AN ORIGINAL RESEARCH ON THE CAUSE OF VOCAL NODULES.*

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I desire to call attention to an entirely new theory of the formation of vocal nodules based upon the personal observation of 234 cases occurring in my private practice. The facts herein mentioned are the results of further patient and persistent investigation of this subject, especially in consequence of many letters received from physicians and voice specialists who have read my article on the same subject in the November 1903 number of THE LARYNGOSCOPE, and have requested further explanation of the cause of vocal nodules. With this object in view, I have had five original and very careful dissections of larynges made by Dr. Edgar E. Stewart and Mr. and Mrs. H. Howard Brown, voice anatomists of large experience, to whose skillful work under my direction this discovery is mainly due.

Summary. Of 234 cases of vocal nodules coming under my observation during the last 15 years, 136 were found upon the left cord, 98 were on the right vocal cord. 32 were bi-lateral and symmetrical vocal nodules, that is to say, on the left side and right side at "C" sharp, that is at the anterior one-third of the cord, the most common place for nodules, two single nodules and two bi-lateral and symmetrical at "F" sharp in company with double bi-lateral "C" sharp nodules. The "F" sharp nodules were situated about the middle of the anterior third of the cord: one at "G" sharp, the remainder at "C" sharp. There was one "B" flat nodule on the left vocal cord and this was in company with a bi-lateral symmetrical "C" sharp nodule. This makes it very evident that these nodules occur at as many as four different points on the vocal cords, although the records of some investigators of this subject seem to allow for one only, and that always occurring at about the same point.

Observation, therefore, and recent experiments led me to believe that if these nodules of singers are to be permanently cured, the means of a correct vocal action must be resorted to in the majority of cases. Many people, not singers, produce nodules by coughing. I have seen a dog with nodules. But the nodules of singers which have caused so much discussion have been referred to by Prof.

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Turck, who first illustrated and called the attention of the profession to *Chorditis tuberosa acuta*. Dr. James P. MacAvoy of this city, in his reminiscences of Professor Schnitzler, of Vienna, says that he was accustomed to say to his postgraduate class of students from all parts of the world, "A guinea to the one that makes a correct diagnosis!" Although Dr. MacAvoy lived with Dr. Bergasse, Professor Schnitzler's first assistant, for three years, he never saw the guinea carried away, or a student able to make the diagnosis of a singer's nodule or the acute chorditis of singers. It is no wonder then, that its diagnosis and etiology have been questioned.

![Diagram of vocal nodules](image)

*Fig. 1A. Diagrams to show crossing of the thyro-arytenoideus and thyro-arytenoideus externus muscles.*

The purpose of this article is to throw any additional light possible upon work which has already been done; and, if issue is taken with any statements made by other observers, it is for the purpose of furthering investigation by causing discussion of any points at issue, in order that eventually we may arrive at the truth. That there must be cogent reasons for the affinity of the vocal nodule for certain portions of the cords, is certainly recognized by the most competent laryngologists, who have advanced many theories as to their cause, most of them mysteriously seductive, but not any of them definite enough to satisfy careful analysis.
**Pathologist's Report.** I herewith give report of the microscopic examination of double nodules. The epithelial layer manifests no deviation from the normal, either in its external hornified stratum (which is very thin) or in its relation to the subepithelial connective tissue, in any portion of the sections examined. Except in one or two very small segments, the thickness is almost uniform throughout. Even with strong magnification (x460) not the slightest evidence of separation from the subepithelial layer can be noted. At a point corresponding to the apex of the nodule there is a flask-shaped invagination, or crypt-like depression, about one-fifth the size of the total mass. This invagination begins as a tubular inversion which gradually enlarges to bulbous shape in the depth. In some of the sections this sacculcation appears as an almost spherical closed cavity, which phenomenon, no doubt, is due to section above or below the level of the outlet to the epithelial surface. It could not be determined whether this was an artefact due to shrinkage in hardening of the tissue or not.

