when he wrote it, but the alarming fact remains that some of the critics took him seriously.

The art of singing reached a peak in the days of Caruso, Melba, Destinn, Sammarco etc., when the teachers used, more or less exclusively, a trial and error method. As I have already stated, these teachers had formed a good picture of what singing ought to be and were governed by the fact that those who sang the leading roles in an opera became ineffective if they were unable to top the orchestra and chorus all the time they were singing. None of the great singers of this age were submerged. We never saw the lamentable picture, so common today, of a singer standing in the middle of the stage opening and shutting his mouth while the orchestra completely drowns his voice.

Today singing is at its lowest ebb. This has been brought about by two causes: First, the development of amplifying systems and the radio which permits singers with no real voices to perform because their intensity is amplified electrically. In other words, science has had an apparently destructive effect, since, without the amplifier, such singers could never have attained any prominence whatever. The second cause can be summed up in a single phrase: Pseudo-scientific teaching. The vocal teacher who has been without scientific training has been forced to use a pseudo-scientific phraseology in order to cover his lack of knowledge. The exciting developments of science have inspired him to propound theories of a sensational nature, which, while they have no basis in fact, delude the vocal student and singer into a belief that they are scientific and up to date, while in very fact they merely parallel the wild imaginings of the medicine man.

Let me, however, end on a note of confident optimism. The reliable scientific information which we now possess has enabled us to establish fundamental laws and we have been able to deduce diverse procedures which can be applied to the training

of the human voice. These laws and procedures have reached a point at which it is possible for us to "make" a voice. The time is not far distant when a great many really fine voices will be developed. As soon as these findings have been generally adopted and a group of scientifically trained vocal teachers have been developed, we will, without question, enter upon a new era in which the Golden Age of Singing will be completely eclipsed. This same science which has, at the moment, been instrumental in destroying the art of singing, must inevitably, in the near future, be the means by which hundreds of great singers are developed. The seed has been planted and is rapidly taking root. The day of great singing is on the near horizon.

APPENDIX TWO

QUANTITATIVE STUDIES ON THE SINGING VOICE

By

S. K. WOLF, D. STANLEY and W. J. SETTE

Electrical Research Products, Inc.

Reprinted from THE JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA, Vol. VI, No. 4, April 1935, by permission of the editor.

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INTRODUCTION

Heretofore exact consideration of the art of singing has been handicapped by the lack of suitable quantitative means for simply evaluating voice characteristics. Recently developed acoustical devices have made possible the inauguration of a series of physical tests on the singing voice resulting in a large amount of objective data of considerable potential significance. The factors studied include intensity as a function of time and pitch, vibrato, vibrato-tremolo and tremolo, and quality. The fundamental aim of our work is to evaluate the caliber of a voice as completely as possible insofar as its external physical manifestations are concerned. Ultimately, we hope that it will be possible to establish a definite correspondence between these external manifestations and a singer's vocal equipment, thus obtaining an objective method for rating the latter. On the basis of present information it is possible to evaluate the performance of a singer in regard to some characteristics of his voice, and to demonstrate improvement or deterioration. It has also been found possible to evaluate certain phases of artistry depending on physical factors and mechanical control. We are, at this time, presenting a preliminary report of our findings.

DESCRIPTION OF INSTRUMENTS

The instruments used included an automatic level recorder,[1] a crystal analyzer[2] and an acoustic spectrometer,[3] all developed at the Bell Telephone Laboratories. As its name suggests, the automatic level recorder is a device for automatically securing a record of fluctuating sound pressure levels in decibels as a function of time. The frequency range extends from 30 to 10,000 cycles. The sensitivity of the stylus may be adjusted to follow intensity level changes up to 360 db. per second. By driving the recorder paper and crystal analyzer tuning control synchronously, the horizontal axis may be made frequency instead of time, and a quick harmonic analysis obtained. The crystal harmonic analyzer has two separate filters incorporated, one giving a band width of 20 cycles, and the other of 200 cycles. The frequency range extends from 40 to 10,900

[1] E. C. Wente, E. H. Bedell and K. D. Swartzel, J. Acous. Soc. Am. **6**, 3 (1935).
[2] W. P. Mason, Bell Sys. Tech. J. July, 1934.
[3] C. N. Hickman, J. Acous. Soc. Am. **6**, 2 (1934).

cycles. The acoustic spectrometer employs 144 reeds, each responding to a different frequency. The lowest reed frequency is 50 cycles, the other reeds being tuned at progressively increasing frequencies with a 2.93 percent interval; i.e., there are 24 reeds per octave. The maximum frequency is 3109 cycles. The reeds are adjusted to give equal response for equal input voltages, the deflection being proportional to the voltages and therefore to sound pressures at the pick-up microphone. A photographic attachment permits records to be obtained.

For all of our measurements the singers were located in an acoustically dead room with the instruments in an associated laboratory. A loudspeaking communication system between the two rooms permitted the transmission of instructions and the singing pitch. Normally, one experimenter remained with the singer for aural check and coaching, while another operated the electrical equipment. The use of a dead room with close microphone pick-up minimized the possibility of errors due to reflection interference. A Western Electric moving coil microphone was always employed as the sound pick-up.

PITCH INTENSITY MEASUREMENTS

If we consider ordinary physical experience, one type of measurement we would make on a singing voice is an examination of the acoustic output as a function of the singing pitch. In rating mechanical or electrical equipment, one criterion is the efficiency of the equipment over a given range of working conditions. In our case we have plotted the power as a function of the pitch range. While the ability to make a loud sound on a few tones does not indicate a good or well-used voice, the ability to sustain a high level of intensity over a wide range does indicate that the voice is being produced at high efficiency. In any case, one criterion for evaluating a voice is the power output available.

With this in mind, pitch-intensity measurements were made for more than fifty voices of various calibers ranging from untrained singers and beginners to successful professional artists. The voices tested included various types of baritones, tenors, contraltos and sopranos. Unfortunately, no true, fully developed bass voice was available.

For such measurements, we used our automatic level recorder. The singer was placed in the acoustically dead room at a distance of fifteen inches from the pick-up microphone. He was told to sing the vowel "ah" at full intensity and as freely as possible. He was asked to start with the lowest tone which he could produce and to hold each tone for about five seconds. Readings were taken at whole tone intervals until the highest tone which he could produce was reached. The microphone was orientated on a level with the mouth and in such a direction as to secure sound incidence at an angle of thirty degrees from the normal. The microphone and level recorder were calibrated daily by means of a standard sound source.

In reading intensity values, the highest sustained part of the tracing was considered, and where vibrato appeared, the repeated maxima were read. In most cases two sets of readings were made and the higher value for each tone plotted.

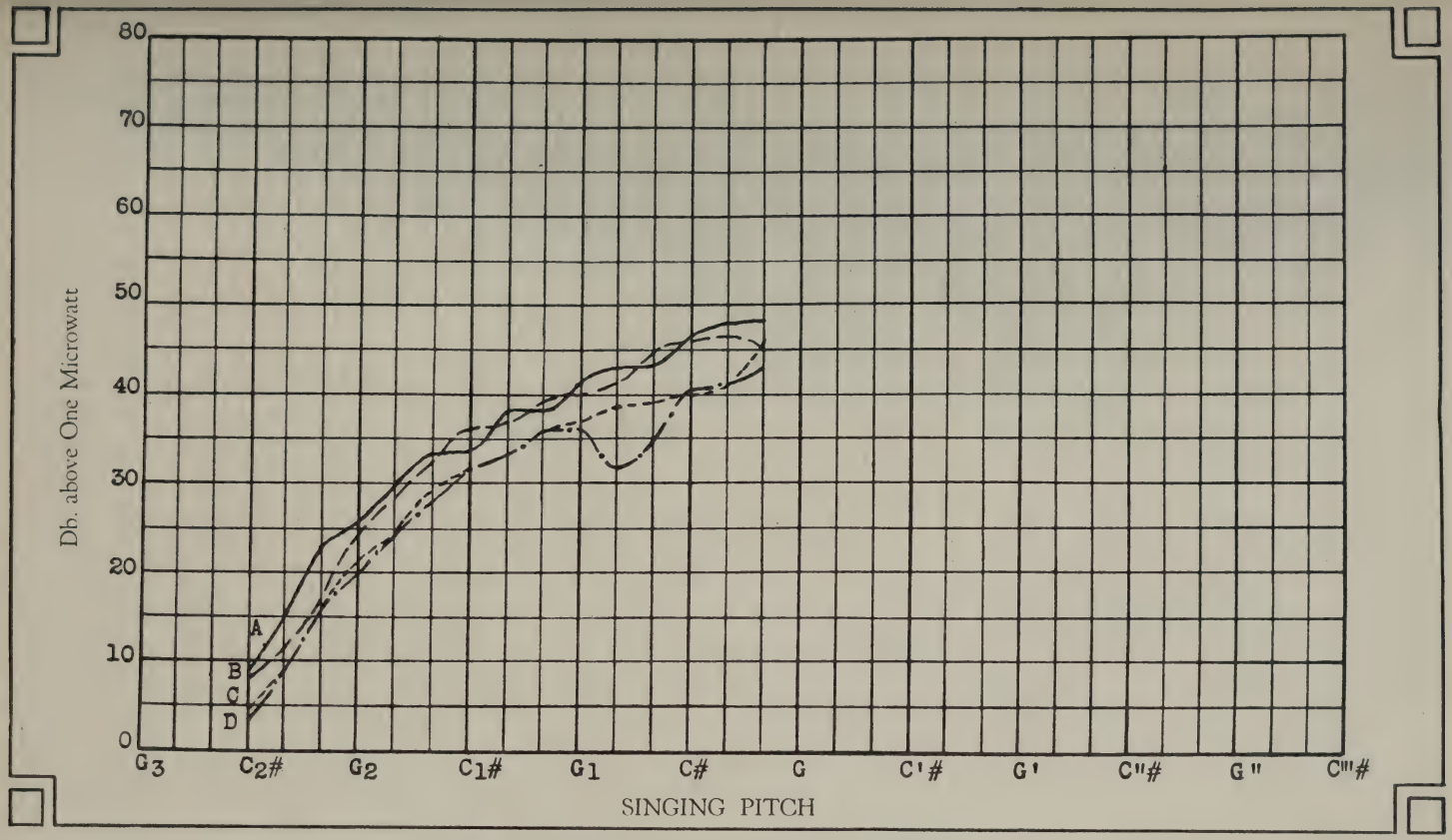


Fig. 1. Full voice power level *vs.* singing pitch.
Average levels produced by five baritones.
A. AH ————. *B.* AY — — — —. *C.* OO - - - - -. *D.* EE —·—.

