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An investigation into the histories of theories and treatment of vocal registers in training the singing and speaking voice in relation to the recently published theories of Douglas Stanley

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AN INVESTIGATION INTO THE HISTORY OF THEORIES AND TREATMENT OF VOCAL REGISTERS IN TRAINING THE SINGING AND SPEAKING VOICE IN RELATION TO THE RECENTLY PUBLISHED THEORIES OF DOUGLAS STANLEY

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CHAPTER I

INTRODUCTION

A. Scope of the Investigation

To place limits on an investigation into the problems of voice production is not desirable but necessary. For, in consideration of its probable interrelationship with many vocal matters, it is perhaps dangerous to isolate for study a single problem in voice production. Basically logical would seem to be a division between the problems of tone production and diction. Yet, several writers insist there is much interdependence between these two. Considered in the same light other divisions in the field of voice production are made with even less justification. It is difficult to consider the subject of laryngeal tone without reference to resonance. For muscles governing resonance may affect, also, the behavior of the larynx in phonation[1] and, since the action of the resonator may be limited by what is generated at the glottis, the activity of the laryngeal muscles may be a factor in resonance.[2] Resonating cavities may determine within

[1] Wilmer T. Bartholomew, "A Survey of Recent Voice Research," Music Teachers National Association Volume of Proceedings for 1937, 123.

[2] G. Oscar Russell, Speech and Voice, 1931, 55.

limits what the glottal lips do, just as the length of tubing in a brass instrument is a determining factor in the vibration speed of the lips. These and other interrelationships exist. Therefore, to limit the scope of a study dealing with voice is not in itself desirable.

Yet there must be limits. The whole problem of voice is an exceedingly complex one making a total consideration impossible in a brief study. A total study must include acoustics with its many complex physical problems. Physiological problems abound. They involve relationship of bones and cartilages to muscles, how muscles function, neurological activation of muscles and glandular influences.[1] Finally there exist many varieties of instructional technique designed to improve the vocal organ or its management. All of these things cannot be considered when time and space are limited.

The question, then, is not."Should such a study impose limits upon itself?" Rather it is "How shall the boundaries be set?" On the part of the investigator, two considerations might well influence his choice of a specific area in the field of vocal research: (1) Is there a point upon which there exists confusion or, at

[1] Judson and Weaver go so far as to devote a long chapter to embryology. Voice Science, 1942.

least doubt, in the mind of the investigator? (2) Is the clearing up of this point of doubt or confusion sufficiently important to the investigator to justify his spending a year trying to solve the problem? In this case the writer has somewhat inadvertently ventured into a reading acquaintance with the theories of Douglas Stanley.[1] These theories are in conflict with his past beliefs and practices. It is claimed that the practical application of these theories can improve and hasten the development of the vocal organ. If the alleged advantages are actual, the writer should adopt them. A unique treatment of vocal registers seems to be the chief cornerstone of Dr. Stanley's system and theories.

The limitations of this study are derived, then, from doubt existing in the mind of the writer concerning Stanley's theories, chief of which is his registration theory. So registers will be considered independently of other phases of the science of voice, except where other considerations obviously weigh so heavily that they must greatly influence the subject at hand.

B. Basic Needs for Such a Study Objectively Considered

It has already been suggested that the practices

[1] Douglas Stanley, M.S., Mus. D., Fellow of the American Association for the Advancement of Science; Fellow of the Acoustical Society of America.

derived from Stanley's vocal registration theory constitute a radical departure from those formerly considered safe. Many would consider such practices ruinous to the vocal instrument. For example, one controversial issue involves the carrying up of the lower register. Mackenzie in his The Hygiene of the Vocal Organs, p. 114 says:

> One can see with the laryngoscope the excessive congestion induced by carrying a register beyond a certain point, and the almost instant return which occurs when the register is changed. Competent authorities affirm that the example of Dupey, the French singer so famour for his high chest tones, had a pernicious effect on other tenors who attempted to . . . imitate him . . .

Therefore, one indulges in the use of a method at some peril. On the other hand, use of the theory in practice has become increasingly widespread, thereby affecting for good or for ill an increasing number of voices. The writer has contacted personally or by letter several individuals who indorse in full or in part Stanley's registration theory.[1] Three have authored either books or articles expressing their version of the theory. The present writer first encountered it not from Stanley but

1
John C. Wilcox, Colorado College,
Edwin Hopkins, stage director, New York,
Crystal Waters, vocal teacher, New York,
Joseph J. Klein, vocal teacher, Los Angeles,
Ray C. Crittenden, vocal consultant, Los Angeles,
Ralph J. Peterson, Los Angeles City College.

from John C. Wilcox's writings. Attending Mr. Wilcox's vocal clinic at Colorado College in the summer of 1946 were about forty persons from many sections of the United States, the majority of whom have probably been using such procedures in voice instruction. At a "bull session meeting" during the process of this clinic, attended by several of the participants including the writer, Dr. Ray Crittenden, eminent vocal diagnostician and teacher from Los Angeles, stated that ninety percent of the Sherwin Williams Metropolitan Opera Audition winners had "been exposed" to the "separation of the registers" in training. This statement by Dr. Crittenden cannot be considered as scientifically valid since no opportunity has availed itself for checking the statement. However, further investigation of this matter might prove interesting and of value. In any case, there can be little doubt that Stanley's procedures or modifications of the same have become quite widely used. Therefore, considering this factor and the amount of opposition the procedures already have encountered and are likely to encounter in the future, their investigation certainly is not out of order.

Another need for such a study derives from a very different consideration. As it will become clear through the reading of this manuscipt, Stanley's theory may

suggest a very different approach to the treatment of the speaking voice.

> " . . . tones which are too low pitched to be of any value in the singing voice, carry beautifully in the speaking voice . . .
>
> "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 . . . " [1]

A safe and sane evaluation of a new theory cannot be made until it is reasonably clear just how it differs from or how it compares with theories of the past or those now prevalent. If we accept the new theory, how much of the old are we rejecting and how much are we retaining? If we accept Stanley's register doctrines, what views concerning registers must now be rejected? How must practical instruction be changed? Wherein the new theory is found to be at odds with the old, the old is also up for investigation. We must know what about registers we are to reject if we accept Stanley's theories. Part of the test of his theory depends on whether or not this rejection should be made. Consequently, it is necessary to place under consideration other theories, past and present.

C. Method of Conducting This Study

It is the present opinion of the writer that there

[1] Science of Voice, 199.

would be much gained if Stanley's theory were to be made the subject of actual experiment. This experiment should be made through the use of the essential practices derived from the theory on a number of voices over a given period of time. However, it is first necessary to determine exactly what should be presented to each group. A preliminary study is, therefore, in order to carefully determine what these things should be. Elements derived from this preliminary study constitute the material of this thesis.

Here is a brief indication of the steps to be followed in the recording of the material to be included in this paper:

I. A re-statement of the aim of this study.

II. To achieve a clear conception of the theory for appraisal, Stanley's theory of vocal registers should receive accurate recording.

III. Next a history of opinion on vocal registration will be checked to discover similarities and differences between other theories and those of Stanley.[1]

IV. Conclusions drawn from the study.

[1] In the discussion of past and present register theories greater attention will be given to those writers who seemingly have derived their theories from some actual scientific investigation. For example, Sir Morrell Mackenzie's laryngoscope studies demand more of our attention than do those of some of his contemporaries since his study was extensive, involving a large number of subjects. Many of his contemporaries confined their laryngoscopy to a small number of subjects or largely to auto-laryngoscopy.

V. An appraisal of the primary matters with relation to Stanley's register theory that need further clarification including suggestions as to the methods by which this may best be accomplished.

D. Aim of the Investigation

It is our aim to discover in the light of historical and contemporary theories about registers if Stanley's views on the matter are possibly justified and what additional steps should be taken to discover whether or not they should be accepted or rejected.

CHAPTER II

STANLEY' THEORY OF VOCAL REGISTRATION

Stanley defines the physical action prevalent in the formation of a vocal register as "A co-ordination of laryngeal muscles in which one or the other of the tensor groups predominates."[1] He elsewhere notes, "Registration denotes the arrangement or co-ordination of the muscles of the larynx which stretch the vocal cords and hold them in tension against the pressure of the breath."[2] Up to this point Stanley's concept does not greatly differ from that of others except that he is more specific, suggesting that fairly definite muscles perform the job of tensing or stretching in the different registers.

Stanley recognizes two registers: lower and falsetto.[3] These two registers are present, though not necessarily healthily active, in every voice regardless of sex or type of voice in a given sex, a point on which disagreement begins to be evident. The man's falsetto is commonly

1 Stanley, Science of Voice, 60.

2 Stanley, Your Voice, 15.

3 In Science of Voice Stanley uses the term "upper" rather more consistently than "falsetto," though there can be little doubt but that his meaning is "falsetto." Elsewhere he uses consistently the term "falsetto." However, in Your Voice, 17, he states, "A scientifically preferable term would be 'arytenoid register,' because the tension on the vocal cords is held, as the tone is swelled in this register (through its intensity range), against the pressure of the breath by means of additional tension on the arytenoid muscles."

recognized and needs little further explanation at this point. However, some will experience difficulty in understanding what Stanley means by the woman's falsetto. Perhaps the best we can do here by way of explanation is to suggest that a woman's falsetto is similar in some respects to what are often termed "head tones" in a woman's voice.[1] In any case it is a light tone perhaps resembling the tones of the flute. The very high acrobatics of the coloratura Stanley would accept as largely pure falsetto.[2] Stanley maintains that there are no essential anatomical differences between the vocal mechanisms of the two sexes

[1] This is a judgment based on the writer's own hearing and the testified experience of others and, therefore, subject to error. There seems to be in all female voices he has tested a kind of light quality of tone, often weak and shaky, no matter how heavy and low the voice may seem, that will quite easily strike pitches of high C or above. Often this quality of tone seems quite different from the voice habitually used in phonation, seeming almost comparable to the difference usually observed between a man's regular voice and his falsetto. Two female voices that have come to the writer's attention have at times been able to touch C above high C. One of these was able to do this with practically no vocal training. Even among the vocal teaching profession such range is considered unusual. However, it may be that it is far more common than originally thought. When some considerable effort is made, the writer's bass voice, in falsetto, will reach F above the high C usually considered quite a feat for most tenors using their regular masculine voices.

[2] "Very light coloratura sopranos may use this adjustment in its more or less pure form." Your Voice, 92.

except in size. Therefore, he reasons that the same phenomena should prevail in both, with this exception that the general pitch of a woman's voice will average about an octave higher than the man's.[1]

Now we pass on to the part of the theory that seems unique. "The registration action is primarily the mechanism for regulating the intensity of the tone when the technic is correct."[2] In other words if the singer is using his voice well, the two registers will exhibit themselves and alternate with each other more due to variation in intensity than due to variation in pitch.[3] Let us say that either register can be used at almost any pitch depending on whether the pitch is sung loudly or softly. We are, of course, not to assume that the two registers bear no relationship to pitch. For at low pitches it is more difficult to activate the falsetto and easier to bring the lower register into play. At high

1 It might appear that Stanley has altered somewhat his view on this matter in his latest publication, Your Voice. He now seems to suggest different methods of dealing with the falsetto in men and women. Your Voice, 103.

2 Your Voice, 15.

3 "By lower register or falsetto action I mean the rate of change in tension on the group of muscles which characterizes the register, and not the actual tension on the muscles." Stanley and Maxfield, The Voice: Its Production and Reproduction, 57.

pitches it is more difficult to bring the lower register into predominance. In other words, to activate the falsetto at low pitches the intensity must be very light, indeed. To activate the lower register at high pitches, intensity must be great.

When singing in either of these registers to the greatest possible exclusion of the other, another phenomena is to be noted. When one is singing the lowest pitches possible in a given register, intensity must of necessity be less than it would be at higher pitches in the same register. Especially is this true of the falsetto which at its lowest pitches in little more than a whisper. It should not be concluded, of course, that it is possible to use one register to the complete exclusion of the other as far as the muscular mechanism is concerned.[1]

Now let us observe some of the alleged characteristics of the two registers.[1] "The falsetto register is responsible, in a large measure, for the range quality and soft effects of the voice."[2] "This register has definite limitations of power and will either crack or 'mix' if pushed beyond a certain point of intensity. In its uncoordinated form the female falsetto is of more or less

[1] See Appendix IV.

[2] Your Voice, 15.

pleasing quality.[1] On the other hand: "The lower register gives strength, power and health to the vocal apparatus."[2] "The lower register is characterized by a far greater intensity at any given pitch than is the falsetto. The quality of this register when uncoordinated is generally crude. The intensity can be increased to the maximum loudness for the given vocal organs without the voice cracking."[3]

Stanley describes a third type of vocal production which he characterizes as "mixed registration." "Mixed registration," regardless of its type, constitutes a vocal fault.[4] In "mixed registration" a faulty relationship or coordination prevails among those laryngeal muscles which govern pitch changes.[5] There are several possible ways that the pitch of a violin string may be changed: (1) changing the length of its vibrating part, (2) making

[1]Stanley and Maxfield, The Voice: Its Production and Reproduction, 53.

[2]Your Voice, 15.

[3]Stanley and Maxfield, 54.

[4]Your Voice, 93.

[5]Three sets of muscles are involved here: the cricothyroid group, the arytenoid group, and the thyro-arytenoidia. The former two function in great part to stretch the vocal ligaments, while the latter has a shortening action and is, therefore, antagonistic to the stretching muscles.

it tighter or looser, (3) changing its weight. It is probable that these same alterations can be made with relation to the vibrating portions of the vocal ligaments. Since there are three ways to change pitch, it is highly probable that the same pitch may be achieved in more than one way. However, in Stanley's mind there would be one correct adjustment for a given pitch and intensity. To deviate from this coordination would constitute "mixed registration." Stanley thinks that the longest cord possible for a given pitch or intensity is probably the correct one. Faulty production or "mixed registration" prevails when pitch must be changed largely through the action of the thyro-arytenoids. This happens when there is weakness in either the arytenoid or crico-thyroid group of stretching muscles or in both.

"There are two forms of mixed registration: mixed falsetto and mixed lower register."[1] In the "mixed falsetto" a faulty balance of tensions prevails between the arytenoid and crico-thyroid muscles, there being an excess of tension at the arytenoid end of the vocal ligaments.[2] Then as intensity is increased, the necessary added tension of the stretching muscles proceeds from both

[1] Your Voice, 93

[2] Stanley and Maxfield, 67

ends of the vocal ligaments so that the correct coordination never prevails. In "mixed register" a similar condition prevails except that the excess of tension prevalent on the attack is at the opposite end of the cords. "When the singer attacks the tone," say Stanley and Maxfield on page 68, "there is an excess of tension on the crico-thyroid muscles. As intensity is increased, both sets of muscles take up the tension uniformly and simultaneously as in the case of the mixed falsetto."

Now the auditory characteristics of "mixed registration" should be considered. One characteristic commonly noted will be slurring. Such slurring may be noted either or both at the attack on an initial tone or during the transition from pitch to pitch within a phrase. Slurring may be considered both a cause and a result of mixed registration." Stanley thinks a purely registered tone difficult or impossible where slurring is indulged in to any marked degree. A symptom closely related to slurring is faulty pitch adjustment.[1] Slurring in itself is a faulty pitch adjustment prevalent through at least a portion of a tone's duration. Accurate pitch adjustment is extremely difficult under mixed register conditions.

[1] Stanley considers accurate intonation an element inherent in good quality. "Pleasing quality depends primarily upon accurate intonation." Your Voice, 12.

Let us consider mixed registration in the male voice.[1] "The type of mixture engendered can usually be designated as 'mixed falsetto.'"[2] The intesnity of the whole voice may be relatively low, lacking adequate lower register support. The power pitches of the range will be weak and probably curtailed in range. "Any definite degree of mixed registration eliminates the lowest tones and renders the lowest tones which can be sung weak and inane."[3] A fairly rapid intensity augmentation may take place as the scale is ascended till the highest tones that can be reached may be relatively loud. However, the loud tones may contain a high degree of "whiteness" or even nasal shrillness. Quality is apparently much better at low than at high intensities. The male mixed falsetto singer seldom holds any tone at a constant intensity. Its thin quality accentuates the higher harmonies making the tone sound higher than it really is. Because the tone sounds better at low intensities he is likely to sing everything in this manner, even when the music calls for tones of high intensity. Stanley sums up mixed register male singing as follows:

> Thus, mixed registration in men's voices is characterized by throatiness, 'whiteness,' shrillness, nasality,

[1] "Absolute mixed-register singing is not quite the same for both sexes. In the case of a man it is based upon soft rather than loud singing." Your Voice, 202.

[2] Your Voice, 202.

[3] Ibid., 202.

> screamed high, loud tones, lack of low tones and an effeminate quality. Practically every tenor of today employs some degree of mixed registration, as do many of the baritones -- the basses are apt to be less mixed." [1]

Whereas mixed registration in the male voice is more likely to be mixed falsetto singing, highly pronounced mixed registration in the woman's voice is likely to be of a mixed lower register type. Since the mixture is due primarily to lack of falsetto development and to excessive development of the lower register component where the falsetto should be prominent, the intensity of this voice may be fairly high. However, this intensity tends to be noise rather than a powerful vibrant tone. Faults like poor intonation, weak lower tones, thickness, or whiteness may be observed. The high tones will probably be white and shrill. Changes in intensity and scooping are likely. In women's voices one register singing is possible to a certain degree provided the falsetto only is used and at low intensity. "After a few years, however, mixture[2] is bound to occur.[3] Good quality depends primarily upon pure, properly-balanced registration and pharyngeal resonance adjustment, but it depends upon pure registration more than upon any other single factor.

[1] Your Voice, 203.

[2] Mixed falsetto.

[3] Your Voice, 205.

Mixed register singing is always very throaty and of most unpleasant quality. Mixed registration is the most pernicious of all technical faults!"[1]

How does Stanley propose to deal with the registers in voice training? "Without the proper working out of the problem of registration, any radical or permanent improvement in a pupil's voice is out of the question."[2]

In the training process the laryngeal muscles must be as completely exercised as possible. Since in the lower register crico-thyroid action is dominant and the arytenoid group in the falsetto, use of these apparent registers should tend to activate, respectively, these separate muscle groups. Proper training demands, first, that these two registers be isolated and purified. Purification demands above all that "mixed registration" be completely eliminated.

"In the process of training the voice, the only possible method of strengthening the muscles of the larynx is to isolate the coordinations 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." Failure to isolate these registers would mean that the

[1] Your Voice, 205.

[2] Ibid., 91.

two muscle groups mentioned would never be completely used and subsequently never attain sufficient vitality to properly control the vocal cords. Likewise, such a failure would mean that these muscles would never have sufficient strength to resist the pull of the thyro-arytenoidia under which circumstance mixed registration would prevail. It would mean, further, that with changes in pitch or intensity the necessary independent movement with relation to the two end pulls would be lacking; and, therefore, the proper stringing with relation to the pitch and intensity would seldom, if ever, be attained.

Isolation of the registers is usually accomplished at rather extreme pitches.[1] The falsetto in its pure form is often found at high C or even above.[2] The lower register in its pure form is best isolated near the bottom of the singer's range.[3] Wilcox finds it in most cases around A below middle C,[4] (an octave lower for men's voices.[5]

[1] In his latest publication, Your Voice, Stanley seems to have modified this position somewhat. Certain manipulations he thinks usually obviate the necessity of the use of extreme pitches.

[2] In the female voice and perhaps in some cases in the male voice.

[3] The lower register of a woman starts, or is first discovered, as a crude, loud, rather unpleasant sound such as is used by 'coon shouters.'" Stanley and Maxfield, 63

[4] John C. Wilcox, The Living Voice, 19.

[5] John C. Wilcox's exercises for establishing the pure registers are listed in the appendix.

The next step is the developing of the registers. The lower register is developed by carrying it upward gradually till it can cover the greater part of the vocal range. This can probably be done only a step at a time with most voices. "The process which may appear 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."[1] Vigorous exercise, however, gradually increases the range of the register till it may cover nearly the whole of the vocal range. This register may have a somewhat crude sound in its uncoordinated form. Under proper resonance conditions, however, it may be rendered more pleasing. Its intensity should increase with a rise in pitch.[2] It is the activating and developing of this lower register or crico-thyroid adjustment which gives body, power, and health to the voice.

According to Stanley's earlier view this register is to be carried to rather extreme pitches. "The lower register may, at first, go approximately only to about F on

[1] Science of Voice, 66.

[2] Recall that Stanley's theory states that the registers change due to intensity more than due to pitch. Therefore, in order to maintain the lower register at higher pitches, intensity must be increased. Only at near maximum intensity can the lower register be maintained toward the top of the vocal range.

the bottom space of the treble clef; after a little while it will reach B, then to D, then to F on the top line and it will ultimately extend over practically the entire range of the voice."[1]

It may be that this technic of carrying up the lower register to higher and higher pitches with mounting intensity is original with Stanley, at least with women's voices. However, the condemnations of such practice would tend to indicate that it has been done and taught. Many writers have warned against such a practice as this. Their warnings have often been based largely on the theory of vocal registration held. With one or two exceptions of a tacit nature where exceptions seemed to exist in practice in the case of women's voices, carrying lower register beyond its "natural limits" was to be done at great peril. Usually rather definite limits were placed on the lower register say F above middle C. However, it was often considered unsafe to carry it beyond D above middle C. Consequently, a soprano would seldom use it. Some thought it did not even exist in the lyric soprano voice. Many admitted its existence but have condemned its use. In short, the practice advocated by Stanley would still be considered very doubtful practice by most vocal teachers, a practice absolutely ruinous to women's voices.

[1] Science of Voice, 66.

Simultaneously with the development of the lower register the falsetto should be developed. "The development of the upper register is accomplished by obtaining the purest and least thickened tone possible and taking it up very high."[1] Some modification of this view is evident in Your Voice, 165:

> Because the lower register controls the falsetto one octave higher, the singer who cannot use the lower register above middle G should never sing above the G, one octave higher, in performance. When she can use the A in the lower register, she can sing the high A in the falsetto, etc. This rule should be strictly adhered to or the voice will inevitably suffer.

This applies to women's voices.

> It may seem very strange to tell the beginner to sing tones above high C, but such tones are quite easily phonated when the proper resonance conditions are complied with.[1]

Exercising the falsetto at high pitches with high intensities gives strength to the arytenoid muscles. Falsetto tension is so developed because such is a necessary concomitant of the extended lower register. The arytenoid muscles must be strong enough to hold their stringing against the pull of the heavier crico-thyroids. But a downward exercising procedure for the falsetto is also in order to develop arytenoid tension in the middle of the voice. When the two registers have been isolated, the upper must be brought down and developed without thick-

[1] Science of Voice, 65.

ening . . . "[1] [2] In its exercise the intensity rise principle is present in falsetto and should be adhered to as with the lower register. In the lower portions of the falsetto care should be used not to push it or straining will result. This will be true till it has gained sufficient strength to permit it to coordinate with the lower register on a crescendo.[3]

In the process of isolating and developing the registers the fault of "mixed registration" is being eliminated. The improper coordination common to "mixed registration" are naturally absent with the establishment of coordinations which activate the pure falsetto or the pure lower register.[4]

[1] Science of Voice, 66.

[2] Wilcox, Crittenden and others make a greater point of a downward extension of the falsetto than does Stanley.

[3] "In its pure form the falsetto is very light in the middle of the range and increases rapidly in power as the scale is ascended. This register has definite limitations of power and will crack or 'mix' if pushed beyond a certain point of intensity. In its uncoordinated form the female falsetto is of more or less pleasing quality." Stanley and Maxfield, 53.

[4] Stanley's manipulation for eliminating "muscular mixed registration" is explained in appendix III.

CHAPTER III

HISTORICAL CONSIDERATION OF REGISTER THEORIES IN RELATION TO STANLEY'S THEORY

A. The Old Italian Masters

Since a voice could not then be recorded and preserved as an artist's picture, no living person has actually witnessed the result of the old masters' teaching. Yet the age 1600-1775 is revered by many as the "golden age of song." It is difficult to say whether or not this reverence is justified. The vocal music of the period indicates that the singers must have possessed considerable vocal skill for it abounds in trills, cadenzas, and other decorative embellishments. It is probably safe to assume that there were many competent performers. Periods of study were lengthy, five or six years or more. Study probably began at an earlier age than is now common. However, it may also be possible that perhaps this age of singers has, due to legend and tradition, been somewhat over-rated. Many present day instructors like to claim the old masters as authority for their own systems. Some like to point to the old masters as evidence that scientific matters have little bearing on the vocal art. The old masters, they tell us, knew nothing of these things; therefore, such knowledge is unnecessary or even harmful.

When present day scientific knowledge is the scale of comparison, it is obviously true that the old masters knew little about their physiology and acoustics. However, it does not follow that they were not interested in such things. It is doubtful that they held scientific matters in such disdain or were quite as ignorant of physiological matters as some modern voice teachers like to infer. Two sources would tend to indicate that the opposite is true: Mancini, one of our few original sources on the old masters, and Kolfer. Mancini's description of certain of the organs of phonation surely indicates, at least a lively interest in the physiology and functioning of the vocal mechanism. He theorizes that the strength of the voice depends on the quantity of air velocity which is compressed from the lungs: "thus the wider the chest the larger the aspra anteria and the larynx." Mancini states that it is the opinion of the physiologists that the lungs, however, are not the real organs that form the voice in the throat: "The air from the lungs acts upon the larynx in singing, just as it acts upon the head of the flute that is leaned to the lips for playing." Instead of the lungs which furnish only the material, the air, being the actual organs of voice, these voice formers are: the larynx, glottis, palative arch, hard palate, and lips. "These organs are the means by which the voice is given its diverse modulations so that the better organ-

ized they are, the more perfect, strong and clear the voice will be." Among these it is the muscles of the larynx that carry the greatest burden. They contract strongly in the higher tones and relax in the lower tones. Since imperfect organs are incurable and contributory to imperfect singing, on testing a new pupil prospect, the teacher should carefully determine whether:

1. the epiglottis is free
2. there is hardening of the thyroid glands (goitre)
3. the action of the laryngeal muscles is impeded by the somissilar glands or from hardening of the amigdoles
4. there is any disorder of the uvula or arch of the palate
5. there is tooth irregularity
6. the nose is too flat or too long

If tonsils are to be removed, thinks Mancini, this must be accomplished in youth to prove successful. The candidate should have a noble, sweet, and pleasing face; otherwise, he will have to have great talent.[1]

Brown and Benke quote Kofler on the scientific attitude of the old masters:

[1] Mancini, Practical Reflections of the Figurative Art of Singing, 53-55.

> The great masters of the old Italian school were of the opposite opinion. The renowned singer, composer and musical writer, Giovanni A. Buontempi, who died before he could get a glimpse of the old Italian school informs us in his History of Music, of which Dr. Burney gives us a great many long abstracts, that at this time the daily study of the physical laws that govern the singer's tones was required of the pupils. The same is told by Arteaga of his times. J. F. Agricola, in his translation of Tosi's important work, gives in the first chapter a description in detail of the larynx and its functions. Dr. Marx, in his noteworthy book, The Art of Singing, in section two treats upon vocal physiology with such a thorough knowledge that we wonder how it was possible to achieve such scientific results thirty years before Garcia first saw the vocal ligaments in operation in a living body. . . . No rational being can decline the advice given by Agricola in his previous mentioned translation of Tosi: 'The knowledge of the vocal organs is always very useful to the singer, and especially to the teacher, and in many cases indispensible. For even when nature has adorned a singer with the best qualities, the knowledge of physiology is necessary to prevent all damage that might be done through ignorance. But when a teacher finds natural faults and defects in a voice, how can he successfully battle with them if he is unacquainted with the seat of the evil.' [1]

Nevertheless, in spite of this seemingly ample testimony, it must be acknowledged that the admitted probable good results of the old masters were probably achieved with little accurate scientific knowledge.

As with many other matters related to the vocal instruction of the old masters, their views concerning vocal registers are on many points obscure. In general, the evidence points toward a belief in the existence of

[1] Brown and Benke, Voice, Song and Speech, 5-6.

two registers.[1] Little is said regarding a possible difference in register phenomena noted between men's and women's voices, though Mancini states, "Every student, whether he is soprano, contralto, bass or tenor, can easily know the difference between these registers."[2] Of the nature of the two registers there is some reason to assume that they might be termed "chest" and "falsetto."

According to Henderson,[3] the first reference to vocal registers is made by Caccini, Nuove Musiche, written about 1600, at a time when music was leaving the church to enter the theater. Likewise it might be said that Caccini was writing in the dawn of the "golden age" of singing. Caccini noted two registers: "voce piena," meaning full voice, and "voce finta," signifying disguised, faked or feigned voice. Here is obviously a two register theory. Whether or not "voce finta" is synonymous with falsetto is a question. The term itself would definitely indicate that possibility.

Another early writer expressed a two-register theory.

[1] There is one possible exception to this belief to be discussed later that has possible further ramifications.

[2] Practical Reflections of the Figurative Art of Singing.

[3] W. J. Henderson, music critic, New York Sun, 1896-1932, Art of Singing, 1937.

In Henderson's book there is this statement:

> We have the careful account of Ceroni (1613) on this matter, and he recognized two registers . . . chest and head. Since, therefore, the head voice has been known since the earliest period of the art of singing, we may accept it as a demonstrated fact.

If Henderson's interpretation of Ceroni can be accepted as correct, we have another early expression of a two register theory with no indication, however, of the meaning of "head" register. It may or may not have signified falsetto.

Now we must take up a matter that adds more confusion to the question of the "head" voice. The data comes from Mackenzie,[1] probably to be considered one of the most competent of last century's vocal investigators. It should be noted that Mackenzie himself supported the two register theory, maintaining that the upper one is falsetto and that he is corroborated in his view by the old masters.

> The Old Italian Masters . . . recognized only two registers, of the human voice, the 'chest' and the falsetto or 'head,' the two latter terms being exactly synonymous.[1]

Mackenzie thinks that Tosi, for example, as well as Mancini (a probable fact if the writer's reading of Mancini is accurate), make no distinction between 'head' and

[1] Mackenzie, Hygiene of the Vocal Organs, 76 and 77.

falsetto, however, a footnote added by Mackenzie discussing Galliard's English translation of Tosi indicates that well back in the time of the old masters the view that a distinction exists between 'head' and falsetto and, consequently, three register theories probably were extant, at least in England, well back in the period of the old masters. Though Mackenzie's following footnote may indicate Tosi did identify the two as "synonymous," it likewise indicates the opposite view on Galliard's part:

> Galliard, however, the English translator of Tosi, seems in a footnote to make a distinction between the 'falsetto' and the 'head' register. He says (in the second edition, London, 1743, page 22), 'Voce di petto is a full voice, which comes from the breast by strength, and is the most sonorous and expressive; di testa comes more from the throat than from the breast, and is capable of more volubility. Falsetto is a feigned voice, is entirely formed in the throat, has more volubility than any, but of no substance.' There is no such differentiation of the falsetto in Tosi's text. [1]

Galliard's differentiation, however, may be interpreted to mean that others, at least in England during the period of the old masters, may have accepted the view that not only are the 'head voice' and the falsetto differing phenomena as well as that three registers exist.

We have one other writer, Mancini,[2] who discusses

[1] Mackenzie, Hygiene of the Vocal Organs, 76, footnote.

[2] Mancini, Giambattista, Practical Reflections of the Figurative Art of Singing.

voice near the end of the period of the old Italian masters.

> The voice ordinarily divides itself into two registers, one called the chest register and the other head register, or falsetto.

Such is the opinion of Mancini in his Practical Reflections of the Figurative Art of Singing which he wrote in 1777. If the translation is accurate, we have this one writer from the latter part of the period of the old masters who not only believed that there were two registers but also that "head" and "falsetto" were synonymous.[1]

Concerning the manner with which the registers were dealt, we do not have too much information. According to Henderson careful blending was the goal of the old masters. At what period in the training of the voice this blending began is not indicated. Blending of the registers was the goal according to Mancini who explains that it is the art of the singer to imperceptibly pass from one register to the other or to unite the two for perfect quality throughout the range each tone on level with the chest tone.

Mancini mentions one other thing that may be of importance to our study. He notes that in a few rare cases it seems possible for the singer to produce his

[1] Here again Mancini's use of the two terms "head" and "falsetto" may indicate that some held to the view that the two were not synonymous.

entire scale in the chest register. It will be seen that Mackenzie may have observed similar phenomena by way of a laryngoscopic mirror. Mackenzie quotes Mancini:

> . . . says that in certain rare instances there is only one register -- the chest -- throughout the whole compass of the voice: 'Si da anche qualche raro esempio che qualcheduno riceve dalla natura il singolarissimo dono di poter eseguir tutto colla sola voce di petto.'[1]

Our study of the school of the old masters cannot be considered complete without reference to the artificial sopranos and altos of the period. For of the male singers of that time these were far and away the most renowned. Most celebrated were Farinelli and Cafferelli, masters of coloratura singing, both pupils of Nicolo Porpora of Naples. Though these two, according to some, sang beautifully in falsetto, the majority of opinion would seem to indicate that these singers were castrati singing in normal voice though there may have been falsettists among them. Francis Rogers says concerning certain of the singers of those early days:

> The falsetto appears first in musical history in the time of Palestrina when the two upper voices of the music sung in the Sistine Chapel were carried by Spanish falsettists especially trained therefore. In the first decade of the seventeenth century it was discovered that more satisfactory results were to be obtained from castrati, male singers who had not been permitted to reach manhood and whose voices, without losing the range, sweetness and lustre of boyhood, had by vocal discipline and maturing powers acquired

[1] Mackenzie, Hygiene of the Vocal Organs, 65.

> an intensity sufficient to meet the demands of their times. For two centuries the castrati were the dominating figures in Italian vocal music.[1]

Kofler, writing at or somewhat before the turn of the present century is of a similar opinion:

> Some think that the English male alto is identical with the male alto or male soprano of the old Italian school. This is not so. The male trebles of this latter school were probably the product of Greece, or some other oriental country. It was undoubtedly observed at an early period, that eunuchs, as a rule had very melodious voices, of remarkably large compass. It was probably well known in Italy two hundred years ago, perhaps longer, that a boy possessing a naturally good voice, if made a eunuch long before the mutation of the voice, would gain a voice that in richness, endurance, and compass would excel the best natural voices of both the male and female singers.[2]

To conclude our present discussion of the old Italian masters let it be said:

1. Two register theories seem to predominate.

2. At least in England three register theories seem to be known.

3. It is not clear if the term "falsetto should be taken in its modern significance, though the term "voce finta" might be interpreted as "feigned" voice, and consequently, "falsetto."

4. In the treatment of the registers we know little more than that the teaching of the

1 Rogers, Francis, "The Vagaries of the Falsetto Tone," Musician, November, 1930.

2 Kofler, The Art of Breathing as the Basic Tone Production, 181.

time tried to blend them.