The connective tissue composing the bulk of the nodule is densest immediately beneath the epithelial layer and gradually becomes more and more rarified as the base or attachment to the cord is approached. Throughout these portions the spaces formed by separation of the

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**Fig. 1B.** Diagrams to show crossing of the thyro-arytenoidus and thyro-arytenoideus externus muscles.
connective tissue fibers are infiltrated with a greater or less amount of homogeneous or very finely granular translucent substance in every way resembling coagulated edematous (serous) fluid. Near the base or cord attachment, the tissues are so loosely arranged that the fibrous fibrillae form a fine reticulum, the spaces of which are infiltrated with the translucent homogeneous or finely granular material. Here the tissue cells have assumed a marked stellate shape with decided prolongations which anastomose with fibrillae from other cells of like nature to form this reticulum. This appearance is unquestionably due to edematous infiltration of a passive and very probably a chronic nature; since there is nowhere any evidence of cellular proliferation, except in the intima of the smallest vessels which show a moderate degree of nuclear activity, but not sufficient to markedly encroach upon the lumina. No red blood corpuscles and but rarely a polynucleated leucocyte (wandering cell) were noted outside of the blood vessels. Except for a slightly thicker horny layer of the epithelial covering, the nodule lowermost upon the pin presents the same histologic features.

Conclusions drawn from careful microscopic examinations made by Drs. Henry T. Brooks, of the Post-graduate school of medicine, and John Larkin, of the College of Physicians and Surgeons of New York.
York, made especially for this article, show that in its simplest form, the nodule is a superficial oedema, manifesting itself on the edge of the vocal cord, sometimes appearing on one and then on the other, and at times on both, making symmetrical and bi-lateral nodules dependent entirely on causation. For instance, the cause might be a simple case of coughing, and to simplify matters, pathologically the nodule is an oedema, a swelling from effusion of watery fluid in the cellular tissues beneath. If aggravated by continued use of the voice, it may develop and become exceedingly dangerous to the voice by extending outward to the tissues of the cord itself. The cure for this state of thing is by absorption of the fluid contents and a consequent diminution of the size of the nodule, until finally the condition of the cord becomes normal and the voice is fully restored. In the formation of the nodule it is worth remarking that the traumatic or coughing nodule may appear at any point of the cord. It shows at first at one point and then at another. The nodule caused by vocal weakness, however, displays an exasperating, even puzzling affinity for particular portions of the vocal cords. It is generally found protruding from the anterior and middle third on one or the other side of the glottic opening. In fact, it frequently happens that the traumatic nodule, and what for convenience's sake has been arbitrarily styled the "vocal nodule," are simultaneously present, the traumatic nodule existing by itself in unusual portions of the cord or superimposed upon, or blended with the vocal nodule, each to be distinguished by its well defined location, although produced by totally different causes. Those who would explain this by the theory of attrition or segmentation, would refer you to the stroboscope of Professor Oertel, or possibly to the more or less familiar trick of the vibrating string and the bit of paper. If the paper be laid upon the string at a certain point it will be flirted away, while if it be laid upon the string at another point, the rest point, if you please, it will slip unagitated to the floor. Inasmuch as the vocal cords, are subject to the same laws, the lesson drawn from the string and the bit of paper applies, the nodule taking the place of the paper. Note, however, the difference. The string is single and there is no attrition. If there were two opposing strings, the bit of paper might be caught and sadly twisted in a miniature whirl-wind of opposing vibrations, and a nodule produced symmetrically on its mate, the opposite cord.

"By studying the laws of vibration of strings and pipes in physics, we find that there are sections of the vibrating string and portions of the air in the organ pipes which do not vibrate with the string
or pipe as a whole, but which, as nodules and segments, subdivide the string and pipe into active and passive portions." By careful observation we are able to see whether the vocal cords are making a segment in the center or whether they are vibrating longitudinally without making a segment with the opposite one by vibration. Dr. H. Holbrook Curtis says, "As a matter of fact, the tiny pearls of mucus are driven by the centrifugal force of the vibrating vocal cords to the middle point of the vibrating segment and from thence are thrown outward. They mark then, if anything, points of greatest movement in the vibrating segment, and not points of rest." Again, "this observation confirms the theory advanced several years ago by me as to the formation of nodules of attrition in singers' cords, and explains the removal of the same by exercises of vocalization."