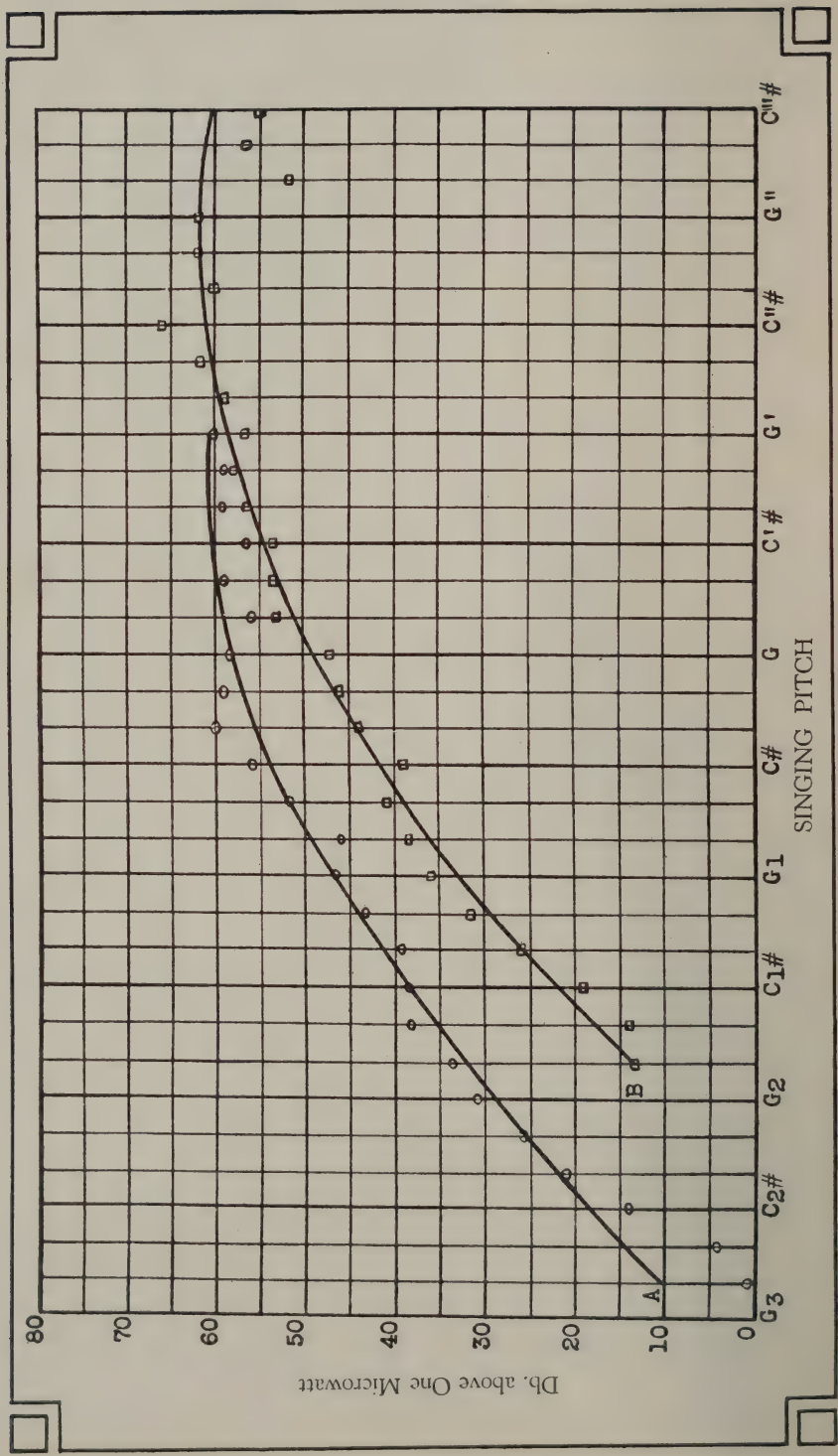


Fig. 2. Full voice power level *vs.* singing pitch. Reference curves. *A.* Men. *B.* Women.

In the cases of women whose registers were isolated, but not coordinated, separate readings of the falsetto and the lower registers were taken so that, over a certain area of the range, two points were obtained. Where the registers were not isolated, only one curve could be obtained. A few readings were made of men's falsettos, but this test was not taken in most cases, since men should not use the falsetto in performance.

Figures given in this paper are all total sound output levels relative to one microwatt. They were computed from the measured intensity levels assuming hemispheric radiation from a singer's mouth. The assumption of hemispheric radiation seems the most likely one to make. However, a few tests we made indicated that the level existing fifteen inches from the side of the head were in the order of 4 db. lower than those existing fifteen inches in front of the mouth. This difference varied with the singing pitch. With the singer facing away from the microphone and his lips fifteen inches from it, the intensity was down an additional 2db. For vowel sounds other than "ah" the differences were of varying magnitudes. In general, the darker vowels showed smaller differences.

"Ah" was selected as the standard vowel to be sung, primarily because it is an open vowel and widely used in exercising. In order to investigate the relative intensities of the different vowels with regard to pitch, we took measurements over the ranges of five good baritones singing on the vowels "ah," "ay," "oo" and "ee." We then plotted the means of these readings, as shown in Fig. 1. It will be noted that "ah" and "ay" are at a somewhat higher level than "oo" and "ee." This is not surprising in view of the fact that the mouth is generally in a somewhat closed position for the latter and relatively open for the former. The relatively smooth rise in intensity with pitch of three of these curves is an outstanding characteristic. For the vowel "ee" there is a sudden drop centering at the pitch of A below middle C (C=261.6 cycles). This effect was extremely pronounced for some of the singers, but repeated measurements of the same voices did not show it to be consistently present. It is accompanied by a noticeable change in the quality of the vowel and the original quality being sung determines whether or not the drop occurs. The effect was also noticed for a good contralto and apparently is connected in some way with the vowel determinants.

Our subsequent measurements are all concerned with the vowel "ah."

In order to obtain a basis of comparison, it was decided to draw two reference curves, one for male and one for female voices. For these curves the points used corresponded to the highest levels obtained by any singer on the various tones. In drawing the curve for men's voices, allowance was made at the extreme low end for the fact that no real bass voice was available. The curves, as well as the determining points, are shown in Fig. 2.

The ranges considered were from A_3 to G′ (55 to 784 cycles) for men's voices and from A_2 to C‴ sharp (110 to 2216 cycles) for women's voices.

It will be seen that there is a uniform rise in intensity in both curves as the pitch rises, except at the extreme upper end. The extreme high points are not well determined since, in the women's curve, only one girl

tested was able to sing above G″ and, in the men's curve, only one man was able to sing above D′ sharp. This may account for the droop at the top of both curves. For the balance of the curves, various singers were able to contribute.

It is possible that, if enough readings were taken from the voices of really great singers, the men's and women's curves would be exactly similar but an octave apart.

Various hypotheses are possible in order to explain the increase of intensity with pitch. As the pitch rises the tension on the vocal cords and on the muscles of the thorax increases. The resultant increase in breath pressure should partly account for the rise in intensity. Another possible explanation of increased intensity lies in the fact that, as the pitch rises, the lower harmonics generated by the larynx more nearly coincide with the resonance frequencies of the vowel sounds. If the assumption made by various people[4] that the distribution of energy among the partials generated by the vocal cords varies inversely as the cube of the harmonic number, then, when the lower partials of a high tone are accentuated through resonance, a higher level of energy should result. Still another consideration is that, if the amplitude of vibration remains constant with frequency, the energy should increase according to the square of the frequency. It is possible that all three factors enter into the phenomenon in some proportion. In any case, it is well known that a great deal more exertion is involved in singing a high tone than in producing a lower one. The phenomenon is in accordance with the common observation that, when one speaks loudly, he raises the pitch.

The maximum values measured for both men and women were of the same order of magnitude, i.e., one watt. This compares with the value of forty-one microwatts given by Fletcher[5] for the average phonetic power of the vowel in the word "talk." For extremely loud speech, Fletcher gives one thousand microwatts. The values we found do not appear excessive when it is remembered that a soloist can be heard over a large orchestra and a chorus.

As already stated, the reference curves are a composite of all types of voices. We find that good voices of lower tessitura (contralto and baritone) meet or cross the reference curves for the lower and middle tones while those of higher tessitura (soprano and tenor) meet or cross them for the upper tones and tend to fall below at the middle and, more especially, at the low ends. Of course, this is only true where the voice is properly developed.

EXAMPLES OF PITCH-INTENSITY READINGS

We will now consider some "pitch-intensity" curves taken on the voices of individual singers. In order to demonstrate the relative consistency of our results, there are shown in Fig. 3 three tracings taken at different times of a stabilized baritone voice. The curve taken on July 25, 1934 is lower throughout the upper range than are the other curves. On this occasion, the singer had a bad cold. Despite this fact, through-

[4] J. C. Steinberg, J. Acous. Soc. Am. **6**, 1 (1934).

[5] H.Fletcher, *Speech and Hearing*, pp. 67, 68.

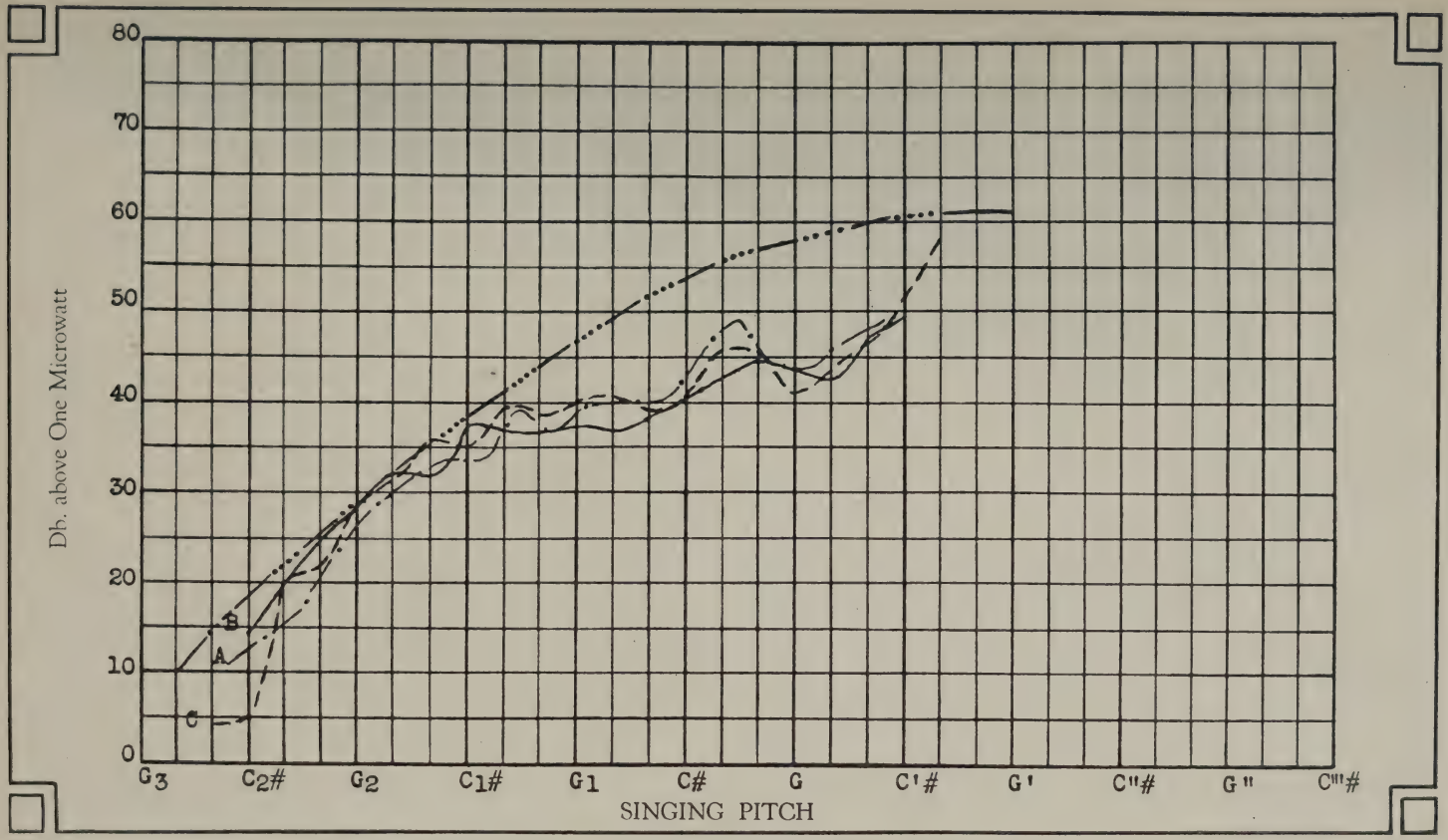


Fig. 3. Full voice power level *vs.* singing pitch. Stabilized baritone.
A. 6/13/34 —·—. *B.* 7/25/34 ————. *C.* 9/5/34 – – – – –. Reference —·····—.

