an almost or altogether innocent nature." The patient, a female aged 20, was sent to me by our laryngologist, Dr. Middlemass Hunt. She had suffered from gradually-increasing dyspnoea for two years. When seen the growth involved the right side of the larynx in the neck, and had spread under the mucous membrane to the neighbourhood of the epiglottis and pharynx, where it appeared as pale rounded elevations of unbroken mucous membrane, which obstructed the view of the interior of the larynx. Dr. Hunt obtained snips from the growths in this situation, which I examined with the microscope, and finding them of a probably innocent nature, resolved to explore the tumour in the neck with a view to the possibility of being able to shell it out, or at any rate to relieve the breathing. Up to this time tracheotomy had not been absolutely necessary, but it became urgent before she was fully under chloroform, and information was at once obtained which showed that the growth had spread beyond the scope of removal, for it already surrounded the top of the trachea and bulged into it between the cartilages. Through the incisions the tumour in the neck was examined, and found to consist of bunches of more or less spherical growths, which could easily be isolated and separated, both from each other and the surrounding tissues, but their distribution was too wide to encourage an effort to make a clearance of them. The microscopical appearance of the nodules removed exactly resembled the illustration in the BRITISH MEDICAL JOURNAL of January 7th, and the arrangement of the growths would support Mr. Shattock's suggestion of their neuro-fibromatous nature.

I showed the patient again at the Liverpool Medical Institution in 1894. She had not only never been able to dispense with the tracheotomy tube, but it had to be gradually increased in length, and was now 5 in. long. The tumour showed no tendency to spread upwards, but extended further down the trachea towards the chest. From this time there was an increasing difficulty in respiration. We used rubber tubing fixed in a rubber shield for a tracheotomy tube, and lengthened it until it reached the bifurcation of the trachea, when the strangulating effect of the growth got the better of our efforts, and she died on March 7th, 1895.

A *post-mortem* examination was not allowed, but a free examination of the neck showed that the entire larynx and trachea down to the bronchi was surrounded by bunches of "soft fibromatous" growths, such as those depicted by Sir Felix Semon.

I call attention to this case because of its extreme rarity, as indicated in the paper referred to, and because it was only published in a provincial journal, in which it would not be likely to attract attention. It may be, too, that a knowledge of the natural course of such a tumour when unchecked by operation might be a help and encouragement to thorough and radical surgical treatment of the disease when seen in an earlier stage.

COMMONLY OVERLOOKED FACTORS IN VOCAL MECHANISM.

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THERE is an almost universal idea that all of us *naturally* possess either a good, bad, or indifferent voice. As a matter of fact, Nature is directly responsible for one, and one only, of these conditions; the others must be attributed to man's unconscious departure from Nature's laws. The tone of the voice may be compared to the rings a smoker can make; if he does not get a ring to his satisfaction he places the parts employed in its production in another position; and, once a perfect ring is formed, if the position of the parts is not altered, all the following rings will be perfect also. Of course the size of the tone, like the size of the smoker's ring, will depend upon individual differences, but it will be none the less perfect for that.

Now, if the proper breath pressure is used and the cords are kept approximated throughout the whole compass in the position that first produced a good tone—of course they must relax and stretch to determine the pitch of a note, but the space between them must remain unchanged—and the pharynx and mouth are kept properly opened, a perfect tone is bound to be the result; the tongue and lips must, of course, be moved for the purposes of pronunciation, but this can be done without greatly diminishing the cubic capacity of these resonance chambers.

It cannot be too strongly insisted that the avoidance of needless escape of breath is the only way to attain a correct, clear, well-controlled voice. If it is borne in mind that it is the breath which is resisted in its passage outwards through the vocal cords which originates tone, and not the amount of breath which passes through, it will be readily seen that the closer the cords are approximated the acuter is the tone and the less the waste of breath, consequently less effort is required to sustain a tone. In other words, a certain degree of approximation of the cords is necessary for the scientific production of tone, and this condition must be present at the very instant that the tone is sounded and be maintained throughout phonation. Only by careful experiment can the proper degree of approximation be determined. When right it will be found that the amount of breath pressure necessary to set the cords vibrating fully is very small. If they are too wide apart, great breath pressure—speaking comparatively—is needed, even for the production of soft tones. On the other hand, if the glottic chink is too small the resulting tone is very acute, metallic, and penetrating, whatever amount of breath pressure is used.

By far the greater number of us do not possess full control of the adductor muscles of the cords, and are therefore unable to quickly place and keep the cords in the most appropriate position, and it is surprising what a number of professional voice users, as well as amateurs, fail in this respect.