There are those who define a "singer's nodule" as an inflammatory growth situated at the junction of the anterior and middle thirds of the vocal cords, a definition which is certainly most unsatisfactory when we know for a fact that nodules occur between the middle of the anterior third and at the posterior third, and also on both cords, as well as at the junction of the anterior and middle thirds. It has also been said that these growths are due to the employment of an injurious method of attacking tones, and are to be eliminated by using a "focus" of tone, (a term certainly very hard to understand); that this "focus" of tone places the initial impulse upon the cords in such a manner that attrition becomes impossible. I take issue with this statement because I believe that attrition is not necessary to form the nodule, as will be seen when I state my theory. It may be after these growths have been started they may be enlarged by attrition.

The defenders of the segmentation theory (portions of the vocal cord being divided into parts), state that the damage to the singing voice occurs in the upper medium register. What is meant by this is probably the upper half of the middle register, relatively high or low according to the voice, whether it be soprano, contralto, tenor or bass. It is also said that this segmentation is rearranged for higher pitches in such a manner that the vocal cords do not rub against one another.

On the theory of the specific action of the thyro-arytenoideus-externus muscle that I now propose, this rather mysterious statement is unnecessary. I also take issue with the following statement: "That singers' nodules are the result of a direct mechanical effect caused by the interference of opposite vibrating segments, and are
not true nodules in an acoustic sense has been proven beyond doubt by the investigations with the steoboscope of Professors Oertel, Koschlakoff and Simanowski." Of course we will have our own opinions and having made some investigation, we think that this is not proven beyond a doubt; and we do not believe that it can be so for the one grand reason that it is impossible to make proper observation with an instrument which employs a human subject whose cords are to be seen, again the eye and hand of the operator, and still further an instrument whose revolutions are too rapid for the human eye to make correct observation; and then again in all of these observations we can see only the one side of the cord, that being the upper side.

A short history at this point describing the typical occurrence of a singer's nodule will help the reader to understand the theory about to be advanced. At first there is a tonsillitis of varying intensity, the crypts of the pharyngeal tonsils usually containing yellowish cheese-like plugs of debris. The vocal cords are noticed to be slightly bowed and a little later reddened. Now the nodule appears at one side as a very slight elevation on the edge of the cord. This increases but little in size and one may appear on the other cord opposite the first.

My theory on the causation of singers' nodules is as follows: A great majority of the subjects present a follicular tonsillitis. Accompanying this there is more or less congestion of the mucous membrane in the larynx. This renders that portion over the vocal cords more liable to become oedematous. It is further thought that there is a hyper-activity of certain fasciculi of the thyro-arytenoides-externus muscle, and that where these bundles cross the true cords there is produced a localized oedema or singer's nodule.