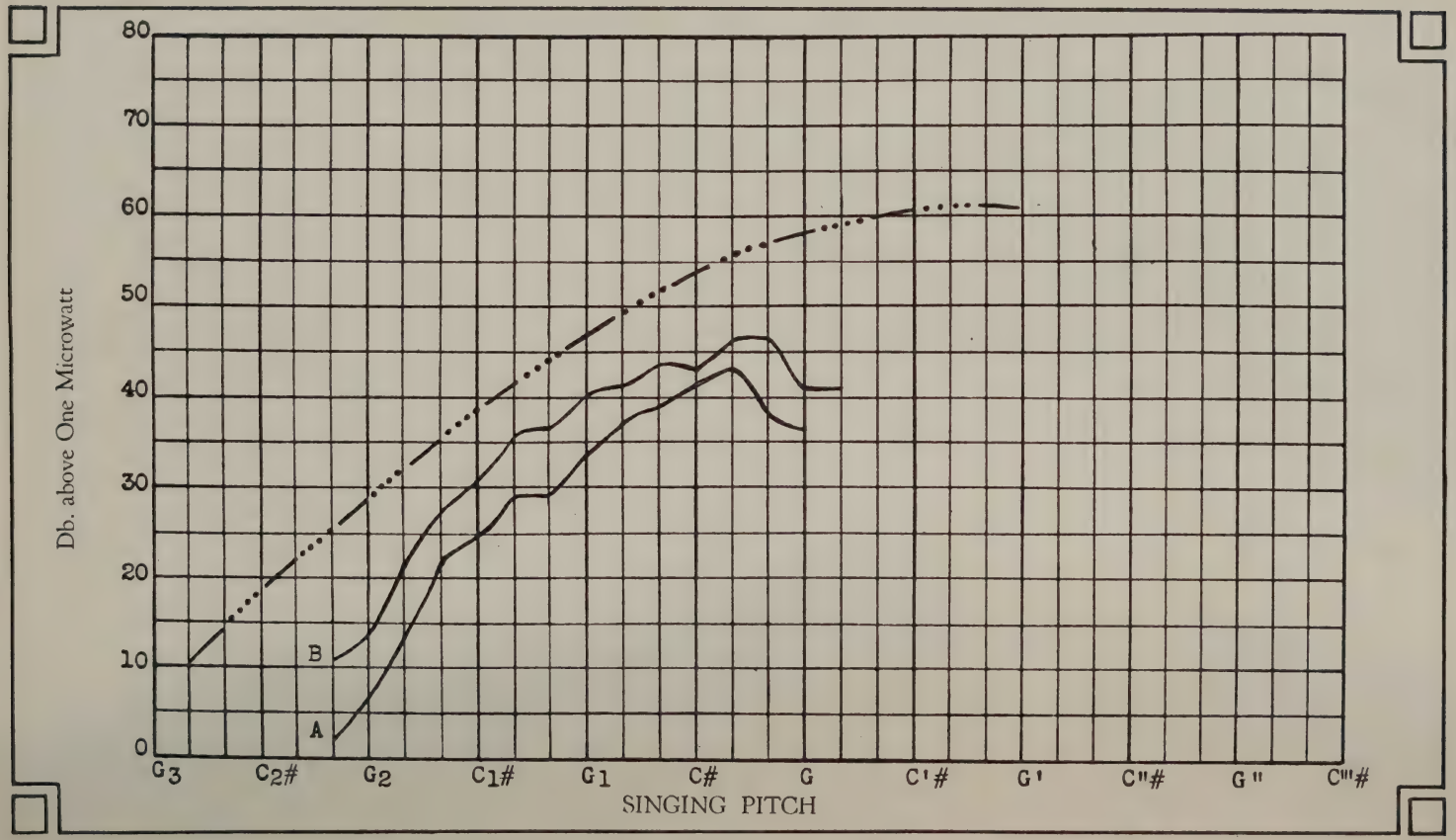


Fig. 4. Full voice power level *vs.* singing pitch. Beginner—baritone.
A. 6/7/34. *B.* 10/17/34. Reference —·····—.

out almost the entire range the intensity variation is generally less than five db. Notice that the range is very wide, over three octaves, and that above $D_1\sharp$ the average increase of intensity with pitch is small relative to the reference curve.

Fig. 4 shows two curves for a young baritone in the beginner's stage. Curve *B* was taken four months later than *A*. The improvement in his voice is apparent since curve *B* is situated from five to eight db. higher than curve *A* over most of the range. Note in curve *A* the sudden drop which starts at *D* sharp. In the curve *B* this effect does not take place until the tone *F* is reached. Notice also that the range has been extended by one whole tone. The voice is of limited range and the power level is rather low. Curve *A* is over 20 db. below the reference curve at the top and bottom of the range. The middle of the range is somewhat better, but even here it is about 13 db. down. In curve *B* the intensity has risen, and in the middle of the range, comes within about 8 db. of the reference curve.

The drops starting at D♯ and F, i.e., at the uppermost tones, are paralleled by similar drops at diverse pitches for other voices. Pronounced drops of this sort seem to indicate that the higher tones are poorly produced. One physiological explanation we may offer is that a constriction of the throat occurs at such points. Whatever it is due to, the condition apparently is ameliorated in the course of training.

The two curves in Fig. 5 are for a fine tenor voice under training. Curve *B* was taken four months later than *A* and shows not only a striking increase in power but also a wide increase in range at both ends.

Curve *A* is somewhat irregular, and through the middle of the range is often ten or more db. below the reference curve. Curve *B* is more regular and comes up throughout the range to within 5 db. of the reference curve except for the lowest tones. The slight drop of 2 db. between *B* and C′ sharp in curve *B* may indicate a somewhat faulty adjustment for the C′♯ but the marked drop at D′♯, which does not occur for the contralto of Fig. 6, may be taken to indicate some physiological effect; i.e., improper resonation, reduced laryngeal efficiency, or both. Except for this drop and the minor one at C♯, curve *B* has a relatively smooth rise, which we might assume to be a desirable attribute.

That the young man has exceptional talent may be assumed because of his high power level over a wide range, uniform rise of intensity with pitch, and from his susceptibility to training, judging by the progress shown by curve *B*.

Fig. 6 shows the curves for a fine contralto voice. In this case the lower register and the falsetto are plotted separately. Since equal intensities are shown on two consecutive tones; i.e., C′♯ and D′♯, the former tone being produced with lower register adjustment and the latter with falsetto, she is able to sing up the scale without any sharp transition in intensity. The point at which she should change from lower register to falsetto at full intensity is, therefore, D′♯. The curve crosses the reference curve at several points throughout the range with no material drop at any point and with the highest tone in the voice considerably above the reference curve. An unusually good voice of great power which should be effective throughout its extremely wide

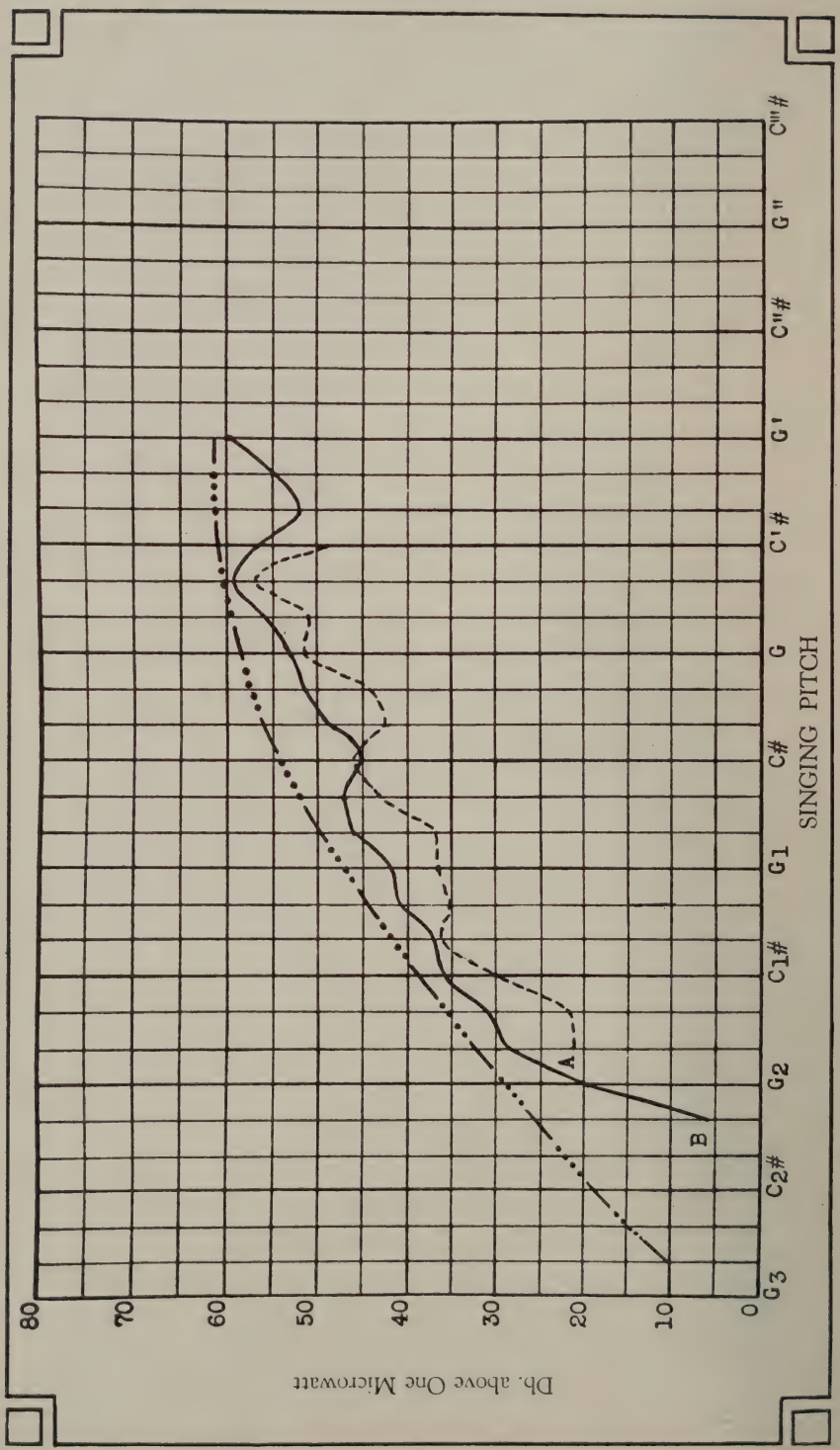


Fig. 5. Full voice power level *vs.* singing pitch. Advanced student—tenor. *A.* 5/23/34 - - - - - -. *B.* 9/26/34 ————. Reference —·····—.