5. Mancini mentions certain cases where singers sang their whole scale in the chest.

B. The School of Transition [1]

With Mancini we take leave of the old masters. Our present period may be said to date back to Ferrein's Treatise on the Vocal Organs, published in 1741, and ends with Garcia's invention of the laryngoscope in 1855.[2] The growing scientific spirit of the time seems to have reflected itself into many fields including that of phonation. Though it has been shown that interest in the organs of voice and the manner in which they functioned was not, as some suggest, completely lacking in our former period, most vocal knowledge that existed had been learned from the way voices sounded to the ear, and most instruction probably had as its basis a great deal of imitation. [3] During this period actual experimentation began in the

[1] Term and divisions of historical periods to this point from de Bruyn, Historical Schools of Singing, who seems to have taken his cue from Taylor.

[2] The date 1855 is the one in which Garcia first read a paper describing results achieved with his new instrument. The date upon which the glottis lips were first seen in action was earlier.

[3] Taylor, Psychology of Singing, maintains that the chief cornerstone of learning to sing during the old Italian period was imitation.

field of the physical vocal apparatus and in acoustics.

According to Judson and Weaver we get our term "vocal cords" from Ferrein (chordea vocalis of Ferrein).[1] Ferrein, apparently, was the first to produce tones on the exsected larynx of a dog. He also proposed the string theory of the vibration of the vocal ligaments. Others followed Ferrein in experimentation on exsected larynxes including those of humans. In 1835 Lehfeldt observes that in "chest voice" the cords vibrated throughout their bulk including the thyro-arytenoid muscles and that in falsetto only the edges seemed to vibrate.[2] Magendie, 1838, experimenting on living dogs with vocal cords laid bare, decided that essential to tone production was an approximation of the pyramids and that no tone results when the glottis is open.[3] He concluded that the pitch is higher or lower according to whether the ligaments vibrate partly or in their entirety. On an exsected larynx, Mueller[4] attached weights to the thyroid and activated it with bellows. The air was blown over tepid water to keep the cords moist since they gave no response in a dry state. While relaxing the cords by pushing up the thyroid, the lowest

[1] Judson and Weaver, Voice Science, 52.

[2] Brown and Benke, 141.

[3] Ibid., 141.

[4] Ibid., 142-3.

bass tones were produced. Allowing the ligaments to vibrate through their entire length, merely by stretching and relaxing two serviceable octaves were produced. An attempt to raise the pitch beyond this limit gave a shrill and hissing tone. Mueller added tubes to the larynx. He found that a greater length of tubing is necessary to alter pitch than is found in the resonating cavities of the body, and that, therefore, the pitch of the voice is independent of the length of the vocal passages. Power of the air blast was also found to be a factor in pitch. By increase of the air blast a rise in pitch of a fifth could be obtained without altering the stretch of the cords.

Mueller also confirmed Lehfeldt's views on the falsetto that in such production only the edges vibrate. Lehfeldt was led to this conclusion when on an exsected larynx upon which he was experimenting he accidentally blew with less than the intentional force, thus getting a tonal result reminding him of the flageolet. This led him to conclude that the essential element in falsetto production is an air blast too weak to throw the whole

[1] Where the length or shape of the resonance cavities probably will not alter glottal pitch per se, it should not be concluded that these have no effect on glottal action. The lips will probably work more efficiently if little or no forced resonance is necessary.

breadth of the cords into vibration. Mackenzie quotes Lehfeldt as stating, "'I was,' he continues, 'led to the conclusion that whilst in the production of the chest tones I could see the vibration with a magnifying glass, I could not see them in the utterance of falsetto notes. Only the edges seemed to act.'" Mackenzie continues, "But what kept the substance of the cords from vibrating? This puzzled our inquirer till he found an old anatomist (Fabricus ab Aque-pendente) had shown that certain fibres of the thyro-arytenoid muscle pass horizontally into the vocal cords, and Lehfeldt conjectured that by the contraction of these the vibration of the outer edge of the cords might be checked."[1] So thinks Mackenzie that this marginal vibration theory rested on slender basis and would have been lost had not the great physiologist, Mueller, picked it up. Subsequently, the theory has been accepted by most investigators "chiefly on the mere authority of its reputed author."[2] [Mueller]

The investigators went definitely at the problem of the operation of the glottis from a physiological standpoint using actual larynxes for their experiments. However, when the larynx of a dog or human is laid bare or when it is removed from the body and activated with bel-

[1] Mackenzie, The Hygiene of the Vocal Organs, 79-80.

[2] Ibid.

lows and weights, one must be very careful of the statements he makes about it. Two register theories seem to prevail during this period. Some indication there is that the upper one should be called falsetto. Nothing seems to have been learned about the way such registers operate except that the bulk of the cords may vibrate in the lower register, and the edges during falsetto, a theory resting on slender basis according to Mackenzie.

C. The Laryngoscope School

Numerous attempts were made during the first half of the nineteenth century to view the vocal ligaments.[1] It

[1] Numerous attempts to observe the vocal ligaments in action before Garcia's success reported in 1855. Bozzini of Frankfort on the Maine, 1807, had an instrument for illuminating cavities inside the body. In 1827 Senn of Geneva, using a mirror, tried to explore the larynx of a young girl. Babington in 1827 apparently produced the instrument but got no results. Beames of Lyons in 1838 used a mirror attached to a whalebone. In 1840 Liston employed a long glass as used by dentists which he considered an aid to diagnosis. A mirror attached to a stem a and an artificial light was used in London by Avery in 1840, but he left no description of the instrument. Warden of Edinburgh, 1844, used prisms and reported catching sight of the glottis in two instances. Garcia succeeded " . . . and he was certainly the first to conceive the idea of making observations on his own larynx in the act of singing. These he carried out in the most marvelous manner, giving a detailed description of even the minutest movements of the vocal ligaments, which is still recognized as being substantially accurate, and which is more wonderful as Garcia had practically to create the whole process of investigation for himself, and was neither an anatomist or a physiologist. Garcia is, therefore, to all intents and purposes the real inventor of the laryngoscope, and he is also universally recognized as such." Data from Brown and Benke, Voice, Song and Speech, 145-7.

remained, however, for Manuel Garcia, one of the most renowned vocal teachers of all time, and member of a great family of singers, to be the first to see the ligaments in action. Someone stated that after the report of this discovery, every vocal teacher got himself a laryngoscope.[1] Laryngoscopy took two general courses: It became an important adjunct of the throat specialist. It attained wide usage in an attempt to learn the secrets of phonation. But as Mackenzie stated the instrument has probably become of greater importance to the medical profession than to the vocal scientist. States Mackenzie on page 40 of Hygiene of the Vocal Organs:

> Indeed, with the exception of certain points relating to the 'falsetto' register, the laryngoscope can scarcely be said to have thrown any new light on the mechanism of the voice.[2]

In addition to practicing laryngoscopy on others, many began the practice of auto-laryngoscopy, a method by which the teacher could observe his own cords in action.

1 "These philosophers of voice appear to see in the correct glottal action the possibility of maximum realization of the physical principle of the transformation of energy and of the conservation of that energy." de Bruyn, "Historical Schools of Singing," Etude, October and November, 1942.

2 Numerous improvements have been made in instruments used to view vocal ligaments:
1. The stroboscopic principle,
2. Russell's laryngo-periskop,
3. Rapid movies of phonation as seen by laryngoscope.

It is obvious from the outset that in probing the secrets of the larynx, the laryngoscope has extensive limitations. First, the pharynx is extremely sensitive to tickling or pressure. The tongue is likely to get in the way. The epiglottis and tongue shut off the view in the process of many vowel sounds. Mackenzie found that in the case of numerous subjects it is not possible to view the ligaments in phonation through the entire range of the voice. Some kinds of tone are more satisfactory than others. Some were in the habit of assisting the process of observation by forcibly pulling the front of the tongue out of the mouth. The exercise of such violence to the resonance cavities might induce unnatural compensatory action in the larynx. As laryngoscopy is practiced continually on a subject, the throat becomes more accustomed to it, facilitating the process. Consequently, the use of few rather than many subjects was encouraged. It took much time and effort to tame numerous throats. It is not improbable that many of the theories were derived largely from auto-laryngoscopy. Mackenzie suspects the results of laryngoscopy among his singing master contemporaries. His study and that of Mills were probably the only ones in which a large number of subjects were studied. Mackenzie states concerning other studies:

The observations that have been made hitherto have

> for the most part been confined to a few trained throats, and in many cases the examinations have been almost entirely auto-laryngoscopic. [1]

Likewise, Mackenzie suggests in part reasons why accurate results were not obtained by his contemporaries:

> The difficulties in the way of an adequate examination are so great that to obtain a complete view of the whole process a very large number of singers have to be examined. Thus in order to study the working of the vocal cords through the entire scale in fifty persons, I found it necessary to examine between 300 and 400 singers. [2]

It is perhaps Mme. Seiler, however, who suggests the limitations of laryngoscopy which are most pertinent to our study.

> When those who had become accustomed to the introduction of the instrument sang, at my request, a, as pronounced in the English word man, in a deep tone, the epiglottis rose, the tongue formed a cavity from within forwards, and thus rendered it easy to see into the larynx. So soon as the a, as in father, was sung, the cover quickly fell, the tongue rose and prevented all observation of the organ of singing. The other vowels are still less favorable to observation, because they do not admit of any such opening of the mouth. Strong tones also are unfavorable to observation, as Garcia also remarked; and this is very natural, because strong and sonorous tones require greater exertions of the singing organ, and, above all things, the right position of those parts of the larynx and mouth which serve as a resonance apparatus in the formation of sound. In order to see perfectly the whole glottis, all this resonance apparatus must be drawn back as far

[1] Mackenzie, The Hygiene of the Vocal Organs, 75.

[2] Ibid., 58.

> possible, and the rim of the larynx must be tolerably flat. Thus only faint and weak sounds are favorable to observation. [1] / underscoring the writer's /

Seiler has perhaps inadvertently suggested the reason why so many observers of this period placed limits on lower registers. It is possible, the tones observed being soft ones, that insufficient volume was used to bring the heavier register tones into play at higher pitches. Should it have been possible to observe the cords during more intense phonation, these register limits might never have been noted. Further, observation might have identified registers more with intensity if these limitations had not prevailed. In any case, it would have been difficult to have reached Stanley's register conclusions through laryngoscopy and the exclusive use of "faint and weak" sounds. It should be noted, additionally, that a great deal may have been missed because observations were made on a very limited number of vowel sounds.

Where it might seem that a new key was now available to unlock the secrets of the production of the voice including those vague points concerning vocal registers, in actuality the result appears to have been a far greater amount of confusion. Where in the past registers had received incidental mention, they now became the hot seat

[1] Seiler, The Voice in Singing, 52.

of controversy. Since the inventor of the laryngoscope figured prominently in this picture, it is well to begin our discussion with him. Further, the prestige of the Garcia family is so great that it is difficult to deny it place in the picture. A large number of the great vocal artists of the turn of the century seem to have studied with Manuel Garcia, his sister Viardot-Garcia, or from pupils of these. Also many of the register theories of the period were in part modifications of those first enunciated by Manuel Garcia.

In his book, Hints on Singing, 8, Garcia gives this definition of a register which has become one of the most acceptable extant.

> A register is a series of homogeneous sounds produced by a single mechanism, whatever modification of timbre and of strength they may offer.

With his definition Garcia continues:

> Each of the three registers has its own extent and sonority which varies according to the sex of the individual and the nature of the organ.

The suggestion here is that failry rigid confining pitch ranges exist in relation to the individual voice, but from voice to voice variations may be expected.

Garcia calls our attention to three main registers.[1]

[1] Both Mills and Mackenzie state that Garcia divided the voice into 5 rather than 3 registers due to subdivisions of the chest and the head. Indications are that they are correct in their interpretation, their information being derived from others of Garcia's several publications.

> Every voice is formed of three distinct portions, or registers, namely, chest, medium and head. The chest holds the lowest place, the medium the middle, the head the highest. These names are incorrect but accepted.[1]

In the chest register:

> The whole length and breadth of the lips (comprising the anterior prolongation, or process of the arytenoid cartilege and the vocal cords) are engaged in vibration. As the sounds arise in the register the tension of the lips increase and the thickness diminishes. Meanwhile the contact of the inner surfaces of the arytenoids will progress and extend to the end of the vocal processes, thereby shortening the vibratory length of the lips. The medium or falsetto is the result of similar actions, save that the lips come into contact not through their depth but merely at their edges. In both registers the glottis has its length diminished from the back by the arytenoids, which advance their contact till their adhesion is complete. As soon as this takes place, the falsetto ceases and the glottis consisting of the vocal cords alone produces the head register. The resistance opposed to the air by the large surfaces generates the chest register and the feebler opposition presented by the edges produces the falsetto. [2]

The three registers exist in both men's and women's voices. But the chest voice predominates in men, the other two being but the remnant of the boy's voice. "The falsetto in men's voices, when good enough to be used, has the same extent as in women's." [3]

[1] Hints on Singing, 7. From his words we might assume that 3 register theory was widely extant before Garcia. However, since the above citation is derived from an 1894 publication, such an assumption would be dangerous.

[2] Ibid., 2.

[3] Ibid., 10.

Apparently with women's voices the chest register is capable of greater upward pitch limits than safe use permits. Garcia indicates that in theory the lower register may cover all the notes encompassed by the middle register. However, the usual warning is implied that such use is dangerous.

> Though theoretically these two registers may have a ninth in common, from B to D flat, practice only admits a third. (from middle C to E.) [1]

Garcia may have reasoned that these notes could theoretically be contained in either register due to the glottal action which is apparently similar in each register with one main exception the amount of the cord substance that vibrates. In the middle or falsetto only the edges vibrate. But in either case, perhaps he means, the cartilagenous glottis closes as the pitch rises, leaving the vocal cords of equal length. The distinguishing feature of the head, then, is complete closure of the cartilagenous portion of the glottis leaving only the ligaments themselves to vibrate, in general a "shortened string." This register Garcia definitely distinguishes from the falsetto. There is little similarity in the action of the cords in falsetto and head. Actually it would seem that the falsetto and chest have more in common, since the cords vibrate in whole in both and shortening results

[1] Ibid., 10.

from closure of the cartilagenous glottis. The essential difference between the two is the thickness of the vibrating element.

Madame Seiler's views should be given brief attention.[1]

> Mme. Seiler followed Garcia in her arrangement of the registers though differing from him as to certain details. [2]
>
> She recognized three registers, chest, falsetto and head, with their subdivisions. [3]

Mills states the she

> . . . used the term 'falsetto' in a sense different from its ordinary one. Usually this term is not applied at all to the female voice, but only to that modification of the male voice seldom employed now, and almost never except by tenors. With this writer (Seiler) 'falsetto' as applied to the female voice replaces middle in the commoner usage. [4]

Like Garcia and Seiler, Brown and Benke place the falsetto in this central position. It is possible, as Mills suggests that the concept of falsetto as held by these writers did differ from that held at the time as well as that held currently. Mackenzie, it should be noted, says

[1] Seiler's views apparently were first published in German in 1861.

[2] Mackenzie, Hygiene of the Vocal Organs, 78.

[3] Mills, Voice Production in Singing and Speaking, 153.

[4] Ibid., 154-5.

nothing of this possibility. As is usual Seiler gives the registers quite definite pitch limits. In Seiler's view, and in opposition to Brown and Benke, all the registers seem to be present in both male and female voices.

The theories of Brown and Benke received a considerable amount of attention during this period. These two collaborated to further elaborate on the theories of the time. Mackenzie thinks their views were borrowed:

> Mr. Emil Benke, taking his classification from Mme. Seiler and his nomenclature from Mr. Curwin, prefers to parcel out the voice into a thick (chest), a thin (falsetto), and a small (head) register, the thick and the thin being again subdivided into upper and lower, as in the Garcia-Seiler scheme. Mr. Benke has been able to indoctrinate with this his collaborator, Mr. Lennox Brown, whose formerly expressed opinions on the question, though somewhat hazy, showed a leaning toward the more simple division into two registers.[1]

In the opinion of these collaborators all the five registers are not necessarily found in every voice. All the typical registers are sometimes found in the contralto, four of them usually in most women's voices. In men's voices only three appear, except perhaps as falsetto. Where the contralto may be very limited in or actually excluded from the small register, the soprano can carry on in this highest of all registers. In the vocal ranges of the contralto and tenor there is much register duplication except at the extremities of these two types of

[1] Mackenzie, Hygiene of the Vocal Organs, 78.

voices. Our collaborators call attention to a difficulty in distinguishing between contralto and tenor when the singer is heard but not seen. Radio listeners have often experienced a similar difficulty. Stanley has issued a new theory in relation to this matter: Properly produced, all voices singing at a given pitch and volume should sound alike. That is: all voices when properly produced when singing C, 256, at a given volume, should be relatively indistinguishable, whether they be bass, tenor, alto, or soprano.[1] Fucito tells of a time when at a time of emergency, in the performance of an opera, Caruso sang the bass aria "Song of the Cloak" in a good bass quality.

The falsetto may be sung in two ways, according to Brown and Benke. It may be executed in the mechanism of the "upper thin" carried beyond its proper limits. An eliptical vocal chink appears. The tone is feeble, and little crescendo is possible. Cultivation of the falsetto in this mechanism does not strengthen it. The second manner of executing the falsetto is with the mechanism of the "lower thin." The vocal chink here is linear; the tone is strong; a considerable swell is possible. It may be converted into "mixed voice" (voce mista). It can

[1] Your Voice, 227.

be made more powerful by practice.[1] It should be noted that both Brown and Benke, and Garcia, opinioned that the falsetto is derived from the middle register or mechanism. In two types of falsetto noted by Brown and Benke, that derived from the "upper thin" shows an eliptical vocal chink whereas that derived from the "lower thin" shows a linear vocal chink. This latter seems more comparable to Garcia's description of the cords in what he designated as falsetto.

Like Garcia, Brown and Benke observed a rather heavy laryngeal mechanism for the "thick" or "chest register." The vocal ligaments are thick and heavy. In the process of ascending the scale in the "thick" the front aperature between the cricoid and thyroid cartilages narrows to the point of disappearing. If the pitch rise in this register is carried beyond F, first space treble clef, for tenors, sopranos, or contraltos, strain results. It is curious to note here that the practical limit of the chest register appears to be the same identical note for both men's and women's voices. It is easily observed here that the greater part of the range of the female voice (except perhaps the contralto) lies above this point and the greater part of the male singing range lies below it (almost entirely below in the case of the bass or baritone).

[1] Voice, Song and Speech, 238.

In other words, the first major change in mechanism comes near the top of the range in some voices and toward the bottom of the range in others. In the case of the contralto it occurs near the middle of the vocal range. If Brown and Benke are correct on this point, one is more or less forced to assume that the larynges of men and women function quite differently. According to the ranges indicated by Garcia, we find Brown and Benke substantially agreeing on the amount of upward extension safe for the heavy mechanism.

Sub-divided again into upper and lower extending from F, first space treble, to F, top line treble, is the "thin" (from which as has already been stated the falsetto is derived). It is not clear whether "thin" is falsetto or may merely become so. It is inaugurated with great sensation of relief, after having sung high in the "thick" mechanism. In uncultivated voices a great diminution in volume is noted, when the change is made from "thick" to the "thin." Alterations in the mechanism according to Brown and Benke are as follows:

> . . . the lid /epiglottis/ is more raised than before, and we consequently get a complete view of the larynx, so much so that we even see the cushion of the lid . . . and the insertions of the vocal ligaments in the shield /thyroid/ cartilage. The vestibule seems longer and narrower, and the ary-epiglottis folds thinner; the pocket ligaments /false vocal cords/ are closer together and the entrances to the pockets less marked than before. The vocal ligaments seem quite still and their tone production vibrations appear to be confined to the thin inner

> edges. But more, the vocal ligaments . . . are made much thinner than they were in the thick register.[1]

A further alteration was observed to be an opening of the crico-thyroid aperature which tended to disappear with the pitch rise. The slit between the ligaments is linear

> and that the pitch is evidently raised by the vocal ligaments being stretched. This fact is corroborated by the state of the ring-shield aperature, which again commences to become smaller and smaller, until at last it once more quite disappears. In this manner the voice is carried to about where a new change is found compulsory if straining and forcing is to be avoided and we now see an elliptical slit between the vocal ligaments . . . which slit is gradually reduced in size . . .[2]

as the contralto and soprano sing from C, fourth space, to F, fifth line.

> It is, however, worthy of notice that his mechanism may be resorted to almost from the beginning of the thin register, and that even tenors may use it, and do use it, in the production of the few tones just above the thick register which form the highest part of their compass as applied to modern music. /upper thin/ But tones so produced are very poor and unsatisfactory, and they constitute what is commonly called the 'falsetto voice' . . .[3]

We find, therefore, that Brown and Benke are in some substantial agreement with Garcia concerning the falsetto. Where some have related the man's falsetto to the head

[1] Voice, Song and Speech, 166.

[2] Ibid., 168.

[3] Ibid., 168-9.

voice of women, Benke classifies it with the upper thin register and an elliptical glottal opening. It should be recalled, however, Benke finds another type of falsetto identified with the lower thin.

Last among the registers is the "small."[1] In this register the action of the vocal ligaments is limited to a small section. This section is oval in formation and is located in the forward part of the glottis.[2] It contracts as the pitch rises. This voice starting F#, fifth line, is mostly in the realm of the soprano voice alone. The indication is then that the contralto is usually limited to the mechanism and pitch extreme of the thin, and that no comparable mechanism exists in the male voice.

Brown and Benke's observation of the shape of the glottal opening could be subject to error due to the apparatus for observation. Recent observations with rapid moving picture apparatus have been able to slow the vibrations of the cords at 125 cycles to one vibration every two seconds.[3] It is probably demonstrated that the cords under simple laryngoscopy would not necessarily

[1] Named such by Curwin: "because the action of the vocal ligaments is confined to a small part of them . . . Voice, Song and Speech, 164.

[2] All observers do not find the oval necessarily in the front part of the glottis.

[3] "Foundations of Speech" 120-1, Bell Laboratories' Monograph.

appear as they actually work. It appears that on a low note the ligaments are together and touching for as much as half the vibration cycle. As the pitch rises the time they are together is decreased.

> In the highest range of the voice (the falsetto, or 'head voice') the period of opening in each cycle becomes so much greater than the period of closure that the glottis may not touch at all.

So it might be safe to conclude that the appearance of the vocal bands would be governed in great part by the proportion of the cycle they remain open. For example, if the bands were separated for the greater part of the vibratory cycle, it would seem logical to conclude that the bands reflected in the laryngoscope mirror would appear open. Joined with the special difficulties of laryngoscopy, this would make it somewhat doubtful that the action of the mechanism could be diagnosed accurately in a laryngoscopic mirror. It is difficult to judge from Brown and Benke's text to what extent the heard sound determines the register. It could easily be inferred, however, that most of the registers discussed were diagnosed by sight, through the mirror, rather than from the heard results. No mention though is given concerning the visible change which occurs from the "lower thick" to the "upper thick."

In the opinion of Garcia, and Brown and Benke, then, we have register theories containing much in common. Each

finds three main registers. Hearing, probably, on the part of Brown and Benke distinguishes two additional subdivisions. In Garcia's mind all registers exist in every voice. To Brown and Benke only the contralto has them all. Neither identifies falsetto with the "head" register but more with a middle register. Both place definite safety limits on how high a register should be taken but admit it can be carried higher at considerable peril. The register theories of both are pretty definitely governed by pitch ranges and in no sense by intensity.

A possible contribution to the technique of laryngoscopy was made by Brown and Benke. This was accomplished by illuminating the larynx from the outside at a point slightly inferior to the glottis.

> This process is particularly successful in the case of very lean individuals, and it shows the vocal ligaments to be almost transparent, while in the thick register they are much more opaque.[1]

The writer has seen no evidence that this type of laryngoscopy has been repeated.

Kofler wrote a book, mostly devoid of scientific validity, but one that definitely belongs to this period and a text that gives us no little amount of insight into views held during the laryngoscopic period.[2]

[1] Brown and Benke, Voice, Song and Speech, 167.

[2] Kofler, Leo, The Art of Breathing .

He makes the following amazing statement in the proof that the registers exist:

> There are and must be registers in both the male and the female voice, because there is no voice without a lower, a middle and an upper range of tones. [1]

We are forced to conclude from this that Kofler believes that three registers exist in both the male and the female voice. He is adverse to the idea that registers should be considered as separate manners of producing tones in various ranges of the voice so that the registers may be distinguished from each other by sound. On the other hand,

> One of the most important and, frequently, most difficult tasks of the singing teacher is to obliterate the registers, or, in other words, to equalize the transition from one range of tones to another, so that not the slightest vocal break or unevenness can be detected.

Most sources that the writer has found which admit the existence of registers would agree with Kofler that to "equalize the transition from one range of tones to the other" is a thing to be desired.

Kofler discusses at some length the manner in which the registers should be blended. In blending the "chest" and the "middle" it is necessary, on the transitional tones, to "divide the muscle action," that is "use partly that of the medium and partly that of the chest register."

[1] Ibid., 163.

Such a procedure will strengthen the transitional tone belonging to the middle register and mellow the tone belonging to the chest register. This evens the two registers both as to quality and intensity.

> . . . in trying to blend the upper two registers it is always safest to practice the head tones softly down into the range of the middle tones.[1]

Some resemblance to a part of Stanley's system is to be noted in Kofler's suggestion that the high register should be carried down in practice into the area of the one below it. This resemblance, however, is one of minor importance only. It has long been fairly common practice to sing the so-called "head tones" downward toward the middle of the vocal range. Carrying a register up as Stanley suggests would meet with Kofler's hearty disapproval.

However, Kofler's reference to treatments other than those he recommends occur so often in his text that these must not be excluded from our consideration, since they suggest that some of Stanley's procedures were used by others in actual practice.

> Our attention is forcibly directed to them, since the modern Italian and French schools declare that these terrible breaks or registers should be cultivated in every singer . . . at least in every female singer; while, for the male voice, some of them go to the opposite extreme and admit no registers.[2]

[1] Ibid., 174-6.

[2] Ibid., 163.

> Now let us listen to the same series of tones sung by a lady trained according to the three-register system of the modern Italian school. As soon as she strikes the lower C, our ears are rasped by an uncouth boyish sound, produced as if by the working of a secret spring . . . This is the 'chest register' of the degenerate descendents of the old masters! The higher this terrible tone is carried, the more disagreeable it sounds, like the rough cry of a street Arab.[1] On G, however, as if by magic, a little thin tone with a slight nasal twang is ushered in, which, frequently, sounds also quite hollow and gravel-like. This is the 'medium register' of the 'signor' of the modern Italian school. Upon reaching D, our singer astonishes us with a new trick; a shrill yell reaches our ear, raised by the 'head register' of our 'modern maestro' [2]

Such references as this are common enough to suggest that systems did exist where the registers were separately trained. As noted before, however, most of the literature on voice that the writer has been able to obtain soundly condemns such practice.

Very pertinent to our study is the author's mention (again condemnation) of carrying lower register tones high into the middle of the vocal range. Condemnation of this practice likewise is common in the literature.

> It frequently happens that the tones of the lower range, or the so-called chest-tones, are forced too high into the middle range . . .
> . . . I have met female trebles that used this means of forcing up the chest tones as high as middle A, B, C,[3] and (one can hardly conceive of the physi-

[1] According to Wilcox, The Living Voice, the heavy mechanism, used for vocal development, is generally, though not always, unpleasant in quality.

[2] Kofler, op. cit., 165.

[3] Opinion of the voice masters of this period usually set F as the outside limit for the use of this register.

> cal possibility of so doing) even as far as D and E flat.[1] The reason why this practice is so dangerous to the throat lies in the unnatural way in which the larynx is held down in the throat, and in the force that is exercised by the tension muscles of the vocal ligaments and the hard pressure of the muscles of the tongue bone . . .
>
> I have examined with the laryngoscope many ladies who had the habit of singing the chest-tones too high, and without exception I have found their throats in a more or less diseased condition. Laryngitis either alone or complicated with pharyngitis, relaxation of the vocal ligaments, and sometimes paralysis of one of them, is the most frequent result of this bad habit. If a singer is affected with catarrhal trouble, it is always aggravated by this abominable method of singing.[2]

Kofler does not state whether or not schools of vocal instruction trained singers to carry the heavy register so high. His statement merely seems to be that it was commonly done and with disastrous results.

Use of the falsetto in men's voices during this period becomes more evident with the following:

> . . . However, from experience, and from the testimony of the best singers of all times, I can state that falsetto practice is the fundamental work for the developing of high tones of all male voices and for equalizing them with the medium range.[3]

It should be noted that no definite claim is made that the use of the falsetto benefits the voice, gives it quality or anything of this sort, except that it helps to

[1] To about Stanley's limit in forte singing.

[2] Ibid., 168.

[3] Ibid., 179.

develop the mechanism of the high notes for the male voice. Likewise, as do Brown and Benke, Kofler believes the mixed voice is developed from the falsetto.

> I have already said that the mixed voice is developed from the falsetto. The first step, therefore, is the practice of the falsetto . . . As a rule, soft humming exercises will lead the singer, in the simplest way, to a practical knowledge of the falsetto . . . [1]

It is somewhat difficult to determine just what Kofler means by falsetto. It may be, as in the case of Brown and Benke, Kofler recognized two types of falsetto. Apparently there were persons during this period who considered light upper tones of the female voice falsetto, which would seem to be out of agreement with Benke and Garcia and perhaps in some amount of agreement with Stanley.

> Some call the highest tones of the soprano, when sung softly, the falsetto. Others understand by it the softest tones of male and female singers throughout the whole compass. [2]

This latter statement is even more in agreement with Stanley, since the falsetto with him is more a soft mechanism that a high mechanism, except that Stanley's falsetto does not necessarily remain soft as the pitch rises.

> I am of the opinion that the old Italian masters understood by the term falsetto the soft production of the highest tones of a male voice sung with closed throat.

[1] Art of Breathing, 182-3.

[2] Ibid., 180.

> This distasteful and shocking mode of tone production does not find a place in my book because of any desire on my part to aid in its introduction into the United States. On the contrary, I wish to impress all my readers with a sense of its positive ugliness . . . [1]

How Kofler arrives at such an opinion is difficult to see. In the first place, Mancini indicates a probable belief that the falsetto is a part of all voices:

> Every student whether he is soprano, contralto, bass or tenor can easily know the differences between these registers.

Whether or not they somewhere indicated falsetto was produced with closed throat is doubtful. The "open throat principle" has quite a venerable history. However, Russell's x-ray photographs indicate that what sounds or feels like an open throat may be actually the opposite. The author continues with a reference to the English male alto who he thinks uses an "open throat" production. He seems not to approve of this type of singing either. However, as before indicated, with open or closed throat the falsetto seems of value in developing the upper notes of the male voice.

Kofler's work, then, is valuable to our study not so much for its own contributions as for the suggestions of practices and beliefs that prevailed during the laryngoscopic period. He supports a three register theory, the highest and lightest in the male voice being the falsetto. He is definite in his opinion that they should

[1] Ibid., 180.

be equalized and this is done by mixing them somewhat at the point where the break appears by carrying the higher one down into the range of the one below. This was a fairly common and accepted principle of the period. He calls attention to many female voices in which the lower register has been carried high into the middle voice, condemns the procedure, having found various types of morbid conditions in all such cases he examined. He does not indicate whether or not schools of singing favored such practices. He indicates that the French and Italian schools of the period trained the registers in female voices as separate units without blending them, often denying the existence of the registers in the male voice. He made use of the falsetto in the development of the higher tones of male voices and as the key to the "voce mista." He is vague as to his own definition of the falsetto but tells us that some believe it to be the soft high tones of the soprano. He states, very significant in our study, that some considered the soft tones throughout the whole range of the voice, either male or female, to be the falsetto. This very closely resembles Stanley's idea of the falsetto.

We now have before us a fairly representative group from the singing masters. All these singing masters tell us of the existence of three main registers. However,

three of them, probably influenced by each other, make sub-divisions till there are five registers. All three of these observers place the falsetto centrally leading us to wonder if Mills' reference to Seiler might be correct in his suggestion that she was not thinking of the true falsetto mechanism which is usually considered a male mechanism only. Among the three there are admissions that a register can be carried somewhat higher than the limits they impose but warn against such practice. Extension of registers down is easier and safer. Pitch range and not intensities govern the auditory phenomena of the registers. For each main register at least a separate laryngeal mechanism is allegedly seen in the laryngeal mirror. Three of the investigators this time excluding Seiler mention the falsetto as the key to the "voce mista;" Kofler, supporting a three register theory, with the falsetto the highest and lightest of the male mechanisms, fails to make the sub-divisions common to the others. He mentions no school that promoted the carrying up of the lower register but in condemning the practice tells us it was done. He tells us of French and Italian schools that train the registers separately for female voices. He used the falsetto to develop the high tones of the male voice and states that the practice had been used for all the great male singers, perhaps an ex-

aggeration. He states that some considered the soft tones in both male and female voices to be the falsetto. We find in the writings of the singing masters certain suggestions of some of Stanley's register practices. That of carrying the highest register downward seems generally approved as a method of blending the top register with the one below. However, Stanley's claim that the procedure is a part of actual vocal development is characteristically absent. Separate training of the registers as well as carrying up the lower register were, perhaps somewhat in harmony with Stanley's ideas, were practiced, but not with the approval of the writers among the "laryngoscopic singing masters." Claims of the existence of from three to five registers is, of course, in definite disagreement with Stanley's two. The idea that registers are closely related to intensity, Stanley's main thesis, is scarcely hinted at.

Still confining ourselves to the same general period we turn from the vocal masters to the physiologists and other scientists who investigated the registers of the voice. Concerning this period our dependence upon Mackenzie is great due to his recording of the investigation of the scientists.

Mackenzie says,

> . . . the word 'registers' has been used in two different senses, one in which it signifies the

> pitch of a given note, whilst the other a particular mode of production is meant.[1] By a register I mean the series of tones of like quality producible by a particular adjustment of the vocal cords. Strictly speaking there is a different 'register,' i.e., a certain appropriate condition of the laryngeal orifices for every note, but the actual mechanical principle involved is but twofold . . . If, therefore, a new nomenclature is thought necessary to replace the old, the terms, 'long reed' and 'short reed' registers would serve well enough to express the two fundamental differences of mechanism in voice production.

Mackenzie states that while the musicians of the period find a complication of five registers, most of the scientific observers [the notable exception being Mills] find only two.

> One can scarcely fail to be struck by the fact the whilst nearly all scientific observers, such as Muller, Mandl, Battaile, Vacher, Koch, Meyer, Gougenheim, and Lermoyez are content with a twofold division of the voice, musicians (Garcia, Mme. Seiler, Benke) affect the more complicated arrangement of five registers.[2]

Likewise Mackenzie is of the opinion that the old Italian masters recognized two.