By a remarkable combination of circumstances, it has been my privilege to have under my professional care all four of the leading solo soprano voices of Old Trinity, St. George's Church, Heavenly Rest and St. Thomas's. These boys have all begun their changes in voice under identically the same conditions. The boys I refer to are Earl Gulick, Allen Schnebbe, Charles Mehan and Maxwell Kennedy, well known boy sopranos who have sung all over the country. The observation consisted of this: First, that it was the inflammation of the left tonsil, then a partial paralysis of the left cord, then the production of a nodule on the same cord at "C" sharp followed by the production of another nodule upon the other cord.
In the left tonsil of each one of these cases were found follicular chronic tonsillitis as determined by the usual signs of this disease, one of which was the fact that there could be expressed from the affected tonsil large cheesy plugs. In all these cases beyond a slight inflammation of the anterior and posterior pillars, there seemed to be nothing else to be observed about the tonsil. All of these little patients did not come to me for sore throat, or because they were afflicted with tonsillitis, but to consult me on their vocal debility and the loss of their singing voice. One of them in particular went away with my diagnosis of cheesy deposits in the left tonsil, and partial paralysis of the right cord, and with my request that he should not sing owing to an impending change in his voice. I did not treat this boy at all, did not even spray his throat because I saw the nature of his voice failure. I merely expressed a few of the cheesy deposits out of the tonsillar crypts with the result that at that service he sang well. He returned to me, however, with a nodule on his vocal cord produced in his attempt to sing “A” sharp at this service. Going from the medium “E” to the high “A” he felt a sudden giving away of his voice, although he was able to hold the note almost to its end. The following Sunday he was unable to sing, and although the boy returned to me during the week, I did no more to his voice than to tell him that I thought the change had begun. On the next Sunday his voice failed completely, so much so that the very remarkable statement was made by one of his musical friends to the effect that while the first spraying of his throat had resulted in a decided relief from all his vocal debility and had put it in good order, the second spraying had brought about a condition that had ruined his voice. Subsequently, at his father’s suggestion, the boy resigned his position. In reality I had not used the spray at all, and did not treat him the second time. Since that time he has not sung at all, his voice having descended an octave without treatment, except for the treatment of the ear on the same side with the inflamed tonsil, which has been affected a long time in consequence of the diseased tonsils. Undoubtedly, this had also affected the ear through the extension of certain catarrhal disturbances. As a result, his voice has completely changed and is now in that broken condition that usually follows the change of boys’ voices always noted at puberty. The nodule, however, has entirely disappeared and so has the paralysis of the cord. While singing, the usual phenomenon takes place, although he is now fourteen years of age. Should he sing from “A” flat down to “C” his voice would immediately break at “C” sharp and jump a fifth, that is, to
the "G" sharp below, either going into the man's voice or giving out entirely. Now in singing his voice jumps the entire octave from "C" sharp down to the lower "C" sharp on almost every occasion, and, strange as it may seem, all of these boys have had exactly the same phenomena.

If we turn to the thyro-arytenoideus-externus muscle we will see that its action is somewhat complicated on account of its fastenings.

A brief description of the anatomical conditions existing in this portion of the human larynx would seem appropriate here. The thyro-arytenoideus-internus extends horizontally backward from the inner surface of the thyroid cartilage in front near the median line to the muscular process of the arytenoid cartilage behind on either side and forms the inferior or true vocal cords. Externally or laterally, but still within the confines of the thyroid cartilage, this muscle is overlapped by the thyro-arytenoideus-externus or wall muscle whose fibres run almost vertically upward from the antero-inferior part of the inner surface of each ala of the thyroid cartilage from its lower border in front, and also from the antero-lateral portion of the inner aspect of the crico-thyroid membrane, to spread out in the mucous membrane of the larynx above, and is inserted in part, into the edge of the epiglottis. Thus it will be seen that these muscles cross nearly at right angles, somewhat in the manner represented in the diagram. (See Fig. 1 C.) It is just at side of contact of these two muscles on the mucous membrane where the vocal nodules occur.

From Luschka's drawing, it will be seen that there are practically three divisions of this muscle. The arytenoid division which unites with the cricoid, the thyroid division and the epiglottic division. The action of this muscle plays a most important part in the approximation of the vocal cords and as normal intrinsic action is dependent upon normal extrinsic action, it will readily be seen that any derangement of the external action would cause a direct tendency of this thyro-arytenoideus-externus muscle to over-act, and it is upon the combination of those tonsillar lesions and the over-action of this muscle that my theory is based.

Acting upon this theory I have caused some dissections to be made with the inference that there must be some factor at work beneath the mucous membrane over the cords which causes a local oedema, and consequently, the slight elevations which appear. The idea was conceived that the venous return might be cut off by the pressure of certain muscles acting in different directions and thus cause the local swelling. (See Figure 1.)
Fig. 3A. Larynx showing thyro-arytenoides-externus.
Fig. 311. Larynx showing thyro-arytenoideus-externus.
The description of wall muscle in larynges dissected is as follows:

Case I. Larynx of a Chinaman, aged about 45. Occupation, laundryman. Voice high pitched, larynx large. Found thyroid fasciculus large, especially in its lower part. Crico-thyroid fasciculus also large, but a space between these fasciculi where the muscle was very thin. Arytenoid fasciculus broad and thin. There were no nodules on these cords. The larynx was a beautiful specimen, but the tonsils were in their normal condition.