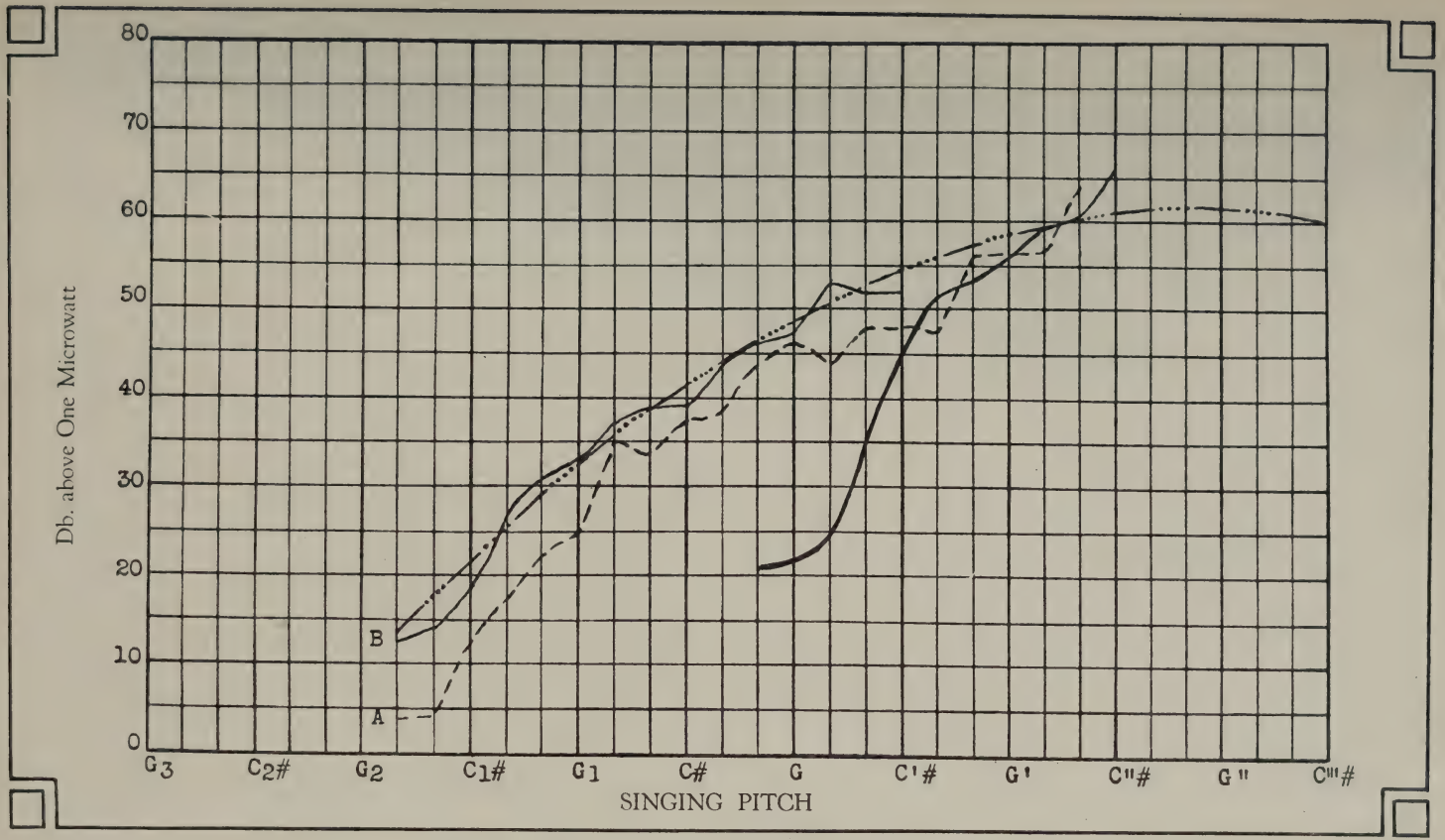


Fig. 6. Full voice power level *vs.* singing pitch.
Advanced student—contralto. Reference —·····—. *A.* 23/5/34 – – –. *B.* 17/10/34 ————.

range is indicated. We have found with women's voices, that, where the range is wide and the intensity high over the range, the lower register is well developed.

Fig. 7 shows the "pitch-intensity" curves of a young soprano. These tracings are of particular interest because this girl, whose voice had been injured, had developed nodules on her vocal cords. At the inception of study, she was unable to sustain any tone and even her speaking voice broke. Before this time only the falsetto register had been employed for both the singing and the speaking voice and it had apparently been strained. The first curve was made some time after corrective treatment had been started. At this stage the lower register was well developed but the falsetto was still weak and the nodules on the vocal cords had not entirely disappeared. The second reading was made three months later when the nodules had disappeared and the strain on the falsetto mechanism was considerably alleviated. The interest in these curves lies principally in the wide change in the intensity of the falsetto throughout the range. The two registers were plotted separately for each occasion. The *A* curves are so far apart that there is obviously no point at which she could change register without an abrupt drop in intensity. The *B* curves show a smoothed out lower register of somewhat higher intensity, especially at *G*; while the falsetto shows an increase in intensity of up to 16 db. In this latter reading it may be seen that, if she changes register at *B*, there is no drop in intensity. The curves show a high intensity in the lower register at about C′ sharp and in the upper part of the falsetto which touches the reference curve at B′. The range covered is three octaves, although as yet the intensity does not rise uniformly.

Fig. 8 shows the "pitch-intensity" curves of two contraltos. Curve *A* is that of the student shown in Fig. 6 and curve *B* is for the voice of an opera singer of some standing.

Considering curve *B* we find an intensity about 15 db below the reference curve throughout the middle of the range, and about 10 db below for the low tones. For the medium high tones (F′ and G′) the intensity is down less than 10 db. At A′, the highest tone which this singer can reach, the intensity is down 10 db. The upper tones are lacking. Notice that the range covered by the opera singer is six whole tones less than that covered by the amateur. It was also observed that the former lacked lower register development.

It may be concluded from this and other similar cases we have tested that some singers are successful in spite of poor vocal equipment by reason of exceptional musical, dramatic or artistic attainments. It seems reasonable to assume, however, that such singers would have attained greater success with better vocal equipment.

CONSIDERATION OF VIBRATO CURVES

Another factor of great importance in singing is the movement of the voice, which imparts a live, pulsating character to sung tones. Some sort of movement is essential not only from a listener's viewpoint, but when correctly effected, is considered to be technically advantageous.

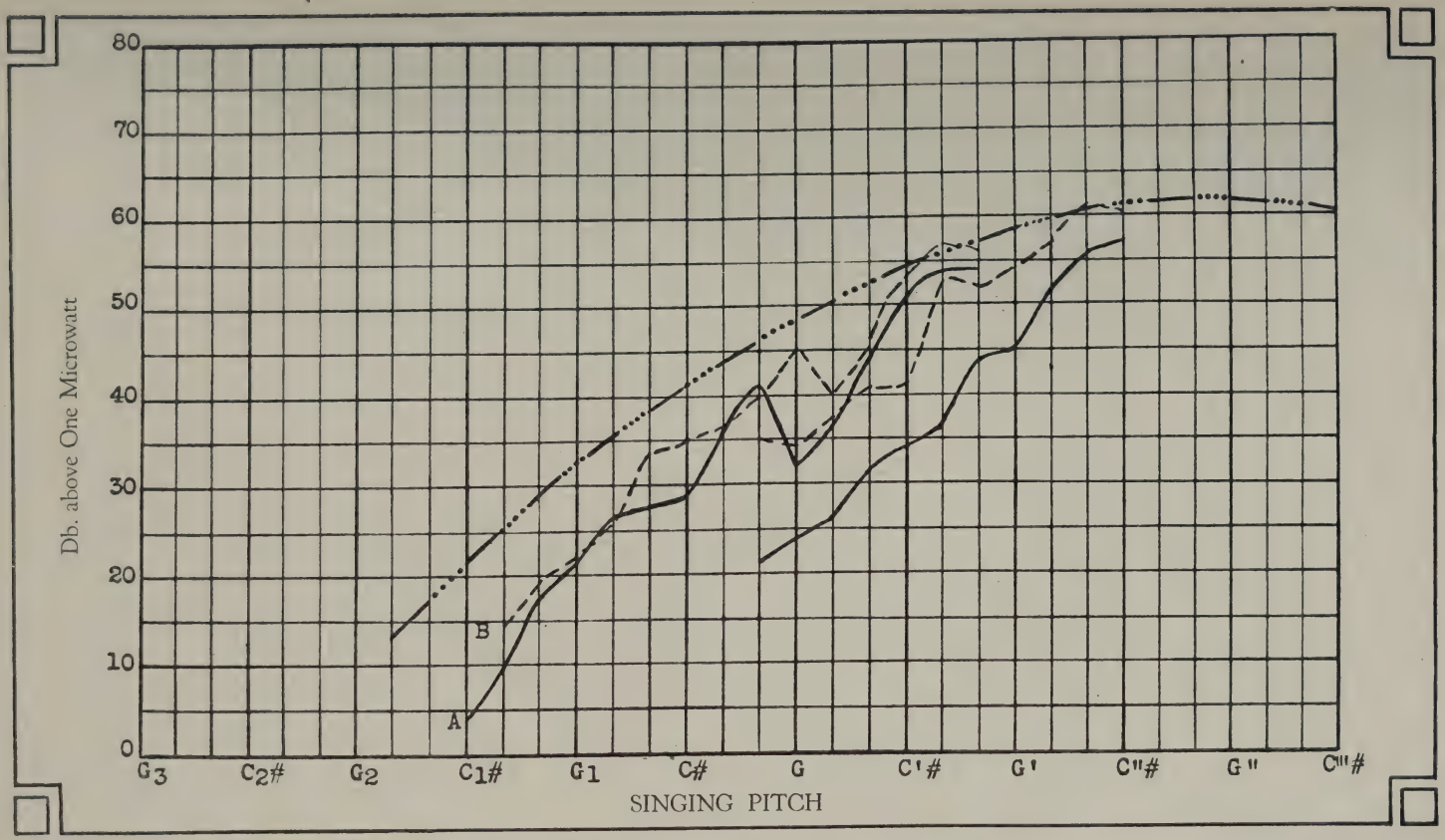


Fig. 7. Full voice power level *vs.* singing pitch.
Soprano (See Text). *A.* 6/13/34 ————. *B.* 9/12/34 – – – –. Reference — · · · · —.

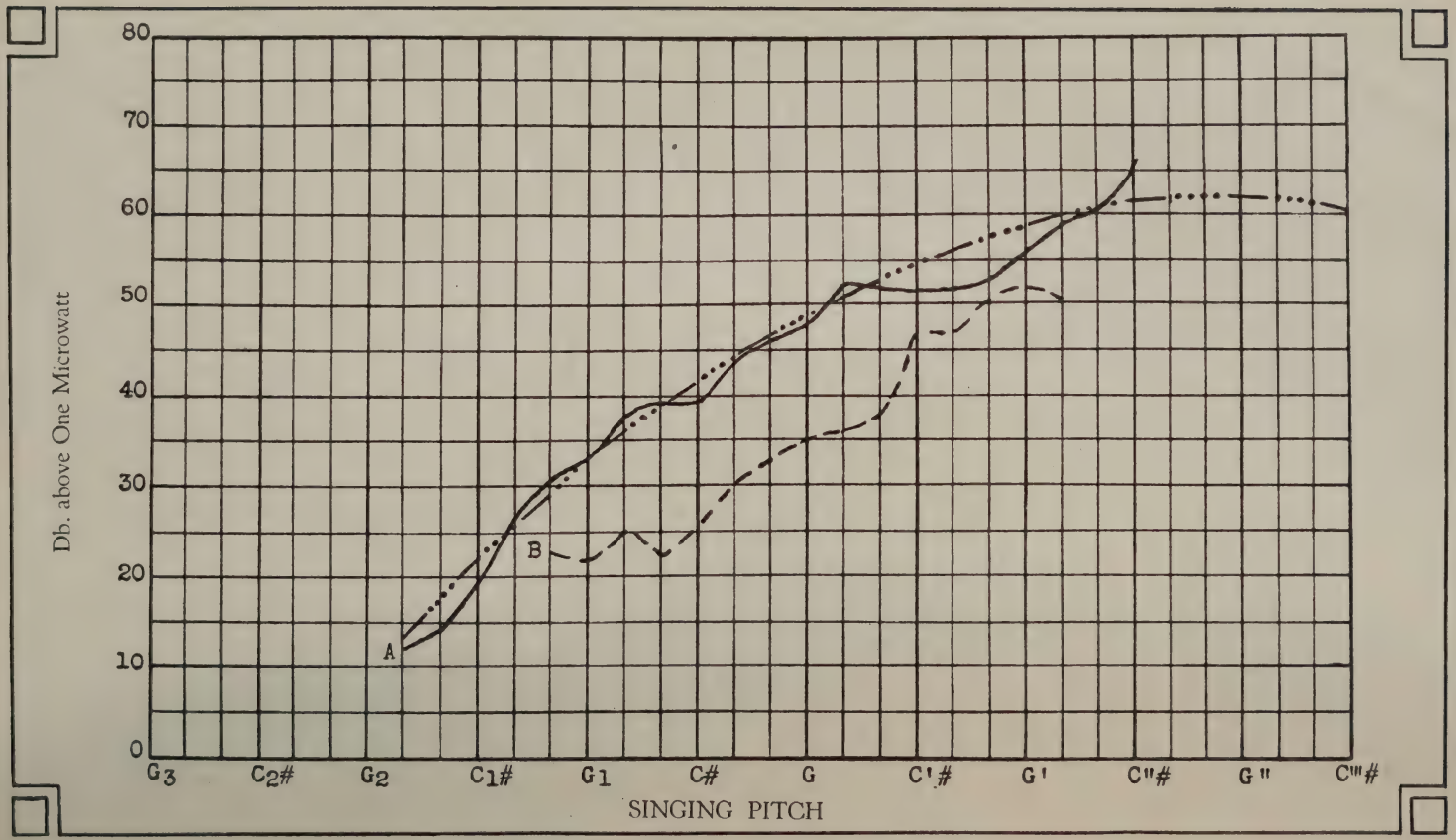


Fig. 8. Full voice power level *vs.* singing pitch. Two contraltos.
A. Student ———. *B*. Opera performer – – – – –. Reference — · · · —.