> The old Italian masters . . . recognized only two registers of the human voice, the 'chest' and the falsetto or 'head,' the two latter terms being exactly synonymous.[3]

This likewise is the writer's general conclusion. However, the evidence of Galliard's footnote quoted by Mackenzie himself tended to indicate that some at least

[1] Hygiene of the Vocal Organs, 54-5.

[2] Ibid., footnote three, 55-6.

[3] Ibid., 76.

in England held that the head and falsetto were not synonymous. At least, Galliard seems to have so believed.[1]

The first two of the scientific investigators, Lehfeldt and Muller, made their investigations with exsected larynges of animals and humans. It is probable, though it is not completely clear, that Lehfeldt supported a two register theory. However, in his experiments, accidentally blowing on an exsected larynx with less force than intended, he produced some very high notes reminding him of the flageolet. He jumped at once to the conclusion that he had discovered the secret of the falsetto voice, which he attributed to 'want' of force in the air blast,[2] which is too weak to throw the whole breadth of the cords into vibration. It is difficult to relate this theory to what Lehfeldt apparently observed in an exsected larynx since such muscles, if they exist, would not come into action under such an experimental situation as this. It is not, of course, necessarily far fetched to attribute falsetto production to "want of force in the air blast." At least, the writer's experience with his own voice would indicate that though air is expired faster in falsetto, pressure does not appear excessive except for very high falsetto tones.

1 See page 30 above.

2 See page 36 above.

Among Stanley's experiments the only one which the writer has found satisfactorily described is one dealing with the amount of air expelled in well-produced and in poorly produced voices. He finds in what he terms the well-produced voice expulsion of air is highest on pianissimo tones. Since he fairly well identifies pianissimo with falsetto, it is assumed that expulsion of air in this type of production will be high. This, however, does not necessarily mean that breath pressure is higher in falsetto.

Mackenzie opines that Lehfeldt's theory would have been lost were it not that the great physiologist, Muller, picked it up, and that the theory assumed important proportions due to Muller's eminence. For nearly all have founded doctrines on falsetto on Muller's chapter on voice. It is not clear from Mackenzie's text that Lehfeldt supported the two register theory. However, it is clear that Muller so believed though the term "head" is used instead of falsetto in this relation in some places in Mackenzie's text.

Next in line among the scientific observers whom Mackenzie calls in to support his two-register theory is Bataille. This observer was actually a singing master but had had a complete medical education and had been a teacher of anatomy. Bataille maintained that the cords, which are extremely tense especially in the anter-posterior

direction, vibrate in their entirety in the chest register; but in the falsetto only the free borders vibrate, the cords being less tense in this register.

> The difference between Bataille's view and that of Muller consists in this that the former divides the vocal ligaments into three parts, viz., subglottic, inner free border, and ventricular. In the chest register the subglottic part vibrates with the rest. In the falsetto the other two alone come into play. Bataille gives an elaborate anatomical description of the subglottic part of the cords to which he attaches so much importance, but he has failed to inform us how he was able to see below the cords at a time when, according to his own account, they are in close opposition. [1]

Martels, according to Mackenzie, substantiates a two-register theory but differs from Bataille and others concerning the manner of the production of each.

> Martels claims to have proved experimentally that in chest singing it is only the mucous covering of the vocal cords that vibrate not the substance of the ligaments themselves. The situation is, according to him, very loosely adherent to the parts which it covers, and if sound is produced in an exsected larynx, by blowing through the windpipe, the membrane can be distinctly seen to detach itself from the underlying cords, and to take up a position in the glottis, where it vibrates. If the part thus seen to vibrate be pricked with a needle, the muscular tissue is never reached. [2]

Martels suggests that this contraction of the thyro-arytenoid muscles bends the cords slightly outward which tends to slacken the membraneous lips, permitting them to vibrate due to the air blast rushing through the glottis

[1] Ibid., 82.

[2] Ibid., 87.

from below. However, in this register it is the crico-thyroid muscle which actually produces song by giving the vocal membranes the length, breadth, and degree of tension required for each note, the function of the thyro-arytenoid being, in this production, to prepare the way by shaping the lips somewhat elliptically thus freeing the membraneous parts for vibration. "Chest" according to Martels is essentially a reed type of vibration. Stanley maintains that the crico-thyroid muscle is the activating agent in the production of lower register tones. However, Stanley does not follow Martels concerning vibrating membranes. Falsetto, on the other hand, is flute-like in nature. Here it is the air itself that vibrates after the fashion produced by lips blowing into the orifice of the flute. Martels agrees with most of the observers of this period concerning closure of the posterior portion of the glottis; but believes the essential factor in falsetto production is not such a closure but, rather, an approximation of the ventricular bands. Such approximation causes air passing through the lower orifice to strike these bands, giving rise to the alleged flute-like production. Accordingly a singer with destroyed ventricular bands would be incapable of producing head tones. Here is a theory considerably at odds with Lehfeldt and Muller, former experimentors with

exsected larynges, who considered themselves to have noted edge vibration in the falsetto instead of the lower register and deep vibration of the ligaments themselves in the lower register. Bell Laboratory motion picture photography of the vocal cords in action would seem to demonstrate rather conclusively, in lower pitches, at least, more than mere vibration of the bulk of the ligaments. A rather violent opening and slapping together can be clearly observed on these pitches, such actions probably demonstrating the verity of the puff emission theory long held by some. Here with Martels we have another exponent of the two-register theory but one who attributes their causes to very different actions in the larynx from those observed by Muller and Lehfeldt or much later by the Bell Laboratory.

Gouguenheim and Lermoyez also support a two-register theory but add to the causes two differing conditions of the resonating mechanism. These writers lay much stress on quality as well as pitch differences observable in the falsetto in contrast to the chest. Entering into the causation of the flute-like quality of the falsetto, they maintain: closure of the nasal cavities by a strong contraction of the soft palate, and a special adjustment of the mouth cavity in which the cheeks are more tense and vibrate more freely than in the chest register. In gen-

eral the characteristic physical phenomena observable in the two registers are:

1. In the chest voice the larynx is contracted and the pharynx relaxed.
2. In the head voice the larynx is relaxed and the pharynx contracted.

Shortening of the vibrating portion of the glottis is observed, as by numerous others, a characteristic of head or falsetto production. In general such a theory is not totally out of harmony with known accoustical principles if a relaxed pharynx is a large one and a contracted pharynx is a small one. Relatively speaking, large cavities resonate low pitches. Stanley maintains, however, that the widely open throat is by no means a relaxed throat. On some occasions he seems to maintain that the throat is to be held rigidly open.

In general Macknezie finds the scientific observers, in spite of certain outstanding disagreements, in harmony on essential things. First, they all, with the exception of Dr. Wesley Mills (to be discussed later), they elect to support a two-register theory. All note that there is, comparatively, a greater amount of antero-posterior tension of the ligaments in the chest register. A small glottal aperature seems to characterize the head register when it is compared with the chest. In the head

tones a smaller amount of cord substance seems to be in vibration. In the head voice the air blast is less strong.

Now we come to Mackenzie himself, one of the key figures in our study. He is important to our study for two reasons: First, he conducted what could probably be considered the most exhaustive laryngoscopic study made during this period. Secondly, certain of his conclusions and some of his intimations have a rather important bearing on Stanley's register doctrine.

Mackenzie classified and evaluated methods of vocal investigation. He suggests four possible ways to study the voice:

1. Subjective sensation
2. Analogy
3. Experiment
4. Direct observation

> Whilst some of these methods are simply fallacious, none of them is entirely satisfactory. Sensation which is always an untrustworthy interpreter in all that relates to our internal economy is particularly treacherous in regard to the throat.[1]

However, sensation, thinks Mackenzie, is useful in confirming results arrived at in other ways. It can always be relied on when it tells whether or not an action causes strain. Mott studying the neurological aspect of the vocal mechanism pointed out in 1910 that hardly any sen-

[1] Hygiene of the Vocal Organs, 73-4.

sory nerve endings are to be found in the vocal cords or the muscles of the larynx. This factor would seem to give more emphasis to Mackenzie's view concerning especially when related to the mechanism of the larynx.[1]

"Experiment is so difficult of application that its range of usefulness is necessarily limited."[2] The writer is led to believe that to experiment in Mackenzie's view consists largely of work done with animals, i.e., various operations performed on the larynges of live dogs and other animals in order to observe the workings of the live larynx, observation of the human larynx in cases of injury or surgical operation, and the use of exsected animal and human larynges. Obviously the "range of usefulness" of such experimentation is drastically limited. The writer suggests, however, that the experimental range may not of necessity be so limited. The method of the group studies of the development of voices under controlled conditions has not been sufficiently exploited in the field of vocal research,[3] though much has been accomplished in this manner in the field of educational psychology.

1 "A Survey of Recent Voice Research," Wilmer T. Bartholomew, Music Teachers National Association Volume of Proceedings for 1937, 116.

2 Hygiene of the Vocal Organs, 75.

3 See Appendix I.

Granting that the limitations of the process of observation are also limited, Mackenzie describes the set up for his study and its results. First, the throats to be examined should be those of singers only. Mackenzie sees little value in adhering to Grutzner's distinction, i.e., the use of three types of subjects in a laryngoscopic observational study: trained singers, natural singers, and non-singers. Mills criticizes Mackenzie's study on the grounds that non-singers were excluded.[1] On the other hand, Mackenzie criticizes Mills' study in that Grutzner's distinctions were adhered to an few outstanding singers were used. Secondly, in Mackenzie's study, a subject was to be considered invalid if it were not possible to observe the cords in action throughout the whole scale.

> The difficulties in the way of an adequate examination are so great that to obtain a complete view of the whole process a very large number of singers have to be examined. Thus in order to study the working of the vocal cords throughout the entire scale in 50 persons, I found it necessary to examine between 300 and 400 singers . . . I have looked only at the throats of persons with fine voices. My cases include a great many of the best singers of the day; of the 50, 42 were trained, whilst four were natural singers . . .[2]

As with the scientific investigators which Mackenzie calls to his support, Mackenzie notes two registers. The

[1] Mills, Voice Production in Singing and Speaking, 159-168.

[2] Hygiene of the Vocal Organs, 58.

physical differences most notable between the two registers is the length of the vibrating element.

> The only novelty which I have ventured to put forward is that the essential factor in head delivery is the short read. [1]

Mackenzie noted that in the low tones of the vast majority of voices the whole glottis is open. This includes both the ligamentous and cartilagenous portion. However, in the upper tones of the chest register closure of the cartilagenous portion is usually observed. This may account for some observers' belief in more than two registers. However, Mackenzie does not consider this closure as a factor greatly affecting production.

> The closure of the posterior portion of the glottis does not seem to be a very important matter, as it does not affect the vibratory element and it is highly probable that some air passes through the hinder portion during singing even when apparent closure has taken place. [2]

The closure of the cartilagenous glottis, thinks Mackenzie, is not of great importance since this in itself does not change in itself the length of the vibrating element. This is due to the fact that in Mackenzie's opinion "only the ligamentous portion forms the true reed." This matter is of interest in relation to Stanley's breath expulsion experiments. He finds breath expulsion somewhat greater in the case of low notes than in

[1] Ibid., 57, footnote.

[2] Ibid., 63.

the notes in the middle of the voice. If, as Mackenzie suggests, the cartilagenous glottis is open on low notes, reason may be given Stanley's observation. In the head voice or falsetto Mackenzie notes a not inconsiderable change in the length of the vibrating element, for here a segment of the ligamentous glottis is tightly closed leaving only a part of its length to vibrate.

> . . . in the head voice of women and the falsetto of men, stop closure . . . always takes place in the posterior portion also. In the former cases there is an elliptical opening extending to the anterior commisure of the vocal cords; in the latter the elliptical opening occupies the middle one third of the ligamentous glottis . . . Whether the stop action occurs only behind or both behind and in front, the elliptical opening between the lips of the glottis becomes progressively shorter (from behind forwards) as the voice rises. In only two cases have I seen any exception, and in these the elliptical opening was found at the back of the glottis just in front of the vocal process. [1]

This closure of the portion of the glottis is accomplished by apparent tight pressure of the closed portions of the lips against each other. In some cases the closure seems to be accomplished by the edges of the cords overlapping; in others by such tight pressure that the edges are turned upwards. In either case pressure is more than sufficient to completely prevent vibration.

Whereas the vocal masters of this period set rigid bounds above which the registers of the voice should not be carried and made blanket distinctions to which all

[1] Ibid., 62-4.

voices should adhere, Mackenzie is not nearly so dogmatic. He speaks with the others in deploring the practice of carrying a register too high, but "too high" in Mackenzie's mind seems to be a matter of the individual vocal instrument.

If in the attempt to develop the voice, a register is forced beyond its natural limits in a given individual, injury to the vocal organs results.

> . . . It is in order to guard against evil of this kind that I have laid much stress on the necessity of dealing with every voice according to its idiosyncracy.
>
> One can see with the laryngoscope the excessive congestion induced by carrying a register beyond a certain point, and the almost instant return which occurs when the register is changed. Competent authorities affirm that the example of Dupuey, the French singer so famous for his high chest tones, had a pernicious effect on other tenors who attempted to imitate him. [1]

However, it seems in the case of some voices there is no practical limit to the use of the chest register. Any note which might be demanded of such singers can be adequately and easily produced in that register. Nearly all the male singers except falsettists and tenors are one register singers. Some tenors are actually able to produce all the notes demanded of them in the chest register.

> The proper use of the register is a point of the greatest importance in teaching. Some tenors can attain a very high pitch with a long reed (chest register), and a few others have been able to hold

[1] Ibid., 113-4.

> the high C, whereas most tenors experience great fatigue of the tensor muscles of the vocal cords if they sing very high notes in the chest register; indeed, the attempt often brings on serious congestion of the windpipe. On the other hand, by using the short reed (falsetto) such singers can produce charming tones without any injury to the delicate muscular apparatus of the larynx. Many sopranos can produce two octaves and two or three notes with the long reed and do not find it necessary to shorten the vibrating element, but a large number of mezzo-sopranos can only reach their higher notes with the head register (short reed), and contraltos also usually employ this mechanism. It is in the latter class of voice that, when the shortening of the vibrating substance of the cords begins to take place, tones of peculiar quality are produced, to which the term middle register is sometimes applied. [1]

However, for the majority of tenors use of the falsetto is advisable at extreme high pitches. Pure sopranos, Mackenzie thinks, can execute most song ranges demanded of them with the long reed mechanism. He calls attention to three sopranos examined by him, Nilsson, Albani, and Valleria, who apparently maintained the "long reed" mechanism throughout the extent of their scales. Mezzos and contraltos, on the other hand, usually resorted to the short reed or "head" mechanism for their higher notes.

It is not to be concluded from the foregoing that Mackenzie considered the falsetto mechanism lacking in any of the examples mentioned though perhaps it is unused in many. He maintains that the finest male alto singers spring from bass or barytone singers who use the

[1] Ibid., 112.

short reed.

One curious point concerning Mackenzie's study, not mentioned by him, is that the long reed mechanism is used almost exclusively in the case of the heavier of the male voices. On the other hand, the similar condition seems to be no adequate explanation of why this should be the case.

Concerning one of our problems in this study: Is the exercise of the falsetto mechanism of value to the development and health of the vocal instrument? Mackenzie makes no definite statement on this point. He does state, however, that no harm is done to the regular register if falsetto is not exclusively used, but that the exclusive use of the falsetto is destructive to the natural register.

> The finest alto singers amongst men spring from bass or barytone singers who use the falsetto or short reed, but the exclusive use of the falsetto by these singers ultimately destroys the natural register or long reed. If both registers are constantly exercised, no harm is done. [1]

In Mackenzie's general view of registers some slight support of Stanley's ideas can be seen. First, they agree on two. Second, both think that similar mechanisms activate both the head voice of women. Stanley calls both falsetto; Mackenzie uses the term "short reed."

[1] Ibid., 65.

Both agree that pitch is not the only factor that governs which register is being used. Here, of course, Stanley goes much further than Mackenzie in naming intensity as the dominant causal factor. However, it can be said that the intensity factor is not entirely unrecognized by Mackenzie:

> Every singer knows by his own experience that it is difficult to render a high chest note piano, and that the higher the pitch the less easy it becomes. It is, on the other hand, almost impossible to sing a true falsetto note forte. [1]

Mackenzie finds that in some cases the "long reed" is used throughout the whole of the voice. Stanley thinks that the lower register can be so trained that it can be used almost throughout the whole range. Likewise Stanley considers it possible to phonate throughout the greater part of the range in the falsetto. Stanley contends that the practice of the falsetto is beneficial to the voice if the lower register is likewise practiced; Mackenzie believes it does no harm to the voice if it is not used exclusively. He makes no claims that it is beneficial.

One other investigator of scientific reputation, Dr. Wesley Mills, receiving only casual mention to this point, should merit some of our attention, he being somewhat at odds with Mackenzie in that he seemingly sides with the vocal masters concerning the number of the regis-

[1] Ibid., 89-90.

ters. Mills' point of variance with Mackenzie cannot be taken lightly since, like Mackenzie, he put forward another laryngoscopic study of some fifty voices. Whereas Mackenzie considered Grutzner's distinctions of little importance, Mills' study took them into consideration. Grutzner's distinctions of trained singers, natural singers, and non-singers has been mentioned before in connection with Mackenzie.[1] The issue involved here seems to be: In the attempt to discover truth about the registers of the voice, is it important to conduct investigation into cases in the latter two and especially the third of the above categories? Each investigator thought the other's study weakened by his attitude concerning the importance of these latter categories. It would seem to the writer that Mills was right to include these in the study and that Mackenzie was wrong to ignore them. However, another problem is involved in such a study, namely the size of the task. Mackenzie felt that to include non-singers would not only be of little value but would greatly extend the job of investigation. Whereas Mackenzie's investigation may have suffered from the exclusion of non-singers, it would seem definitely superior in its exhaustiveness. For Mackenzie was reluctant to record results for every subject examined,

[1] See page 73 above.

counting as valid in his study only those subjects in which he could see the cords throughout the whole scale. To get fifty satisfactory subjects it was necessary to examine three to four hundred throats. No such number was examined by Mills. Mills' text is not clear concerning the manner in which his subjects were distributed among the three of Grutzner's categories. However, the writer assumes they were published elsewhere [1] since Mackenzie gives a rather complete account of Mills' investigation. Only ten were trained singers, twenty-one natural singers, and nineteen non-singers. There were a far greater number of male subjects than female.

> Adopting Grutzner's classification of 'trained singers,' natural singers, and non-singers, Dr. Mills examined fifty persons, and gives the results as far as could be ascertained in every case; it must be observed, however, that in a very large proportion of these subjects the action of the vocal cords could not be seen throughout the entire scale . . . Indeed, amongst Dr. Mills' cases there were only ten trained singers, whilst there were 21 natural singers and 19 non-singers. The result of the investigation was, therefore, somewhat incomplete as regards the working of the vocal reed in the singing voice.
>
> Of the fifty cases thirty seven were males and thirteen females.

Of the 13 women only 3 could make genuine head notes and in two of these Mills was able to see the glottis as more

[1] Probably in "An Examination of Some of the Controverted Points of the Physiology of the Voice, especially the Registers of the Singing Voice and the Falsetto," (American Association for the Advancement of Science, August, 1882). This source is noted by Curtis, Voice Building and Tone Placing, footnote, 109.

or less closed anteriorly and of the same appearance as the male larynx in the falsetto. He found that in the falsetto range the inter-cartilaginous glottis is entirely shut with part of the ligamentous glottis also closed, the cords being pressed firmly together behind but in a variable degree in different persons. They were generally approximated in front as well.[1]

In general Mills claims to follow Seiler in her interpretation of the registers. He suggests, however, that the divisions of the chest register observed by Seiler and others is splitting hairs.

> Probably in many male voices there are distinctions of registers Mme. Seiler alludes to, i.e., first chest and second chest, or some change analogous to the middle of females; but from one cause and another, this seems to readily disappear. Whether it would be worth maintaining is a question that the author suggests as at least consideration. Certain it is that, speaking generally, there is no change in males equally pronounced with the passage from the lowest to the next higher (chest to middle) register in females. [2]

It is probable that a three register theory will satisfy him. Mills dissents from the terminology of the vocal masters in that they, Seiler included, labeled a middle register falsetto.

> Dr. Wesley Mills inclines to Mme. Seiler's arrangement of the registers but pleads for a terminology

[1] Hygiene of the Vocal Organs, 84-6.

[2] Voice Production in Singing and Speaking, 170.

> that shall involve no theory as to production, but merely indicate relative pitch, i.e., lower, middle, and upper. [1]

In actuality it may be that Mills was not in his own mind sure concerning the number of the registers. There are probably fairly definite limitations though the process of training may seemingly circumvent these limitations in some cases. To consider the range extent of a register as a very individual matter with Mackenzie is much further than Mills wishes to go.

> Dr. Wesley Mills, in his excellent paper, seemed to agree with the divisions of Garcia and Mme. Seiler; but in a private letter to Mackenzie said he did not care to be set down as a hard and fast advocate of any of the divisions of the registers now adopted. [2]

> The diversity that Mackenzie found in singers does not, in the author's opinion, exist in nature; much if not most of it was due to training, and all that can be said that several people may sing in different ways with not greatly different aesthetic results; but such investigation as in this case may lead to conclusions that are dangerously liberal. [3]

To the question, "Is the head voice of women the same or similar to the falsetto in men?" Mills seems in substantial agreement with Mackenzie.

> The high falsetto of men and the head voice of women are produced by a similar mechanism and method. [4]

1 Hygiene of the Vocal Organs, 78-9.

2 Curtis, Voice Building and Tone Placing, 111-2.

3 Voice Production in Singing and Speaking, 167 and 168.

4 Ibid., 159.

However, in eliciting the secrets of the registers, more attention should be given to the breathing. Stanley's experiments on breath expulsion indicate falsetto as using more air than the lower register. Other observers (in Mackenzie's time, that is) tell of the absence of as great a pressure of breath in falsetto as seems not to be the case in the lower register. These two ideas do not necessarily conflict since the rapidity of the escape of air does not indicate the amount of breath pressure exerted during vocalization. The amount of breath pressure used in either register actually may vary greatly according to the pitch and intensity of vocalization. To produce falsetto above high C may necessitate a pressure tremendously greater than that needed for falsetto an octave lower. At the same time escape of air might be quite rapid. Many authorities have considered the pressure of the air itself as a factor in pitch. Increase of air pressure, it is said, will in itself raise the pitch or at least assist the cords to adjust to a higher pitch. Stanley's register theories may first have been derived from the results of his breath expulsion experiments which will be described later in this study.

Is the use of the falsetto a factor in the health of or in the proper development of the voice? Mills

neither affirms or denies this question. He states that the old Italian masters trained singers to the use of the falsetto. However, he makes no claim to its value except that in its use the singer can get relief from the high tension caused by carrying up the lower register.

Mills' description of certain probable intrinsic laryngeal muscular action is of interest to our study and, perhaps, of some value to it. He seems in agreement with Stanley concerning the function of the crico-thyroid muscle.

> Just as the diaphragm is the most important muscle in breathing, so is the crico-thyroid the most important in ordinary speaking and in singing in the lower register. [1]

He believes, agreeing with some, in opposition to others, that the pull of the muscle is toward the larger or thyroid cartilage. Thus as the crico-thyroid contracts upward tilting is to be observed in the anterior portion of the cricoid cartilage rather than downward tilting of the cricoid. It would seem that no essentially different effect would be produced on the vocal bands themselves in either of these cases or even if movement were observable in both cartilages. In any case contraction of the crico-thyroid, if no other factors were to modify the picture, produce a stretching and lengthening of the vocal ligaments. Yet a very strong pull that would give much

[1] Ibid., 83.

tension to the ligaments, thus raising the pitch greatly, might be possible without the gap having reached its limit of closure and without the muscles having reached their limit of contraction. Such a condition would seemingly suppose adequate holding action at the arytenoid ends of the ligaments as Stanley maintains should prevail. Mills believes, however, that the position of the muscle and the small size of the gap between the anterior cricoid and anterior thyroid must of necessity impose a limit on the pitch ascent possible in the lower register. Further there is a limit to the amount of contraction in a given muscle. If these can be considered as valid factors, then it might seem that at least in a given individual case the lower register would be quite definitely limited.

Mills recommends with Stanley lower register or crico-thyroid action use for all singers. However, the reason for such use is again not Stanley's. Stanley proposes its use as a major factor in vocal development. Mills wants it used by our soprano because "without it the best tones of the lower register are impossible." He also with Stanley recommends that it be not used exclusively.

> The tragic actor, elocutionist and public speaker, and the singer, whether soprano or bass, should neglect no muscle, though they may be justified in developing some in excess of others, but even with

watchful eye on the weakest part.[1]

Stanley would object to any uneven development in any voice. Again the reasons are not necessarily the same. Stanley maintains that exclusive use of one register destroys the voice. Mills claims that such practice will draw down the larynx causing it to be used in a cramped position.

Here at the end of what we have termed the "laryngoscopic period" it is perhaps truthfully stated that not a great deal of support has been found for Stanley's register theory at least in its fully developed form, i.e., registers being more related to intensity than to pitch, separate development of the registers being essential to vocal training. True it is that among the most competent observers of the period there is great support of a two-register theory in which Stanley believes. Mackenzie vaguely approaches Stanley's doctrine in his maintainance that in some cases one register can be used practically throughout the vocal compass, in his belief that with many individuals many notes can be sung in either register by the same individual, and in his statement suggesting the difficulty in rendering high chest notes piano or loud falsetto notes. Mills approaches Stanley's doctrine in maintaining that lower register action is produced largely

[1] Ibid., 84.

by the crico-thyroid muscle, and in that he maintains that no part of the laryngeal mechanism should go completely unused. Agreement with Dr. Stanley is evident in the claim of several including Mackenzie and Mills, that the falsetto of men and head voice of women are similar, if not identical, vocal mechanisms.

CHAPTER IV

THE PRESENT CENTURY

Our next period to be studied begins roughly at the turn of the century and lasts generally up to the present time. In many ways the study of matters vocal became more scientific in nature. However, scientific study tended to de-emphasize registers if we are to compare this period with the one just past. This does not mean that disagreements on registers became resolved or that they were neglected. It means only that whereas in the period of Mackenzie preponderant attention was focused on registers, in the next vocal generation preponderant attention was focused on other things.

Wilmer T. Bartholomew gives us a very fine summary of the advances made in the science of voice during this period.[1] His material suggests that the work done during this modern time is perhaps best divided into three kinds: physiological, psychological, and physical.

On the physiological side the general manner of vocal cord vibration has been considered. Bartholomew credits Garcia with having realized the explosive character of this vibration. Bell Laboratory's rapid motion pictures of the cords in action leave little doubt for lower pitches at least, that the "puff" theory of the vibration of the ligaments is essentially correct.

1 Bartholomew, "A Survey of Recent Voice Research."

Merkel extended Garcia's observations. Ewald described the cord movement as a cushion action. These conclusions have been verified, thinks Bartholomew, by Rethe, Musehold, Scripture, Nagel, Weiss, and Metzger. Mott in 1910 made this significant observation of a neurological character: That there are hardly any sensory nerve endings in the vocal cords and muscles of the larynx.[1] This being the case, little hope may be found for any possibility of achieving direct control of the laryngeal mechanism. In actual practice, of course, many vocal masters had long before realized that direct control of the larynx is not possible or even dangerous to attempt. The logical conclusion is that the ear alone can be the judge of pitch, intensity, or color. Important contributions from the physiological angle have come from the University of Iowa. In an article by Erickson the basic factors of the human voice are summarized.[2] Metzger should be mentioned for his thorough research on the action of the vocal cords.[3] Paget's work should be mentioned insofar as he considers the pharyngeal region of great

1 Mott, F. W., The Brain and Voice in Speech and Song, 1910.

2 Erickson, C. I., "The Basic Factors in the Human Voice," University of Iowa Studies in Psychology, No. X, Psychol. Monog., 1926.

3 Metzger, W., "The Mode of Vibration of the Vocal Cords," University of Iowa Studies in Psychology, No. XI, Psychol. Monog., 1928.

importance in resonance thus tending to support Stanley's more extreme view of pharyngeal resonance.[1] Bartholomew also gives Russell credit in the physiological field for his x-ray technique and his moving pictures of the larynx.[2] Bartholomew doesn't mention Russell's development of the Laryngo-periskop, nor his work in detecting resonating portions of the body through measurement of surface vibration. He does, however, state that Russell, and also Cotton,[3] lay great emphasis on the throat surfaces as a conditioner of tone quality.[4] Panconcelli-Calzia should be mentioned for his moving pictures of the vocal cords. Nagus' analysis of the vocal mechanism, Bartholomew thinks, is the most complete published.[5] Maljutin using the stroboscopic principle

1 Paget, Sir Richard, Human Speech, 1930.

2 Russell, Speech and Voice.

3 Cotton, J.C., "Resonance in Soft-walled Cylinders," J. Acoust. Soc. America, V. No. 3, Jan. 1834. A Study of Certain Phonetic Resonance Phenomena, Abstracts of Doctors, Dissertations, No. 21, Ohio State University, 1937.

4 Bartholomew may be goind a bit far in stating that Russell lays great stress on the character of throat surfaces. Rather he suggests the possibility that the character of the throat surfaces may have no inconsiderable effect on tone quality.

5 Negus, V. E., The Mechanism of the Larynx, 1930. "The Mechanism of Phonation," Speech, 1, 13-33, Jan., 1936.

finds a large proportion of voice students have unequal and irregular vibrations of the cords. Josephson has investigated the anatomy of the thyro-arytenoid and the influence of the ventricles on tone quality.[1] Moore's article on the history of laryngeal investigation gives valuable material on the accomplishments of investigators on the physiological side.[2] Added to this, though Bartholomew calls no specific attention to it, should be Kenyon's analysis of the extrinsic musculature of the larynx. Considerable attention is given to the extrinsic laryngeal musculature as more than a permitting or prohibiting mechanism. Some, notably Feuchtinger, (not a respectable authority), consider it a paramount mechanism in the pitch control of the properly produced voice. Feuchtinger proposes that the secret of voice development is to be found in the independent exercise of certain parts of this mechanism.[4] Others of more respectable authority consider that parts of this musculature can assist in raising the pitch. Stanley

1 Josephson, E.M., "The Physiology of the 'false' vocal cords and the Anatomy of the thyro-arytenoid Muscle and of the Thyro-Epiglottic Ligament," Arch. of Otoleryngology, Aug., 1927.

2 Moore, P., "A Short History of Laryngeal Investigation" Quarterly Journal of Speech, XXIII, No. 4, Dec., 1937.

3 Feuchtinger, The Vocal Organ -- Its Mechanism.

4 Kenyon, "Significance of the Extrinsic Musculature of the Larynx."

seems to think so, too, but believes such action destructive and that such should be accomplished by the intrinsic musculature only.

Bartholomew mentions some work of scientific repute done on the psychological side of voice use. Seashore's work should be mentioned at this point as well as that of his assistants at Iowa on the vibrato.[1] This, of course, belongs in part in the other two fields, but as far as perception of the vibrato is concerned, it has within it many psychological implications. Miles also of the University of Iowa studied pitch accuracy.[2]

In the physical field much work has been done. Helmholtz's great study of acoustics has been well carried forward by Miller, Marage, Rouselot, Revier, and Hermann. It is from the last that the term "formant" is derived. A formant is a region of resonance on the musical scale, a kind of fairly constant partial or overtone present in a tone which seems to maintain itself regardless of the pitch or vowel phonated.

> A similar investigation has been under way at the Peabody Conservatory of Music . . . We found a substantial variation of overtone timber confirming Rothchild's work, and have defined two formant

[1] Seashore, C.E., (Editor) "The Vibrato," University of Iowa Studies in Psychology of Music, Vol. I, 1932.

[2] Miles, W. R., "Accuracy of the voice in Single Pitch Singing," University of Iowa Studies in Psychology No. VI, Psychological Monographs, 1928.

> regions characteristic of the properly produced male voice. The first of these centers around the 450-550, or roughly around the C above middle C, confirming Kasansky and Reschevkin, and Stanley's 'pharyngeal resonance.' The second, which is produced in the larynx itself, centers roughly around 2600-3100, or from about E to G of the highest octave of the piano.[1]

The introduction of the vacuum tube has been of immense value in the physical field, it being the chief activator in reproducing, amplifying, and measuring sound. With its help tone cannot only be reproduced with considerable accuracy and amplified as a whole, but also it can be amplified in its parts and its component parts can be put on paper that the tone may, so to speak, be seen with the eye. Consequently, tone quality, intensity, and pitch can be far more accurately measured than by the most acute ear. Perhaps the most exhaustive study with such equipment has been conducted by the Bell Telephone Laboratories. These studies primarily designed to improve telephone communication have branched out till they have covered much of interest to the voice scientist. Such names as Crandall, Fletcher, Sivian, Steinberg, Sacia, and Wegel are to be numbered among the contributors on voice from the Bell Laboratories. Little studied till comparatively recent times has been the voice

[1] Bartholomew, "A Survey of Recent Voice Research," 118-119.

vibrato. Much work has been done on this now realized important element of voice by the Seashore school at the University of Iowa. Before the advent of accurate electrical instruments analysis of this phenomena was not possible. Through study of the vibrato it has been learned that the vibrato is an essential part of good tone quality, that it consists of a variation of pitch, intensity, and tone quality, that its period should be approximately 6.2 per second.

Stanley gives a great deal of attention to the vibrato. He maintains that it is due to a nerve impulse that permits the muscles periodic relief from tension. When, for example, tones are produced under conditions where little tension is required, the vibrato is minute or even absent.

> At very low intensities, under proper technical conditions, the vocal cords are still relatively widely separated. Under these circumstances the breath expulsion is very high, and considerable work must be done by the singer to maintain the breath pressure and phonate with the resonance cavities held in their proper 'set.'
>
> A further increase in intensity augments the tension on the muscles of both the larynx and the pharynx, and narrows, and finally closes the slit of the glottis. At a certain point of intensity, muscular fatigue would result were this tension on the muscles of the pharynx and larynx to be held constant and the breath pressure maintained . . .
>
> When this point at which the vocal muscular system . . . would fatigue, if it were held in constant tension, is reached, the vibrato action begins to come into play; and this action increases as the

intensity rises.[1]

Since in Stanley's view of registers the falsetto is lacking in intensity in its lower pitches, little or no vibrato should be evident there. As the pitch rises sufficiently to permit increased intensity, vibrato action appears. In the lower register, except perhaps in the very lowest tones of the voice, there will be vibrato action. Thus in a sense though the vibrato action may not be directly connected with registration, it is surely, in Stanley's mind, closely related.