Case II. Larynx of a negro, aged 24. Occupation, waiter. Voice guttural, specimen large, cords lax. The anterior fasciculus was larger, broader and stronger than in the former specimen, but the crico-thyroid bundle was not as distinct. The space between these fasciculi was better filled with muscular tissue. No nodules existed. Tonsils normal.

Case III. Larynx of a white girl, aged 18. Occupation unknown. Character of voice not known. Larynx fair size. Thyro-arytenoideus-externus well developed, especially its posterior portions, that is, those arising from the crico-thyroid membrane and from the arytenoid. No nodules present. Tonsils normal.
Case IV. Larynx of a butcher, aged 45. Specimen of medium size. Character of voice not known. In this instance the thyro-arytenoideus-externus was more peculiarly sloped. The lower part extending mostly from the thyroid cartilage was quite thick and broad for about one-half its course. The upper end, while not entirely lacking, was very poorly developed. For this muscle there was no fasciculus more distinct than another. Pharyngeal tonsils normal. No nodules present.

Case V. Larynx of a laboring man, aged 40. Specimen of large size. Character of voice unknown. This larynx resembled the previous one in all particulars except that the upper fibres of the thyro-arytenoideus-externus were more distinct.

Case VI. Male larynx, aged about 35 to 40. History unknown. Very large. Thyro-arytenoideus well developed, especially the arytenoid fasciculus. No nodules were present. Tonsils not enlarged.

By comparing the different larynges dissected, it was noted that the thyroid-fasciculus was stronger in its lower part in those cases where the voice was of a higher pitch. While the number of specimens dissected in which the character of the voice was known before death is still very small, the possibility that the size and strength of different fasciculi of the thyro-arytenoideus-externus causes different tones seems to assert itself.

After procuring these photographs of this muscle, I recently had the following experiments made to try to produce a nodule:

A medium sized dog was examined to see if he had any nodules on the vocal cords. None were found. His larynx was then operated on, using the modern surgical asepsis with the idea of producing nodules. The anterior inferior angle of one ala of the thyroid was trephined (3/8″ trephine) and a mattress suture taken in the thyroid fasciculus of the wall muscle, shortening it. The parts were then closed. The dog was allowed to live two weeks, means being taken to cause him to bark considerably during the time. He was then chloroformed, the larynx taken out and the following observations made: Skin wound healed by first intention; parts beneath in beautiful condition: muscle shortened considerably. No nodules were found.

This would hardly disprove the theory as the tonsils were not in the typical condition observed by me.

Another experiment. A fairly good sized shepherd dog was used. In order to produce a tonsilar inflammation in the animal,
plugs of debris were expressed from tonsils of two renowned singers having nodules, one male, the other female, and rubbed with considerable pressure into the mucous membrane between the pillars of the fauces while the dog was anesthetized. This was done within eight hours after removal from the singers' throats. On inspecting the throat every day for a week no change was noticed.

Several factors were supposed to account for this. First, the bacteria contained in the tonsillar plug from the human pharynx were thought to be of too low a virulence. Second, the resistance of the mucous membrane without any previous congestion was thought to be too high. Third, several errors in technique were discovered which probably played a lesser part.

These several indications were met in the following ways: The resistance of the tonsils and mucous membrane was lowered by painting the region with cantharidal collodion while the dog was anesthetized. This produced a typical congestion and in a couple of days a young and virulent culture of pure streptococci was rubbed on the inflamed parts. No false membrane formed but a true tonsilitis developed. After a few days the dog was prepared for operation (neck shaved and all aseptic precautions taken.) The skin was incised in the median line and one ala of the left thyroid cartilage exposed. This was treated in the following manner: A slit-like opening was made in its lower part about 3/16 of an inch in width and almost as long as the entire width of one ala. The piece of cartilage was removed and the thyro-arytenoid externus lifted into the gap. From its central portion, a piece was removed consisting of the entire thickness but not completely dividing the muscle, leaving the anterior and posterior portions in the hope that nodules would be produced at the joints where these fasciculi pressed on the true cord. The vacancy in the cartilage was then packed with a gauze drain and the latter carried to the surface. The skin wound was sutured and a 1-100 formalin dressing was used. Convalescence was uneventful except that it was noticed that the dog's bark had changed.