A consideration of the physiological mechanism involved leads to the conclusion that voice movements of quite different characteristics may occur. We are arbitrarily classifying them as vibrato, tremolo-vibrato, and tremolo. We have reason to believe that, for what we define as vibrato, there occurs a movement of the thorax as well as of the laryngeal and pharyngeal muscles, whereas in the other cases there is no such thorax action. The vibrato is of lower frequency, ranging from about 4.5 to 6.4 per second, whereas the tremolo and tremolo-vibrato range from about 6.5 to above 8 per second. The distinction between the latter is one of degree. Where there is considerable variation in pitch and intensity at the higher range of speeds we term the movement tremolo-vibrato; otherwise we term it tremolo.

The intensity variation accompanying movements of the voice we measure with the automatic level recorder. As was to be expected, the variations differ between individuals and between separate readings for the same individual. Fig. 9 gives some examples. Specimens *a* and *b* show medium and wide vibratos, having a relatively even form. Specimens *c* and *d* have a sort of square characteristic. Specimens *e* and *f* are quite irregular, *f* suggesting the presence of either two unphased movements or harmonics of one fundamental movement.

Specimen *g* shows a tremolo, there being no intensity variation (within the one decibel minimum indication of the recorder) until the last second or so of the tone. Specimen *i* was taken from the same voice and on this tone a tremolo-vibrato is found. Specimens *h* and *j* are tracings of the tremolo-vibrato, the speeds being respectively 7.0 and 7.6 per second. It appears impossible for what we term the true vibrato to occur at this frequency. Specimen *m* shows a tracing from a recording of the voice of a baritone who at one time was one of the world's greatest singers. This tracing was made with the aid of the crystal analyzer in order to permit more definite measurements of the frequency of fluctuation, which turned out to be 7.5 per second. Other measurements of the movement of this singer's voice showed that he had a true vibrato for many of his tones. It is interesting to note that a little while after this recording was made, this singer practically lost his voice.

Specimen *k* shows a tracing of a tone started softly and swelled to fortissimo on the vibrato. It will be noted that at pianissimo there is no vibrato and that, as the intensity increases, the swinging of the vibrato increases until an intensity fluctuation of about 15 db is reached. Specimen *e* shows the intensity and the frequency of fluctuation of a trill. The intensity change is of the order of 10 db and the frequency about 6.7 per second.

We have made measurements of the frequency of voice movements of some of the world's greatest artists, using phonograph records as our source of material. Out of 115 measurements the frequencies in the vicinity of 6.0 per second occurred thirty-one times and predominated over all other frequencies. We take this to mean that 6.0 per second is in the nature of an optimum frequency of variation, at least from the point of view of the person producing a tone. A frequency of less than about 4.5 per second does not appear as pleasing as do higher ones.

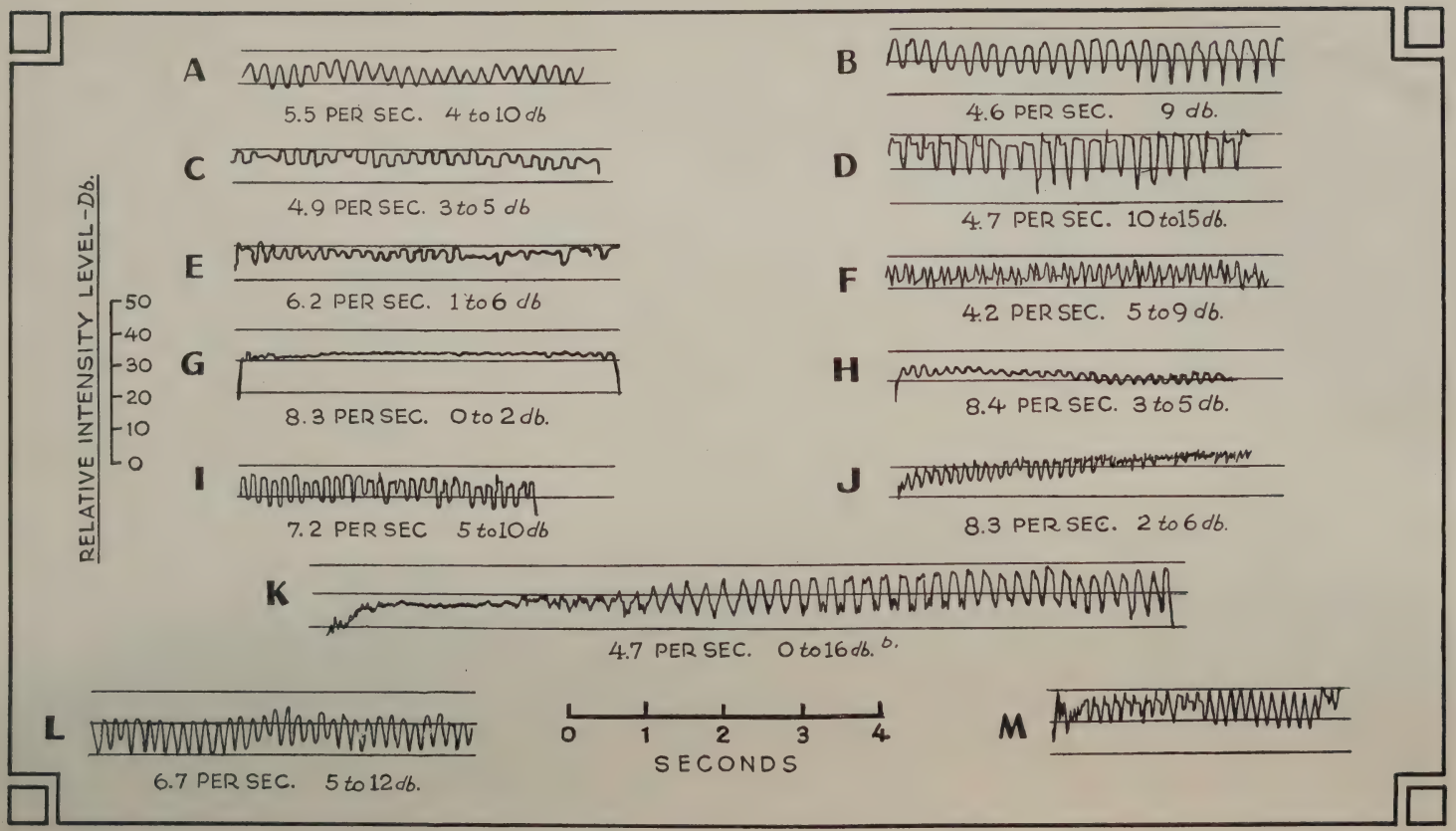


Fig. 9. Level recorder readings of voice movements.

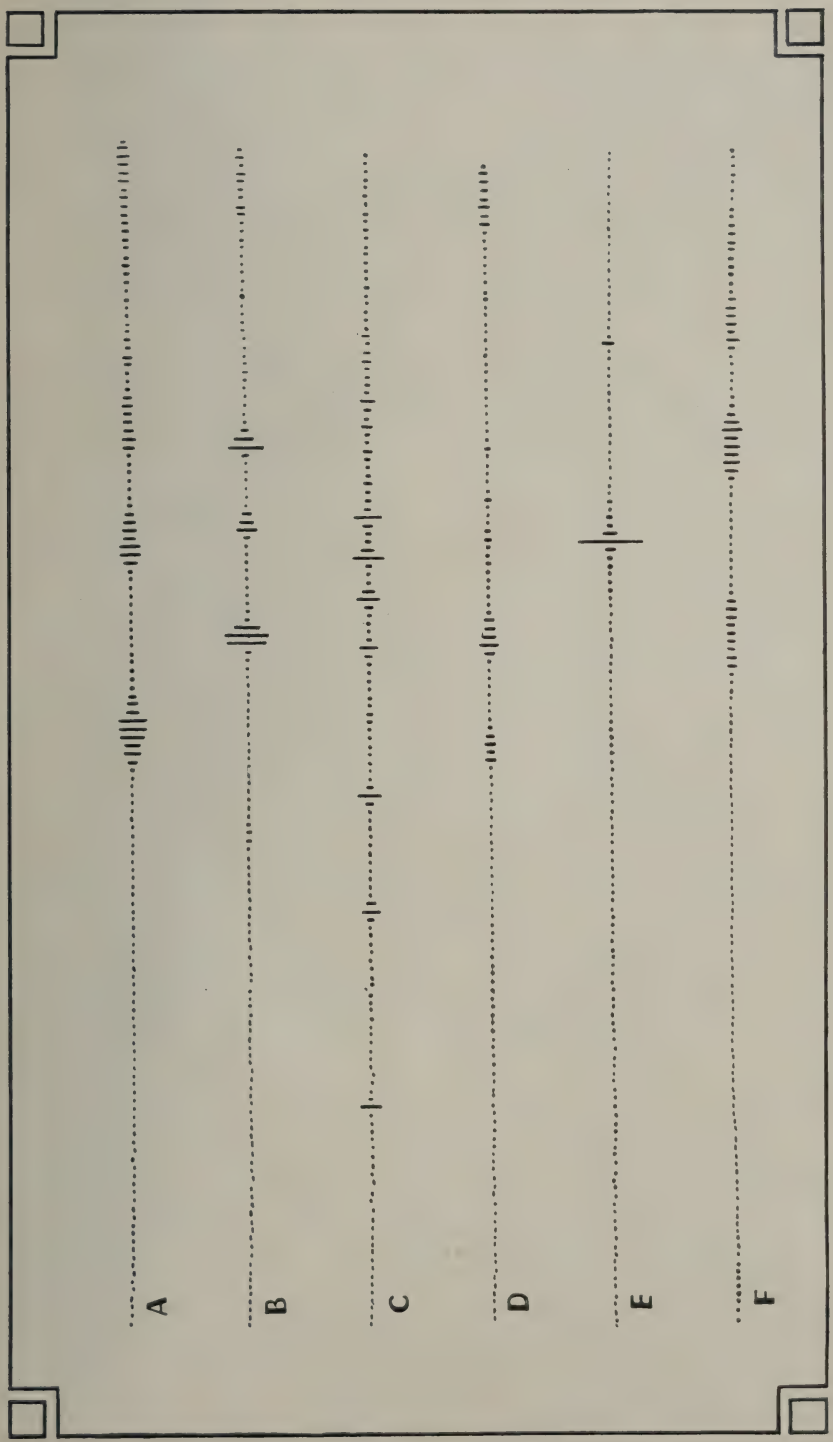


Fig. 10. Acoustic spectrometer readings of pitch fluctuations in the vibrato cycle.

In our work we have studied the development of the vibrato in students undergoing training, and find that, as this development progresses, vibrato is introduced to a greater extent, the movement is intensified, and the frequency raised. The majority of student's fell between 5 and 6 per second.