Needless to say, the singer or speaker who performs with an unduly open glottic chink does not grace the professional stage for long, for unless force is used the voice is deficient in carrying power, the amount of force necessitated depending upon the space between the cords. Now unduly forced breath pressure tends to still further open the glottis, and to prevent this the adductor muscles of the cords are put on the strain; this, if long continued, leads to singing out of tune, hoarseness, and other vocal troubles, and more often than not the muscles of the pharynx and tongue are also involuntarily contracted and cause the throaty tones so often heard. Again, suppose phonation is started with duly-approximated cords, unless great care is exercised and only the proper amount of breath pressure employed, the cords will be forced apart, or the adductor muscles will contract fully and tightly close the glottis, the resulting tone being harsh, metallic, and penetrating.

The majority of voices are lost, not from overwork, but as a result of improper emission. With duly approximated cords the voice can be heard in the largest hall without obvious effort on the part of the performer, whether singing or speaking pianissimo or fortissimo. The vocal cords must be only played upon by the breath if their best tone is to be obtained. A forte tone should only be the result of gradually increased equal pressure. If the voice is properly produced the singer or speaker knows that this is so by the feeling of delightful ease that is experienced; there is such a grip upon every note that he feels he can do just as he likes with it, whether loud or soft.

The only difference between the perfect singing voice and the perfect speaking voice is that in speaking the range of notes used is limited to only a few, and full use is not made of resonance; therefore speech is less musical, more acute and defined in pronunciation than singing.

As will already have been gathered, the whole question of voice hinges on the perfect control of the adductor muscles of the cords. Now, it has long been known to physical culturists that to obtain quickly the thorough control of any muscle, or set of muscles, they should be developed by brisk movements, which fully contract them. In the case of the adductor muscles of the cords, this can only be done by using the voice in a most inartistic although physiological manner. In other words, speak or sing words quickly in acute penetrating tones ("Pat-a-wat-quack" is an excellent phrase for this purpose). As already explained, this tone is the result of the cords being approximated to their closest and fullest extent. The voice should be extended up and down, note by note, in this manner until the limits of the compass are reached. Before this has been done classification into soprano, baritone, etc., should not be attempted.

When able to obtain acute metallic ringing notes in the whole of the compass with ease, sustaining the various vowels should then be attempted, and in the first instance this can best be accomplished by prefixing "Pat-a-wat" to them, thus: "Pat-a-wat-a-way," "Pat-a-wat-a-wee," "Pat-a-wat-a-woy," "Pat-a-wat-a-woh," etc. Afterwards they must be practised by themselves, and when perfected, words, phrases, etc., should be tried in the whole of the compass. It should be

noted that the vowel "Ah" must not be used until the voice is thoroughly under control. When this is so, there is no better vowel for practice, for it helps to give the open throat so very necessary for good voice production, but if used too early in the training, it tends to force the vocal cords apart.

No attention is paid to breathing, the whole of the mind is concentrated at first on getting a loud, sustained, metallic ringing tone. When the habit of contracting quickly and fully has so to speak been impressed upon the adductor muscles of the cords, gradations of tone can be carried out with safety and delightful ease, and it will be found that whatever amount of breath is required for phrasing, etc., can now be taken in and scientifically dealt with without having to worry about breath control. What is thought a normal breath now would not perhaps be considered one in, say, three months' time, for as control is obtained of the adductor muscles of the cords the muscles of expiration will also come under the influence of the will and inspiration unconsciously becomes deeper; but by no stretch of the imagination can this increased chest capacity be said to be abnormal. All the deep breathing exercises in the world cannot prevent the undue escape of breath during phonation, if the aperture of exit is too large, which is the case in ninety-nine out of every hundred persons. Unconsciously, from the first the pupil has been learning abdominal breathing, as it is impossible to say "Pat-a-wat" without an abdominal upheaval.

Now on attempting to sing with a good tone, the utmost use must be made of the mouth and pharynx to add all the resonance possible. The *voce di petto* of the Italians is simply and solely the result of duly approximated cords and an open pharynx and mouth. The chest plays only a very minor part in its production; in fact if any attempt is made to add resonance by filling it out unduly, it will be found most difficult to control this extra amount of air. Moreover, it is hard to understand how a chest full of compressed air can make any difference to its resounding qualities, and under the circumstances singing becomes more a feat of strength than a natural and pleasurable exercise.