The cords were examined with a laryngoscope and a nodule was noticed about where the posterior fasciculus crossed the cord. This dog was shortly afterwards chloroformed and the larynx and tongue were removed. A nodule was observed on the posterior portion of the left cord. The larynx was then placed in a weak solution of formalin and the nodule became smaller. On splitting the larynx open from behind through the cricoid cartilage, the nodule disap-
peared. From this it is suggested that nodules cannot be preserved after death.

This operation of trephining the thyroid cartilage and suturing or excising portions of the wall muscle has now been done on six dogs and one goat without a death or any post-operative difficulties. The experiment was undertaken with considerable hesitation at first, owing to the fear of expected oedema of the glottis, but no such accident occurred. The operation is quite bloodless, even more so in the goat than in the dog. The former seems to be better adapted to this particular research for anatomical reasons, also because of its ability to modify the pitch of its bleating.

We have under way several other experiments of like nature, by which we hope that nodules can be produced in every case by means of infection of the tonsils and perverting the action on the thyroarytenoideus-externus muscle. We hope to have the pleasure of demonstrating the successful outcome of these experiments at some future date.

Treatment. With regard to prevention of nodules, if in childhood adenoids and tonsils receive their proper attention, if lingual tonsils and pharyngeal hypertrophies are watched with care and removed, if children are made to be very careful during the period of voice change, the establishment of menstrual functions and other conditions which cause sympathetic nervous changes to take place affecting the mucous membranes at the age of puberty, if a correct synthetic voice production or voice science be established which can be simplified and studied by proper anatomical and physiological laws, we probably should never have the nodule question to consider except it be a matter of accident.

The following are the results of different kinds of treatment employed by me for the eradication of nodules. Prior to the year of 1902, I employed the ordinary medical means familiar to all of you. I found that such treatment was attendant with more or less indifferent success. Having been a public singer of recognized standing for a number of years, the pursuit of this subject was of especial interest to me and, while recognizing the fact that all nodules known upon the vocal cords did not occur in singers' throats, yet the systematic recurrence of nodules at specific points on the vocal cords, long ago led me to believe that the manner of voice use had something to do with this phenomena.

In all my cases, in addition to vocal means there were used some Swedish massage movements on contracted chin muscles, believing
that much good was accomplished by this means during the first stages of treatment. These movements aid in cure by relieving some of the worst muscular contraction and by stimulating circulation and nerve supply.

In the year 1903 I purchased an apparatus which, as used by me, has proven the sovereign remedy for nodules. This instrument completely supersedes the mechanical work above mentioned, and has more value in that it is an anesthetic and produces powerful desensitizing effects upon the mucous membranes that border upon the marvelous. One knows that a powerful blow behind the ear, upon the chest, back of the ear or in the epigastrium, namely, over the principal vaso-motor ganglia, will shock the subject to whom the blow is given, causing an anesthesia of that part and a blanching of the mucous membrane within the nose and mouth similar to that produced by a sudden most serious hemorrhage. With an instrument which consists of a rubber cap screwed into a swedish massage bulb fastened to a Vosberg's cable and a rapid motor operating this cable, anywhere from 1800 to 3000 revolutions can be administered to the human body in the shape of blows accompanied by oscillation and suction. By placing this instrument at a speed of 3000 revolutions per minute back of the ear and drawing it in the position of the stylopharyngeus from its mastoid attachment to the thyroid, then over the sterno-hyoid and sterno-thyroid, thence over the four layers of chin muscles, thence over the angles of the neck, then again from the occiput down along the spine along the vertical column to the os sacrum, (the whole process not taking over two minutes) one will have produced in the mucous membrane of the nose and throat most remarkable phenomena. A pallor will have spread all through the nares, posterior and inferior, over the pharynx and into the larynx and, particularly, will mark the region of the epiglottis and larynx. Vocal cords with nodules upon them which are red and bulging and covered with mucous will seem to be several shades paler. The cords themselves will be less bowed and the nodule will become surprisingly smaller and apparently absorbed to a great degree. I know of no means that produces such quick and remarkable effects upon the mucous membrane of the vocal cords or upon these various parts mentioned above. So remarkable is this, that nodules, if quite acute, not too large and deeply infiltrated, will be absorbed in from three to five days. Of course, by singing again they are apt to recur, especially if the false mechanism is indulged in or the reflex conditions established by the nodule producing element have not been eradicated.
Dr. H. Holbrook Curtis's demonstration consists in depressing the chin on the sternum, using supra-costal respiration, at the same time singing the syllable "Maw" at middle "C" falsetto, while plucking the lips with the finger and focusing the tone "Dans La Masque." This method I think produces a falsetto tone which cannot be amplified correctly and is therefore not a useful procedure. It is also questionable in that it is apt to upset a voice mechanism acquired after years of arduous study. In the true falsetto, the larynx is raised from the fifth cervical vertebra where the longus colli muscle divides, especially so that the larynx rests upon the spine proper, which, as anyone can readily see, allows for resonance from the spine and added leverage for amplification of tone. Consequently, there is no point of control for the use of the extrinsic muscles which are so necessary, not alone for amplification but for overtone. For instance, the palato-pharyngeus, one of the longest of the extrinsic muscles, also useful in giving the Italian resonance to tone, and one of the great producers of overtone on account of its length, is noticeably deflected from correct production of tone by singing falsetto.