The pitch variation occurring in the voice movements is also of considerable interest. In order to study this phenomenon our acoustic spectrometer was employed. The singers were requested to hold the tone and the acoustic spectrograms, shown in Fig. 10, were taken, using a three-second exposure. The deflections along the vertical axis are proportional to the sound pressure and the reed number is proportional to the pitch, along the horizontal axis.

In Fig. 10 are given specimens showing the various types of pitch fluctuations which may occur. The pitch variation which accompanies the vibrato may be very wide or relatively narrow. The gradation from wide to narrow is illustrated by specimens *a*, *b* and *c*. Specimen *d* shows the pitch variation occurring in a tremolo-vibrato. It will be observed that the pitch change is a relatively wide one. Specimen *e* shows the true tremolo frequency variation of a successful radio "crooner" of the better type of music; the frequency variation is so small as to be negligible. The pitch change occurring in the trill is a very wide one, as will be seen from specimen *f*. The trill is usually characterized by an intensity peak in the neighborhood of both high and low intensity points.

The results obtained with the spectrometer serve to indicate the relative amount of pitch variation occurring, but the absolute amount is not determined. This follows from a consideration of the physical and mathematical nature of the vibrato. In some respects, a vibrato tone is similar to what the engineer calls a frequency modulated signal, that is, it involves a tone whose frequency is varying periodically. In addition, the true vibrato also involves a periodic intensity variation. If only that part of it in the nature of a warble tone is considered, it will be recalled that it could be represented mathematically by the sum of an infinite number of components for each partial tone, these components being separated from each other by the frequency of the vibrato, i.e., by approximately six cycles per second. The amplitude of these components, or "side-bands" is determined by Bessel's functions, involving the vibrato rate and the percentage pitch variation occurring.

QUALITY

With regard to singing, the term "quality" takes on several aspects. In its strict scientific sense the term is used relative to the harmonic composition of a complex tone. However, with respect to the singing voice, it has assumed more general significance and is used with reference to the total impression created by sung tones. It includes not only harmonic distribution, but also the ability to vary it, maintenance of proper pitch and intensity, and the vibrato or tremolo movement of the tone. For the present we shall be concerned with the strict physical interpretation and discuss it as a factor in singing.

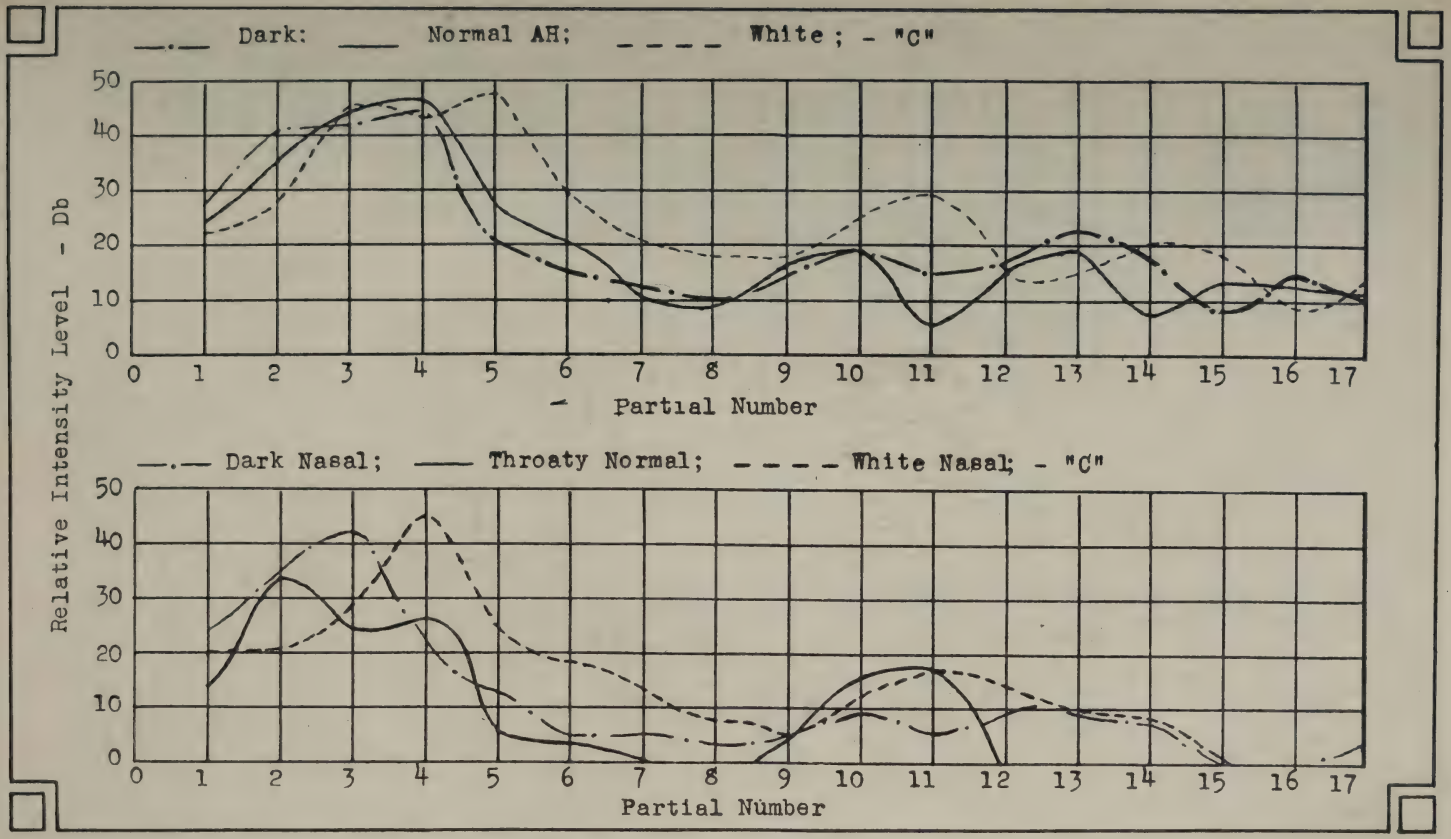


Fig. 11. Vowel "AH," "middle C," six qualities, baritone

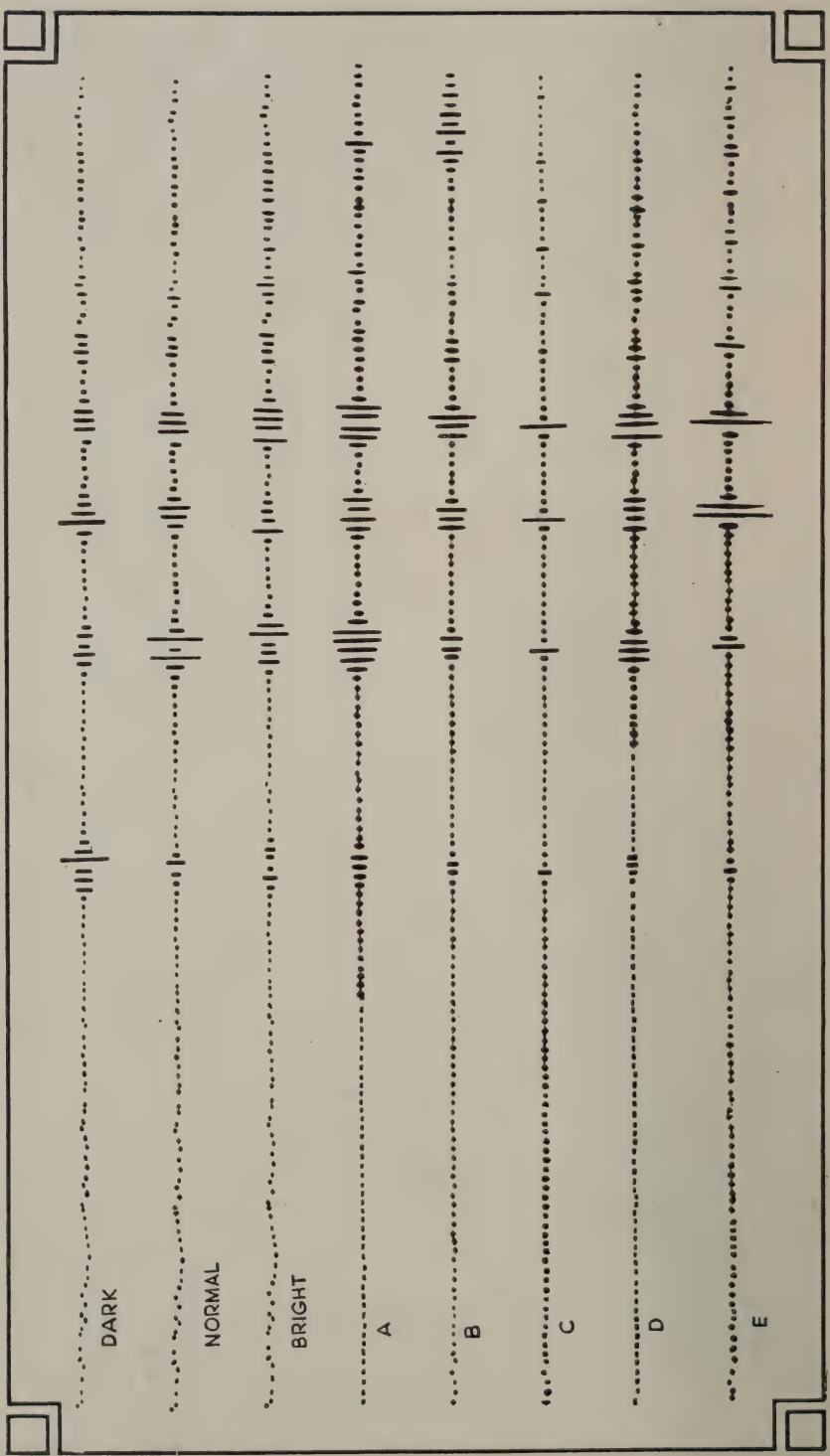


Fig. 12. Vowel "AH"—"middle C"—Different singers.

The quality of a phonated tone is, then, determined by the number, frequency and relative intensity of its components. That a singer has some control over this is evident since he can vary the "color" and change the vowel quality. Furthermore, it may be observed that quality and vowel quality both depend on the harmonic distribution. Only a few frequencies are necessary to determine a vowel although the other partials which are present must modify the impression created, i.e., impart such characteristics as "brilliance," "shrillness," etc. It may be possible to consider that frequencies outside the vowel bands determine vowel "timbre," whereas variations in relative levels of the partials within the bands determine merely the vowel. However, this can be true only within unknown limits, and we are not at this time prepared to make such a division. Accordingly the term "vowel quality" will be employed for that general factor in singing dependent on the harmonic configuration and corresponding to the physical conception of quality. With this in mind we may proceed to a discussion of experimental results.

Harmonic analyses were made with both the crystal analyzer-level recorder combination and the acoustic spectrometer. With the former the 200 cycle band was used, giving adequate separation for pitches above and including middle C (261.6 cycles per sec.). The use of the 20-cycle band is impractical because of the wide frequency spread introduced by vibrato, especially for the higher partials. A motor was used to drive the analyzer tuning control from 100 to 4600 cycles per second in ten seconds. A few readings have also been made from 4600 to 10,900 cycles, but the amount of power contained within this range is usually very small. The acoustic spectrometer observations extended from 50 to 3100 cycles per second. Photographs were taken using a three-second exposure. Because of the influence of vibrato, and the contraction of the frequency range at the upper end (the instrument has a uniform pitch scale) which causes a crowding together of the partials, the spectrometer results serve mainly as qualitative indications.