Vowels have lent themselves perhaps more readily to physical study than to physiological investigation. Russell's extensive vowel investigation has been a notable exception, being essentially phsyiological in its attempt to determine the throat shapes that produce the vowels by means of x-ray studies. Bartholomew gives credit in this field to Miller, Stumpf, Liddell, Crandall, and Paget. Much of the work has dealt with ascertaining regions of resonance which produce the various vowel colors. It is of interest to note that some of the regions of vowel resonance are so low that it is difficult, if not impossible, for a soprano to phonate them on her higher pitches. By the use of organ pipes, sets of tuning forks, electrically controlled sound combinations attempts have been made with varying success to reproduce the vowel sounds mechanically.

The average vocal master considers the well-produced tone as being rich in overtones. Especially in the high "head tones" of sopranos have they been considered abundant. However, Kasansky and Reschevkin report that the female voice above pitch 580 is practically without overtones. They noted a spreading of energy in a poorly produced voice as compared with a relative limitation to certain frequencies in the case of good voices. They noted a "formant" region near pitch 512 in low and medium male voice regardless of vowel. However, this "formant" region was noticed to rise considerably on the production of an "open" or "white" tone.

For the most part the investigation mentioned by Bartholomew (except Stanley's to whom he devotes a paragraph) have little to say about registers. Few, except Russell and the Bell Laboratory staff, have given much attention to the working of the glottis itself. However, the work of a few of these scientists and several not yet mentioned by Bartholomew will be brought up later.

Generally speaking, during this period dating roughly from 1890 to the present, the register controversy is left to the throat specialists, music critics, and vocal masters.

First in line among the throat specialists in chronology, influence, and probably in value of work present-

ed is Curtis.[1] That Curtis had influence in high vocal circles is evident from Blanche Marchesi's denunciation of him and the school he apparently formed among the Metropolitan artists.

> The triumvirate, [Curtis and the de Reszke brothers] decided after many conferences that it is the hit of the glottis which endangers the singer's throat . . . But they could not distinguish between the hitting and the closing of the glottis, and at once decided to condemn every method that allowed singers to make their vocal cords meet when emitting sound.
>
> Other singers were invited to be present at those discussions and some of our school, like Melba, Eames, Calve, Susan Adams, and Sybil Sanderson, who had all been trained in the Garcia-Marchesi Method, were shown the 'bogey' of the 'coupe de glotte' and its terrifying consequences. At these meetings war was declared upon all followers of our method, and the artists' minds were worked up passionately until they really believed their way of using their voices was perilous.[2]

Curtis explains the general activity of the pitch mechanism as follows:

> The thyroid cartilage is fixed, ... , by the very strong muscles attached to it, and Meyer says direct tension of the vocal cords is produced to some extent by the mere adjustment of the glottis, partly through the approximation of the vocal processes of the arytenoid cartilages, and partly through their depression by the thyro-arytenoid or their elevation and adjustment by the lateral crico-arytenoid muscle. Following this preliminary adjustment, there is a fixation of the arytenoid cartilages by the combined action of the posterior with the latero-crico-arytenoids.[3]

1 Curtis, Voice Building and Tone Placing.

2 Marchesi, The Singer's Catechism and Creed, 91.

3 Voice Building and Tone Placing, 37.

Stanley considers an alleged holding action on the arytenoids of paramount importance.

> The posterior crico-arytenoid muscles draw the outer angles of the arytenoid cartilages backwards and inwards. The lateral crico-arytenoid muscles draw the arytenoid cartilages forwards and downwards. These two groups of muscles are, in a sense, antagonistic and when both are in tension they 'hold' the arytenoid cartilages firmly to the cricoid cartilages, thus making possible the 'stringing' of the vocal cords. Tension on both the posterior and lateral crico-arytenoid muscles establishes a condition of equilibrium between the cricoid and the arytenoid cartilages.[1]

Curtis inclines toward the view of Mackenzie that the places on the musical scale where register changes are to be noted vary from person to person.

> By register we mean the tones which are produced by a particular arrangement of the vocal cords.[2]

He calls particular attention to Mancini's early notation that in certain rare instances there is only one register -- the chest.[3] He points out that Mills /an advocate of fairly definite register boundaries/ stated that in certain instances only the chest mechanism is used.[4] He Follows by restating Mackenzie's "remarkable observation" that pure sopranos seem to use the chest

1 Your Voice, 59 and 60.

2 Ibid., 109.

3 Mancini, Practical Reflections of the Figurative Art of Singing, 43.

4 Mills, Dr. Wesley, "An Examination of Some of the Controverted Points of the Physiology of the Voice, Especially the Registers of the Singing Voice and the Falsetto," American Assn. for the Advancement of Science, Aug., 1882.

register throughout and that basses and barytones usually use the chest register exclusively.[1] Though he agrees perfectly well on these matters allegedly observed by others, he does not necessarily draw from these factors Mackenzie's conclusion.

Curtis maintains that there are but two distinct mechanisms, but that for practical training purposes they are three in number. Where Mackenzie noted that in some cases the "long reed" was apparently used throughout the vocal range, Curtis seems to believe that the instrument can be so trained in all cases so that the long reed may be used for all the tones.

> We are, however, convinced that one mechanism may be cultivated throughout the entire compass of the voice; that the vocal cords may be made to assume a position in which they are to all intents and purposes parallel throughout their whole extent; . . .[2]

To accomplish this the cords assume a condition in which they are able to vibrate in segments, rather than as a unit.

> In this method of production the vocal cords, as we pass from one register to another, divide themselves into vibrating segments by the formation of one or more nodes in the length and breadth of the cords.[3]

In addition to this process of node formation is the action of the resonating cavities which adjust them-

1 Hygiene of the Vocal Organs, 55.

2 Curtis, Voice Building and Tone Placing, 115.

3 Ibid., 115.

selves not only to resonate the glottal tone but also to greatly influence the glottal pitch. The cords are now acting as "flexible reeds, sometimes commanded by the vibrations of the columns of air in the resonating cavities."[1] There may be involved as many as four vibrating air columns. Thus four registers actually can be distinguished in some cases. Usually, however, there are three, the fourth showing up as falsetto, usually in "highly trained voices" and generally in voices of soprano or alto variety. Curtis describes this fourth register as "a beautifully clear and birdlike quality."

Such a theory of such vast influence of the resonance cavities on pitch in the upper registers of the voice, held by Curtis as well as others, becomes open to criticism when one considers the length of tubing contained in a brass or reed instrument or flute. It is notable that for a mere half tone alteration in pitch in one of these instruments a considerable length change is required. However, it should also be mentioned here that the cavities of the resonance mechanism are not only alterable as to length but as to width and shape as well. Yet experimental evidence tends to indicate that the resonance cavities of the voice are not sufficiently extensive or variable to have any great influence on the pitch of the voice. This does not mean that

[1] Ibid., 116.

pharyngeal or oral alterations cannot make a certain pitch easier to produce. A properly tuned resonator vibrating in tune with the glottis may assist that vibrating glottis by offering no air resistance to its oscillations, that is, permitting free sympathetic vibration to interact between resonator and glottis. The shape of the resonators, governed as they are by muscles that might be termed part of the extrinsic musculature of the larynx, may influence glottal pitch somewhat by granting the larynx its proper amount of freedom or on the other hand by curtailing its freedom by incorrect tensions.

That it is probable the resonating mechanism has little direct influence on vocal pitch, of course, does not mean that Curtis is wrong concerning segmentation of the vocal cords. That segmentation of some form takes place is highly probable. Curtis maintains that under certain circumstances segmentation can be very complex taking place both longitudinally and transversely. The Bell Telephone Laboratories monograph describing the laboratories' high speed motion pictures study of the cords in action notes in this connection:

> When the cords close, a wave-like motion or ripple is seen to pass over the top surface from the glottis towards the walls of the larynx, as the edges of the cords press frimly together.

However, this apparent vibrational complexity is to be

noted in the loose vibrations of lower pitches for:

> As the pitch is raised, the motion becomes somewhat simpler; when the folds become firmer due to muscular tension the move more nearly as a unit, so that the opening from below is less and less apparent.

It is noteworthy to observe that for some time it has been known that voices do not necessarily acquire more overtones as the pitch rises. The so-called "head tones" of the vocal range are not necessarily rich in overtones as has been commonly supposed.[1] Yet, Curtis thinks that segmentation of the cords on higher pitches has been demonstrated by several observers through use of the stroboscope on artificial larynges, exsected larynges, and the vocal folds in action. Among first to use the stroboscopic principle in laryngeal examinations was Oertel of Munich. Oertel maintains that the theoretical assumption that in the upper register vibration is confined to the free borders of the cords lacks firm basis. He reasons, according to Curtis, that if only the thin edge of the cords is presented to the outgoing air, the internal fibres of the thyro-arytenoid would have to be strongly contracted, and the elastic fibresof the cords themselves considerably narrowed,

> and the result of such contraction of the muscle would be too greatly narrow the glottic slit, which is exactly the condition we do not find in the head tones.[2]

1 Bell Laboratories Monograph, 9.

2 Ibid.

This phenomena has been demonstrated more apparent than real by the Bell Laboratories' pictures, however. Furthermore, observation and expreiment convinced Oertel that this muscle is, in the head register, only passive in its action, simply giving tone and elasticity to the vocal ligament. That the edge only of an elastic membrane should be set in vibration by the air blowing against it is impossible, and a further argument against this theory. However, it is admitted that the most active vibration in the high register is to be found in that segment of the cords near the free border. Oertel says,

> In mild cases of catarrh . . . tinly pearls of mucus may be seen to move from the ventricles of Morgani out toward the edge of the vocal cords and run toward apparently fixed points, where they remain till expectorated.[1]

Observers have always spoken of these spots as nodal points on the cords. Oertel says that this is not the case; that . . .

> The tiny pearls of mucus are driven by the centrifugal foce of the vibrating vocal cords, to the middle point of a vibrating segment, and from thence are thrown outward. They mark, then, if anything, points of greatest movement in the vibrating segments, and not points of rest. This fact Oertel proved conclusively with rubber membranes stretched over a tube through which air might be blown . . . On the membranes were placed little drops of mucus-like jelly, and when the membrane was set vibrating, the drops were thrown toward the free edge, from which points they were expelled, or they sometimes moved along the free edge to the point of greatest

[1] Voice Building and Tone Placing, 123-127.

> vibration in the middle of the segment, and from there would be carried out by the blast of air. The points at which the pearls of mucus would come to rest were not fixed, but varied very much from time to time in each membrane, so that there could be no doubt that they were not nodal points . . . Oertel found that membranes set in motion by the air blast vibrate in their entire length and breadth, and at the same time subdivide into segments, longitudinally and transeversely, the segments being divided by nodal lines. Under these conditions the membrane vibrates longitudinally, like a stretched string and transversely, as a rod fixed at one end. Two membranes under the same tension vibrate synchronously. If, however, . . . they are subjected to a different tension, the vibrations become alternate. Oertel was the first to discover this fact, and it has been confirmed by Koschlakoff and Simanowski.[1]

Curtis then described Imbart's experiments on rubber membranes for which he used Oertel's stroboscope.[2] Imbert's discoveries here are of interest and perhaps of some value. He found that rubber membranes set into vibration divided themselves transversely into segments separated by nodal lines. Interesting results were obtained when portions of the membrane were damped in a transverse direction. Imbert found that moving the solid damping plate toward the free border caused a fall in pitch. Moving the plate toward the fixed border, on the other hand, caused a rise in pitch. Damping of the inner fixed border to about two-thirds of the membrane's width caused a strange phenomenon, "a remarkable increase in the intensity of the tone." Curtis' explanation of the reason for this is not clear to the writer.

1 Voice Building and Tone Placing, 123-127

2 Imbert, Nouv. Montpellier Medicale. 1892, Supplement, 149

But if, as Imbert seems to think, damping can cause an increase in intensity, we have an item of perhaps no little importance to vocal science. Imbert also finds that an increase of transverse tension up to a certain point produces a rise in pitch, but that tension increase beyond this point causes the pitch to fall. The explanation here given is that tension increased beyond a certain point eliminates nodal points; and, consequently, the number of vibrating transverse sections. In other words, the sections remaining in oscillation are of greater magnitude. Concerning the vocal cords themselves, Imbert thinks that the internal thyro-arytenoid acts as the damping plate does when it is applied to the membrane. It increases or decreases the vibrating surface of the cords, thereby raising or lowering the pitch.[1]

In his stroboscopic examinations of vibrating membranes in artificial larynges Koschlakoff, according to Curtis,[2] confirmed in every detail the experiments of Oertel. Koschlakoff maintains that the angle of incidence of the cords affects the type of their vibration, alternate vibrations being normal where the angle is increased. Vibration as a whole prevailed when the membranes were

[1] Voice Building and Tone Placing, 128-131.

[2] Ibid., 131.

not in place but as vibration became synchronous with a greater angle of incidence, segmentation took place. It would be pretty hard to dispute a simple experiment like this if observation and reporting are accurate. However, it does not seem to correspond adequately to what would reasonably be expected to happen when Pascal's law of fluid pressures is taken into consideration. Perhaps it might be maintained that rarifactions above the glottis might produce some such phenomenon. However, it is improbable that Pascal's law of fluid pressures would be in operation at this point also. Yet Curtis makes no little point of the ability of the intrinsic mechanisms to change the angle at which air from the trachea contacts the glottis.

Curtis summarizes his beliefs concerning vibrating membranes as follows:

> We have thus seen that membranes do divide themselves into segments, and that under all conditions the entire membrane is set into vibration; that in certain conditions, however, it is the outer edge and the more superficial parts which participate most violently in the vibrations. We shall see that these phenomena are to a considerable extent reproduced in the vibrations of the vocal cords when seen with the stroboscope.[1]

In the chest register with the stroboscope and the cords vibrating in unison, Curtis notes:

[1] Voice Building and Tone Placing, 131-132.

1. A transverse concavity extending the entire length of the cords.

2. A convex line formed by the free border extending from the anterior to the posterior insertion.[1]

If the stroboscope and cords are put out of place, Curtis notes:

1. The cords are now seen in oscillation.[2]

2. The excursion of particular points in the cords increases with their distance from the fixed border. [the excursion of the middle part of the edges would therefore be greatest.]

3. The cords vibrate in phase.

4. The extent of oscillation is considerable.

5. With a pitch rise an increase in length and a decrease in breadth transpires. Bell Laboratories pictures also note increase in lnegth, a greater increase in length taking place with pitch rise if intensity is small.

In the upper register Curtis notes:

1. Cords vibrating in entire length and breadth.

2. Character of movement, however, altered.

3. Cords are flatter and the edges thinner.

4. They are divided into segments which have their own vibration rate. It must be repeated here that there seems to be a complete divergence of opinion between these observations and those of the Bell Laboratories. The latter pictures show

[1] In this case, in theory at least, the cords would appear stationary. However, such synchronization would be difficult.

[2] Direction of oscillation is not noted. Bell Laboratories photos indicate both up and toward the point of attachment in a puff action.

complexity of vibration at low pitches and simplicity of vibration at high pitches. Harmonic analyses would tend to support the Bell Laboratories observations.

5. An oval line marks off a zone comparatively close to the free border. This oval line divides the cords transversely into tw unequal segments. It is the nodal line.

Oertel says that in one case only, in a cultivated singer, with a remarkable falsetto, who had very broad vocal cords, did he see a second nodal line . . . In this case the vocal cord was divided into three segments. . . Oertel's observations on the living larynx have been confirmed in every particular by Koschlakoff, except that he saw a second nodal line in an exsected larynx with which he was experimenting. Curiously, it was in a larynx the mucous membrane of which was much infiltrated and loosened, and the whole cord considerably broadened, which partially fulfilled the condition present, i.e., of a broad vocal cord where Oertel saw two nodal lines. Koschlakoff is of the opinion that the formation of more than one nodal line in the cords is found under pathological conditions only.[1]

Though Curtis indicates that there are three and possibly four registers as far as the training of the voice is concerned, he confines most of his discussion to two. Instead of a general re-shaping of the vocal cords to produce the upper register, Curtis believes that segmentation can be made to do the job as far as vocalization is concerned. This matter is not clear but it seems that Curtis almost infers that fundamental pitch alterations are possible due to segmentation of the cords. At least he seems to indicate that there is a great lack of stability as far as the cords are concerned when segmentation has

1 Voice Building and Tone Placing, 134-135.

taken place, the resonators then gaining the upper hand in pitch control. He suggests that with segmentation of the cords they can act as does the reed of a clarinet -- furnish energy that is governed as to pitch largely by the length of the resonator. Thus in his mind resonance becomes a paramount matter in the consideration of the registers. As far as resonance is concerned, he places great emphasis on the nasal cavities. For this attitude Blanche Marchesi soundly berates him.

> On welcoming my dear friend Jean de Reszke to my house after his fourth return to our shores, I said to him: "Jean, have you any new facts for my poor book?" . . . "Yes," he responded, "I find that the great question of the singers' art becomes narrower and narrower all the time, until I can truly say that the great question of singing becomes a question of the nose . . . [1]

He considers that nasal resonance is an important concomitant of the head register, and further, that through extending downward the compass of the head register such resonance is led to largely permeate the voice. He suggests exercises with prefixed hum sounds. It may be, as Madame Marchesi points out, that the use of the hum mechanism had its origin with Curtis. Surely it has had great effect on the vocal teaching profession.

Russell has made a rather thorough investigation of nasal resonance through the use of an instrument he calls the sonometer. This instrument is so constructed as to be

[1] Voice Building and Tone Placing, 160.

relatively insensitive to air vibrations and highly sensitive to surface vibrations. By placing this instrument on various parts of the anatomy Russell could estimate largely the contribution that portion of the body was making toward the energy content of a tone.

> It is obvious that if with this surface conduction transmitter a comparative measurement of the energy or carrying power present in the tone as it emits from the larynx and that of the same tone after it comes in contact with any sinus or other head, nasal, or chest cavity . . . if the carrying power is increased by any one of these latter cavities . . . the energy is increased by any one of these latter cavities . . . the energy deflection of the needle on the dial will be greater than when the surface contact transmitter is placed over the larynx . . .
>
> Our proof, however, that not even the nasal and bony head cavities served to function as resonators, or in other words, to give the voice better carrying power, may be looked upon as perhaps the most outstanding contribution of this year's work on this general problem. However, we may hasten to say that this evidence does not prove that these cavities have no function at all. It merely says that the carrying power of the voice cannot be ascribed to them and hence that they cannot be called resonators in the strict sense of the word; but they undoubtedly serve to alter the concomitant of partials present in the complex tone. Hence, the mouth, nasal, head (and chest) cavities could undoubtedly all be more justifiably called modifiers, which they are, rather than resonators.[1]

It may be that we have an approach to one of Stanley's principles in Curtis's recommendation that the light upper register should be carried downward. There is no good evidence that Curtis meant falsetto, though it is

[1] Russell, G. Oscar, "Physiological Cause of Voice Quality in Singing," Yearbook 29, July 1, 1929 -- June 30, 1930, Carnegie Institution of Washington, 415-4-418.

rumored that Jean de Reszke, teaching in France, did actually use it. The de Reszkes were very closely associated in the Curtis "school" of Metropolitan artists.

A considerable amount of space has been devoted to his views on segmentation of membranes and the cords because his discussion introduces the work of several scientists to whom the writer has found only meager reference elsewhere. Further, it is the writer's opinion that in discussing the pitch mechanism in relation to register causation this material should not be ignored. True, many of the conclusions seem to oppose what may seem to be later and better evidence. However, it does not seem likely that these men should have been totally wrong, at least in their observations concerning vibrating membranes.

Second, among the laryngoscopists, Dr. Marafioti should be given brief consideration.[1] Usually the techniques of developing the singing voice are recommended for those who would improve his vocal instrument for speaking only. Dr. Marafioti would have the process reversed.

> The pitch and the dimensions of the singing voice -- the volume, the quality and loudness -- are determined by the speaking voice. Speaking high or low, resonant, loud or soft, in any gradation and shade of color, lays the ground for singing in high or low

[1] Marafioti, P. Mario, M.D., Caruso's Method of Voice Production, 1922, in which Dr. Marafioti gives much attention to his own opinions and a few paragraphs to Caruso.

> pitch, loud, resonant or soft, in any musical color or expression.[1]

Marafioti would have voice education begin in the elementary schools where the children should be taught in the correct use of the speaking voice. Secondly, he suggests certain reforms in the vocal teaching profession that may not be entirely without merit. Since there are in general two phases of vocal culture, specialization is in order. To one class of specialists Marafioti gives little attention. These are the vocal coaches. Their job is to understand musical interpretation, not to develop the voice per se. The other class, the voice specialists, should be forced, as are doctors and lawyers, to take state administered examinations

> in scientific and musical matters related to the voice -- They must get their practicing licenses from this board, as in the case of other professions.

In relation to the use of the voice itself Marafioti stresses proper resonating conditions. These conditions, he feels, are largely matters of the tongue and epiglottis. He considers that far too little attention has been given to the epiglottis. In swallowing, the epiglottis serves to cover the larynx in a protective manner, but in phonation no such covering should be prevalent. In fact its po sition should be erect in order to leave the larynx

[1] Caruso's Method of Voice Production, 51.

wide open.

> The epiglottis is attached to the base of the tongue and their relationship is very important, as together they play one of the most essential roles in the mechanism of voice production, which unfortunately, not enough consideration has thus far been given.[1]

The tones should reach the mouth unhampered. Therefore, the laryngeal sounds must travel freely through the larynx and pharynx. This demands a well-opened pharynx. Such a condition is secured if the epiglottis stands erect. An erect epiglottis is usually the result of a tongue free from constriction that does not force the epiglottis back toward the pharyngeal wall and down toward the larynx, partially closing the air passage.

Concerning registers Dr. Marafioti states:

> There are no registers in the singing voice, when it is correctly produced. According to natural laws the voice is made up of only one register, which constitutes its entire range.[2]

Among the register advocates he considers that Mackenzie's position is the most logical. However, he takes issue even with Mackenzie and contends:

> The breaks in the voice are the result of abrupt and artificial changes in the laryngeal adjustments when the vocal cords are adapting themselves to produce higher tones; the normal function of these organs is then disturbed and a defective vocal production is then brought about.[3]

1 Caruso's Method of Voice Production, 63.

2 Ibid., 136.

3 Ibid., 136-7.

He cites, to illustrate Mackenzie's position, by hypothetical example of a soprano who sings from low C to middle E producing the tones by a particular adjustment of the vocal cords. Then with another adjustment of the vocal cords she would produce the remainder of her scale, the head register. Then our author asks what can justify this change of the vocal cords to a second adjustment.

> No concrete reason has been given by Dr. Mackenzie for his classification. . . . Therefore, Dr. Mackenzie's classification, having no definite scientific basis, remains purely a personal view, which, however, stands out prominently among the many others as the most logical.[1]

No concrete reason is given by Mackenzie except that he considered himself to have observed such an alteration in many voices. It should be recalled, however, that Mackenzie also observed that in certain cases no change took place. It would seem in this case, though, that it is up to Dr. Marafioti to demonstrate that Mackenzie was either in error in his observations or why the two types of production, apparently observed by Mackenzie, constituted wrong management of the vocal instrument. About all we have from Dr. Marafioti is that it is logical for the voice to have a single register only; it is illogical for the voice to have more than one register.

Dr. Marafioti then states that the head register is

[1] Ibid., 140.

sometimes considered to be a similar mechanism to the mezza voce. However, he considers it to cinsist of only the mechanism of the full voice with light intensity. Marafioti believes that the use of the lowest tones is important in the development of the voice.

> In the upbuild of the voice there is a series of tones which are of the lowest pitch, and of limited sounding power; they nevertheless form the corner-stone in the formation of the voice. These tones which carry the low part of the compass of the voice to its physiological limit can be formed only by the minimum of breath and the minimum of tension of the vocal cords; thus they create an easy and natural mechanism of voice production by establishing a preliminary adjustment of the vocal cords which will rule throughout the entire range of the voice.[1]

Stanley would also contend that the exercise of these notes would have importance since pure lower register would be found here and exercise of the lower register is of great importance in vocal development.

Having considered two throat specialists of widely diverging views may we turn now to an important voice scientist of the turn of the century.[2] Muckey worked in collaboration with Hallock, who apparently handled the technical side of Muckey's experiments as well as advising him on the physical properties of sound.[3]

1 Caruso's Method of Voice Production, 76.

2 Muckey, Floyd S., M.D., C.M., The Natural Method of Voice Production in Speech and Song, 1915.

3 Hallock, William, professor of physics, Columbia U. Hallock dead at time of Muckey's writing of The Natural Method of Voice Production.

> The life work of each /Muckey and Hallock/ might be considered in the light of special preparation for an investigation of the mechanism of voice. They agreed not to publish any statement which could not be based on these fundamental facts. Their problem consisted in the application of these facts to the voice mechanism itself. This required a period of eighteen years of almost continuous application.[1]

Thus the good intentions of Muckey and Hallock seem established. Yet, due perhaps to the inadequacy of equipment available at that time or to assumption difficult of demonstration, some of the important conclusions of these men seem highly questionable today. However, careful investigations, such as Muckey's seems to have been, should not be ignored. Further, as will be seen later, Muckey was not without his influence on other writers.

Rather early in Muckey and Hallock's study certain important conclusions seem to have been reached, namely:

1. Voice is air waves.
2. The voice, in nature, is a stringed instrument.

With our present knowledge of the nature of sounds, it would be difficult to find any essential fault with the first of these conclusions. The second, however, remains seriously questionable. The stringed instrument works acoustically according to the sounding board principle when its resonating qualities are considered. The laryngeal mechanism, on the other hand, has no solid connection

1 The Natural Method of Voice Production, preface, viii.

with any part of the body that might function as a sounding board. Further the vibrating mechanism of the voice becomes active in most cases through the emission of air puffs. Strings are not able to do this. In high pitches or soft tones perhaps something nearer to the string is achieved since here the puff action is less evident. But, in general, the action of the vocal cords would seem to resemble the lips as they activate a brass wind instrument. It is probable that an attempt to catalog the voice is dangerous in that it partakes of similarities as well as differences from several different kinds of instruments.

It is not maintained here that because Muckey's classification of the voice may not be strictly correct his derived conclusions concerning the manner in which the glottis functions is wrong. He does incidentally give certain reasons for terming the voice a stringed instrument namely: analysis of the voice shows the overtones of the vocal cords to belong to the "series of a string, and not that of a reed, plate or membrane" and that the tuning mechanism of a reed, plate or membrane is lacking. He does not mention the brass horn. Surely there is some validity in his maintaining that the tuning mechanism of the vocal cords has certain properties of the string.

Following the discovery that the voice is a stringed

instrument certain conclusions about the pitch mechanism were drawn:[1]

1. Pitch equals the length, weight and tension of the vocal cords.[2]

   a. To quadruple tension, on the vocal cords, will raise the pitch one octave. This is done by the crico-thyroid muscle.

   b. Photos show that by the action of the arytenoids the vocal cords may be shortened by at least half their length. According to the properties of vibrating strings this would mean another octave rise in pitch.[3]

   c. Since the thyro-arytenoideous sends fibers into the cord capable of damping and, therefore, able to decrease the size of the cord,

[1] "Having established this fact, we reasoned that the vocal apparatus should include a mechanism for changing the length, weight, and tension of the vibrator (vocal cords) similar to that found in other stringed instruments. This led to a discovery of the correct action of the 'vocal muscle' (thyro-arytenoideous), and the crico-thyroid muscle in pitch changes." The Natural Method of Voice Production, 5.

[2] "The vibration rate, which corresponds to the pitch of the voice, depends principally on their /the vocal cords/ tension." Bell Telephone Laboratories Monograph, "High-speed Motion Pictures of the Vocal Cords," 7.

[3] Bell Laboratories' photographs, however, tend to indicate that the cords do not necessarily shorten for rises in pitch; rather in most circumstances they lengthen. "With regard to (a) for instance it has been stated that the length and tension of the cords increase with increasing pitch. However, changes in intensity also call for different cords tensions so that under certain conditions the pitch of the voicing might increase with little change in length of the cords. Nevertheless, for untrained subjects intoning a sound of moderate intensity it is obvious from the film that the length and tension of the cords did increase considerably as the pitch or vibration rate increased." Bell Telephone Laboratories Monograph, "High-speed Motion Pictures of the Vocal Cords," 8.

laterally by one-half, we have a third mechanism able to raise the pitch by one octave.[1]

2. These three actions go on at once. Therefore: "There is no change in the action of the mechanism, and, therefore, no registers."[2]

3. Since each one of these mechanisms can account for at least an octave of pitch change, the voice should easily have a range of three octaves.[3]

1 This third point may be questionable. However, even Bell Telephone Laboratories' pictures apparently show thinning of the vibrating elements in falsetto. Numerous others have considered that they noted this phenomenon.

2 Natural Method of Voice Production, 54. Muckey, unfortunately, gives us little evidence that these three functions do progress simultaneously in the well-produced voice. Therefore, it might be assumed as equally logical that one of these mechanisms might be dominant in pitch changes in one part of the range while another carries the burden of pitch change in another part of the vocal compass. Nor does Muckey mention the fact that differing muscular actions might prevail in differing tonal intensities. In relation to this problem he mentions only that intensity is gained through adequate resonance facilities (he makes much of these) and a wider swing of the vocal cords. Any of the factors he mentions, length, weight, or tension, could, presumably, affect the amount of swing of the vocal cords. Again it should be called to our attention that the Bell Laboratories' pictures show length variations and greater length variation with pitch changes when the tones are of low intensity.

3 Here is one of Stanley's major contentions. Muckey does not tell us, however, whether or not in his experimental teaching such ranges were actually realized. M. Barbereux-Parry, Vocal Resonance Its Source and Command, likewise maintains that there should be three octaves in the voice. Traditional thought calls a range in excess of two or two and one half octaves somewhat unusual.

Certain other theories advanced by Muckey are of sufficient importance or interest to be mentioned:

1. Good voice quality is rich in fundamental, the fundamental being the loudest singel part of the complex tone.[1] "We have already pointed out that a tone of good quality must have its fundamental or lowest pitch in the tone the strongest. It is a well-known fact of physics that to re-inforce a low pitch, a large cavity is necessary."[2]

2. The swing of the vocal cords is hampered if interference exists, causing the cords to swing in partials more than as a whole. Thereby, the fundamental is not dominant and good quality does not result.

3. The tone producing muscles are involuntary while the interfering muscles are voluntary. "We found the action of the tone-producing muscles is voluntary. This is the fundamental fact underlying the natural method of voice production. It is the great stumbling-block in the path of every teacher and student. Every method now in vogue igmores this, the most important fact underlying the training of the vocal mechanism.[3]

4. Resonance is the most important factor in both volume and quality of tone.[4]

1 This seems to be generally true, but it might be more accurate to state that a good tone needs a strong fundamental and/or emphasis on the lower partials.

2 Natural Method of Voice Production, 65.

3 Natural Method of Voice Production, 8-9. It should be recalled that Mott in 1910 found that hardly any sensory nerves exist in the laryngeal mechanism.

4 It is generally believed that resonance and quality are the same things. This is not, strictly speaking, true. Resonance is actually intensification of tone. Thus a highly resonant tone might be a very bad tone. Good quality results if the proper proportion of the fundamental and overtones is emphasized, i.e., increased in loudness.

5. Interfering elements include the muscles of the tongue and chin, the epiglottis, the false vocal cords, and the soft palate. [1] [2]

6. Muckey is in agreement with Curtis concerning the importance of nasal resonance. "This act /raising the soft palate/ cuts off more than half our resonance space and produces a corresponding diminution in volume of tone."[3] It may well be that the importance of the nasal resonance idea in vocal training finds its origin with Muckey as well as with Curtis. Both writers advocate the use of the hum to secure such resonance. Muckey insists that the labyrinth of turbinated bones in the nasal cavities offers many chambers of resonance. It has already been pointed out, however, that Russell finds no contribution to tonal intensities in the nasal cavities. He suggests, however, that these cavities may have importance as modifiers of sound. It is possible that no little amount of harm has resulted from this doctrine for it is probably responsible for the general concept of "voice placing." If the idea of directing tones is placed in the pupil's mind, tensions may be activated. A tone can be permitted to resonate in a cavity byt can't be directed there.

[1] Interference is detrimental according to Muckey in two respects: (1) There is impingement upon the free action of the cords, and (2) interference causes closed off or restricted resonance cavities.

[2] Concerning Muckey's idea of false cord interference, Russell states: "We have repeatedly noted . . . when the voice passes to a strident, clashing, high-pitched sound, the false cords and muscular surfaces which lie immediately above the true vibrating glottal lips producing tone, are shown by the laryngo-periskop to be pressing down forcibly, and impinging on the whole outside edge of the glottal wedge until nothing but the thinnest strip is left exposed. As a matter of fact these red muscular surfaces above sometimes contract until they blanche and get white, showing an undoubted forcible impingement on the exterior edges of the true vocal lips. Sometimes the vocal shelves themselves are no longer visible at all. It is, therefore, evident that under such circumstances the false cords will not leave any part of the vocal lips free to vibrate except the thin sharp glottal edges. In this case they would naturally be very tense . . . Speech and Voice, 232.

[3] Natural Method, 63.

Little light is shed on Stanley's register theory by Muckey. Muckey maintains that there should be none. It should be remembered, however, that like Stanley, Muckey maintains that the normal vocal range should be three octaves or more.

Shaw should here receive brief discussion since in his second book he reiterates Muckey's doctrine.[1] In his earlier publication Shaw makes a strong appeal for a return to the principles of the old Italian Masters. As is usual there is considerable indefiniteness as to the exact procedures. However, this is explained in that each of the old masters had his own particular methods. Little has come down to us because these methods dealt, probably, only with the production of tone. In short, these men taught singing and bothered little with the mechanism of voice.[2]

Scientific study of the vocal matters, Shaw believed at the time of the writing of The Lost Vocal Art, had done the cause of vocal training more harm than good.[3] Of

1 Shaw, W. Warren, Lecturer on Voice Production, University of Pennsylvania, Director Vocal Department, U. of Vermont, The Lost Vocal Art and Its Restoration, 1914. Authentic Voice Production, 1930.

2 The writer, though agreeing that they had little accurate scientific knowledge of the mechanism, is yet of the opinion that they were not uninterested in such things.

3 At the present time many well schooled in vocal science realize above all that certain parts of the vocal mechanism are not subject to direct control. This does not mean, however, that suitable controls can't be set up by indirect means.

course, this is not purely a matter of scientific study of the voice but of the way the knowledge gained is utilized which Shaw as much as admits. He considers that which is generally termed scientific voice culture is mechanical guidance of voice by paying attention to physical parts based on knowledge of physiology and anatomy. Nor is Shaw opposed to placing the old Italian idea of instruction on a firmer basis. If empirical instructions bring favorable results, it should be reduced to scientific principles in order that it may become a rock of vocal ages.[1]

Voices should be trained from the natural conversational tones of the speaking voice

> generally from the highest easy speaking tone downward, and then from the lowest tone upward, taking care that the extension exercises should be carefully graded. At no time should the voice be forced upward or downward, beyond the pitch of comfortable delivery.