The "Maw" method for curing nodules is advocated as well for correct rules of voice production, and when scrutinized carefully, it will be found to consist of the same old empirical formulas established by maestros of long ago. Even in the last twenty years, one of our famous lady teachers, Marie Bissell, has advocated the singing of "Maw" in about the same way, but not falsetto, for bringing the voice forward and obviating the so-called breaks and holes in the voice which were probably due to the results of nodules.

Dr. Curtis's idea might be explained on the ground that by singing falsetto, the position of the arytenoids are so changed in their action on their cricoid facets, that the edges of the vocal bands have a different alignment, hence, vibration under such conditions might benefit and reduce the nodular condition of the cord, as it would no longer be irritated by the opposing cord. But the voice specialist should not use vocal exercises for inflammatory conditions nor allow singing at all for at least ten or fourteen days, dependent, of course, upon circumstances. The practical treatment of these cases resolves itself into the following: The chief beauty of any voice is its quality. To test this, patients are actually made to sing the scale of "C" for a low medium voice (male and female voices an octave apart); a medium voice, the scale of "E"; higher voices, the scale of "A" flat. The low voices will break in the vicinity of "C", and the higher voices, "C" sharp, "D", "E" and possibly "F", dependent upon
the closing of the crico-thyroid niche, the lack of harmony between
the extrinsic and intrinsic muscles, and other reasons already stated.
As the patient sings these scales which are given them from a small
reed pipe, the quality is judged and the break noted. I sit directly
opposite them and can almost invariably tell on which side the nodule
is in the same manner as I can tell when stepping on my front
stoop, whether the cars of any one of the three roads are running
and in what direction, and oftentimes I can feel in my own throat
sympathetically on which side the tension is, the affected cord be-
ing opposite the one from that in which I feel the tension. In this
way one has arrived, as the music teacher would, objectively and
subjectively, at the cause, and has an excellent idea as to what makes
the quality of the voice under examination deficient. The next step
is to get at the underlying cause. I had never yet seen a nodule
in its inciency but that cheesy plugs could not be found in some
one of the crypts of the tonsils. More than twelve cases had been
sent me by other physicians stating that this condition was not to
be found, and in each case by deep pressure on the tonsil over the
anterior pillar and carrying it downward to the base of the tongue
carefully so as not to abrade the surface of the mucous membrane,
cheesy plugs could be expressed. These tonsils are carefully treated
by deep spraying into the crypts with a ten per cent solution of
argyrol, which generally relieves the condition, and the patient will
state that the voice is much clearer and that they feel easier. Some-
times touching the tonsil in such a condition causes a violent reflex.
The next procedure is to use the Vosburg vibrator as already di-
rected, which vibrates the cord, as can readily be seen by looking
at the larynx with the laryngoscope, or making the patient sing,
then the egophony will be apparent, showing that the cords do vi-
brate by means of the vibrator and that any further explanation is
unnecessary. Before leaving the office they are instructed to
massage the throat as follows: Straight and boring movements
from the tip of the thyroid cartilage to the mastoid, from the same
point on the thyroid cartilage down to the clavicle; from the same
point again on the thyroid to the point of the chin. This is kept up
for ten minutes morning and night. The solution to be rubbed in
contains one-half drachm of salicylate of methyl to an ounce of white
vaseline and lanoline, equal parts.