To lay the foundations for a thorough investigation of vowel quality observations were made on the vowel "ah" intoned in different manners. Fig. 11 is a plot of readings taken with the crystal analyzer for a baritone voice singing middle C. The partial number is plotted along the horizontal axis, and the relative intensity level in decibels along the vertical axis. In the figure continuous curves are drawn through the intensity levels of the various partials. The upper set shows the spectra for "dark," "normal" and "white" intonations. When listened to, these are heard as "aw," "ah," and "ah" with a suggestion of ă, respectively. It will be noticed that the dark quality is differentiated from the normal by a shift of energy to the lower partials in the region of the vowel determinants, whereas the reverse takes place with the white timbre. These shifts are a general occurrence and are, of course, directly traceable to the vowel characteristics. Variations in the relative intensity of the partials above the sixth (1570 cycles per second) are also apparent, but we are not yet ready to discuss their significance beyond stating that the brilliance of the tone must be affected. The lower set of curves are for dark nasal, normal and white nasal "ahs" on middle C, produced by the same singer using a purposely "shut off" technique. The so-called normal one differs

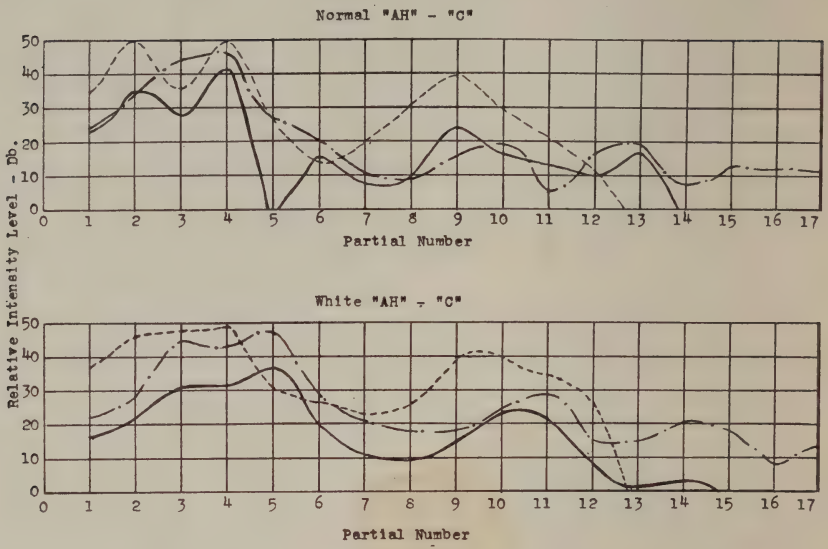


Fig. 13. Analyses of tones produced by three baritones.

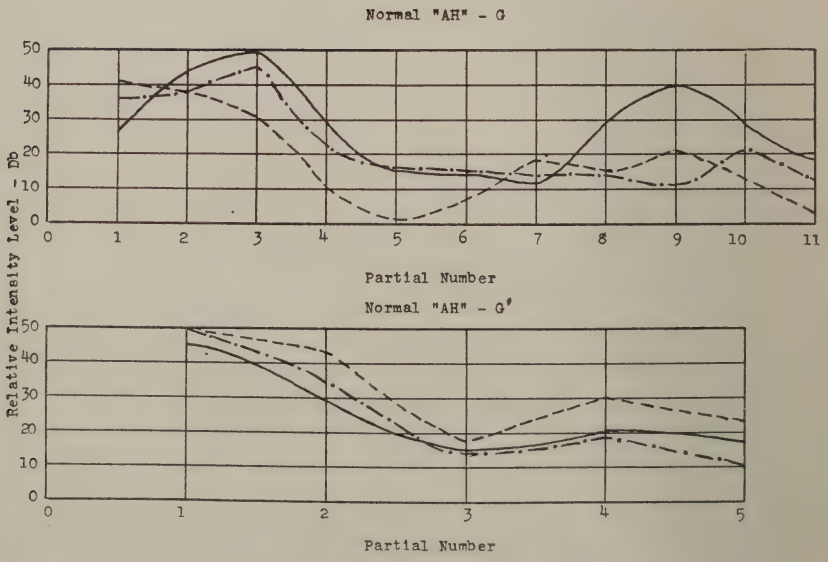


Fig. 14. Analyses of tones produced by three sopranos.

from the normal one produced with an "open" technique, and a difference is audible. For the nasal tones there is present a relatively sharp peak in the determinant region. The appearance of such a peak, which does not always occur, seems to depend on the degree of nasality and the singing pitch.

When different singers are asked to sing the same vowel, marked differences in vowel quality are frequently noticeable. The question arises: Are there any general trends in the harmonic distributions of phonated tones which would indicate whether or not the vowel quality would be considered pleasing, and whether or not a singer is using his voice properly? Our data has so far led to mainly negative conclusions. We present some typical data relative to these points.

The acoustic spectrometer was at first used to perform harmonic analyses. The types of results obtained are shown in Fig. 12. The vowel sung in all cases is "ah" on middle C. The first three, a_1, a_2 and a_3 are for a good baritone singing with dark, normal and white colors respectively. It will be noticed that, as the vowel is brightened, there is a shift of energy upward along the pitch scale. Specimens *b*, *c* and *d* are for three baritones who sang well, fairly well, and poorly, respectively; and *e* and *f* are for two sopranos who sang well and poorly. The outstanding difference between the better and the bad singers is the lack of vibrato frequency spread which characterizes the poor voices. In regard to harmonic distribution, there is no pattern which may be selected as indicative of a good singer. For example, the good singer, *b*, has a prominent partial in the vicinity of 2500 cycles per second which is not present in a_1, a_2 and *e*. The fair singer *c* has an area of strong intensity in the vicinity of 2700 cycles, which is missing in the other voices. The poor singers, *d* and *f*, have prominent third and fourth partials, indicating a whitish quality, but the good singer, *e*, with a predominant fourth partial is whiter than either of these, and the fairly good singer, *c*, is the whitest of all the specimens.

A more limited amount of data taken with the crystal analyzer is similar in import. Fig. 13 shows the analyses for normal and white "ahs" as produced by three baritones. Two of these used their voices well. Their curves are shown in dotted form. Except for the fact that the singer who produced his voice badly (solid line) gives a lower intensity than the others, there is no consistently outstanding characteristic.

In Fig. 14 are shown analyses of the voices of three women. The upper curve corresponds to the pitch G above middle C and the lower curve to the pitch G below high C. The former was produced in the lower register and the latter in the falsetto. Here again the two good voices are shown by dotted lines and the poorly produced voice by the solid line. It will be noticed that for G there is a very pronounced area of high intensity in the vicinity of the ninth partial (3528 cycles per second) for the poor singer. This voice, in the lower register, is of shrill, disagreeable character. The curves of the lower set are rather similar in contour, despite the fact that the solid curve is of a throaty, poorly produced voice, while the other two curves are of well produced voices. At this higher pitch, G′, the vowel quality is relatively pleasing.

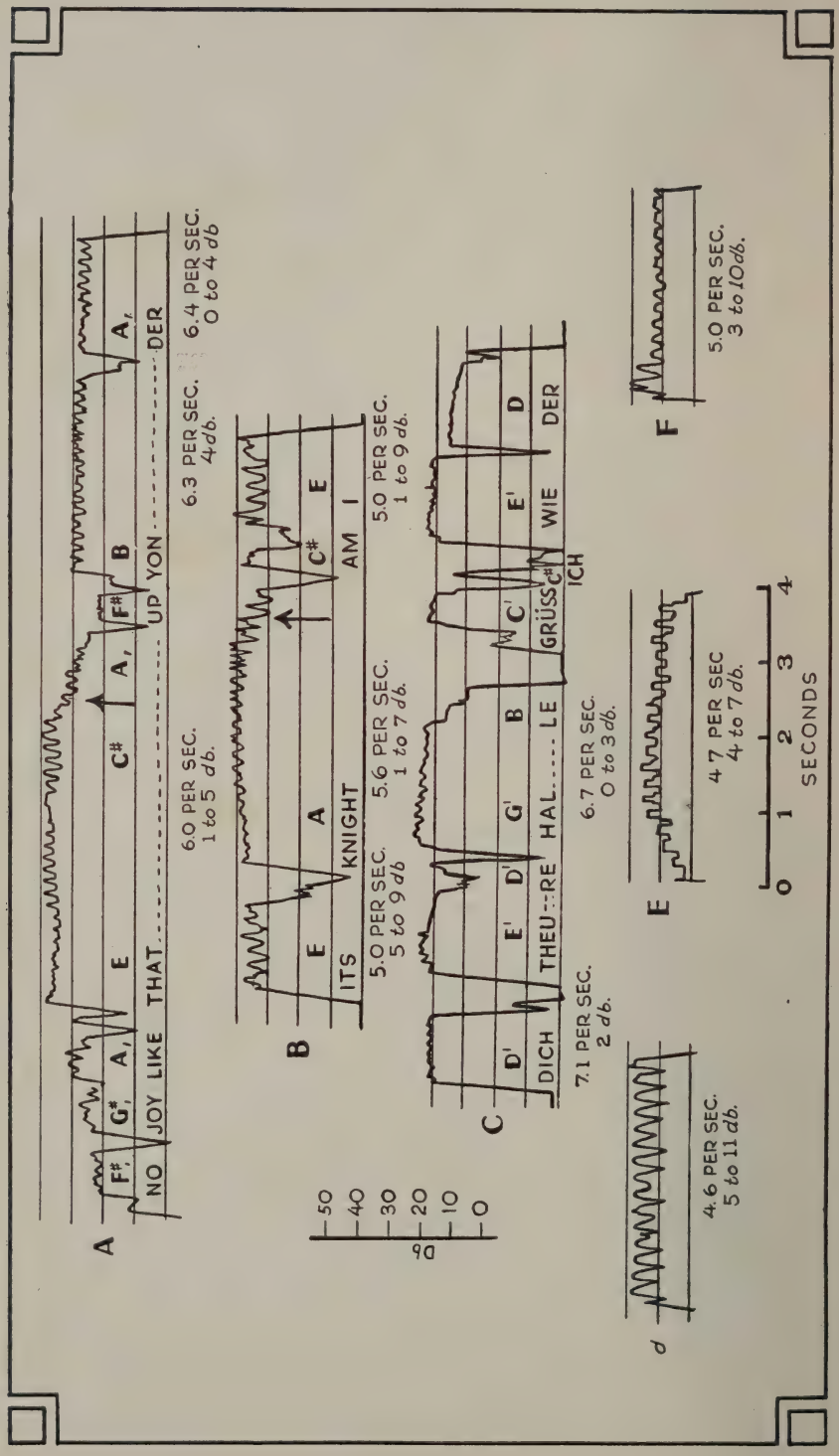


Fig. 15. Level recorder tracings of sung musical phrases.

Our harmonic analyses represent averages over a period of time, and as portrayed here, do not indicate the timbre variations occurring during the vibrato cycle. With the crystal analyzer the amount of time allowed for any one partial is of the order of one-half second, i.e., long enough to include about three vibrato cycles. Curves obtained using the level recorder and the crystal analyzer serve to indicate a few db. change in level for any one partial in a vibrato cycle, but as yet we have made no attempt to determine the phase relations of these variations.

Another requirement for good singing concerns the ability of the singer to hold a constant mean pitch as long as the tone is sustained. If the pitch varies, apart from the vibrato fluctuation, the quality is not pleasant. It is not improbable that good musical quality, from the acoustical standpoint, lies primarily in accuracy of intonation and in proper vibrato variation, provided that the harmonic distribution is not abnormal.

In discussing Fig. 8 we showed how an artist could have a certain measure of success with limited vocal equipment. While this statement was not intended to depreciate the vital importance of voice, it did indicate the equally great importance of artistry. While many phases of artistry are a matter of temperament and can, therefore, hardly be measured in scientific terms, certain other phases involve mechanical skill.

Fig. 15 gives some illustrations of the use of the level recorder as an aid in studying a singer's performance.

One important factor in the interpretation of music lies in the singer's ability to start, or attack, a tone in the center of the pitch and to hold the tone constant at the desired intensity. When the tone is badly attacked, the singer starts under the pitch softly and slurs up, increasing the intensity as he raises pitch.