In this case Shaw makes no reference to vocal registers or even to qualities of tone, but the general plan of attack vaguely suggests a Stanley procedure, exercises of the opposite ends of the vocal range. Shaw's mention of the use of the speaking tones of the voice suggests a matter of interest. According to Dr. Ray Crittenden, an acquaintance of the writer's, much was made of the spoken word in voice training by the eminent late Percy Rector

[1] The Lost Vocal Art, 21.

Stevens. That techniques involving the use of the speaking voice for the training of the singing voice originated with Stevens is doubtful (both Shaw and Marafioti recommend them in one form or another). However, in the writer's own knowledge both Crittenden and Wilcox as well as others make extensive use of them. In their use, perhaps, is a tacit admission of the exceedingly close relationship between the singing and the speaking voice: that the development of one is the development of the other, and to achieve in one is to facilitate achievement in the other. Crystal Waters, somewhat of a disciple of Stanley's concerning the use of the light and heavy vocal mechanisms as an aid to voice development, calls the two mechanisms "groan voice" and "whine voice." It is probable that she leads he pupils to the discovery of these two mechanisms by first having them speak in them.

In Shaw's second book he proposes to discuss the voice under the new light that Muckey's investigations allegedly placed on the subject. In addition he proposes to treat psychological matters in voice training which were largely neglected by Muckey. His position concerning the validity of scientific knowledge of the voice is greatly modified. Shaw then considered that the decadence of the vocal art was concurrecnt with the advance of the physiological schools which point emphasizes in no uncertain terms

that a little knowledge is a dangerous thing; for an art without a comprehensive scientific background is in constant danger of disintegration.

In this second book Shaw follows Muckey's views with emphasis on matters of resonance:

1. Most of the interference with proper resonance is to be found in those muscles connected with swallowing.

2. The best position of these muscles during the act of phonation is a condition of rest.

3. Resonance changes are produced mainly by the front of the tongue and the position of the lips.

This latter opinion of Shaw and Muckey is of sufficient importance for a momentary digression. A considerable amount of thought during the present century has tended away from the idea of forward vowel formation. The subject has been specifically pointed up in the question: Should the lips be used to form the vowels? Earliest among those whose works have come to the writer's attention and who have cast considerable doubt on the validity of lip vowel formation is Clara Kathleen Rogers. Stanley is very emphatic on the matter and Wilcox seems to have followed Stanley. Others have stated similar opinions. It is in general that lip formation of the vowels tends to inhibit the pharyngeal region where actual vowel formation should take place. It is notable that Russell's x-ray studies tend quite clearly to point to characteristic throat positions assumed in the phonation

of the different vowels.

Shaw has little to say about registers. In The Lost Vocal Art he suggests that there should be no conscious management of them.

> What may be termed registers unquestionably exist in the operation of the normal voice and depend entirely on pitch and character of expression.[1] /underscore the writer's/

Here we have an indication that things other than pitch can designate which register is used. However, intensity is not mentioned as a factor. In Authentic Voice Production nothing is said about registers. It should be recalled that Muckey denied their existence in the properly trained voice.

It is of interest to note that Shaw believes the puff action theory of the vocal cords is proved fallacious in so far as phonation is possible upon inhalation.

David C. Taylor's book, Psychology of Singing, could not be well passed over in a study such as this, for its author demonstrates himself to be one of the most penetrating thinkers in the field of vocal science. Further, here is a writer, surely, well schooled in the literature on voice. He is discussed at this time principally because, like Shaw in his earlier work, Taylor

1 107.

sees very little hope for a voice teaching profession that deviates too widely from the basic procedure of the old Italian Masters. The fundamental cornerstone of the Masters' teaching, he thinks, was so simple, generally, and taken for granted at the time that no writer of the period thought it worth recording. The method of the old Masters was based on imitation.

> Singers are trained today exactly as they were trained 200 years ago, through a reliance on the imitative faculty. The only difference is this: In the old days, the student was directly and expressly told to listen and to imitate, while today the reliance on the imitative faculty is purely instinctive . . . [1]

Further, Taylor thinks that all modern teaching that achieves any constructive results still is imitation and that the modern maestro's teaching is likely to be effective in proportion to how much he has his pupil resort to imitation.

Scientific investigation of phonation, thinks, Taylor, has brought about a great vocal fallacy: the attempt to consciously manage the vocal mechanism.

> For the purposes of scientific voice culture this is one of the most important facts which have been determined. The attempt to manage the voice, by paying attention to the mechanical operations of the vocal organs, causes an involuntary contraction of all the throat muscles, and so interferes with the normal instinctive vocal action. Even the mere thinking of the throat in singing, and especially in practicing, is enough to induce throat stiffness.[2]

[1] Psychology of Singing, 134.

[2] Ibid., 261.

This attempt to consciously manage the mechanism leads to throat stiffness which is the mortal foe of good singing. Scientific investigation always seems to begin with the assumption that some discovery may be made that will assist the voice user better to control the mechanism and thereby the effect will be better because the causal element is correct.

> Notwithstanding the wide diversity of opinion on most topics connected with vocal training, there is one point on which all authorities agree. This is that the voice must be consciously controlled. In all the conflict of methods this basic mechanical idea has never been attacked. On the contrary it is everywhere accepted without question an the foundation of all instruction in singing.
>
> The idea of mechanical vocal control is also the starting point of all analysis of the vocal action. Every investigator of the voice approaches the subject in the belief that an exact determination of the muscular operations of correct singing would lead to an absolutely infallible method of training voices. The problem of tone-production is identical in the common belief with the problem of vocal action.[1]

Taylor thinks, on the other hand, that scientific vocal investigation should begin in a very different way, through the observation of voice itself.

> Vocal science must be reconstructed. This can be done only by following the general plan of all scientific investigation, beginning with the observation of all ascertainable facts bearing on the voice . . . The scientific method of inquiry is therefore to begin by observing these sounds. Sounds as such can be observed only be the sense of hearing. It follows then that the attentive listening to voices is the first step to be taken. . . . Many facts regarding the voice have been observed so continually that they are a matter of common knowledge, and yet

[1] Psychology of Singing, 109.

> these facts have never been recorded in a scientific manner.[1]

Taylor seems considerably ahead of his time in recognizing error of several important concepts.

> Several of the accepted doctrines of vocal science notably those of breath control, chest and nasal resonance, and forward placing of the tone, are found on examination to contain serious fallacies.[2]

His discussion of breath control is so excellent that the writer is reluctant to leave it without some consideration. Taylor calls attention to two types of breath control theories as those generally representative:

1. The antagonistic muscular or opposed action control.
2. The breath band theory

The first of these theories:

> As a definite principle of vocal science, was formulated by Dr. Mandl . . . [2]

Its main points are:

1. All expired breath must be converted into tone.
2. Control must be had over the rate and strength of expiration.
3. Therefore, the speed of expiration must be held back at some point.
4. The glottal muscles are too small and weak to perform this function, and the vocal cords will be strained and their proper action rendered impossible if called on to withstand this pressure.
5. Or if attempt is made to control the expiration in the throat above the glottis, this part of

[1] Ibid., 155.

[2] Mandl, Die Gesundheitslehre der Stimme, Brunswick, 1876.

the mechanism must be greatly reduced in size; therefore, throwing the whole mechanism out of adjustment.

6. Therefore, the point of control should be in the breathing muscles.

7. The resulting action in this type of breath control is a holding action of the muscles of inspiration as the expiratory muscles feed the air gradually to the glottis.

This explanation, thinks, Taylor, is so simple and reasonable in appearance that it has been accepted without question by most vocal scientists. However, it contains one serious fallacy for those who have taken time to study Pascal's law of fluid pressures, that pressure exerted anywhere on a mass of fluid is transmitted undiminished in all directions, and acts with equal force on all equal surfaces. The probable conclusion of these advocates has been that the vocal cords must withstand the pressure of the total force of the breathing muscles. Another thing forgotten is that the glottis must receive a certain strength of air blast to achieve a given result, no matter how this is accomplished. Therefore, if the muscles of inhalation hold back, this means that more work is necessary to produce this given result. Whether or not the muscles of inhalation are in action the same amount of "unvocalized"[1] air will escape

[1] Unvocalized breath is a common term used by teachers to denote breathy tones or a tone in which an excess amount of air escapes.

if the glottis permits this to happen. Strictly speaking air coming through the glottis is not vocalized. This air constitutes the motive power which activates the glottis. If some other manner of making the glottis swing could be found, the result would not necessarily differ. The air set in vibratory motion is that within the resonance cavities. An excess of air escaping, of course, may set up an extra or breathy sound. Or such a sound may be due to inefficient glottal action. In line with these factors it would seem evident that such a means of controlling the breath is not only useless but actually wasteful; and Taylor so believes. However, many state that in actual practice this method seems to be the best. Taylor negatively indicates that such may be the case.

> Theoretical writers generally do not claim that the control of the breath brings about the correct laryngeal action, but merely that it permits this action by non-interference.[1]

The possibility that more efficient glottal action is produced in another way by such means is not to be hastily denied. Stanley maintains that such action is in harmony with efficient closure of the glottis as well as the maintainance of an opened throat. In other words such action does not produce control of the breath but it reflexively furnishes the set-up for the best action of the rest of the mechanism. Wilcox maintains:

[1] Psychology of Singing, 27.

> We have no power to open the throat save through the act of breath inhalation. The throat opens automatically to accommodate an indrawn stream of air . . . [1]

Though Wilcox makes no such claim, it is possible that continued tension on the muscles of inhalation might help maintain such a condition. It might be a kind of conditioned reflex action; the throat having been conditioned to open to accommodate the air might continue to do so at the signal of the muscular action that ordinarily permits inhalation.

The second type of breath control mentioned by Taylor, seldom heard about now, is the breath band theory. He credits Charles Lunn[2] with its origin thought he states:

> There is reason to believe that this idea was also worked out independently by Orlando Steed . . . [3]

The procedures according to this theory go as follows:

1. Lungs are filled to capacity and breath held.
2. Glottis closes to prevent escape of air.
3. A sudden expiratory pressure causes the ventricles to be gorged with air.
4. The sudden pressure within the ventricles causes the ventricular bands to come into contact in automatic valvular action.

1 Wilcox, John C., The Living Voice.

2 Lunn, Charles, The Philosophy of the Voice, 1878.

3 Steed, Orlando, On Beauty of Touch and Tone, Proceedings of the Musical Assn., 1879-80, 47.

5. The ventricles control the escape of air, permitting only a small stream of air to escape.

6. The action is initiated by a "glottal stroke" which is the key to correct breath management.

Taylor's opinion is that matters of breath control should not be consciously managed.

> Very little is definitely known regarding the manner in which the subject of registers was treated by the old Italian Masters. Suffice it to say here that the Old Masters did not refer the registers to changes in the laryngeal action. They were treated simply as different qualities of tone, each quality best adapted to be sung only in a portion of the voice's compass.[1]

Garcia, however, was carrying out observations as early as 1840 on the positions the larynx takes as the various registers are used.[2] With the invention of the laryngoscope investigations of register action were, as we have seen, immeasurably extended.

Concerning the actual treatment of the registers Taylor makes a statement such as the writer has found in none of the literature on voice he has examined up to Taylor's time:

> . . . it is found that the subject of registers is very seldom treated in the manner suggested by the theoretical works on the voice. This would be to make the "placing" of the voice in the different registers the exclusive subject of instruction for a certain number of lessons; --to train each register of the voice separately; --when the correct vocal cord action had been established in each register,

[1] Psychology of Singing, 34.

[2] Garcia, Manuel, Memoire sur la Voix humaine, 1840.

> to unite the different registers, and to correct any "breaks" which might have developed. Comparatively few teachers attempt to follow this course. The great majority treat the registers in much less systematic fashion."[1]

Stanley maintains that the registers should be isolated and practiced separately. That which is lacking, in comparing Taylor's suggestion with Stanley's theory, is that no mention is made by Taylor that vocal development might result from such a "systematic" treatment of the registers.

Taylor makes a further statement that is very pertinent to our study.

> One important phase of the registers has not received much attention from the laryngoscopic investigators. This is, that most of the notes of the voice's compass can be produced at will in more than one register. Vocal teachers as a rule recognize this fact. Julius Stockhausen, for instance, in his Gesansmethode (Leipzig, 1884) says, 'The registers cross each other. The two, principle registers of the voice have many tones in common. The perfect blending of the registers on a single tone leads to the crescendo called in Italian the messa di voce.'" [2] [3]

Stanley states that the registers are governed by intensity more than by pitch. Stockhausen's comment here is of extreme interest in that during the process of swelling the tone phonation will probably have taken place in

1 Psychology of Singing, 34.

2 Ibid., 40.

3 Stanley proposes an exercise for the male called going the falsetto. It consists of a crescendo in falsetto till the correct point of intensity is reached for the lower register to join in. If the registers are fully developed, this can be done without a noticeable break.

more than one register. Stanley's theory still is not completely duplicated in so far as Taylor's use of the term "at will" does not specifically state that the voice user changes intensity in order to change registers on a single note.

It is considered by Taylor that in practical instruction extension of the vocal compass is usually treated "rather loosely perhaps in most cases" as a matter of the registers. In Stanley's view extension of the range is almost totally a matter of the registers. Stanley's opinion is that the falsetto, if pure, has tremendous possibilities of upward extension. The lower register on the other hand will extend downward to a greater degree than traditional thought usually permits. It comes to a point where a "well-registered" voice has a range of over three octaves. Teachers usually, thinks Taylor, begin by "placing" the middle notes first. [1] This apparently assumes a middle register the existence of which Stanley and numerous others have denied. Such practice in Stanley's opinion would constitute the worst possible

[1] The usual reason for beginning in the middle voice is that this is already more or less the part of the voice customarily used and, therefore, easiest to manage. This would be good psychological procedure provided other factors do not enter the picture. Wilcox would begin training at a point where a good tone shows itself regardless of its place on the scale.

procedure since this would engender "mixed registration" and begin training where the worst vocal faults are usually prevalent.

> In the case of contraltos and bassos, the voice is usually trained from the middle in both directions. Most teachers favor the "chest voice" for singers of these types throughout the entire compass.[1]

This is something of an unusual statement in relation to the contralto voice. It should be remembered that most of those of the "laryngoscopic school" found the greatest diversity of registers, often five, in the contralto voice. The same investigators found one or at most two to be used by the barytone and bass voices. If here is an assumption that the lower register can be carried throughout the entire range in the contralto voice, we find perhaps agreement with Stanley as to vocal possibility. In the well developed voice Stanley thinks the lower register can cover the greater part of the range if phonation is at high intensity. In the practical singing of the male voice Stanley would have a predominance of lower register since the male falsetto is not suited to actual performance. However, in the case of no voice, regardless of type, would Stanley tolerate the falsetto to remain undeveloped or unexercised. Such procedure would lead to wrong co-ordination, cause the voice to lack quality contribution of the falsetto mechanism, and

[1] Psychology of Singing, 42.

ultimately destroy the voice. According to Stanley the arytenoid or holding muscles are those that activate the falsetto. These muscles being neglected throws too great a burden in pitch and intensity changes on the thyro-arytenoid resulting in improperly strung cords, the cords being far too short for a given pitch or intensity. One exception in permitted by Stanley in the use of the falsetto in actual singing by men. This is in the tone of pianissimo intensity. This type of production is and should be falsetto. At higher pitches a tone somewhat greater than pianissimo could be maintained in the falsetto register. However, it is rather seldom a singer is called upon for a high pianissimo tone.

Taylor even goes somewhat further in his partial identification of registers with intensity. He does this indirectly while speaking of difficulties involved in the examination of the registers by sight through the laryngoscope and the question of whether or not the glottal action is a factor in tone quality.

> This theory that the quality of the tone is determined solely by the resonance cavities is directly contradicted by Professor Scripture. He proves that changes in tone quality result from changes in vocal cord adjustment . . . Even before this matter had been definitely settled by Professor Scripture, there was a strong presumption in favor of the vocal cord adjustment theory . . . Several empirical observations support this theory. Most important of these is the fact that a single tone, swelled from <u>piano</u> to <u>forte</u>, goes through a wide variety of changes in quality. Stockhausen's mention

of this fact has already been noted.

> This fact tends to cast some doubt on the value of laryngoscopic obaservation as a means of determining the laryngeal action. Under the conditions necessary for examination with the laryngoscope it is impossible for the singer to produce any but soft tones in the head quality of voice.[1] Most of these tones, if swelled to forte, would change from the head to the chest quality. It is probable that this change in quality is effected by a corresponding change in the vocal cord adjustment, as the condition of the resonance cavities remain the same. But this cannot be determined by a laryngoscopic observation.[2] [3]

Since Taylor mentions no middle register, it might be assumed that he upholds a two register theory. However, his text makes no definite statement to this effect.

1 In the technique developed in the Bell Laboratories this factor has apparently been overcome in so far as some of the pictures are of tones made at almost maximum intensity. It is probable that Russell's laryngo-periskop also tends to eliminate this difficulty.

2 Psychology of Singing, 214 and 215

3 It may be that Taylor is inconsistent here. It would be impossible to examine the vocal cords during sound intensification only if the resonance cavities did not remain the same. If they remained constant, the view of the vocal cords should remain constant. The vocal cords would become hidden only because of a change in the resonator. However, Russell comes to Taylor's rescue. First Russell observes that differences between certain vowels are far greater when they are voiced than when they are whispered. He assumes here that the resonating functions are present in both cases. But clarification of the "front" vowels results when the glottis comes into action. Secondly, Russell notes that certain singers are able to phonate high pitched bright vowels with a flat tongue, a thing they are not able to do when whispering the same vowel. Third, on what Russell terms initial experiments some differences seem to be noted in the vocal cords for certain vowel differences. Speech and Voice, 84-94.

Nor is there any indication whether or not Taylor identifies "head quality" with falsetto.

In the foregoing discussion of Taylor the material should not necessarily be considered always as Taylor's views. Some is in explanation of beliefs held or practices followed. Yet in some of the ideas expressed we have the closest approximation to Stanley's register theory yet recorded in this work. First it is possible Taylor accepts a two register theory. No evidence is presented that one of them is falsetto. Pitch is not the sole determinant of the register used, but quality or intensity or both may determine the register utilized. Most notes in the vocal compass may be produced in more than one register. Since tones of low intensity must be used during laryngoscopic examinations, it may possible to observe thereby only the mechanism of "head" quality. This may prove to be a matter of vast importance, for had it been possible for the "laryngoscopists" to observe the cords as tones of moderate or loud intensity were produced, their register theories might have been different. It would seem logical, Taylor thinks, to train the registers separately. Some of the differences in qualities from one tone to another may be attributed to glottal action.

It should be noted once more that Taylor is very

emphatic in his proposals on teaching methods:

1. Concentration on the mechanism causes of throat stiffness.

2. There should be a return to the method of the Old Italian Masters.

3. The cornerstone of their methods was, "Listen and imitate."

Henderson, not a voice teacher or scientist, but a music critic, approaches the subject of voice with a considerable amount of good sense.[1] He seems to be numbered with Taylor among the few who in our century have troubled themselves to look carefully into the history of vocal training.

Speaking of those who have claimed that four or five registers exist he states that few of these maintain that there is a mechanical change that ushers in each of the five. Even those maintaining that there are three seldom claim that there is a mechanical change between the chest and medium register.[2] Therefore, Henderson tends to take the view of the more scientific observers of the laryngoscopic school who in general agreed that the registers were two in number, the same as was found by the old Italian masters. He explains the change of register pro-

[1] Henderson, W. J., The Art of Singing.

[2] It is feasible that a mechanical change could exist between "chest" and medium that is not observable under the conditions required for a laryngoscopic examination.

cess about as well as any other writer:

> . . . when the pitch has been raised as far as possible by an increasing of tension on the vocal cords, the mechanical process is altered, and additional notes can be obtained by a different method. In producing their added tones the vocal cords relax a trifle and then substitute for vibration involving their entire length vibration of only a part of it.[1]

Henderson repeats the traditional warning about strain resulting from carrying the lower register too high. The registers should be made as equal as possible as to tone quality thereby eliminating the break between them.

Next to be discussed is Blanche Marchesi,[2] daughter of Salvatore and Matilde Marchesi, disciple, through her parents of the Garcia School, and, as someone has said, "with some ideas of her own." "Those who seriously wish to learn the truth about the voice and its production may find it here," stated Blanche Marchesi.[3] Certainly on the surface of things such a claim would not seem totally unjustified.

> It is a mystery to the author why the method has not been adopted by the singing and teaching profession generally -- the world might surely have guessed that this regular output of great and small artists was due to some infallible underlying principle.[4]

Apparently the following were trained all or in part in

1 The Art of Singing, 66.

2 Marchesi, Blanche, The Singer's Catechism and Creed.

3 Ibid., preface, vii.

4 Ibid., viii.

some division of the Garcia-Marchesi School and were all singing at the Metropolitan at one time: Melba, Eames, Calve, Susan Adams, and Sybil Sanderson. Other artists at least passing through some branch of the Garcia School were: Jenny Lind, Stockhausen, Gunther, Michaeli, Nissen, Nourrit, Bianchi, Lund, Brant, Cary, Organi, Gustave, Favelli, Geraldy, Alda, Gerster, Gulbranson, and Krause. Any method which had such an outstanding record of achievement as this should be investigated in attempt to ascertain the probable factors leading to its success.

In considering reasons for the apparent success of the Garcia-Marchesi methods some psychological factors should be mentioned. First there was the fame that the Garcias achieved as singers. Manuel Garcia's father was considered by many to be the leading tenor of his day. Coming to Italy, from Spain, in the early years of the nineteenth century, he is thought to have acquired the traditional precepts of the old Italian masters. His daughter, Malibran, whose short career is considered to have been one of the most brilliant ever achieved; his other daughter, Viardot-Garcia; and Manuel Garcia, the younger, all were singers of considerable reputation. Then Garcia, the younger's, alleged invention of the laryngoscope and reputation for having put voice study on a scientific basis, the numerous contributions he made to the literature on voice all added to a reputation already established. Such reputations are not only

important in enticing promising vocal students to a studio but in marketing the finished product as well.

Stanley characteristically maintains that the success of the Marchesi School is derived from the fact that little harm was done to the natural voices of the pupils. They were permitted to sing out so that they could be heard over an orchestra and were not housed or confined in their production in the manner that many vocal teachers greatly limited voices.

Blanche Marchesi states a register theory that to the writer's knowledge does not seem to be involved in Garcia's system. The registers, three in number, are closely related to the use of three sounding boards. These sounding boards are the sturnum which vibrates in the chest register, the hard palate which reinforces the middle register, and the "vault of the pharynx" which takes up and reinforces the sound in the head register. Concerning this latter type of resonance, she believes that the frontal bone and the whole skull are made to vibrate when the vault of the pharynx is hit by the sound. The writer is of the opinion that the "vault of the pharynx" must signify a raised soft palate, since she seems to believe that the back of the nostrils should be closed. She states, "The inside of the nose may be compared to a dead lump of cotton and the way to it must be barred

while it is produced."[1] This view is in direct opposition to Curtis who maintains that the key to a good head tone is nasal resonance and to Muckey who thinks that half the resonating potential of the voice is lost when then passage to the nasal cavities is barred. Russell in his x-ray studies find, however, that some voices use an open passage, others a closed or a semi-closed one. His sonometer tests demonstrate no resonance contribution of the nasal cavities as such, but admits the probability of their action as tonal modifiers.

Thus we find two authorities, Marchesi and Curtis, in direct opposition to each other concerning the sources of head resonance. The probability is that neither is correct in his belief in that there can actually be little head resonance whether it be produced by nasal cavity resonance or by skull bone sounding board reinforcement. Russell's tests give little support to either and neither can be judged as acoustically accpetable. The nasal passages and labyrinths are stationary in size. Practical resonators need to be adjustable as to size and shape in order to resonate differing pitches. Miss Marchesi's sounding board theory is also highly questionable for several reasons. Flesh and bone are not constructed of material that permits them to be good sounding boards. Where the sounding board condition prevails in

[1] Singer's Catechism and Creed, 60.

a musical instrument, there is a solid connection between the vibrator and sounding board. This condition is absent in the vocal mechanism. For the larynx is not connected directly to any bone in the body. Further it is fallacious to believe that sound can by any method be directed toward any part of the anatomy. Sound travels in all directions if no barrier prevents. It will pick out a resonance cavity if the cavity's period is the correct one to accommodate it.

In any case, however, in Miss Marchesi's theory of registers we have the view (one not to be completely discounted) that resonating properties play an important part in producing the various registers. It is not to be thought, of course, that she intends us to interpret the registers as mainly functions of resonance, but that each vocal register can work efficiently only if the proper sounding board is hit. For each register there is a corresponding sounding board.

Miss Marchesi notes no special actions of the glottis as corresponding to the various registers. However, attention is called to varying laryngeal positions in the three registers. According to Taylor, Garcia noted this phenomenon long before his invention of the laryngoscope. Varying laryngeal positions would be more likely to indicate resonance changes than changes in glottal action though such positional change can pos-

sibly through the extrinsic laryngeal musculature affect glottal action.

Blanche Marchesi notes a considerable amount of difference in the use of the registers according to the sex of the singer. Women use all three registers; men use only one. Though no register change apparently takes place as a man ascends the scale, he reaches a point on the scale about high E flat where he must "cover" At this point he begins to use the sternum and the "vault of the pharynx" sounding boards simultaneously. "When men sing falsetto they, like women, use the head voice . . . "[1] The question is asked asked, "Why do women change registers?" To this question which she submits, Miss Marchesi gives the incontrovertible reply, "Because, belonging to another sex, their voices work differently."[2] No mention is made of the reason why a man can't or doesn't use his hard palate sounding board. He is capable, she states of the three larynx positions.

In relation to Stanley's theory we have here an identification of the head voice in women with the male falsetto Garcia's terminology has been dropped. He termed a kind of middle register in women's voices falsetto. The registers are capable of extension either up

1 Singer's Catechism and Creed, 11.

2 Ibid., 35.

or sown though this is often unwise. Fairly definite limits should be placed on upward extension of the registers.

> Women, on the other hand, can carry their chest register high into the medium, imitating men, and they often do so with disastrous results. Again they can take low notes in the medium register instead of using the chest voice. Weakening of the voice will follow, and the development of the other registers will be hampered. Also they can continue the medium into the head register failing to observe the change on the F sharp. This, too, must inevitably destroy the voice. Lastly, women can, as I said before, use the head register downward and all along the range, in which case the voice will melt and disappear.[1]

The foregoing contains much that is pertinent to our study. First, it is inadvisable to carry up the chest register beyond its natural limits as men do. Stanley, on the other hand, thinks that vocal development demands this be done. On the other hand, though women can take their low notes in the medium or even the head register, lack of use of the chest register resulting thereby will weaken the voice and hamper the development of the other registers. To this Stanley would probably agree except that he doesn't recognize the existence of the middle register. He maintains that the lower register must be put in and kept in good health by exercise extending it much higher than is correct accord-

[1] Singer's Catechism and Creed, 20. The writer is not able to state surely whether "melt and disappear" refers to the tone petering out at the bottom of the range or whether it refers to permanent vocal damage.

ing to the Marchesi view. As to the use of the head register downward Stanley would recommend it for practice. This vocal register may or may not correspond to Stanley's falsetto. In actual singing it would be used low in the scale for soft effects. Both Stanley and Marchesi seem to consider the lower register and the upper important to the health of the voice. As to the middle register, Stanley does not recognize it.

Blanche Marchesi does not state whether or not the falsetto is to be used in the training of the male voice. Since she does not mention the process, it is probably to be assumed that this is not a part of the "Garcia-Marchesi" system. She does state that failure to "cover" in the high pitches of the male voice gives rise to the tremolo. If, on the other hand, the man covers all his tones, "it will never develop but shrink and deteriorate."[1] This much agreement seems to exist with Stanley, that the health of the voice in women at least demands utilization of the higher and lower register.

Blanche Marchesi mentions one other item which may or may not be related to Stanley's digital manipulation to stimulate lower register action. Since according to Stanley's theory lower register action involves stretching the vocal cords by a tilting down of the thyroid, he

[1] Singer's Catechism and Creed, 24.

considers that such action can be stimulated by a downward pressure of the fingers exerted on the thyroid cartilage.

> Only recently it came to my notice through a pamphlet by Dr. E. Krauss (Paris), presented to the French Medical Academy, that not all eunuchoid voices belong to sexless men. He made the most important discovery, which I will explain here, as it shows clearly that a man can keep a boy's voice and be a normally developed man at the same time.[1] Dr. Krauss explains as follows: At the time of puberty, a boy's voice breaks and assumes sometimes the character of a eunuch. The explanation generally given was that this phenomenon was due to spasms or ataxic movements of the laryngeal muscles, but Dr. Krauss found that the real reason of the vocal perturbation came from a different source. According to him the eunuchoid voice, which has nothing to do with the voice of a eunuch, although it resembles it entirely, is due to a disparity between the development of the cartilage of the larynx. The latter, too much developed in the anterior-posterior direction, keeps the cords continually stretched even without muscular contraction. Any muscular contraction attempted then produces over-stretching, with the result of a child-like eunuchoid voice.
>
> Dr. Krauss has invented a device by which he trains the laryngeal cartilage to keep down whilst sound is produced, and by repeating several times a short treatment such as that described, the larynx is placed in a normal position forever and the person thus treated speaks with a perfect male voice.[2]

The exact nature of the treatment is not described.

Next on our list is the eminent Italian vocal teacher

[1] A considerable amount of opinion considers the male falsetto a relic of the child voice.

[2] Singer's Catechism and Creed, 37.

Lamperti.[1] Only a short treatise concerning his views has come to the writer's attention, but it is probable that much of his doctrine has been absorbed by his pupil, William Shakespeare, who will be discussed next. It should be mentioned that Lamperti's list of successful pupils is nearly as impressive as those from the Garcia-Marchesi school. Stanley considers Lamperti's success to be attributable, as in the case of the Marchesi's, to the fact that he permitted his pupils to sing out with full volume.

> Because the beginner neither can or ought to attack notes piano, and by trying to force him to do so, instead of favoring his progress, it will only retard him and besides tiring the muscles of the chest, often get him into a cramped way of singing.[2]

Lamperti would be considered an exponent of the Italian School[3] yet his views on registers do not differ greatly from those held by the singing masters of the laryngoscopic school. Though he supports a three register theory, his pupil Shakespeare is not reluctant in some cases to admit that in considering practical vocal

1 Lamperti, Francesco, a treatise on the Art of Singing, translated under his direction by his pupil, J.C. Griffith, Edward Schuberth & Co., New York, date not recorded. This is probably the elder Lamperti. Taylor credits to G.B. Lamperti a text, The Technics of Bel Canto, translated by Dr. Th. Baker, New York, 1905. The Francesco Lamperti treatise discussed in this paper, Taylor dates "original about 1876, Psychology of Singing, bibliography, 370.

2 Lamperti, Art of Singing, 15.

3 Not necessarily in the Old Masters' traditions.

matters it is not a bad thing to subdivide, especially the medium register. Lamperti considers the registers to be the chest, mixed voice, and head. Women possess all three, the men the first two. Shakespeare admits to three in the case of men also, the last being the falsetto. Lamperti does not consider the falsetto.

Since Shakespeare makes a great point of breath control in relation to the registers, it might be well to state that Lamperti considers his views on breath control to be those of Mandl.[1]

Shakespeare [2] notes that in singing up the scale in any one of the three registers there is a progressive growth of tension in the muscles between the larynx and the point of the chin. However, this process seems to involve a broader or narrower group of those muscles depending upon whether phonation is in a lower or higher register. A corresponding tension is to be noted in a downward pull of the muscles just above the breastbone.

> Thus the registers seem to be influenced by different placing muscles, the latter through interchange of action balance, the larynx in the exact position necessary to any note, high or low, loud or soft, simultaneously, the muscles inside bring about the infinite and remarkable modifications in the length and breadth of the vibrating vocal cords to which reference has already been made.

[1] According to Taylor, the idea of antagonistic muscular action breath control can be attributed to Mandl.

[2] Shakespeare, William, The Art Of Singing, 19.

[3] Art of Singing, 21.

> The control over the placing, tuning and register changes should be unconscious.
>
> Of course, if, on starting a note, any muscles are rigidly contracted, both the balance of the placing as well as the freedom of the tuning muscles would be destroyed; a proof of the right production is afforded, however, when the note commences in fullness exactly on the pitch intended.[1]

Thus we find Shakespeare supporting the view that the registers, though not caused by muscles that govern resonating properties, still are closely joined to the correct behavior of these muscles. Stanley insists that proper register action is impossible if not accompanied by proper action of the resonator controls. Likewise Stanley would agree with Shakespeare that proper action in the breathing muscles must prevail in order that proper laryngeal action may be maintained.

> Thus, the higher the note in any register, the greater is the pressure of breath required, and the greater the art of controlling this pressure.[2]

Stanley is adamant on the necessity of correct interaction of these muscular groups, that if one collapses, the whole mechanism does likewise.

> The vocal apparatus is a single co-ordinated sound producing unit, each part of which is dependent upon the other parts. If any one part breaks down, the other parts break down also. It is similar to an electrical circuit connected in series(like the lights on a Christmas tree). Thus, all the muscles

[1] Art of Singing, 25.

[2] Stanley, Your Voice, 63 and 64.

> which function in phonation must be developed simultaneously and in balance -- equilibrium -- in every stage of the "opening" process.[1]

Shakespeare gives a slight indication of the idea of registers corresponding to intensity.

> While the good singer can change imperceptibly from one register to another in order to vary the force of the note, he can undoubtedly also increase or diminish its force while keeping in the same register.[2]

Shakespeare recommends the use of the head register for both men and women. However, this is merely for the purpose of facilitating production of the upper notes in the case of men to facilitate the upper medium and because the register is practical for public use in the case of women. It is used rather to develop a feeling of ease rather than as an actual element of vocal development.

> A genuine head-note can always be swelled into medium voice by a man, but a spurious head-note will not swell without breaking.[3]

Stanley proposes an exercise for swelling a single note in falsetto till it is sufficiently intense to permit the lower register to take over. Such will take place without a break if the falsetto is sufficiently developed and the technic is correct. For this purpose "pure" falsetto must be used.

[1] Stanley, Your Voice, 63 and 64.

[2] Art of Singing, 40.

[3] Ibid., 101.

Shakespeare at first seems to allow considerable liberty concerning how high a register may be carried.