No reference has been made to such terms as registers, chest note, head note, forward tone, etc., for in the properly-produced voice there is only one register or mechanism, and as long as the mind is capable of conceiving the pitch of a note, the cords will relax or stretch to produce it; but the size of the aperture between the cords remains the same throughout the whole of the compass. Every vibration partakes of the whole resonance of the cavities into which it can enter, and there is only one place of origin and emission of both the highest and lowest notes whatever the sensation may be.

A system of instruction such as the one sketched is actually in existence, and it has produced and is still producing amazing results in an incredibly short time.

But, to be a successful singer or speaker the possession of a voice is not enough; mental ability of an artistic kind is also needed, with, of course, a thorough knowledge of elocution and music.

SOME OBSERVATIONS ON THE PATHOGENESIS AND PREVENTION OF LOSS OF VOICE IN SINGERS.

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THE often-heard lament of the present age over its poverty in fine voices, and the want of lasting power in singing voices generally, has led to various explanations and to the formulation of extravagant theories. Some have attributed the decline in singing to the rise in pitch, which has been gradual, yet very considerable, during the past century; others have held composers responsible for not having sufficiently considered the voice, with the result that the vocalist has had to disregard his capabilities and put his vocal cords at everything—singable or unsingable. It is not the purpose of this paper to consider whether these explanations are or are not sufficient, or to offer any new theory in place of them; in passing, however, one might point out that neither the British language nor the British climate lend themselves so naturally to the old Italian method of voice production as a language teeming with vowels, and particularly with final vowels, and spoken in an atmosphere which is not conducive to chronic head colds.

The purpose of the paper is to summarize briefly the sequence of changes that are induced in the vocal cords by excessive or unnatural use, which may be represented in modern language by the word "strain"—an excellent term, unscientific, comprehensive, and truly descriptive of the "begin-all" and the "end-all" of faulty voice production.

The following facts have been arrived at partly through clinical observation and partly through *post-mortem* investigations, and it is hoped that the recording of them will serve further to emphasize the interdependence of art and science which has recently been brought under our notice.

The laryngoscope unaided affords practically no information about the finer movements and vibrations of the vocal cords, which are so essential to the production of the singing voice. To observe these it is necessary to supplement the laryngoscope with the stroboscope—an instrument known to scientists for nearly a century, and to children as a toy, in its modified form of the zoetrope, for almost the same length of time. To Dr. Musehold, of Berlin, we are indebted for knowledge about the singing voice that has been gained by the means of this instrument; in his clinic in Berlin, in 1897, I was afforded the opportunity of witnessing the more delicate functions of the cords, unobservable with the unaided laryngoscope.

Now to pass to the physiological changes which take place in the vocal cords during the production of the singing voice, changes which, when exaggerated, become the pathological factors to render the cords unfit for performing the finer movements required in singing. Of these changes hyperaemia is *facile princeps*.

Increased vascularity is the natural concomitant of increased function. The determination of blood to the vocal cords is in direct proportion to the effort made to produce the voice. It is possible to verify this by transillumination of the larynx. If in a darkened room an electric lamp—such as that used for illuminating the frontal sinus—be placed against the thyroid cartilage and the image of the cords be observed in a mirror in the pharynx, it will be noticed that the greater the effort used in the production of notes the more opaque the cords become; the increased opacity is due partly to increased muscular tension, but mainly to increased congestion of the vessels of the cords and to general vascularity. This hyperaemia may be further verified by observing the surface of the cords in the usual way. The increase both of muscular tension and of vascularity is illustrated in the accompanying photographs (Figs. 1 and 2)

Fig. 1.—Vocal cords in "falsetto register," *ad libit.*

Fig. 2.—Vocal cords in "chest register," *ad libit.*

taken by Dr. Musehold in 1887. The two photographs were given to me by Dr. Musehold to show the condition of the vocal cords during the production of the singing voice in the "falsetto" and "chest" registers respectively. One conclusion arrived at by Dr. Musehold from his investigations being that in the "falsetto" register the glottis is only widened and narrowed, whereas in the "chest" register the glottis is opened and closed, and the cords themselves become more rounded or sausage-shaped, in contrast with their condition in the "falsetto" register.

At the present time I am not concerned with registers, nor can Dr. Musehold be held responsible for my deductions from his physiological observations to explain my starting-point of a definite morbid process. I desire only to draw attention to the condition of the cords during the excessive or unnatural use of a register with a view of considering the pathological changes which result when the abuse is persisted in. The superficial vessels, owing to the determination of blood to the surface of the cords, become tortuous to a degree almost amounting to varicosity. In fact, submucous haemorrhages have been recorded as occurring after a straining of the singing voice. Excessive vascularity if often repeated acts as an irritant, and the capillaries and vascular elements proliferate, as