It so happens that we often have an acute inflammatory condition
involving nares, pharynx, tonsils and bronchial tubes with this con-
dition. Then I treat them thoroughly by means of an inhaler, prefer-
ably a Dr. Louis Sass inhaler, four or five long inhalations with a
mixture of iodoform, 20 grains, and ether, one ounce. This has the
effect, on being inhaled, of covering the entire mucous membrane with
a fine layer of iodoform and seems to invade the entire respiratory
tract. This caution must be observed, that a lady can scarcely stand
more than three such inhalations, and a full-fledged man, more than
two, and they must be made to lie down immediately after taking it
for ten minutes. By this means startling effects are produced in all
the membranes affected, especially upon the nodule if inflamed or
edematous. If this condition is at all accompanied by coughing,
the following mixture is given: Spirits of chloroform, spirits of
camphor, of each, one drachm, codeine, one grain, syrup of acacia,
one-half ounce, spearmint water enough to make three ounces. Two
teaspoonfuls every hour until relieved. Another point about the
ether and iodoform mixture is that it must not be used over three
times the first day and not over two days in succession, and should
always be freshly made. It has a tendency to thicken up the mucous
membrane and mats down the cilia of the bronchial tubes.

When the tonsils remain seriously affected by more deep seated
conditions than first mentioned, combined with malarial or rheumatic
affections, appropriate treatment is given, sometimes even the re-
moval of the tonsil. I have a decided disinclination to do this, not
because it will do any harm or affect the quality of the voice, but be-
cause I have known it to produce a psychological voice failure that
was astounding, although time has shown the operation to be of
wonderful benefit in every way to the voice.

One other suggestion, I should like to make in regard to these
acute conditions just described, is that for one or two treatments,
not more, the whole respiratory tract be sprayed with solution of
adrenaline, one to five (5) thousand, followed immediately by ten
per cent of solution of argyrol, the argyrol is objectionable on ac-
count of its nasty black staining qualities, but this can be easily
remedied by cold water, strong ammonia water, or plain bichloride
mercury solution. A simple and effective medical help to clear up
the hoarseness that accompanies this nodular condition is potassium
acetate and potassium bromide, 15 grains each, tincture belladonna,
15 minims, menthol, one-half grain, alcohol, syrup of acacia, each
one-half ounce, and camphor water enough to make four ounces.
Mark it two teaspoonfuls every two hours until relieved.

By combining our efforts, we, throat specialists, might become
largely instrumental in helping singers and singing teachers to cast
aside forever empirical methods, and accomplish the development of
the only true thing, a synthetic method. Although the main purpose of this article seems to be the establishment of the origin of nodules, I should feel highly gratified if the ultimate outcome of it should be their prevention.

The nodules themselves can be removed from the cords by means of a Miles, a Krause-Heryng or a Schroetter's forceps. I have repeatedly removed large ones, single and double, without harm to the voice. I have recently seen Signor Monte-Griffio, whose nodule was removed by Sir Morrell Mackenzie at the request of Dr. Louis Elsberg, without any effect on the voice.

Singers' nodules have been burned off by cautery, silver nitrate stick, chromic acid tips, lactic acid and latterly by Prof. Epstein of Vienna, with tri-chlor-acetic acid as related to me by Dr. Clarence Warfield to whom I am indebted for the argyrol solution.

But in spite of this, I have seen nodules of three years duration well cured by proper vocal exercises. The psychological effect on singers with nodules causes them to practice pinching methods which destroy their good voices. Singers can be quoted who lost their voices by such procedures.

It is the earnest hope of the writer that this article may stimulate additional interest in the causation of vocal nodules and that it may further investigation and research on the subject.

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