> As far as one can with the throat open and the breath well under control; as far as one can in unconscious freedom of the tongue and jaw; as high as one can start the note unerringly and proceed in a legato style from one note to any other.[1]

Stanley's view would seem to be in a way quite similar to this. His idea would be that the register could be carried gradually higher with practice as long as openness of throat can be maintained. However, apparently these permissive conditions that Shakespeare sets up are seldom maintained much above the traditional limits for this register. So in actual practice the other registers are pretty well confined to the limits usually considered safe. Whereas Blanche Marchesi considers that the head register in women can be sustained down to middle C, Shakespeare thinks its lower limit to be about middle A where its intensity is too limited for its public use. However, he does recommend its practice down as far as this limit. To secure good production in the upper middle register Shakespeare recommends a smiling position of the upper lip, a device frowned upon by some others. He proposes quite an elaborate set of sensation points for certain notes in the various registers as the front teeth, eye teeth, first molars, etc. The idea was apparently acquired from Lamperti. Sensations are con-

[1] Ibid., 33.

sidered very unreliable by some since we have little assurance that the correctly produced note will cause each person to experience the same sensation. Dr. Ray Crittenden expresses the idea as follows:

> I can tell how an apple tastes to me, but I can't tell how it tastes to you.

> The head voice consists of a series of notes differing in character from those of the chest and medium registers, and presumably produced by a different action of the vocal cords. It is characterized by a flutey and bird-like quality, lovely and essentially womanly. It can be produced by both sexes, but while in a man it is so feeble and effeminate that few would venture to sing it in public, its use by mezzo-sopranos and sopranos is in the present day more highly prized, not only by reason of the loveliness of its quality but because of its comparative rarity.[1]

This can be presumed to be comparable to Stanley's falsetto. However, from the descriptions given of these various tone qualities, it is impossible to say definitely. The male teacher should be able to produce this voice, thinks Shakespeare, for demonstration purposes. It differs in the male from the common "whoopy falsetto" which is often mistaken for the head voice. Neither is it "that soft effect sometimes heard in the very high notes of the tenor voice, which are produced by the medium register." Some very fine distinctions are made by these vocal masters.

So again we find certain suggestions of Stanley's

[1] Art of Singing, 37.

register theory as well as a considerable amount of material which does not agree. It is probable that in certain matters concerning resonance there is more agreement. Both Shakespeare and Stanley consider that an open pharyngeal cavity is a concomitant of good vocal technique, the "open throat" as it is often called.

Care should be exercised in wholeheartedly accepting the "open throat" principle as a necessity to good phonation. If one considers it from the point of view of pharyngeal resonance, he is probably on much more solid ground. Russell's x-ray studies do not show what could be termed an "open throat" for the "a" sound. They do show, however, a fairly consistent type of closed throat. On the other hand, they consistently show quite a tremendously "open throat" for the "i" sound. In general the pictures demonstrate that, certainly, the pharyngeal cavity is of importance in the formation of the vowel sounds. It may be verified by simple armchair experimentation that all the vowels can be formed without change in lip position. One can, if he likes, begin with almost any set position of jaw or lips.

Since Louis Arthur Russell speaks somewhat in harmony with Shakespeare on the "open throat," it is well to give him his brief part in our study at this point.

> Among the many errors of teaching which have so long stood in the way of singers' advancement in art is the thought that correct vowel making is a matter of lip shaping . . . Every shade of vowel color can be readily made and should always be made without interference of the lips . . . [1]

> The open throat and back mouth must be the care of the student; here at the line of and back of the pillars of the fauces is where we want the freely wide open space, and we should have control over this condition whether the front mouth at the lips and teeth be wide open or close together.[2]

Russell then introduces a further concept accepted in the main by Stanley and somewhat corroborated in recent years by G. Oscar Russell.

> Flabby tissue of any sort diminishes resonance; therefore, the firm but free condition of all members of the mouth and throat doubtless adds to the resonance of the voice . . . [3]

Stanley has gone so far as to suggest the throat should be "rigidly" open. Louis Graveure states:

> The throat must be like steel; there must be no relaxation -- remembering, of course, that the tension and the steeliness to which I refer are the result of muscular expansion.[4]

Stanley has been strenuously attacked for his attitude concerning a rigidly open throat. Certain of those who follow him partially believe that his choice of words has been unfortunate but that firmness of the pharyngeal cavity is necessary to make it an efficient resonator of

1 Commonplaces of Vocal Art, 32.

2 Ibid., 33.

3 "Louis Graveure Presents New Theories of Vocalism," as told to R. H. Wollstein, Etude, February, 1931, 129.

4 Commonplaces of Vocal Art, 37.

sound. The term "rigid" they think implies the idea of inflexibility. The resonator should be flexible.

Russell thinks that though no sensible teacher will deny the existence of the registers, a great deal more has been made than is necessary.

> Where the action was too subtle for the laryngoscope's searching mirror, men have found no difficulty in formulating a complete theoretical process and putting it before the public as a discovery of importance . . . [1]

Russell believes that many instructors make a great error in taking a small falsetto tone for the "head voice." Such falsetto even in the case of women has little color or warmth and are good only for "fioriture," flutelike passages. Shakespeare, on the other hand, seems to like such tonal qualities. There is little of importance here except that Russell seems to think that falsetto and "head voice" are two different mechanisms.

> The ease with which the falsetto "head" tones are produced is misleading. We must have ease, but we must also have the right quality throughout the voice's range.[2]

Another pioneer believer in the theory of pharyngeal vowel formation is Clara Kathleen Rogers. The writer has been able to review only one of her several publications. In Clearcut Speech in Song she makes no refer-

1 Commonplaces of Vocal Art, 54.

2 Ibid., 61.

ence to registers, but a great deal of back formation of vowels that is worth brief attention.

> It apparently has not occurred to students of phonetics that these movements in the mouth are consequences not cause and that, therefore, they should not be independent local adjustments. The fact that the movements in the mouth are simultaneous with the graded movements of the voice box has led both singers and speakers to suppose that the way to insure correct vowel shapings is to begin at the mouth.
>
> It is a strange fact that the colorless voices, without substance or volume, which are now so prevalent have not, so far, been recognized as the immediate outcome of these same local adjustments.[1]

THE FALSETTO

Albert E. Ruff, in presenting his views concerning the working of the intrinsic laryngeal musculature, comes very close to the subject under investigation.[2] Unfortunately his articles are probably too limited in length for the size of the subject he discusses, and some of the material presented is vague and difficult to grasp. Ruff was born in 1854 and, consequently, at the time the articles were written, was a very old man. Early in his career he studied the anatomy of the throat under Merkel and some of the views presented may be attributable to him.

1 Ibid., 35.

2 Ruff, Albert E., "Improve Your Voice Production," Etude, November and December, 1939.

Here is a writer who thinks without any apologies that a requisite for voice building is a knowledge of the vocal muscular system.

> This system consists of two actions. One is voluntary, which can be developed by will power. The other is involuntary, as it can only be brought into action by the breath pressure. The voluntary are situated outside and the involuntary inside the larynx.
>
> It is principally with the inner muscles that the voice teacher is to be concerned.[1]

In other words, the chief area of the vocal instructor is in the field where the student has no conscious control. Of these intrinsic muscles, Ruff has considered the most important to be the thyro-arytenoid.

> They are the keystone of voice production and capable of making or unmaking the singer. If these muscles are correctly developed, they will last and still be useful in old age. If they are not, it will be only a question of time before one or more faults will appear, among the worst of which are: loss of upper tones, scratchiness, nodula, partial paralysis, flatting and the pernicious tremolo.[2]

1 "Improve Your Voice Production," Part I, Etude, Nov., 1939. Muckey and others tend to consider certain of the extrinsic musculature as voluntary or potentially so. Muckey considers the swallowing group of muscles to be the ones which create interference. These he considers to be voluntary. Most authorities will agree with Ruff that the intrinsic musculature is not under any circumstances subject to voluntary control. This was widely considered to be the case before Mott's investigations, 1910.

2 "Improve Your Voice Production," Part I, Etude, Nov., 1939.

Unfortunately Ruff does not clearly state what the proper action of this muscle is. He does consider "bunching" of the fibres of the thyro-arytenoid to be a definite evil. Such a condition often prevails where the immature boys voice has been extensively used before, during, or immediately following its change. Stanley opines that the proper condition of the thyro-arytenoid is that in which this muscle is in its longest state for the pitch and intensity to be phonated. Stanley reaches this conclusion on admittedly inconclusive evidence. Such a condition would seem to prevent bunching, but there is no good evidence that his is the type of action that Ruff refers to. However, our special interest is in Ruff's explanation of the falsetto mechanism.

> The crico-arytenoids come into play when singing triple piano, in which case they act alone, that is, the edges of the thyro-arytenoids, and not the body, are brought into play.
> By this action the so-called falsetto is made.[1]

And again,

> The crico-arytenoid muscles join the cricoid with the arytenoid at the back. These are principally brought into play in very soft singing. These muscles are so constructed that they pull on the arytenoid when the cords are in repose, keeping them apart to allow the breath to pass freely in and out of the lungs.[2]

Stanley maintains that the predominating action in falsetto production is carried by the arytenoids. He does

1 Ibid., Nov. 1939.

2 Ibid.

not specify as does Ruff that the action is due to any one muscle of the arytenoid group.

> However, every high tone ought to diminish into the falsetto, the finishing touch of the tone. To do this smoothly is one of the finest points of a singer's art.
>
> As it is more difficult to swell from the falsetto into the body tone, this should not be attempted until the diminishing has been perfected. This action, swelling from the falsetto, is accomplished by combining the muscles of the body tone and the outer neck muscles in focusing the tone on the vocal cords thus making the voice most powerful and ringing.
>
> The old Italians called this manner of tone production "voce mista," (mixed voice). I cannot conceive of a tone being mixed; so I call it a combination tone, as it is constructed by a combination of the muscles.[1]

Here is a considerable amount of identification of intensity changes with what might be termed register changes, though Ruff states, "I condemn the use of the name registers."[2] Here is a theory in which falsetto may be the result of a diminuendo, or a kind of full body tone the result of a crescendo and a fairly clear resemblance to Stanley's "going through the falsetto" exercises.

> The Germans have no love for the falsetto, and most of them insist that all tones should be sung with the Brustton (chest tone) as being the acme of voice culture. This method usually ends in disaster to the thyro-arytenoid, which soon finishes the singer's career.[3]

1 "Improve Your Voice Production," Part II, Etude, Dec., 1939.

2 Ibid.

3 Ibid.

A third point in common with Stanley's theory is suggested namely that the use of the falsetto is a concommitant of vocal health. Stanley thinks that failure to keep both registers alive and balanced precedes, in most cases, vocal ruin.

Similar as these three points are, Ruff does not necessarily draw similar conclusions to Stanley in matters of training.

> Some teachers had their pupils practice each register separately, until each could be clearly distinguished. This made a very uneven quality of voice, which not only disturbed the tone but also played havoc with the fibrous continuation of the thyro-arytenoid muscles. I, therefore, condemn the use of the name register.[1]

Whether or not the falsetto should be practiced separately is a question Ruff's text does not clarify. It may be that falsetto is not included in his idea of registers. Nor does Ruff include in his discussion any reference to a heavy mechanism, crico-thyroids as activating the body tone. He does not show definitely why he considers the thyro-arytenoid so important nor what its specific action is with relation to pitch and intensity. He merely warns against its "bunching." Stanley would consider that there would be danger of such bunching if the end pulls were not sufficient to prevent this. In other words, if one or both end pulls are so weak that

[1] Ibid.

the burden of the cord alterations must be born primarily by the thyro-arytenoid, mixed registration has been engendered and vocal ruin is not far off.

At least it can be said three similarities seem to exist in the laryngeal action theory of Ruff and Stanley:

1. Falsetto production is connected with the action of the arytenoids.
    a. Ruff specifically names the crico-arytenoids.
    b. Stanley is unspecific but probably has similar muscles in mind.
2. Falsetto is identified by both as being a softer mode of production. Therefore, except that Ruff denies the term register, probably a matter of terminology largely, we have both authorities somewhat agreed on a close relationship between intensity and register action.
3. Death of the falsetto means eventual vocal ruin.

Finally each seems to support a similar exercise procedure, that of swelling the falsetto into the regular body tone, and both think that under proper technical conditions this can be done without a break. Stanley and Ruff are not alone in the use of such an exercise.

W. Henri Zay, writing before 1917 and, therefore, obviously not influenced by Stanley, does not propose this as an exercise byt admits something of the sort can be done.

> The quality of each of these registers has a color of its own, while the character of the singer's voice should make all three homogeneous. A skillful singer can sing in any one of these registers on a single note in the middle voice, and this

gives him a great advantage where variety of tone color is needed.[1]

Homer Henley, writing at a much later date, 1936, having had opportunity to read Stanley's works, but showing fairly definite evidence that he has not done so, approaches the idea even more closely.

> There are but few male voices, of whatever classification, which can, by nature, successfully negotiate the path from pianissimo to forte, and back again, without the voice slipping to and from a falsetto on either side of the forte sound. This is especially true in the upper middle and the highest ranges. The tenor is as much subject to this humiliating "break" as is the basso or baritone.
>
> Anatomists claim that his break is caused by the abrupt change of the larynx from one position to another. They also claim, in the case of those fortunate male singers who have no discernible break in their scale, that the wide gulf between falsetto and true tone is bridged by a sort of automatic muscular shock absorber . . . That is to say, the break has been gradually dispersed over the given distance by a lucky natural adjustment of the necessary muscles of the throat. Other persons, not so happily endowed, must, however, seek means of bridging this awkward break . . .
>
> It may be asked if the falsetto tone may be legitimately employed in artistic singing. The writer replies that it can be legitimately so employed; provided it be so joined to the true tone that no perceptible break can be detected . . .
>
> The male voice break, then, may be bridged over by long continued practice . . .
>
> Here is the exercise: begin the chosen note pianissimo, in falsetto tone. As the point is approached where the inevitable break occurs, throw the tone quickly into what is unfortunately called nasal placement . . .[2]

1 Zay, W. Henry, Practical Psychology of Voice and Life.

2 Henley, Homer, "Training the Male Voice," Etude, Jan., 1936, 46.

Dr. Nicholas Douty admits the possibility of a similar accomplishment.[1]

However, the writer thinks that among those who probably have not been influenced by Stanley's doctrines, Ruff, by far and large among those whose literature has come to the writer's attention, most closely approaches Stanley's theory of vocal registration.

Since the second register in Stanley's theory is the falsetto, the comment of several writers on that subject will now receive brief consideration.

Francis Rogers thinks the male falsetto a legitimate mechanism for public use, "a highly desirable addition to the colors on his vocal palette."[2] Stanley does not consider the male falsetto suitable for public use, except for comedy effects. He states that the falsetto appears for the first time in musical history in the time of Palastrina when the two upper voices of the music sung in the Sistine Chapel were carried by Spanish falsettists. In the first decade of the seventeenth century it was discovered that castrati could do the job better.

> For two centuries the castrati were the dominating male figures in Italian vocal music.

There is no way to determine what these voices sounded like, "but they must certainly have had much of the fal-

1 "Voice Questions," Etude, January, 1943, 53.

2 Rogers, Francis, "The Vagaries of the Falsetto Tone and a Discussion of Its Place in Vocal History," Musician, November, 1930, 31.

setto sound."

Anthon corroborates Rogers' testimony concerning the use of the falsetto in ecclesiastical ceremonies and makes a few interesting additions. He thinks a great amount of falsetto use is traceable to the Orient and probably invaded Europe during the period when the Romans maintained "cultural mediations" relations with the East. In any case, the Orientals tend, he thinks, to object to the employment of the regular voice in singing as indelicate due to its resemblance to the speaking voice.

Concerning the time of Bach and Handel, Anthon states:

> The music textbooks of the period discuss the falsetto as a perfectly legitimate and indispensible part of the singer's equipment.
>
> The accomplishments of some of the falsettists were truly amazing, and for this reason they were frequently used as soloists and as leading singers with the chorus. We have testimony that some of them could sing as high as the best modern coloratura soprano at the Metropolitan Opera (e''' and f''') . . . As a matter of fact there is no record of any "female alto" in English churches before 1773, so that it is not likely that Handel heard a woman sing any of his alto arias or choruses in the oratorios.
>
> Some say the idea of a man singing alto or soprano is unnatural and even repulsive. But actually this is a matter of fashion and not of aesthetics. There used to be plenty of women singing tenor and even baritone, especially in convents, and there are women's voices today that could and should be employed in these registers. Conversely there are male voices -- you can detect them by their speaking voices -- that could naturally sing alto or soprano. And almost every one with a bass or tenor voice could sing in the high registers

in their falsetto, with perfect ease and grace.[1]

Rogers doubts that the term falsetto employed in the eighteenth century texts meant true falsetto so much as the normal quality of the voice "modified into an agreeable headiness." However, he does believe that certain arias even operatic roles were written for tenors who must, due to the high tessitura, have been intended to have at least a partial falsetto rendition.

> The falsetto has a long and honorable history and should be cultivated by every male singer. In its undeveloped state it is likely to be thin and strident, but with skillful training it grows both in body and mellowness, shading off smoothly and without a perceptible click into the "voce mista" and thence into the full voice.[2]

Robert Olmstead thinks that the question of identification of the falsetto with the head voice is a matter of opinion, and whether it is legitimate or not is a matter of taste.[3] He thinks as does Rogers that the falsetto is capable of development, changing in development from a thin soprano-like quality to one resembling somewhat the viola or cello. It is useful in cultivating relaxation.

> It is not contended that the normal voice is benefitted by this kind of use.

However,

> It is possible to carry the falsetto into the middle and lower parts of the voice thus cultivating qualities which may be blended with the deeper

1 Anthon, Carl, Etude, November, 1945, 615.

2 Ibid., 615.

3 "More Light on the Falsetto," Musician, Dec., 1930,27.

qualities.

It can often be used as the key to acquiring the true "head" quality.

Ralph Morse Brown thinks that the falsetto is potentially present in both the male and female voice, and that in each it is a relic of the childhood voice. In the case of women, however, the mechanism is usually atrophied.

> The coloratura "lift" or what are termed by some "upper head tones," is the superior group or adjustment from C# in altissimo up. This is a transition of real importance to those few sopranos who can sing these extreme tones and who care to exploit them. Actually they are not capable of development in all sopranos' voices, and are seldom more than four or five in number; relics of the child voice, ordinarily atrophy after puberty.[1]

This is a rather common and even a popular judgment. The voices that use this high mechanism are considered unusual.

> Among women an appreciable falsetto is so rare that it may be classed as a freak, or the result of sickness or accident . . .
>
> Some mature women whose voices have not changed can sing in a birdlike quality resembling a toy whistle, an octave or more above high C. Such tonality, because of lack of character and volume is seldom worth cultivation.[2]

In men the falsetto may be in a more or less atrophied state but can usually be made active.

Brown thinks that continued cultivation of the fal-

[1] The Singing Voice, 12.

[2] Ibid., 50.

setto may react harmfully upon the normal voice.[1] He considers it impossible to join it successfully to the normal voice.

> The real link between pianissimo and fortissimo on extremely high tones, as it is throughout medium degrees of pitch, is the mezza di voce. This means half the legitimate voice -- not half falsetto.[2]

Brown would suggest the use of the falsetto to create a feeling of ease in the working out of certain vocal difficulties.

Homer Henley proposes as an exercise for the male voice[3] the "mezza di voce" which begins and ends in falsetto. The aim in its practice is to learn to eliminate the break which will occur in the case of nearly every voice not schooled in the "mezza di voce." The break is probable as the voice leaves falsetto for the regular voice, and may occur as well with return to falsetto as the tone diminishes. Henley considers the exercise by no means new but one used by the old Italian masters, in which opinion he is correct. The old Italians did make use of the "mezza di voce." Henley may not be correct, in assuming that the note before swelling was falsetto. On the other hand, he may be absolutely right in so as-

1 Stanley would consider it harmful if its development began to exceed the lower register. Your Voice, 102.

2 The Singing Voice, 52.

3 Henley, Homer, "The Rejected Falsetto Made Valuable," Etude, Dec., 1936, and "Training the Male Voice," Etude, Jan., 1936.

suming. In that event, perhaps, the messa di voce exercise practiced by the old masters contained qualities Stanley claims for the exercise of the falsetto and his "going through the falsetto" exercise. Stanley's above-mentioned exercise, at any rate, probably can't be called new.

Wodell does not state his own views concerning the falsetto but calls attention to some of those held by others.[1] Rowley[2] believes that the falsetto belongs to both the head and chest register so combining them that no audible change of quality or break occurs between them. The writer presumes that in order to achieve this co-ordination between "head" and "chest" Rowley puts the falsetto in a kind of middle register position similar to Garcia's classification and that of others during the "laryngoscopic period." A difference in terminology may be involved here. Palmer, states Wodell, wanted the falsetto carried down till the bottom notes of the voice are reached. This has been verified by the writer if Clippinger's testimony is acceptable:

1 Wodell, Frederick W., "The Interesting Falsetto," Etude, April, 1938, 222.

2 Wodell doesn't state what text he composed. The writer has found no other reference to him.

> Davidson Palmer, in his book, The Rightly Produced Voice, says the falsetto mechanism is the only one that should be used in training the tenor voice and believes in cultivating it downward to the bottom of the compass. However, in an interview with him some years ago in London, he admitted that it could not be done with every voice.[1]

Franklin V. Lawson thinks that slipping into falsetto on soft tones should be avoided.

> A falsetto tone, as a rule, is a thin, colorless, insignificant one that need never be used when a pianissimo "head" tone can be properly produced.[2]

The falsetto can, however, be produced by both sexes. The fact that danger exists in letting the voice slip into falsetto at soft intensity tends to identify the mechanism with intensity changes.

Clippinger's general view of the falsetto should have a place here.

> Ever since teachers began to discuss vocal mechanisms there has been a marked difference of opinion on what constitutes the male head voice. Some of the old Italians make it synonymous with falsetto. Others believe it to be a modified form of chest voice. Still others believe it to be a mechanism between the chest and falsetto. This idea I believe to be right for various reasons.[3]

The falsetto according to Clippinger does not appear in the female voice.

1 Clippinger, D. A., Fundamentals of Voice Training, 40.

2 Lawson, Franklin D., The Human Voice, 46.

3 Fundamentals of Voice Training, 39.

There are cases where Clippinger would use the falsetto to attain proper head production.

> I have found many tenors whose falsetto seemed to lie so close to the head voice that it was not difficult to resonate it thus removing the flute quality, and blend it perfectly with the head voice. When this can be done, it gives the singer the most perfect mechanism known, but I do not find myself in sympathy with the idea of carrying it to the bottom of the compass, because in a majority of voices it is impossible, and even if it were possible, it would be a serious mustake, as the thicker string and heavier vibration are as necessary to the lower tones as the lighter string is to the upper tones.[1]

Clippinger is another who admits the falsetto to the "messa di voce" at least where it will coordinate readily. In so doing he, as others, admits its relation to intensity.

> There are many voices, the writer's included among them, that can begin a tone with the falsetto mechanism, the falsetto quality, however, having long since disappeared, and swell it to a ringing head tone with a perfect messa di voice.[2]

Herman is another who considers the falsetto as a remnant of the child voice.[3] The resulting dissimilar voices in his opinion overlap each other to a considerable extent, making it possible to produce the same note in two different ways. Herman also notes the possibility of the gradual change from full voice to falsetto, smoothly executed in gifted vocal organs, having the possibility of developing in organs of less natural merit. To the claim

1 Fundamentals of Voice Training, 40.

2 Ibid., 41.

3 Herman, Reinhold L., An Open Door for Singers, 28.

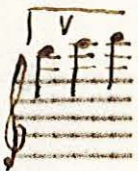
made by some that register action has a close relation to the habitual mechanism employed in speech, Herman cites cases of contraltos with marvelous chest registers who do not use it at all in speech and sopranos who do use such a register in speech. He maintains such apparent discrepancies are due to developments caused by habitual use. The falsetto may be used for certain special effects.

> Only to create certain startling effects of force, of contrast, of echo or of weirdness, the "register" occasionally is used in its unadulterated character.[1]

The falsetto should be trained in the case of the tenor.

> It should be trained in tenor voices, to relieve the voice during practice and for the creation of a perfect "mixed voice."[2]

As have certain others, Herman calls attention to a very light upper production in the female voice.



> The small upper tones marked v in the diagram belong to anomolous voices, or are special property of coloratura singers. Young people often possess these very high notes for awhile, lose them after a few years, when their entire body strengthens its muscular fibre. Moreover, these sounds are'given! The arrangement of their production in the throat is such that you cannot improve or change them much -- scarcely decreases or increases them as a rule.[3]

In other words, such reproduction according to Herman is a gift. It is not the property of all adult female voices. The writer believes this to be a fallacy.

1 Ibid., 38.

2 Ibid., 39.

3 Ibid., 43.

Dunkley offers, generally, a rather bizarre theory of voice training. He works the falsetto very nicely into his theory.

> The term falsetto means a false or artificial voice. It is usually applied to the "head" register of the male voice, but it is applicable to the "head" register of women's voices.
>
> With a majority of singers, "head" register is a delusion; their nasal passage is closed, and there is no resonance in the "head." The characteristic falsetto sound is produced without the help of the nasal cavities; it lacks resonance, and is more of a hoot than singing tone.
>
> In a normal tone, the cords are approximated through their full length; in falsetto only a small part of their length is employed. And correct pitch controlled falsetto, far from being ugly, unresonant and hooty, is a charming resource in passages requiring great delicacy; usable, too, from top to bottom of the voice's range. Of course, it is more serviceable in the female voice, for there is something effeminate in a man's falsetto.[1]

To begin falsetto on a high note the usual preparation for a high note is made, but at the time the tone is initiated the power muscles are relaxed (probably the diaphragm).

> As said before, the lowest notes may be reached in falsetto; but, naturally, there will not be much tone in them. If the student can produce a full-range falsetto, it is proof of mastery of the teachings of this book. The full range falsetto is not obtainable any other way -- except by instruction.[2]

Thus we have quite a great amount of conflicting and agreeing opinion concerning the falsetto. Disagreement is evident in the matter of whether or not falsetto and

[1] Dunkley, Ferdinand, The Buoyant Voice, 66.

[2] Ibid., 66 and 67.

"head" are synonymous. However, Olmstead and Dunkley want no differentiation. Brown, Lawson and Dunkley think the falsetto common to both sexes. Clippinger considers it a male mechanism only. Rowley and Herman want it cultivated at least in the male voice, Clippinger for some tenors. Rogers and Olmstead think the mechanism capable of cultivation; Brown and Herman think this true of the male only. Olmstead, Palmer and Dunkley think the falsetto can be trained down through the whole vocal range. Rogers, Henley, Clippinger, and probably Herman think it the proper soft mechanism of the messa di voce. Brown dissents. Both Brown and Herman consider it the relic of the childhood voice. Rogers thinks it should be cultivated by every male singer; Clippinger and Herman for tenors only. Clippinger, not agreeing with the theory, admits that the falsetto was the "head voice" of the old masters; Rogers thinks not. There is probably no item concerning falsetto on which all of these observers agree. None states specifically in compliance with Stanley that use of the falsetto benefits the voice itself. Brown thinks it might be harmful.

REGISTERS AND RESONANCE

The question of the part differing types of resonance may play in the formation of the registers has been impressed upon the writer. The most venerable terms,

"di petto" and "di testa," chest and head, suggest in themselves possible resonating properties connected with the registers. The terms probably originated in sensations of vibration felt in certain types of production in the chest and in other types of production in the head. From these sensations of vibration, probably felt by numerous persons, it is an easy step to the conclusion resonance for chest tones takes place in the chest and for head tones in the head. Such resonating as this has probably aided and abetted the idea of nasal resonance thought by so many to be concommitant with head tones. The improbability of much actual resonance in either of these anatomical parts has already been discussed; so we see that the terms "head" and "chest" are lacking in validity except in reference to matters of sensation.

To state that ideas of chest or nasal resonance probably lack validity does not mean that resonance could not affect or even cause the register phenomenon. Extensive possibilities still exist in variations in the pharyngeal cavity. The mouth may also be effective in causing a considerable change in the resonating set-up.

Stanley does not think that the origin of the registers is in the resonator. He does, however, think that the laryngeal action which originates the registers cannot work efficiently when the proper resonating conditions do not prevail. The proper resonating conditions, though,

do not necessarily differ for the registers since the quality of voice in each register should prevail. This proper condition should be openness of the pharyngeal resonator.

Homer Henley notes that the high notes of a woman's voice come through best on the "ae" sounds as in "hat."[1] Most writers consider, though, that the common "a" sound is best for the high notes of the female voice. It is probable that numerous vowels are difficult or impossible on the very high notes of the female voice. This may not necessarily be a question of registers, however, but merely that these vowels are outside of the resonance bands of these vowels due to pitch. A curious fact among the register theorists is the differences often observed between the male and female voice in relation to registers. It is not enough to conclude as Blanche Marchesi does of the female voice that "being of another sex their voices work differently." First it is curious that observers note breaks in the scale at about the same actual pitch for all voices, i.e., about 320 d.v./sec. This means that for the soprano the break will be toward the bottom of the range, for the bass near the top, for the contralto near the center. The second difference often noted is that more breaks appear in the female voice than

[1] Henley, Homer, "A New Key to the Head Voice," Etude, May, 1930, 358.

in that of the male. If register changes were due to glottal action, it would seem that these changes would occur more nearly at the same relative position in the compasses of the various voices. Further, it would seem that there is nothing in the female glottis to make it change oftener than the male except its size and the state of her mind. Such phenomena would point to matters of resonance and the vowel in particular.

Aiken and others have observed the pitches of whispered vowels. Other experiments have been conducted to discover the relative frequency band of the different vowels. Further than this, some teachers instruct students to "cover" their tones at these breaking points. Whether such instruction is wise or not is a question, but the writer opines that this covering is often a matter of vowel modification, i.e., changing "ah" to "aw." Aiken may have something of this sort in mind.

> It, therefore, happens that the lowest notes of the resonance scale are brought almost to the middle of the vocal compass, so that the upper octave often coincides with the primary resonance pitches of the vowel sounds in the neck.
>
> It thus becomes clear that a woman's voice is proportionately more deeply resonated than a man's is; therefore, it is more liable to sudden changes in resonation, owing to the greater distance between the reinforced harmonies of the vocal notes.
>
> We, therefore, meet with frequent so-called "breaks" due to this cause, which destroy the even tone of the instrument, and have to be overcome by a careful adjustment of the resonator.[1]

[1] Aiken, W. A., The Voice; An Introduction to Practical Phonology, 114-115.

Acoustically, vowels seem to be produced by concentration of tone energy within a fairly limited band of frequencies. If this bankd is below the pitch of a phonated note, it will be difficult or impossible to form the vowel.

Huey states,

> There has been the statement that the action of the register mechanism of the human voice is concerned with pitch rather than with the quality of tone. In spite of which, experiments based on pitch alone seem to have been practically useless.[1]

However, Huey notes,

> In the formation of pitch alone, on the basis of the hum, with closed lips, there is a scarcely perceptible change in the mechanism when going upward and down the octave. But, when it comes to forming vowel-bearing, or vocalized tone, a marked change takes place.[2]

In other words, Huey's probable point is that register action is not nearly so evident under the fairly constant resonance set-up of the hum as it is when the extra task of vowel formation is thrown upon the voice.

Louis Graveure's attitude toward registers is unknown to the writer, but one pronouncement of his indicates that he might consider registers as produced by differing resonance conditions.

Producing a tone by relaxing the surfaces of the

1 Huey, Luzern Orren, "Registers: Their Cause and Cure," Etude, November, 1935, 674.

2 Ibid.

resonating apparatus makes that sound either breathy or falsetto.[1]

The writer has seen very little material indicating that any experiment of note has been directed at this particular problem. He considers it doubtful that the whole question of registers would be found to be tied up with resonance. Evidence of laryngeal changes have piled up from the time Garcia first saw the glottis to the Bell Laboratories photos indicating for at least two registers, lower and falsetto, fairly significant glottal changes. The latter indicate glottal alterations for the purpose of creating falsetto and tones of low intensity. Yet these glottal changes may not constitute the totality of factors governing register changes. On the other hand, the writer has already noted that the totality of factors concerned in quality, even vowel quality, may not be attributable to the resonator alone. Russell, among others, notes probable laryngeal changes that accompany vowel alterations. Probably there is a great deal of room for further experimentation before adequate solutions to these vocal problems are found. Many singing masters have considered themselves to have heard three to five registers. Even these have not seen in every case glottal changes to account for these changes. If such a

[1] Graveure, Louis, "Louis Graveure Presents New Theories on Vocalism," as told to R.H. Wollstein, Etude, February, 1931, 129.

large number of registers exist, perhaps resonance alterations might account for some of them.

THE LOWER REGISTER

A considerable amount of attention has been given to the falsetto in relation to Stanley's theory, not quite so much to the lower register except as has been with the general condemnation of the process of carrying it too high, a warning of such unanimity as to constitute a "go slow" signal in relation to Stanley's treatment of the heavy mechanism.

Gordon Fory's ideas on the "chest" register will now be briefly covered.[1] Fory may have come somewhat under Stanley's influence, but no evidence of such appears in his terminology, nor is treatment of the heavy register in any sense extreme as Stanley's is. He simply recommends its use.

> Nature has given chest tones as a part of every contralto voice, every mezzo voice, every dramatic soprano, every coloratura and even of a great many pure lyrics. I have rarely known a woman's voice that did not possess chest tones. Why is their use tabu? Men use them. In fact, it is very rare to find a male voice that is not two-thirds chest. Many male voices are entirely chest.
>
> Of course, the wrong use of chest tones is ruinous, to male and female voices alike. But so also is the wrong use of medium and of head tones. One is as dangerous as the other.

[1] Fory, Gordon, "Chest Tones or Not," Etude, December, 1937, 818.

> But why may there not be a right use of chest tones even in female voices? [1]

Fory states that Melba always used the chest tones up to  Fory, to induce the chest voice suggests starting about middle C, working downward in full voice. He does not specifically state sopranos should do this. Nor does he indicate they should not. It should be noted that traditional thought places the bottom note of the soprano at about middle C. Possibly, as does Stanley, he may recognize the potential notes existing in even the soprano down to G or F. He considers this work with the low voice beneficial

> because of the action of the laryngeal muscles it calls for an because the lowest tones use the vocal cords in their entire length, breadth, and thickness. This use of the entire cord is like a good substantial foundation under a wall or chimney.

Stanley thinks lower register practice gives health and strength to the voice.

> The better the voice, the more definite and prominent is the lower register action, and the more necessary does it become. This is the chief reason why no great voice has been heard for an entire generation.
>
> Every contemporary great voice has been eliminated because of this lack of understanding of the register action, and specifically (more than from any other) because of the elimination of the lower register, when it was naturally functioning properly.[1]

[1] Your Voice, 190-191.

THE NO REGISTER SCHOOL

While there have been register schools, there have existed and exist for one reason or another schools that recognize no registers. Several reasons prevail for the non-recognition of registers:

1. The ideal condition of the voice, the even scale and its corollary that recognition of different modes of production leads psychologically to breaks in the voice.
2. The term "register" is not an accurate one.
3. No provision is included in the mechanism for differing types of production.