Specimen *e* shows a level recorder tracing of a hesitant attack. Note that the intensity starts low and rises about ten db. It then almost immediately starts to drop and, just before the end, the intensity is down again about 7 db. This inability to attack and hold intensity suggests a singer of inferior artistic rating and also gives the impression of a weak voice, since the full intensity is not sustained. This singer could not interpret a song with a smooth legato.

Specimen *f* shows an extremely vigorous, somewhat explosive attack. In this case the intensity of the tone, at the moment of attack, is about eight db. higher than the intensity at which it is sustained. Constant use of an ultra-vigorous attack is inartistic, but for certain dramatic effects this device may be employed artistically. Notice that this singer is able to maintain a constant intensity. Specimen *d* shows a well attacked and well sustained tone.

Specimen *a* shows a musical phrase sung by a young man who is a good musician and who also uses his voice quite well. Notice that, except for the second tone $G_1\sharp$, and the E, which is intentionally swelled, each tone is struck at the desired intensity (or with a slightly too vigorous attack—as on the E) and maintained at a constant intensity. Notice the increase in the amplitude of the vibrato as he swells the E, and the relative smoothness and almost ideal frequency of the vibrato throughout.

Notice also the vibrato run-down (see arrow) from C♯ to A_1. An inartistic or bad singer slurs from tone to tone and the vibrato disappears.

Specimen *b* shows a well-sung phrase from Wagner's *Lohengrin*. Each tone is struck squarely in the center. The high A is swelled and run down on the vibrato (see arrow). Notice that each tone rises to its proper intensity level, i.e., the A is at higher intensity than are the E's and both E's are at about the same intensity level. In specimen *a*, this relative intensity level is not always correct, since the E is no louder than the C♯. A criticism of singer *b* lies in his vibrato which is somewhat too slow.

Specimen *c* shows an inartistically sung phrase from Wagner's *Tannhäuser*. The voice is soprano. Notice the lack of proper vibrato throughout and the presence of a fluctuation at tremolo frequency. Notice that the D′ at the end is about eight db below the C′ which is nearly as loud as the E's. These deviations are not accountable for by vowel differences. There is a sag in intensity for each tone sung except the first. This indicates rendition which is poorly-balanced and lacks proper legato. Notice the absolute cessation of all movement of the voice as she slurs from G′ to B on the word "Halle," and the failure to establish the tone D′ on the syllable "re" of the word "theure." Notice the three rolled "r's."

CONCLUSION

The studies reported here represent a preliminary attempt to evaluate the mechanics of the singing voice. The continuation of such investigations we hope will lead eventually to norms of considerable practical value and shed new light on the voice mechanism and the manner in which it functions.

We are now undertaking a series of measurements, similar to those outlined here, on some of the world's great artists. Such tests were recently made on Giovanni Martinelli. His pitch-intensity curve showed a generally uniform increase of intensity with pitch, with the levels approximating those of the reference curve. The vibrato frequency was about 5.7 per second, the shape of the intensity variation being of a smooth rounded form, amplitude of 1 to 4 db. Individual tones were well attacked and well sustained.

APPENDIX THREE

THE VODER

By

STANLEY S. A. WATKINS



Photo 1. The Voder.

THE VODER

By

STANLEY S. A. WATKINS

Throughout this book the authors have stressed the necessity for basing all conclusions regarding the operation of the voice upon known scientific principles. In support of this an entire section of the book was devoted to an outline of the physical principles involved.

The established knowledge of the nature of vocal processes has been largely the result of studies and experiments made with the object of improving the methods of handling speech in its transmission over the telephone and by radio and in recording and reproducing it. Examples of such studies are the vowel characteristics in Chapter XLII taken from investigations made in Bell Telephone Laboratories.

Remarkable confirmation of the results of studies of this kind, and of the soundness of the accumulated knowledge of the nature of speech, is seen in an instrument known as the Voder that has been developed in Bell Telephone Laboratories as a by-product of researches to improve speech transmission. This machine, manually operated, actually constructs speech out of electrical elements of entirely non-human character by following the principles of operation of the human vocal organs.

In the human mechanism, as explained in Chapters II, IV, and XLII, there are two processes, each employing the breath, by which speech sounds are produced. In one the breath acts directly, being forced out of the mouth and setting up local air disturbances in the cavities formed by the teeth, lips and tongue. By this process the sibilant consonants, the aspirates, and all the whispered sounds, are produced. In the second process the breath pressure acts in conjunction with the vibration of the vocal cords to produce the vowels and the other voiced sounds.

The Voder has two electrical energy sources, each originating in a vacuum tube, with which the two processes of the human mechanism are simulated. One of these sources will produce, through the medium of a loud speaker, a sound similar to what one would hear if he could listen to the vibrations of

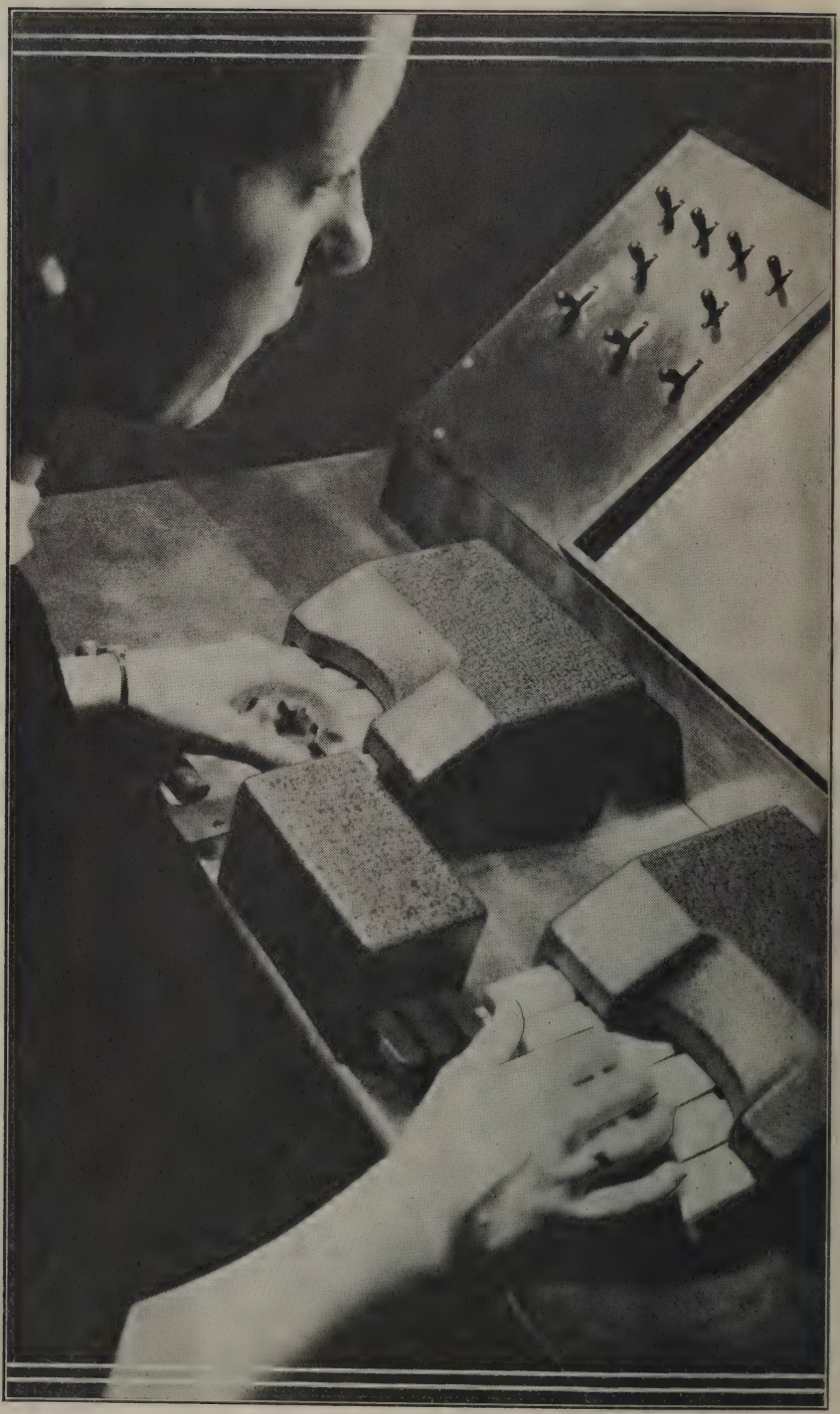


Photo 2. The Voder Keyboard.

the vocal cords without the sound passing through the throat and mouth and so being shaped into speech. This is a kind of musical buzz very rich in overtones. The other energy source originates a noise closely resembling the sound made by the breath when it is forced out of the open mouth. This is the basis for the breath consonants and whispers.

Now, the vocal cord tone and the breath noise are complex sounds made up of components having many different rates of vibration or frequencies. A particular speech sound is produced by picking out from the many components those that have the frequencies characteristic of the speech sound in question.

In the human mechanism this selection is done by the resonances of the throat and the mouth and their subdivisions. (see Chapters IV, XLI, and XLII.) In the Voder the selection is done in a different manner but on the same basic principle. The energy from the source—the vocal cord tone, or breath noise, as the case may be—is split up into parts by electrical filters, each of which will allow only a certain group of frequencies to pass. There are ten filters so that the entire sound from the energy source is divided into ten bundles of sound, grouped according to rates of vibration.

Each filter is brought into action by a finger key, the electric circuit being so arranged that as any one key is depressed the sound let through by that particular filter is heard. The more the key is depressed the louder is the sound. If all ten keys are depressed at one time the entire sound is heard. Depressing the keys one at a time we hear the ten parts of the sound in turn. The extreme left key lets out the components of lowest frequency, the next key a group of slightly higher frequencies, and so on.

The one set of ten keys controls either the vocal cord tone or the breath noise as desired, the change from one source to the other being made by a switch, known as the wrist bar, under the operator's left hand. When the hand is rested on the bar the vocal cord tone is fed to the keyboard and when the hand is raised off the bar the keyboard receives the breath noise.

There are a few special keys to facilitate the formation of the stopped consonants such as "b", "d" and "k" and to assist in producing some very faint sounds such as "th" and "f", but in general any speech sound is formed by combinations of the twenty components available through the operation of ten finger keys and two electrical energy sources.

With this arrangement not only can any speech sound be produced but articulate conversation can be carried on. There would however still be one thing missing from a complete copy of the human vocal mechanism, namely the inflection or change of pitch that is brought about by stretching and relaxing the vocal cords. This has been provided for in the Voder by a pedal, worked by the right foot, that varies the pitch of the vocal cord tone. With this important addition the mechanism is complete and it is possible for a skilled operator to produce speech that is intelligible and surprisingly natural.

There is a characteristic quality to the speech of a Voder that has been referred to as an "electrical accent". This is a function of the electrical anatomy of the machine and a different quality of voice could be obtained by changing the distribution of the electrical filters. This characteristic quality is analogous to that personal quality in the voice of a human being that enables us to recognize his voice over the telephone.

The operation of the Voder is no simple matter. There are about sixty different sounds to be learned, single sounds employing from one to five finger keys. Not only must the operator select the particular combination of keys for each sound, but he must also be able to control his finger action, both as to speed and amount of motion, introduce the up and down movements of the wrist bar at precisely the right instants, give the appropriate inflection to each syllable with the foot pedal, and do all these things with correct timing. It takes an operator, assuming some natural talent, several months to be able to manipulate the machine so as to produce intelligible speech, but it must be remembered that he is doing with his hands what once took him years to learn to do with the organs specially adapted for the purpose.

Although the Voder represents the first successful synthesizing of speech it is by no means the first attempt. Scientists have been trying to produce synthetic speech by mechanical and electrical means for over a hundred and fifty years, not to mention the attempts made in a less scientific manner over a period of centuries.

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