That there should and can be an even scale is admitted by most of the register advocates. In most cases work with the registers, unlike Stanley's procedures, deals with the transition between them, evening them up an ironing out the breaks. However, there are some who say in effect that since no breaks or unevenness should appear in the finished product, there is no such thing as a register. It is further assumed by these people that those who recognize registers must of necessity teach and encourage them or what is worse teach the uneven scale that is thereby implied. Here is a representative statement of this point of view:

> In a certain school of singing, three different "registers" of the voice, "head," "medium," and "chest" are used. There are definite changes of adjustment of the larynx as well as distinct changes in the primary character of the voice for each register. After using this method, the physical damage done to the vocal instrument is almost irreparable. In a free production, there are no registers. The

> production is the same throughout the entire range of the voice.[1]

Stanley works on the registers separately as few voice men of the day do. Yet Stanley's ideal is not unlike that of others. It is a "co-ordinated" voice with an even scale. However, this condition is seldom reached.

> Complete co-ordination is never attained by the average vocal student. Only the exceptionally talented pupil will ever reach this stage of development and with such a student the problem is relatively straightforward. The most important problem for the teacher is the establishment and maintainance of pure registration and the maintainance of a proper balance between the registers. He must not be obsessed by the idea of eliminating the break in the voice, or he will inevitably do irreparable harm.
>
> When the training process is carried out properly, the break is in no way objectionable. The registers will sonn match really well, and the presence of a break does not interfere with the pupil's artistic and musical performance of the compositions she sings.[2]

Differing theories of voice production have brought to the profession a great jumble of terms. In some ways it might be said that this jumble of terms exceeds the actual disagreement which exists. In any case some of the violent disagreements existing have probably had their origin in understandardized terminology. Some object to the term "register" in that it doesn't present the actual conditions with accuracy. Both Wilcox and Waters, for example, recognize two differing types of vocal mech-

1 Bachner, Louis, Dynamic Singing, 11-12.

2 Your Voice, 194.

anism but do not wish to call them registers. John C. Wilcox terms them "heavy mechanism" and "light mechanism." Crystal Waters calls them "groan voice" and "whine voice."

Some finally actually do not recognize a mechanical change that would account for register changes. Muckey, referred to earlier in this study, states that pitch is changed by alterations in length, weight, and tension of the cords. Since in proper production these three types of alterations go on simultaneously, there are no registers. Of course, in improper production one might act alone or at odds with another. In that case probably register breaks might show up.

The objections of the no register advocates can easily be seen to be for the most part invalid. Some merely want to shut their eyes to a phenomenon that often exists but should not. This is probably not a logical way to eradicate breaks in a voice. Some justification, however, might be found for not purposely trying to make the student register conscious. For the second group of objectors, let us give in and say, "Call them what you will," or, "Let us have better, more accurate names for them." As to the third group, few exist who, like Muckey, have made a thorough investigation of voice physiology. The great preponderance of observers maintain that the changes observable in the glottis do not occur simultane-

ously. Bell Telephone Laboratories finds, in fact, that as the cords are tensing, they are sometimes lengthening as well. Marian Anderson is probably the most celebrated contemporary contralto. According to Rose Heylbut, she states,

> As a matter of fact, there is no such thing as a boundary of range within the complete tonal compass . . . the vocal scale should be completely even and unbroken.
>
> Try to get rid of the habit of charting your voice into separate little islands of range.
>
> Actually there is no such thing as a chest tone. Progressive teaching methods are rooting that curious expression out of the singer's definition of terms; . . . [1]

If one listens to Miss Anderson over the radio, it is a bit difficult to know just what she means. She sings with more breaks in her voice than almost any other eminent singer.

THE SPEECH MEN

Aiken,[2] writing about 1910, offers a brief discussion of what seems to constitute falsetto production. This production seems to be derived from an action of the vocal cords which Aiken terms "compression." Compression seems to involve the traditional idea of shortened vibrating portions of the vocal cords. Aiken is by no means satis-

[1] Marian Anderson in conference with Rose Heylbut, "Some Reflections on Singing," Etude, Oct., 1939, 629.

[2] Aiken, W. A., The Voice: An Introduction to Practical Phonology.

fied with the results of the use of this mechanism.

> That singers who are high sopranos by virtue of compression and not by nature, usually lose the middle notes of their voices can be explained by the bending of the vocal processes and changes in the compressed portions of the cords themselves. A voice which is like two voices, with a rich sound on low notes and a hard shrill sound on high notes, and an uncertain gap in between, is almost certain to be one of these.[1]

If a voice, thinks Aiken, is capable of a very low note, it is impossible to produce a very high note without compression; therefore, a careful estimation of the lowest note in the voice is in order. Much of the beauty of a woman's voice is lost by too high tension.

That compression is comparable to falsetto is evident in that Aiken states that excess compression in the male larynx produces falsetto. In the case of the woman's voice a relief from tension and air pressure is marked, and the sound of the compressed notes becomes smaller than the free notes.

It becomes fairly evident that in Aiken's mind such production is injurious to the vocal mechanism and that high tones should be avoided unless they can be produced without compression. It is not difficult to deduce, then, that Aiken would look on Stanley's falsetto procedures with a considerable amount of doubt.

Other registers, Aiken does not use the term, would

[1] Aiken, The Voice, 104.

seem to prevail at times in the female voice due to resonance difficulties involved in primary resonant pitches of the vowel, a matter already discussed.

Judson and Weaver are of great importance to our study in relation to the activity of the laryngeal musculature.[1]

The matter of sex differences in the vocal mechanism has been discussed before. Most writers have noted little or no differences except in size. Judson and Weaver note what might constitute an additional factor. The vocal folds observed in coronal section result in the conclusion that the male folds are more massive and rounded. Even this seems to the writer a matter of size. Such a condition would be a factor in the general pitch level of the voice. It would not seemingly account in itself for register differences between male and female voices.

Judson and Weaver describe the falsetto substantially as follows:

1. It is not a normal mechanism but knowledge of its production is helpful, by way of contrast, to an understanding on phonation.

2. The more external fibres of the thyro-arytenoids relax.

[1] Judson, Lyman S., and Weaver, Andrew T., Basic Speech and Voice Science, 1933, and Voice Science. The material related to this study included in the 1933 text is largely duplicated in that of 1942. Since the latter probably is derived from the more mature judgment of the authors, it will be used most often as authority. However, material on breath expulsion rates, more fully treated in the first text, will be acquired from the earlier text.

3. The more internal fibres of the thyro-arytenoids contract strongly.

4. Contraction of the posterior crico-arytenoids and crico-thyroids slightly increases the antero-posterior diameter of the glottis. The important muscle group in falsetto, according to Stanley, is the arytenoid group, more specifically the crico-arytenoids. As intensity increases in falsetto production,

> The posterior and lateral crcio-arytenoid muscles increase tension -- holding the arytenoid cartilages firmly against the cricoid cartilage. This holding action at the arytenoid end is the distinguishing action during falsetto-register intensity augmentation . . . The tension at the arytenoid and (holding action) continues to increase throughout the falsetto-register range of intensity -- until it is necessary for the crico-thyroid and thyro-arytenoid muscles to increase tension in order to "hold" and keep the thyroid cartilage supported when the amplitude of the vibrations of the vocal cords is augmented beyond a certain point . . . In other words, the crico-arytenoid muscles must increase tension or else the arytenoid cartilages will "give" resulting in excessive thyro-arytenoid action -- that is shortened vocal cords, and, consequently, a mixed falsetto register.[1]

5. The air pressure blows apart the glottis lips which either remain apart or have a period of closure so rapid that the appearance is of a small elliptical opening in the middle or anterior third of the vocal folds.

> As the pitch is raised the motion becomes somewhat simpler; when the folds become firmer due to muscular tension they move more nearly as a unit . . . The unit of time they remain tightly closed becomes smaller, until in the falsetto, complete closure is usually not attained at all.

[1] Your Voice, 187-189.

6. Because of the elliptical opening there is a constant escape of air. Stanley maintains that in voice production of low intensity escape of air is high in the well-produced voice. Further, Stanley's theory except at the very lowest pitches, would term the correct mechanism for low intensity falsetto.

7. Displacement of the glottis lips appears greater in an upward direction than laterally, the opposite being apparently true in normal production.

8. The edges of the vocal folds are thin.

9. Friction noises are produced as they go past the thin glottic lips.

In summary, we may say that the falsetto apparently is much more dependent on air pressure than upon the increased elasticity of the vocal folds. Because of the constant glottal opening, the mechanism is not an efficient one.[1]

Judson and Weaver think that a rise in pitch may be due to:

1. Increased elasticity of the vocal cords [probably tension]

2. Increase in the trachial air pressure

3. Or both

An increase in intensity may be due to:

1. Decreased cord elasticity

2. Increased trachial air pressure

3. Or both

Stanley's opinion on the pitch changing mechanism is:

The combined coordinated action of all these muscles determines the pitch, which rises as the tension increases and as the length decreases. In good tech-

[1] Voice Science, 73-4.

> nic the maximum length for the given pitch to be produced is employed, while in faulty technic, the vocal cords are unduly shortened.[1]

Stanley thinks intensity due to:

1. The pitch at which a note is produced in a given register
2. The register in which a note is produced
3. The vibrato action
4. The degree of tension on the arytenoid muscles
5. The amount of approximation of the cords
6. Resonance conditions

It is of interest to note that Judson and Weaver consider a rather constant length of the thyro-arytenoid as correct.

> The contraction of the thyro-arytenoid muscle fibres may be offset by other forces so that there is neither shortening or lengthening of the vocal folds. Laryngo-periskop observations tend to point to this as the normal mechanism. This permits the finest type of glottic lip adjustment, because other muscles produce a state of near equilibrium for the thyro-arytenoid muscles so that they need not function to produce gross movement, but may function solely to regulate the degree of tension of the vocal folds.[2]

Stanley strongly maintains that a pull from the arytenoid end is essential if the cords are to maintain their stringing. He points to the crico-arytenoids, lateral and posterior, that must increase in tension as the intensity of the falsetto is increased and hold their maximum tension as the lower register is functioning. If these

[1] Your Voice, 55.

[2] Voice Science, 91.

muscles give, the burden is thrown on the thyro-arytenoids which production would be faulty. Judson and Weaver state,

> Presumably, to raise the pitch of the tone produced at the glottis the thyro-arytenoid muscles would pull the arytenoid cartilages toward the angle of the thyroid, thus tending to relax the vocal folds, if it were not for the automatic adjustment of the antagonistic muscles which increase their degree of contraction to fix the arytenoid cartilages in relation to the thyroid cartilages.[1]

Judson and Weaver also note another action that they say produces actual stretching of the cords from the arytenoid ends. The larynx tends to rise as pitch ascends. Because the esophagus is anchored to the diaphragm it cannot rise as does the freer trachea. The arytenoids are anchored through attachments to the coniculate cartilages to the trachea. Therefore, a rise of the larynx produces a backward pull on the arytenoids assisting in the production of high pitches. Judson and Weaver as well as Stanley discuss breath expulsion rates. Breath expulsion rate in Stanley's theory is connected with intensity and thus with the registers. It may be that Stanley's breath expulsion experiments first led to his registration theory.

The table below represents what Stanley, working with Sheldon, found concerning the rate of breath expul-

[1] Voice Science, 90.

sion in well produced voices.

Expulsion rates in relation to intensity -- Table 1

1. Poorly produced voice
   a. Loud tone uses most air
   b. Medium tone next
   c. Soft tone least

2. Well produced voice
   a. Loud tone second
   b. Medium tone least
   c. Soft tone most

Expulsion rates in relation to pitch -- Table 2

1. Poorly produced voice
   a. Low pitch least
   b. High pitch second
   c. Medium pitch most

2. Well produced voice -- The curve here showed less variation than in the case of the poorly produced voice.
   a. Medium pitch least
   b. Low pitch second
   c. High pitch most [1]

The writer summarizes the characteristic amount of air output for both pitch and intensity in the well produced voice. This analysis gives the following results:

Table 3

1. Least air used by
   a. Medium intensity
   b. Medium pitch

2. Most air used by
   a. Soft tone
   b. High pitch

3. Medium amount of air used by
   a. Low pitch
   b. Loud tone

[1] Stanley and Sheldon, "A Description of New Research on Methods of Determining the Characteristics and Possible Development of Singers' Voices," Scientific American, December, 1924, 381-383.

It was probably easy for Stanley to deduce from these results that high pitches and soft tones have something in common and that there is a common factor in low pitches and loud intensity. This matter will be further discussed later.[1]

The breath expulsion experiments discussed by Judson and Weaver were done by Roudet about 1900. The information came to them through Scripture. Results were as follows:

1. Vowel "a" 144 d.v./sec.

    a. Feeble - 10.6 c.c. air expended per sec.
    b. Medium - 16.4 c.c. per sec.
    c. Strong - 24.1 c.c. per sec.

Results in this case seem to correspond to Stanley's findings concerning the relation of expulsion rates to intensity in the poorly produced voice.

Singing the vowel "e" at 120, 160, 192, and 250 d.v./sec. with intensity constant shows a decrease in air expended with increase of pitch. In this case the results do not correspond either to Stanley's well produced or poorly produced voices. Of course, only one octave is covered in this second experiment, the extremes of the voice being not actually checked.

Variations are noted in expulsion rates for the different vowels and for the first, second, and third second

1 Stanley's experiments should be repeated.

of production of one tone on a given pitch. As the tone progresses, expulsion seems to decrease, the decrease being greater between seconds one and two than between seconds two and three.

West, Kennedy, and Carr, possibly getting their cue from Kenyon, note an interesting phenomenon in relation to pinched throat speakers.

> One of the common faults of outdoor public speakers is to use a "pinched throat" in the attempt to make the voice more "carrying." What apparently takes place in this method of vocalization is that the thyroid cartilage is drawn up under the hyoid bone and, at the same time, the arytenoids are rotated on their facets articulating them with the cricoid cartilage. In this rotation the vocal processes are brought nearer to each other; consequently, the bands are aducted to a tighter contact, and in their movements create greater friction.
>
> The best outward symptom of "pinched throat" (other than the voice itself) is the position of the thyroid with respect to the hyoid bone. In normally relaxed phonation the disposition of these structures is such that the entire thyroid notch (V-shaped juncture of the right and left laminae of the thyroid cartilage) is exposed to palpitation inferior to the lower border of the hyoid bone; that is, one may palpitate the edges of each lamina of the thyroid from this juncture upward and outward to the level at which the edges turn backward away from the surface and hence cannot be followed by the exploring fingertip. In the "pinched throat" these laminae cannot be traced to the point where their edges turn, for this point is obscured by the hyoid bone. There is thus created in tense phonation a triangular indenture, the upper side being formed by the lower edge of the hyoid bone, the angle opposite to this side being at the laryngeal prominence, and the two sides enclosing this angle being the inner borders of the thyroid notch. In some cases the thyroid cartilage is so sharply elevated as to shorten this triangle in its vertical dimensions to a mere point; and in still other cases the laryngeal prominence is completely obscured behind the hyoid bone . . .

> The patient should be asked to speak as though before his audience, and the examiner should determine with the tip of his finger how much this triangle is shortened from top to bottom. If there is a marked shortening, it should be called to the patient's attention, and he should be asked to notice that with a relaxed voice, the triangle remains distended. He should be encouraged to practice vocalization, holding his fingertip in the thyroid notch, until he develops the kinesthetic and auditory imagery that will enable him to determine whether he is using the "pinched throat" or a properly relaxed one.[1]

Stanley notes what may be a similar condition which he terms "permanent muscular mixed registration."

> In cases of permanent muscular mixed registration the thyroid cartilage is rotated upward to meet the hyoid bone, so that the space between the thyroid cartilage and the hyoid bone is nearly or completely closed. This condition may be felt by inserting the index fingers between the hyoid bone and the thyroid cartilage. It indicates an extremely bad technic and a poor quality voice.
>
> The individual who does not sing, but who employs a mixed register technic for his speaking voice, is often found to exhibit this physical manifestation of mixed registration. A speaking voice of this type is of a most umpleasant, harsh, throaty quality and it fatigues rapidly.[2]

Stanley works on this condition with a digital manipulation whereby he claims to separate the hyoid bone from the thyroid cartilage and at the same time induce a pure lower register by pressing down the thyroid cartilage. This downward pressure, he thinks, stimulates lower register action by stimulating the crico-thyroids to greater activity.

[1] West, Kennedy and Carr, The Rehabilitation of Speech, 90.

[2] Your Voice, 20.

It should be recalled that Blanche Marchesi mentions some kind of manipulation (not described) to treat what seemingly was a eunuchoid voice of an otherwise normal male.

Temple called attention to a more extreme range of voice than do most authorities.

> The voice is usually capable of producing a range of about three octaves, including tones at the extreme end of the range which are not musically acceptable . . . In expressing several different emotions, a good reader may display a range of over three octaves.[1]

Stanley repeatedly calls attention to a range potential of three octaves or better, a point upon which the writer agrees.

Stanley and others have considered the training of certain of the muscles of phonation a matter of great importance as for example training of the muscles activating the two registers. It is not specifically stated by Stanley that the muscles actually develop by changing in size or strengthening. It can be assumed, however, that Stanley does mean that the muscles activating the falsetto are at least strengthened. Anderson of Stanford makes an interesting comment on this matter.

> So far as voice training is concerned . . . The improvement in voice resulting therefrom is almost wholly neuro-muscular . . . in other words, a matter of habit. No structural changes are wrought in the larynx as a result of vocal training; there is

[1] Wise, McBurney, Strother, Mallory and Temple, Foundations of Speech, edited by J. M. O'Neill, 121.

> any change in size or shape . . . This view is expressed by the eminent English biologist and surgeon, V. V. Negus, who states, "You cannot tell, by any anatomical means, the larynx of a prima donna from that of a woman who had a voice like a raven."[1]

A BIZARRE THEORY

Madame Barbereux-Parry calls attention to a place in the top of the skull as a chief resonating point for the voice.[2] However, on possibly more solid ground she notes pitches in children's voices in the high C octave and thinks such singing as they do should be very high pitched. This very high voice can be preserved into maturity if it is given proper attention and even recovered though it has never been used. This "upper quality" may in maturity be combined with the mature lower quality. Use of both qualities gives the voice a ringing carrying power and a rich fullness. Upper quality in the voice adds to the ease of production.

It is possible that what Madame Parry has observed is actually Stanley's falsetto and lower register. She likewise calls attention to a comparatively great range potential.

1 Anderson, Virgil A., Training the Speaking Voice, 50.

2 Madame Barbereux-Parry, Vocal Limitation and Its Elimination, 29.

BELL TELEPHONE LABORATORIES RAPID MOTION PICTURES[1]

This study has been referred to from time to time throughout this study. On the whole, it probably represents the utmost achieved in studies of the activities of the live human glottis. The throat instrument used was the common laryngoscope mirror jutting out horizontally from a fixed position. The subject whose cords are to be observed sits facing the mirror in close proximity. As the test is made he opens his mouth wide and by merely leaning forward absorbs the mirror and stem in sword-swallowing fashion.

Through the use of a camera the film of which moves constantly instead of intermittently and a rotating cube of optical glass rotating in synchronization with the film, a total of 4000 pictures per second was achieved. Therefore, of cords vibrating at 128 d.v./sec., about 32 pictures of each vibration could be made. In projection of the image, so photographed, at 16 pictures per second, one complete cord cycle would be seen on the screen in about two seconds. At middle C, 256 d.v./sec. one complete cycle would be viewed in about

[1] Bell Telephone Laboratories Monograph on "High Speed Motion Pictures of the Human Vocal Cords;" work carried on by Dr. J.C. Steinberg of the Laboratories staff in cooperation with D.W. Farnsworth and H. J. Smith.

one second. This technique is obviously superior to that produced through the use of stroboscopic illumination by which glottal motion pictures had before been obtained.

However, excellent as the study is, certain imperfections are at once apparent in relation to the fact that the laryngoscope is still the image reflector. This sets definite limits on the study of the cords in relation to vowel modification. There is no assurance, even with considerable practice on the part of the subject, that the glottis is working normally with such an obstruction as a laryngeal mirror in the throat. Through practice the subject may learn to produce tones that accommodate a laryngeal mirror rather than learning to produce natural tones under the unhappy hindrances of the experimental conditions. However, may it be said that the experimentors think not.

> After a certain period the subjects readily adapted themselves and felt entirely at ease and comfortable and could produce a sound as well as they could under any conditions.[1]

As to matters of intensity variation, thought by some to be very limited in laryngoscopy, the problems seem to have been overcome and pictures of both high and low intensities caught.

The greatest admitted weakness of the study is a paucity of trained voices used.

[1] Bell Laboratories Monograph, 11.

> It was impossible for subjects recruited from outside of the Laboratories to devote this much time so that what pictures of trained voices were obtained represent a comparatively hasty effort in this respect.
>
> Thus the pictures of trained voices obtained are not as satisfactory from the photographic standpoint. It has been possible, however, by careful and detailed examination of the films to draw certain conclusions which may or may not be evident in the picture as projected.[1]

This is in direct contrast to the weakness of Mackenzie's study which involved singers only, mostly trained; if not trained, they were "natural singers."

The matters taken into consideration in the Bell Laboratories study are:

1. Changes due to pitch variation
2. Changes due to intensity variation
3. Changes between subjects, including trained and untrained voices
4. Reaction of vocal cavities on cord movement

> The vibration rate, which corresponds to the pitch of the voice, depends principally upon their tension.[2]

Corresponding to pitch rise, however, in certain circumstances, is a lengthening of the cords.

> Nevertheless, for untrained subjects intoning a sound at moderate intensity it is obvious from the film that the length /underscore the writer's/ and tension of the cords did increase considerably as the pitch or vibration rate increased.[3]

1 Bell Laboratories Monograph, 11.

2 Ibid., 7.

3 Ibid., 8.

The length of the cords when vibrating at 120 cycles is about one-half inch (for the subjects studied). . . . At 300 cycles their length has increased to nearly three quarters of an inch.[1] Lengthening, one would think, would tend to produce the effect of lowering the pitch. Therefore, it might seem in the case of untrained subjects that quite a great amount of tension is required for the pitch rise. Further, lengthening of the cords would indicate that the tension of the cords is being created by the end pulls which exceed in the weight of their pull that of the thyro-arytenoid which is antagonistic to them. This would be a condition somewhat out of harmony with Stanley's idea of mixed registration which one might expect to find in voices of this kind, namely untrained voices. Exercising the registers separately in Stanley's system is designed in great part to make the crico-thyroids, and the muscles in the arytenoid group of sufficient strength to withstand their antagonist, the thyro-arytenoid .

> However, changes in intensity also call for different cords tensions so that under certain conditions the pitch of the voicing might increase with little change in length of the cords.[2]

Complex motion seems to characterize the cords at low pitches becoming less so as pitch is raised till at

1 Ibid., 9.

2 Ibid., 8.

high pitches only the edges are seen to vibrate.

> Vibration also tends to be confined more and more toward the forward portion of the vocal cords. This confined motion is known as the falsetto mechanism.[1]

At low pitches on cord closure a ripple is seen to pass over the top surface from the glottis toward the laryngeal walls, as the edges come firmly together. This may have been something like Oertel, Imbert, and Curtis observed as the cords vibrating in segments laterally. However, it should be remembered, also, that these earlier observers considered complexity of vibration characteristic of higher pitches, not the lower.

In general the motion of the cords at low pitches is one of opening and closing. In the open phase a puff of air is emitted. During the closed phase it is probable that pressure is rising below the glottis in preparation for forcing the cords apart to create another open cycle. At low pitches the closed phase may last as long as half the cycle. As pitch rises,

> The length of time they remain tightly closed becomes smaller, until in the falsetto, complete closure is usually not attained at all.[2]

Finally in relation to pitch changes there are alterations in the width of the open phase. At low pitches the width of the opening may be four millimeters

1 Ibid., 8.

2 Ibid., 9.

the width of the opening at high pitches being about two millimeters. Heretofore, the greater width of opening was usually assigned to the higher pitches. This was probably a natural conclusion since the opening width in low pitch production probably would not show in a simple laryngoscopic examination, while the increased length of the opening phase as the pitch is raised would indicate greater opening in simple laryngoscopy.

Next to be considered are glottic alterations due to intensity changes.

> At low intensities the cords are seen to remain open throughout the greater portion or, in some cases, all of the vibration cycle. As the intensity is increased on a given pitch, the closure time becomes greater, up to half or more of the vibration period. This closure is seen to be a vigorous action so that in some cases one may observe a compressional wave traveling from the edge toward the base of the cords. The cords when vibrating at high intensity do not show as great a change in length with pitch variation as at low intensity. In other words the cord length at higher pitches for a high-intensity sound was somewhat less than for a low intensity sound. The maximum opening or displacement increases with increasing intensity, but by no means proportionally. It may well be to point out that the low volume here referred to was actually an extremely low level of sound, about the minimum that the subject could easily produce. High volume on the other hand was about the maximum he could produce. Since the voices were untrained, neither limit was so great as that which a trained voice might yield.[1]

Now if the material so far presented on glottal behavior in both pitch and intensity changes is considered a good number of the salient factors can be so combined

[1] Bell Laboratories Monograph, 9.

as to make a fairly good case for Stanley's register theory:

1. The laryngeal mechanisms for low intensities and falsetto production are very similar, in each the period of cloruse being very brief or absent.

2. The laryngeal mechanism for low pitch and high intensity are similar, both exhibiting closure periods of up to half the elapsed time of a vibration cycle.

3. The maximum cord displacement is to be observed at high intensity and at low pitch.

In short, falsetto and soft production show similar mechanism; low pitches and high intensities show similar mechanisms. Stanley identifies soft production with falsetto as one register. He identifies high intensities and low pitches as the lower register. One can maintain pure falsetto at relatively low pitches only on soft production. One can maintain lower register production at relatively high pitches only if the sound is intense. These conditions prevail in the case of the well produced voice. But the case weakens when it is remembered that the experimental results so far described were obtained by using subjects with untrained and, therefore, probably poorly produced voices.

What differences appear when trained voices are used? It should be remembered that the study is admittedly weak in the use of few trained subjects upon which an inferior grade of photography was obtained. There is also a question of definition involved. Were the trained

voices "well produced?" Would they have met the test of the "well produced" voice in Stanley's breath expulsion studies? Would others have considered Stanley's subjects well trained? These questions must always be involved in such comparisons as are being made.

> In the production of a falsetto or of a low intensity sound, no significant differences were noticed. At high intensities, however, two important differences appear. First, the closure time per cycle of cords movement is greater than for untrained voices and second, the displacement or amplitude of cord vibration is smaller than for the untrained voice in the production of a sound of similar intensity. These two actions may both be explained by the ability of the possessor of the trained voices to exercise better muscular control while producing such tones.[1]

In general this difference is explained in the monograph as a more efficient production in the case of the trained voice. A longer period of glottal closure permits a greater amount of pressure to build beneath the glottis. A narrower aperature on the opening cycle permits less air to escape and, therefore, less loss of pressure. In other words, a given amount of extension in the opening cycle for the well produced voice will produce more sound than a similar oscillation in the case of the untrained voice.

Little injury seems to be done to Stanley's theory by the comparison of the untrained voice with the trained. Stanley's curves of breath expulsion indicate that less

[1] Bell Laboratories Monograph, 11-12.

breath is used on a forte tone by the well produced voice than the poorly produced voice.[1] At low intensities an extreme amount of breath is used in correct production. The almost constant opening in falsetto or low intensity may account for this. But in the poorly produced voice a small amount of air is used at low intensity. Then why was there little difference observed in falsetto and low intensity between the trained and untrained voices?

Stanley may suggest the answer,

> In mixed registration this control of intensity becomes a function of the laryngeal pharynx and of the tension which is already on these constrictor muscles, increases, so that the softening of the tone is actually accomplished by the progressive constriction of the throat. At the same time the breath expulsion diminishes -- thus, the intensity is proportional to the rate of expulsion of the breath. When the technic is correct, the breath expulsion of the breath drops as the intensity rises from pianissimo to mezzo forte. It is at its maximum at pianissimo and at its minimum at mezzo forte (the normal loudness of a full free tone).[2]

Now if enough constriction were present in the laryngeal pharynx to control breath at low intensity, it would seem that the pharyngeal action would have to be so drastic as to conceal completely the glottis from the view of the laryngeal mirror. If what Stanley says on this matter be true, low intensity production conditions

1 Your Voice, 96-7. The results of Stanley's original experiments on breath expulsion were discussed in connection with Judson and Weaver.

2 Ibid., 95-6.

in both trained and untrained subjects must have been correct, if we assume that the rather constant opening of the glottis falsetto production will use a large amount of air.

Although there is much having bearing on our question of study in the Bell Laboratories experiment, they are very incomplete from another point of view. No mention is made of the use of female subjects. Though there may be a tendency in support of Stanley's ideas in the case of the male subject, no data on the female voice is evident.

Earlier in this study the possibility of resonance being in part or wholly the cause of the register phenomenon was discussed. Though most opinion points to the glottis in this matter, Curtis emphasized resonance as a contributing cause and Aiken suggested the idea the vowel resonance bands might account for breaks in the female voice. The Bell experiments on the effect of resonance on cord action will not be discussed. Only the conclusions will be recorded.

> The evidence obtained by these two experiments is that modification of the vocal resonances which ordinarily occur in the production of the various voiced sounds cause little or no reaction of the vocal cords. This implies then, that the various speech sounds are produced by changes in these resonances as has previously been suggested.
>
> On the other hand, changes in the voice quality "timbre" (i.e., the energy distribution with frequency) must be attributed to vocal cords function. During the vocal cords photography a

> microphone was placed near the mouth. Analysis of the sounds thus picked up and recorded on film in the form of a variable area "sound track," show large differences in quality with intensity change, and to some extent with pitch change.[1]

THE STANLEY SCHOOL

Those whom the writer classifies as belonging to the Stanley School would perhaps object to such a classification. The writer places them there only because directly or indirectly they have been influenced by Stanley's doctrine. This does not mean that they adhere to all the principles he teaches. Nor does that mean that Stanley would accept them as representative. Stanley, in a letter to the author indicates in no uncertain terms that he would not.

First among these representatives is Wilcox.[2]

> In the first edition of this book the author included a chapter under the caption, "Registers," quoting the theory of Douglas Stanley and retaining his terminology of "lower register" and "falsetto register." A certain amount of confusion and misunderstanding has been noted among readers who could not easily dissociate the term "register" from its traditional meaning (a specific span of the vocal range) and who could not accept "falsetto" as applied to the female voice. In order to save readers of

[1] Bell Laboratories Monograph, 14-15.

[2] In a note to the writer G. Oscar Russell states concerning Wilcox . . . "But I have long known Wilcox. He would have made a fine scientist just as he has a voice teacher. For he keeps an open mind and is painstaking."

> this revised edition from such confusion, the term "register" will be discarded and "falsetto" will be used only with reference to the male voice. "Light Mechanism" and "Heavy Mechanism" will be employed instead of "Falsetto" and "Lower Register." [1]

Wilcox probably offers here a rather significant contribution to a clearer understanding of Stanley's idea, especially for those who had once entertained the idea that "registers" were largely a question of pitch ranges. Dr. Ray Crittenden, thinking the terms still more accurately descriptive, uses the terms "arytenoid adjustment" and "cricoid adjustment." Crystal Waters, using terms describing the mechanisms from the auditory point of view, calls them "groan" and "whine" voices, drawing her analogy from the sounds of various numbers of the animal kingdom or sometimes "robust voice" and "thin voice." The writer is dissatisfied with the elimination of the term "falsetto," from the terminology in the case of the female voice. In his mind "falsetto" gives the most accurate picture. However, the term may be highly confusing to many. The matter of terminology was discussed in relation to the "No Register School."

Wilcox further states that to sense the significance of the new terminology "The reader should understand that it is based upon the following factual empirical /underscore the writer's/ theory:

[1] The Living Voice, 1945 ed., 9.

1. Two sets of laryngeal muscles function in stretching and holding the cords in tension:

   a. The crico-thyroid group (heavy mechanism)
   b. The arytenoid group (light mechanism)

2. The first group being stronger function in the production of :

   a. Low pitches
   b. Loud intensities

3. Muscles of the second group arytenoid, being of lighter texture, function as tensors when the tones are of

   a. High pitch
   b. Soft intensity

4. The terms used bear no fixed relation to pitch range, but merely designate certain adjustments of the muscular mechanism.

In actual singing no conscious attempt should be made to manage the mechanism.

> Once the process of voice training has been carried to a point where both groups of muscles under discussion are equally developed, they will automatically co-ordinate so that each group will do its respective part in producing tones of varying pitch, intensity and quality. It is usually necessary, however, to guide the participation of these respective muscle-groups consciously in exercises designed for developing the voice.[1]

This material seems to fairly well express Stanley's earlier views on the co-ordination of the registers. In his latest text, Your Voice, 1945, however, he seems to have revised his opinions somewhat. First, he now considers complete co-ordination of the two vocal mechanisms unlikely for most voices, it being accomplished at such

[1] The Living Voice, 10.

an advanced stage of development that few attain it, only certain of the great voices. Secondly, he considers then, that in the period of training training the registers should remain separate even during the interpretation of song literature. In singing the pitch at which one register will give place to another depends on the degree of training and the intensity being sung. This presupposes a certain amount of break in the voice.

If the voice is to its full power, range and efficiency, the heavy mechanism must be carried through the lower pitches up into the middle range.

> Indeed, the lack of such development is undoubtedly responsible for the almost universal weakness in tones of medium and low range among soprano voices; for the equivalent weakness in many tenor voices, for the "hollow" and weak middle-range tones in almost all contralto voices (particularly when past the period of youth) and for the lack of vital intensity in voices of all types which have failed to realize their natural inherent power."[1]

Basses and baritones, on the other hand, usually begin with this heavy mechanism well developed, employing it habitually in the speaking voice.

Wilcox stresses the vast importance of a "deeply opened" throat, in conjunction with heavy mechanism practice.

> The ability of the vocalist to make a powerful tone in the low pitch and to carry it upward through the medium range without harmful strain or "breaks" will be determined by his or her success in

[1] The Living Voice, 10.

> keeping the lower throat "deeply open." Keeping the throat "deeply open" can probably be considered a resonance function in connection with this mechanism. However, the deeply opened throat would probably be considered relatively correct for all phonation.[1]

The writer interprets that this throat condition in the minds of Stanley and Wilcox is a concomitant of good laryngeal behavior, not a cause of register action. However, breaks that some term register phenomena could be caused by faulty resonance conditions. The writer has earlier suggested that care should be used in taking the term "open throat" too literally.

This general theory that the two mechanisms are used alternately in relation to intensity rather than to pitch fairly well eliminates the idea of a definite pitch limitation for the heavy mechanism. But for those who retain the idea of pitch governed registers, carrying the heavy mechanism up through the middle voice will still be objectionable. However, Wilcox thinks no harm can come if the throat remains freely open.

Wilcox offers a strong challenge to traditional thought on questions of both range and dynamics. The female voice should attain a vocalizing range of at least three octaves. The male voice should master considerably more than two octaves, the male three octaves being attainable if the falsetto is added.

[1] The Living Voice, 11.

> The author has tested the voices of hundreds of girls of high school age, none of them having had any individual voice training, and fully ninety percent of them were able to vocalize immediately throughout a range of approximately three octaves, without undue effort or any evidence of physical strain, once the proper procedure was indicated to them.[1]

The writer attests from his own experience that Wilcox is approximately correct in this statement.

To those voices of sweet tone having insufficient power to be heard in large surroundings the name "parlor voice" has often been given. Wilcox says,

> I have no hesitation in stating that there is practically no such thing as a small voice -- small in the sense that it cannot be developed into sufficient power to adequately fill any average auditorium where public gatherings are held.[2]

Traditional thought has often greatly confined voices by requiring students to vocalize softly, never letting their voices come out. Mezzo forte, thinks Wilcox, where voices work with maximum efficiency is the best intensity for practice.

> The mechanical device which revealed indisputable evidence to the scientists in the research laboratories established the reasonable fact that the extensor muscles which must resist the interfering pull of the constrictor muscles in order to keep the throat open during phonation are put under much greater stress when a soft (low intensity) tone is being sustained than when the power is greater because energy (tonus) of the throat

[1] The Living Voice, 12.

[2] Ibid.

> extensor muscles is not as greatly stimulated in soft singing as in reasonably vigorous singing.[1]

Soft singing is one of the last things to be practiced and when technical development is sufficiently along to make soft practice desirable, pianissimo no longer needs a great deal of practice. Wilcox does not reveal the scientific source of this information, but the writer expects it is Stanley. Stanley, unfortunately, is often meager in his descriptions of the manner in which his conclusions are derived. Yet, the theory seems not totally unreasonable.

If Stanley's theory as it appeared in 1929 [2] and the theory in Wilcox's text are compared, little difference seems to be found as to actual views concerning vocal registration. However, between theory and actual interpretation of tone qualities suitable to the registers or mechanisms there may be a wide gulf. Wilcox, in a letter to the writer states,

> In my considered judgment, Stanley himself is unduly radical in (1st) including too heavy a tone in the low range and (2nd) forcing that too-heavy tonus upward.[2]

This opinion is based upon my auditions of some of his

[1] Science of Voice, 1929.

[2] Crystal Waters in a letter to the writer states: "Glancing through the Wilcox, The Living Voice, again, it seems to me his statements are very good . . .
"Stanley makes his students sing the robust voice /Stanley's 'lower register' and Wilcox's 'heavy mechanism'/ up to high C. His students' voices sound stiff, rigid, hard, cold."

> advanced pupils as he was teaching them in his own New York studio (pupils whom he had himself selected to demonstrate to me the results of his training) and, subsequently, upon my observation of the vocal habits of four different persons who came to me for instruction after considerable periods of study with Stanley. Each of the four could produce tremendously powerful tones in the lower ranges and not one had free tones in the upper range or could sing a well-graduated scale from low to high pitch, or vice versa.

In conversation with the writer Wilcox inferred concerning Stanley's pupils whom he heard, "I would have been ashamed of them had they been mine." Stanley in a letter to the writer states:

> The most utterly ridiculous idea you have propounded is that you should study my procedures with Mr. Wilcox. This gentleman has never taken a lesson with me in his life.[1] His work constitutes a direct denial of the basic consepts embodied in my teachings. I have heard some of his ex-pupils. They all have employed a white, infinitely throaty, mixed, shouted lower register, which they do not use in performance; and a mixed squeak-voice sung in absolute constriction and carried up very high. In other words he has merely deduced the fact that high throaty tones -- neck whistles[2] -- may be derived from extremely throaty, high lower register tones. The vital principle underlying my work is that only the most open, free, unconstricted tones should be sung. Squeak tones should never be employed. Throaty, high tones are without virtue and are actually harmful in the extreme to the vocal apparatus.

From these rather hearty condemnations of each other's work, among other things, the deduction can easily be drawn that, though on paper the theories may be similar,

[1] Wilcox says he paid ten dollars to listen to Stanley's pupils.

[2] Constricted falsetto tones.

some considerable differences must come into play in the practices of the two men with regard to what is termed the right kind of tone to employ in exercising the vocal mechanism.

Crystal Waters seems to be in essential disagreement with Wilcox.[1] However, a description of her analogies may assist the reader to clearer understanding. In the use of the "groan" and "whine" tones natural in the voice, the process of building and co-ordination can be compared with building a suspension bridge across a river. Construction begins on both sides of the river; the construction of the voice, likewise, begins with each crude end, the heavy voice and the light one that may seem far apart at first. However, as each end of the bridge is built toward each other to meet in the center. In vocal training not only do these two voices meet but each is extended considerably past the point of meeting till they greatly overlap each other in exercise. When a great amount of overlapping has been achieved, these mechanisms will co-ordinate to produce one unified voice. It should be recognized that in the case of the suspension bridge the weight of the center is supported by the pillar on the north and the pillar on the south.

1 Waters, Crystal, "Bridging the Voice," Etude, July, 1942, 449. "The Most Rapid Way to Improve Your Voice," Etude, March, 1940, 155-6.

In the center of the vocal range the two mechanisms are about equally in control given a tone of moderate intensity. In the suspension bridge the north pillar is supporting most of the weight of the north part of the bridge but not all of it; the south pillar is supporting most of the weight of the south portion but not all of it. The north pillar helps to support the south side; the south pillar helps to support the north side. How much support each pillar gives to a portion of the bridge will depend on the distance of that portion from the pillar. But no matter how far, it will carry some of the weight. In the co-ordinated voice each mechanism will always be somewhat active. How active a given mechanism will be depends on the place on the scale and the weight or intensity of the note.

Miss Waters seems to be in some disagreement with Wilcox on the probablility of an extensive break between the mechanism in the case of the untrained voice, but this is not a disagreement on principle. Miss Waters does not place as much stress as Wilcox on the use of the mechanisms being governed by intensity, but this is more or less inferred by the terminology given to the mechanism.

Miss Waters gives a brief indication as to the probable glottal mechanisms of the two voices.

Thick edges vibrate to produce the robust voice,

and thin edges to produce the thin voice.[1]

As Wilcox and Stanley, she stresses the necessity of throat opening, suggesting the use of the yawn, while Wilcox thinks throat extension is achieved through the intake of breath. There may be no essential difference here, as part of the yawn involves a deep intake of air combined with a low larynx position which Wilcox recommends.[2]

As in the case of Wilcox's doctrine, Stanley's theory has obviously had great influence on that of Crystal Waters.

Hopkins, not primarily a voice teacher, has composed a small text for the purpose of helping actors get their voices out so that they may be easily heard.[3] He discusses singing and registers briefly apparently not for offering actual instruction in either of these but merely to clear the air of misconceptions and guide aspirants to seek instructors who offer training based on fact rather than fiction.

His material on registers appears to have come from

[1] "Bridging the Voice," Etude, July, 1942, 449.

[2] The yawn may be objectionable in that it could set up undesirable tensions. Numerous writers praise it; others oppose it as a means of securing throat extension.

[3] Hopkins, Edwin, Secrets of Voice Production Self-Taught, "Edwin Hopkins, Twenty Practical Exercises to Improve Your Voice," Etude, April, 1943, 235-6.

someone familiar with Stanley's procedures. Some of the ideas suggested seem comparable to Stanley's newer ideas, published in Your Voice, 1945. This being three years later than Hpokins' publication would possibly indicate contact with Stanley or with one familiar with his later procedures. The writer sees no reason to review Hopkins' description of the register theory except where he has added his own explanation of phenomena or deals with obscure points in Stanley's doctrine.

> My explanation of registers is that in the narrow register the outer edges of the vocal cords or lips do the vibrating, the vibration not engaging the full width of the lips, at right angles to their lengths. In the broad registers the whole widths and depths of the lips, away from the glottis, do the vibrating; that is pop up and down, popped up by air pressure from the windpipe and pulled back down, as a whole, by the stronger crico-thyroid muscles.[1]

This action is as if the fingers wagged for the narrow register, the whole hand with the fingers locked wagging in the broad register.

Stanley's idea of "mixed registration," that serious vocal fault, occurs when both the edges and the whole vocal cord are "popping up and down" simultaneously. However, the two mechanisms are not vibrating in phase. This action is as if the hand were flapping from the wrist while the fingers are flapping separately forming a kind of figure "s" movement.

1 Secrets of Voice Production, 78.

> This double action makes the pitch uncertain, the loudness wobbly and the tone in general throaty.[1]

The writer has found in Stanley's work descriptions of the way various laryngeal muscles act in "mixed registration," but no explanation like Hopkins' of the possible behavior of the cords themselves.

It is problematical whether or not Neubauer should be classified under the Stanley school.[2] The terms used in his writing suggest no direct Stanley influence. His ideas concerning the lower register vary considerably from Stanley's. Writing in 1937, however, would make possible an acquaintance, direct or indirect, with Stanley's doctrine. Further, his theories on falsetto so resemble certain of those of the Stanley school that the writer, lacking information as to the genesis of Neubauer's theories, is reluctant to credit him with having arrived at his conclusions independently. The opposite conclusion would tend to contribute more weight toward the validity of Stanley's conclusion on falsetto, and it is not at all difficult to derive that conclusion.

> The old Italian masters recognized no difference between falsetto and head voice. There is no difference in the larynx; and as Caruso once stated, "Falsetto is merely a state of development." When weak, it is called falsetto and when well-developed, head voice. It would be better to drop the term falsetto entirely and to use the term head voice for that part of the voice above the break in both the

1 Ibid., 78

2 Neubauer, E.J.,"Turning the Falsetto to Account," Etude, September, 1937, 602.

> male and female organs. What students and teachers term head voice is really mixed voice, a voice composed partly of chest voice and partly of falsetto or head voice.[1]

Thus the primary problem in sound voice culture is to prescribe exercise best designed to achieve smooth transition from register to register. Fucito, who claims to have been Caruso's accompanist and coach for a number of years, states concerning the development of Caruso's falsetto voice:

> Even his falsetto tones, which he seldom used /in performance, practice or both?/ were supported by sufficient breath, which gave them body and made them sound like mezza voce tones. Here was another contribution to the remarkable homogeneity of his entire range.[2]

In those voices with the most pronounced break some overlapping can yet be observed. Rather than attempt to develop the head voice by vowels conducive to it, "a very inefficient method," it is much better to develop the head or falsetto as far into the chest as possible. This falsetto development must be low in the voice rather than high. Thus a great portion of the vocal compass becomes mixed voice in which the head voice predominates in a considerable area.

To achieve this large amount of mixed voice, the chest voice should be let entirely alone for a considerable period during which the falsetto is diligently

[1] Ibid.

[2] Fucito, Salvatore, Caruso and the Art of Singing.

exercised up to as much as an hour a day.

> As the falsetto or head register gains in strength, marked changes in his voice will be noticed, due to the increase of the mixed voice. The load will be felt to be gradually taken off the notes up to the break, along with a marked difference in quality. The harshness of the chest voice will disappear, and in its stead the notes will become resonant and velvety, floating on the breath . . . The student will realize that he not only has begun to get rid of his break, but also that he is adding a whole series of notes to his voice . . . [1]

The continued use of a chesty speaking voice, however, will delay this progress.

Neubauer maintains that this was the method of the old masters.

> It is certain that the Old Italian Masters recognized only two registers in male and female voices, calling the lower the chest, and the upper, the head register. They made no distinction between falsetto or head voice in male voices. They treated both male and female voices according to the same general principles. They knew that over carrying of a register up, whether it be head (falsetto) or chest, but particularly the latter, would tear a voice to pieces. They would not tolerate much of the present day forcing up of the chest register and never ignored the falsetto in the male voice.[2]

Neubauer assigns a more radical course to the old masters than do most. Best evidence seems to point to their belief in two registers. They often called one of them falsetto. It is not easy to know just what was involved in this term. Neubauer's assumption that they exercised the falsetto downward into the area of the "chest"

1 Ibid.

2 Ibid.

register is perhaps no more illogical than are the various other opinions held. He would seem to agree with Stanley in this. Neubauer, in the matter of the lower register, seems very much opposed to Stanley.

Bartholomew of the Peabody Conservatory of Music has composed an excellent little treatise on modern vocal research upon which the writer has leaned heavily at times. In it he devotes a small section to Stanley's work which though it doesn't deal exclusively with registers will be quoted in full:

> In this country, Stanley has investigated the singing voice. His work, although containing many of the characteristics of "method" books, nevertheless, presents valuable material. Among other matters, he discusses registers, breath expulsion, the nature of the vibrato, and the importance of an enlarged throat as the chief resonator of the properly produced voice. He states that the mouth resonance has little effect on properly produced vowel quality, since, when the technique is correct, the jaw, lips, and cheeks can be moved to a large extent without altering the tone quality or vowel purity. The importance of an enlarged throat has been realized and stated by many investigators and teachers prior to Stanley but perhaps not in as emphatic a manner nor with the various supporting arguments presented by him and other recent students. A similar investigation has been under way at the Peabody Conservatory of Music, where we used a high quality oscillograph in a study of the voices of many singers and have established again the paramount influence of the vibrato on tone quality. We found a substantial variation of the overtone timbre in the vibrato cycle, confirming Rothschild's work, and have defined two formant regions characteristic of the properly produced male voice. The first of these centers is around 450-650, or roughly around the C above middle C, confirming Kasansky and Reschevkin, and Stanley's "pharyngeal resonance.[1]

[1] Ibid., 118-119.

Bartholomew's description of the laryngeal mechanisms would tend to indicate that he had observed the Bell Telephone Laboratories rapid motion picture studies or their accompanying monograph. The writer does not know whether or not the Bell experiments were complete by 1937. The monograph is not mentioned in Bartholomew's rather extensive bibliography. Bartholomew describes two register mechanisms:

A. Usually termed the "chest register"

1. Cords are relatively thick.
2. Vibration acts as a "pair of cushions."

a. First forced apart by air pressure, letting an explosive puff through.
b. Tension pulls cords together as pressure builds to force them apart again.

3. Open stage may be only a fraction of the vibration cycle.

B. Usually termed the "head register".

1. Cords thinned and stretched.
2. Probably only the edges vibrate rather than whole cord.
3. Glottis probably somewhat open during whole cycle vibrating more or less as bowed strings, the air corresponding to the bow.

The precise muscular mechanism for the two types of cord vibration is not "settled." However, whatever the mechanisms are, they frequently act simultaneously. It is probable that in each register pitch rise is accomplished by stretching action caused by tilting forward

of the thyroid. The crico-thyroids cause this tilting in the lower pitches of a given register. In the higher pitches of a register tilting of the thyroid is aided by extrinsic muscles especially the palato-pharyngeal muscles.

Concerning actual voice training Bartholomew states:[1]

> We should realize the anatomy of the larynx sufficiently to know that these two registers should each be trained past the point of break with the other, so as to have a considerable overlapping region and enable the quality to be changed gradually, one register taking over the work as the other releases its tension.

In correspondence with the writer Bartholomew upholds the separate training of the registers, identifies the male falsetto with the female head voice, considers that Stanley should be given a considerable amount of credit for the work he has done and the vigor with which he has upheld them.

> Surely he has said much that is important, and some, perhaps much, that is original with him. His attitude and personality seem to make him enemies, however.[2]

1 Ibid., 129.

2 Bartholomew in a letter to the writer.

CONCLUSIONS

I. Observations of glottal action indicate the existence of two registers. Four types of glottal observation have been used to study the registers: exsected larynges, laryngoscope, laryngo-stroboscope, rapid motion pictures.[1] In the case of two of these types of investigation, namely: of exsected larynges and rapid motion pictures no claim has come to the writer's attention that more than two exist. In the case of stroboscopic examination we have Curtis who claims in practical application there are more than two registers but admits in general the two mechanisms. This leaves only the dissension among those who practiced laryngoscopy. The extent of the investigations of Seiler, Garcia, Kofler, and Behnke are not known. Much of their investigation was apparently autolaryngoscopic. As indicated by Mackenzie, the number of subjects observed by these vocalizing throughout the whole scale was probably small. Mills, numbered among these as supporting a theory of more than two registers is by no means positive. Mackenzie, conducting the most competent study, found that the registers were usually two and, in certain rare cases, one only. It seems relatively safe to say from observation of the glottis itself two register mechanisms seem to exist, and

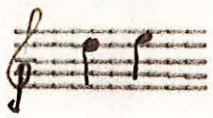
[1] No evidence has reached the writer to indicate Russell's stroboscope has been used for such investigation.

that Stanley's theory that the registers are two in number is in harmony with the observed facts.

The empirical observers studying the voice from its more auditory characteristics and without the aid of any apparatus save the ear are divided in their opinions. The old masters, however, less influenced by theories and opinions, seem to have been more or less agreed on two registers. The writer has not found any work in which the auditory characteristics of the register phenomena per se have been studied with mechanical apparatus.

Physiological investigation on this matter is inconclusive. Even Stanley admits of his own theory of the action of the laryngeal musculature that it is unproved. Observation of the laryngeal musculature indicates an almost endless number of differing adjustments is not only possible but probable.

II. There is a probability that the male and the female glottis function similarly with relation to register phenomena. In his earlier publications Stanley firmly insisted on this point. In his latest publication, Your Voice, however, the point has become obscure. He now maintains that all properly produced voices singing at forte intensities will alter register adjustments at



This means that the female singer makes the alteration at a moderately high point

in the scale and that the male will never make the alteration in practice since no tenor music is written that high. Therefore, with relation to the relative pitch even Stanley is now recognizing differences due to sex. However, this is not a difference as great as some have claimed, e.g., contraltos with five registers, basses with one or two. The writer will formulate such conclusions as may be derived here on the basis of Stanley's earlier views.

That there is reason for differences in the laryngeal mechanism is doubtful. No significant differences in the male and female larynx have been pointed out except differences in size. This accounts for the average variation in general pitch between the two sexes of about an octave. Now unless this factor brings up accoustical variations, there should be no other differences, and such differences would probably not be matters of variability of glottal behavior.

In general notation of register differences according to sex have been those supporting three, four, and five register theories while those who have noted two registers have noted these registers in the case of both sexes. It has been stated that those who support the two register theory seem to have a better supported theory. Thus the writer tends also to conclude that if differences in register phenomena exist between male and female, the cause

for that difference should not be sought in the glottal action but in the resonator, possibly with relation to vowel sounds. In other words, if this problem exists, it is probably accoustical in nature.

III. It would be unsafe at this time to state that Stanley is correct in his idea that registers are governed more by intensity than by pitch. This is probably Stanley's most original theory. Others have hinted at it, but none have stated it.

Many writers, probably a majority of those whose work the writer has seen, have indicated that some relation exists between intensity and the registers but none except among the Stanley School and, perhaps, Ruff, has given it first place.

Therefore, though it is possible to state that there is a probable relationship between intensity and the register phenomena, it would be premature to conclude that intensity is the major factor. It should be stated, however, that probably the intensity theory is fully as logical as the other.

IV. There is some evidence, however, in support of what is probably related to the intensity theory, the idea that a single mechanism activates low pitches and high intensities, and that another single mechanism activates the falsetto and low intensities. The Bell Laboratories rapid motion pictures pointed strongly in the direction

of this portion of Stanley's theory. It should be recalled, however, that this experiment included few trained voices and probably no female subjects, and, therefore, is inconclusive. Stanley's breath expulsion experiments pointed to similar implications in the case of "well produced" voices. The Bell experiments were conducted largely with untrained voices.

V. The concept of the two octave vocal range should probably be abandoned. Wilcox's experiments with teen age girls' voices indicate an immediate vocalizing range of three octaves. A three octave range is common to the male voice if falsetto is used. This does not indicate, of course, that it is beneficial to the voice to be exercised at such extremes of pitches or that these extreme notes will all be usable in performance.

VI. That good results are obtained by isolation and separate exercise of the registers is uncertain. Actually here is the crux of the our problem -- "The proof of the pudding." If the procedure works, though the theory behind it is completely wrong, we still have something. It would be a happy thing if we could accept the testimony of those of the system's adherents. But most adherents of any school of vocal development bear joyous testimony. A more scientific method of measuring the results of any vocal method should be found.

VII. Stanley's theory carries important implications concerning the development of the speaking voice. Women, Stanley thinks, generally carry too much falsetto tension in their voices. Women likewise tend in speaking to suffer greatly from the fault of mixed registration and greatly need separated exercise of the mechanisms. Some men are likewise afflicted. If Stanley's system is of value to the development of the singing voice, it is probably as greatly needed for speech.

VIII. As mentioned repeatedly in the text of this study, it has been considered unsafe to carry a register higher than its "natural" pitch limits. Upon this theory the most natural objection to Stanley's register practice might be based, in that Stanley's practice involves an extensive carrying up of the lower pitch limitations before the advent of the laryngoscopic school. However, there may have been some. Madame Seiler states,

> My aim, in the employment of the laryngoscope, has been directed exclusively to the discovery of the natural limits of the different registers of the human voice . . . [1]

Seiler continues telling us that the vowel "a" as in man seems the only suitable vowel for laryngoscopy and continues significantly:

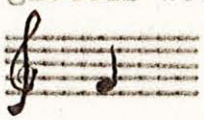
> Strong tones also are unfavorable to observation, as Garcia also remarked . . . [2]

[1] The Voice in Singing, 51.

[2] Ibid., 52.

and again:

Thus only faint and weak sounds are favorable.[1]

It is possible that due to this factor a great amount of havoc was instigated by the laryngoscopists. Faint sounds according to Stanley's doctrine would tend to become falsetto very low in the vocal range. At such intensities the female glottis would by all means want to make a change about  But if the intensity of the tone sung were much greater, the same alteration might take place much higher in the scale. Thus because light intensity tones were best for observation, and, perhaps, due to the fact register change occurred low in the scale at light intensity, unjustified pitch limits were assigned to the lower vocal registers; and the possible relation of register; and the possible relation of register action to tonal intensity went largely unrecognized by the members of the laryngoscopic school.

IX. Certain further investigations are in order. A modification in the trend of vocal investigation may be in order. The writer is here in no sense criticizing the scientific investigation condicted in the past. But to a great extent it has been laboratory work involving anatomical and physical investigations. It may be that much of practical value can be elicited through group experi-

[1] Ibid., 52.

mentations involving careful observation of groups of voices rather than waiting for the physiologist to give us the complete secrets involved in action of the mechanism. To the writer's knowledge little work along these lines has been done in relation to the normal or superior vocal organ. However, educational psychology, in general, offers us a preponderance of this type of investigation. Where knowledge of the vocal mechanism remains very imperfect, it would seem that the logical way to test theories and procedures would be by this suggested method. Further discoveries of phenomenon by this method should be of assistance to those who attack the problems in the laboratory.

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APPENDIX I

The writer is of the opinion that further experimentation might well throw light on some of Stanley's theories. Some suggestions for additional experimental investigation will be outlined.

I. Continuation of Bell Laboratories rapid motion picture studies.

   A. More trained subjects should be used.

   B. Female voices should be given an equal place with male voices in the study.

   C. Voices should be used that have been trained by the separation of the registers technique.

      1. It would be desirable to follow a few voices during the process of register training with this type of investigation.

      2. A control group would be desirable.

   D. An attempt should be made to combine Russell's laryngo-periscopic technic with the Bell technic.

II. It might be desirable to make qualitative studies by oscillograph of all types of register phenomena. Such a study should combine well with further use of the Bell technique. Russell's sonometer might be used in attempt to compare relative resonance contributions in register changes.

III. Stanley's breath expulsion experiments should be repeated.

   A. It would be well here for another committee to judge what constitutes a well or poorly produced voice.

   B. It would be possible again here to combine this with the experiments suggested above.

IV. Actual vocal training experiment with twenty voices.

A. Division of twenty voices.

1. Experimental group of 10. In the training of these voices the separation of the registers should be included.

2. Control group of 10. For this group the significant element under study, separation of the registers, should be omitted.

B. Careful periodical recording studies of vocal results should be used.

1. Rating of vocal results should be done by competent observers not knowing whether voices belong to experimental or control group.

2. Recording situations and perhaps song material for each voice should be kept as constant as possible.

C. Vocal analysis with ossilograph recordings would be a desirable addition to this experiment.

D. Practice time and conditions for both experimental and control groups must be governed as rigidly as possible.

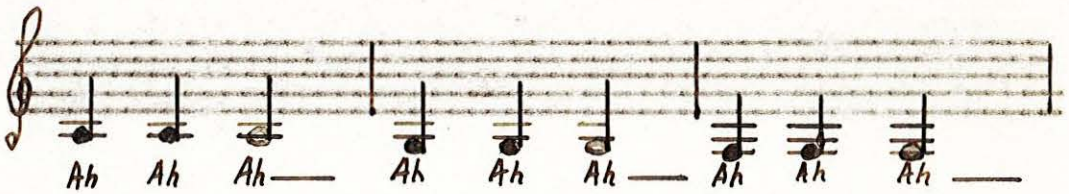
E. An obvious difficulty in such an experiment as this is that of keeping twenty subjects in the experiment a sufficient length of time.

V. An investigation that might to some extent substitute for some of those proposed might be a survey of singers to discover what proportion of successful performers have been subjected to some sort of a separation of the registers in vocal training.

APPENDIX II

Wilcox's Exercises for Inducing Activity in and Training of the Mechanism

(Exercises are illustrated in full step transpositions. Usually in practice half step transpositions are used.)

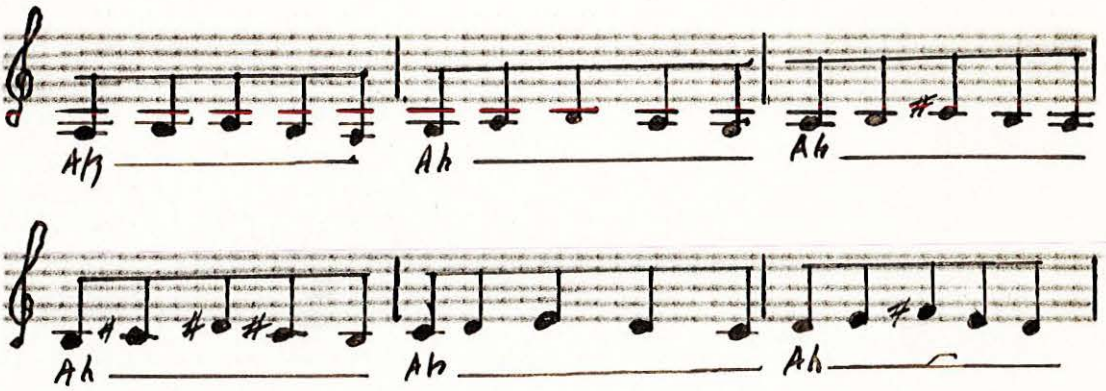


The above is the primary exercise for inducing the lower register. The tones sung here are single tones each to be followed by expulsion of the unused breath, drinking in a fresh deep breath before singing the next tone. The deep breath will assist in giving the tone some vigor in spite of its low pitch, and in consequence of its vigor and low pitch the resulting tone should be a fairly pure "low mechanism" tone. It is best to get one good free lower mechanism tone before proceeding to any more complex exercise. Some members of the Stanley school recommend speaking the tone at a low pitch as often being more effective in securing a heavy mechanism tone than singing it.

The pitches indicated will seem very low to some, lower than many voices have ever gone. The A indicated as a beginning pitch is not a must. Sopranos, for example, might start at B flat or B. But even sopranos

should experience little difficulty carrying this mechanism to F or G. Male voices sing this exercise about an octave lower. In case the first exercise fails to establish heavy mechanism, other simple devices may be used at the teacher's discretion.

Step 2



This exercise is designed to carry the lower mechanism up to higher pitches. The beginning is usally made on the lowest comfortable pitch reached in the primary exercise. The limits of the upward extension of this mechanism is by no means indicated in the illustration, though F or G, first space or second line, may constitute its limit in the early stages of the training.

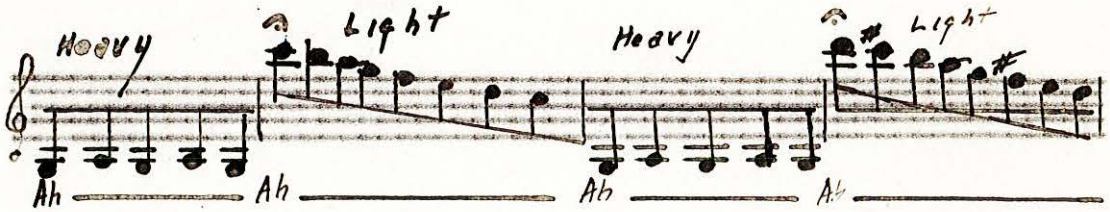
> The problem is to keep the throat open. To succeed in maintaining the open throat established at the time of inhalation there must be continued energizing of the muscles involved in the act of deep breathing and the tone must be sung at rather loud intensity.[1]

[1] The Living Voice, 24.

Gradually, through the use of the exercise illustrated or similar exercises, the upper limit of the heavy mechanism should extend itself up through the middle of the vocal range.

No special attempt should be made in this exercise to secure a pleasant tone. In soprano voices, especially, it will probably be crude. The writer believes this is the mechanism used by great numbers of our popular women singers. It is a rather heavy tone and usually somewhat crude.

Exercises for establishing pure
"light mechanism."

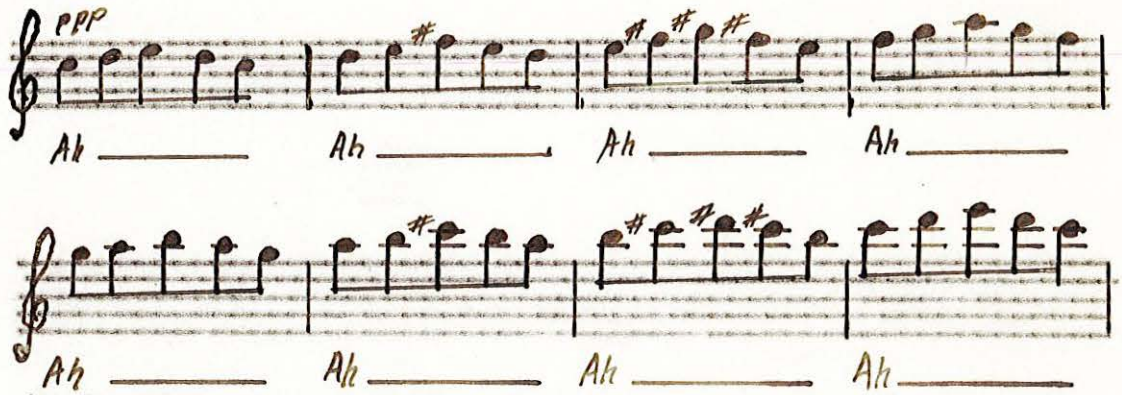


(One octave lower in the case of the male voice)

Pitches indicated are again relative. The part indicated light mechanism may again start at a pitch the pupil has never before sung. But often in the case of sopranos a pure light mechanism tone may not be attainable even as low as high C. In this case the procedure indicated is to go higher to E flat or E to attain it.

Such procedure often demands considerable courage on the part of the pupil. Usually the pupil "knows" before starting that his voice will not extend that far. The name that is given to this adjustment indicates that the tone used should be one of very light weight.

Sometimes difficulties encountered will indicate a more indirect attack on the problem of inducing the lighter mechanism. The following simple exercise indicates this approach:



(Male singers may find a dark E vowel better in the falsetto.)

The light mechanism, especially in the male, may sound weak and breathy at first. It will probably never give high intensity in its lower pitches, though its development will not be inconsiderable. Care should be exercised at the lower pitches to which this mechanism will be extended that in exercise it does not mix with the other mechanism. Proper preliminary exercise for the

voice is the use of the two mechanisms in their pure form.

Again some members of the Stanley school find that the lighter mechanism is best found in the speaking voice. Baby talk at a very high pitch is indicated.

APPENDIX III

Stanley's Thyroid Manipulation

Manipulations are not new in voice training. A teacher once gave the writer a spoon to hold down his tongue. This is probably the most common one. However, there have been used instruments designed to place the velum in its "proper" place for phonation. Several have apparently been used for breathing, such as corsets. The most commonly known, however, is the placing of weights on the stomach or on the chest depending on what the master wished to accomplish in relation to his theory of "correct" breathing. One case is mentioned in which the teacher sat upon the pupil's chest in order to encourage it into inactivity. At the present time various forms of osteopathy have come into use to help establish correct posture, good breathing, and general release of interfering muscular tensions.

In his latest book, Your Voice, Stanley has introduced several manipulations, some of them having rather radical implications. He uses a head manipulation which seems to be merely a matter of holding the head high in order to reduce tension in the neck muscles. Then there is a manipulation whereby the jaw is thrust open and back past what Stanley terms the "lock" or middle position of

the jaw. Third is a manipulation designed to induce pharyngeal resonance by the use of a "tongue instrument." The tongue is pressed back toward the pharyngeal wall by pressure against its under side. The muscles react against the pressure of the tongue instrument causing the back of the tongue to come forward opening the lower pharynx.

Two of the manipulations affect the thyroid cartilage and, allegedly, registration. The first of these is to help secure relief from mixed registration. In cases of badly "mixed registration" the space between the thyroid and hyoid bone may be tightly closed in phonation. Often it is necessary to forceably separate the two by thrusting the index fingers between them.[1]

Stanley's chief manipulation begins similarly to the one above. As the thumbs rest at the notch of the thyroid the index fingers are inserted between the hyoid and thyroid at a point just back of the point where the thyroids begins to bend downward toward its notch. As the pupil begins to sing, downward pressure is exerted on the thyroid by the index fingers.

> It is obvious that if the "pull" on the thyroid muscles dtermines the lower register, this "pull" can be helped by pressing down the thyroid cartilage.

1 This matter was discussed briefly in connection with the relation found between the hyoid bone and the thyroid in cases of tight voices by West, Kennedy, and Carr.

> This manipulation is, then, immediately indicated . . . It enables the teacher to "pull in" the lower register, by direct manipulation, when it is weak and undeveloped and thus speed up the process of isolating it an developing it to an enormous degree. Furthermore, the development of and isolating of the lower register automatically breaks off the falsetto register. Hence, the thyroid manipulation helps also to purify and develop the falsetto.
>
> This manipulation is perfectly simple and straightforward. It is an obvious outcome of an established theory of registration, and its effectiveness is a direct proof of the truth of this theory.[1]

With relation to the efficacy of this manipulation some questions need to be answered. First, is the theory itself true? Second, does helping a muscle stimulate it to activity?

The writer is of the opinion that Stanley, in the various manipulations, wants to activate some muscles by opposing them and others by helping them.

It is unlikely that the effectiveness of Stanley's manipulations can be established or dis-established till they are placed under a situation of controlled experiment.

[1] Your Voice, 97-99