Revisiting the Laryngoscope

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prov·e·nance (prŏv′ə-nəns) *n.* Place of origin, source. [Lat. *Provenire*, to originate.]

Manuel Garcia (1805–1906) did not invent the laryngoscope. There. I said it. It feels sacrilegious to articulate these words, and especially to have them here in print in the *Journal of Singing*. However, the time has come that we must accept that Garcia did not invent the laryngoscope.

St. Clair Thomson stated, "Before Columbus landed in America, doubtless many a mariner had been wrecked upon its coasts; and before Manuel Garcia had easily sighted the living vocal cords, more than one ardent explorer had caught a glimpse of them."[1]

Hans von Leden discusses the history of the larynx in *Professional Voice: The Science and Art of Clinical Care*. He separates this history into four stages.

Four Cultural Stages of the Concepts of Voice Production

1. Fictitious or Mythical Stage: falls under the heading of folklore, magical, religious, or supernatural
2. Metaphysical Stage: knowledge gleaned through observation
3. Traditional Stage: information based on tradition or revelation
4. Realistic Stage: knowledge based on actual observation experimentation, and coordination (scientific)[2]

In the book he discusses stages one through three in great detail. There is no need to reproduce that scholarly work here, since as of the date of submission of this article, this particular chapter is available through a preview in Google Books.[3]

Therefore we will begin with Stage Four. In telling this history, please know that it is not exhaustive in nature; every new or small discovery is not mentioned, and the principal focus will be on the most significant achievements through the time of Garcia.

Philipp Bozzini (1773–1809) was born in Mainz, Germany. "Bozzini started his medical studies in Mainz, and approximately in 1794, went to Jena to complete them. On June 12, 1797 Bozzini was granted the title of doctor of medicine, which allowed him to establish in Mainz as physician. Soon afterwards, he traveled several times to France and the Netherlands in order to acquire professional experience."[4]

Bozzini was interested in creating an instrument that would allow physicians to see into the inner cavities of the human body *in vivo* (i.e., in a living organism). Via dissection, anatomists had already documented the inner

Journal of Singing, March/April 2019
Volume 75, No. 4, pp. 467–475

makings of the human body; however, Bozzini knew there was much to learn by seeing the functionality of the moving parts. At Frankfurt in 1804, he presented the idea of such an instrument, only to be met with ridicule.

> Bozzini seems to have drawn on himself an undeserved amount of criticism by the publication, in 1807, of a brochure, describing a double cannula with a mirror placed at an angle at the end, which was supposed to transmit light through one compartment, and reflect it from the mirror on to the parts examined, whose image, received on the mirror, was reflected back to the eye through the other compartment. It was supposed, singular to say, that the light passing in would interfere with the perception of the reflected image if one tube was used. A wax candle with a reflector behind it supplied the illumination. This instrument was used successfully. With it and others, Bozzini claimed to be able to inspect the various canals of the body, among them, the larynx.[5]

Bozzini continued to work and improve upon this device, and in July of 1806, he first demonstrated his new instrument.[6] The following article written by Bozzini in 1806, discusses the need for examining the internal cavities of the body and how he resolved this problem.

[Excerpts from]

THE LICHTLEITER: AN INVENTION TO VISUALIZE THE INTERNAL PARTS OF THE BODY AND THEIR DISEASES

DR. BOZZINI[7]

Although our eyes may mislead us more than the other senses, the optical illusion is in most cases negligible when compared with the real image. The eye guides the other senses and verifies their impressions. Rarely does the eye need their support, while the other senses can seldom do without its assistance. Though the sense of touch provides ample knowledge, vision will support its findings, and the more of our senses that are concentrated on an object, the less likely will we be deceived. Until now, we were unable to look into the internal cavities and spaces of the living animal body. The anatomist's knife taught us only their forms; their functions could only be surmised. This is one of the main reasons why we are so far behind in our knowledge of the important laws of motion in the animal organism, even though no change can take place in nature except through increased or decreased motion!

Medical Science becomes more perfect, its branches complement each other, and thus improved, it ascends the missing steps easier and faster to the final goal.

To visualize the internal processes taking place in the cavities and interstices of the living animal body, it is necessary that (1) a sufficient amount of light be introduced; (2) the light rays be reflected back to the eye.

Execution of the first condition requires: (a) a physiological or pathological opening; (b) a light container; and (c) light conductors.

Fulfillment of the second condition necessitates a transmitter for the reflected rays, which I shall call a reflection conductor to differentiate it from the transmitter of the entering rays.

In order to best serve its purpose, it must (a) have a bright, steady light in a fixed position; (b) allow the in and outgoing conductors proper passage and easy mounting; and (c) have a suitable shape and size. To meet these requirements to some extent, I used in my light container a device that can best be described by distinguishing between the outer and inner surfaces, the upper part (a), the middle part (b), and the lower part (c).

It has the shape of a vase; its height is 12 inches and 5 lines, the width of the anterior and posterior outer surface is 8 inches, 2 lines, and the width of the outer lateral surfaces is 1 inch, 8 lines.

These dimensions are necessary to allow air circulation for a bright light and to prevent overheating. The whole contrivance is made of sheet metal covered with paper (cardboard) and finally with leather; the protruding round openings for the small rods and the compressed sphere on the upper part are made of brass and not covered.

The upper part has at the top an opening, to which is fastened with four rods a hollow compressed segment of a sphere which opens towards the bottom to permit insertion of a moist sponge because of the flame inside. It can be removed and should be considered the cover of the light container.

To the same degree as the strength of an artificial light is diminished by daylight, so will experiments with the light transmitter lose in clarity if conducted in a lighted room. The light transmitter has to be used in a dark room which may be lighted by a small flame.

Since a flame burns only in an upright position, the light transmitter must be kept upright. A horizontal position of the animal body is therefore the most desirable for its introduction. After the light in the light container has been lit, the reflection conductor put in place, and the upper part of the light container closed, the light conductor can be introduced alone into the cavity to be examined. Then the light transmitter can be moved close or be fastened to the light conductor, depending on purpose and circumstances.

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Irish physician Benjamin Guy Babington (1794–1866) began his career in the Royal Navy as a midshipman. He left the service and travelled to Madras in 1812 to serve in the Indian Civil Service. Due to health reasons, he returned to England in 1819 and began his studies in medicine, becoming a full physician in 1855.[8]

In 1829, Babington presented his "glottiscope" before the Hunterian Society. It was a double-bladed device with an oblong stainless steel mirror attached to a long shank and a tongue retractor united to it by a simple mechanism. Sunlight from behind the seated patient would be reflected by an ordinary looking glass held in the left hand, onto the laryngeal mirror introduced with the right, while the tongue depressor retracted the tongue base forward. He used the glottiscope on many patients, but left no record of his results. Although his design made laryngoscopy theoretically possible, it required two hands and lacked a practical source of illumination. It never became popular, and Babington himself abandoned the combination for a mirror without the tongue depressor. Indeed, but for the lack of documentation of his findings, Babington may well have been the first to successfully perform mirror laryngoscopy repeatedly.[9]

Walter A Wells presents a story of his experience with observing the introduction of the device created by Babington.

BENJAMIN GUY BABINGTON— INVENTOR OF THE LARYNGOSCOPE

BY WALTER A. WELLS[10]

On March 17, 1905, a little before noon, there was assembled on the auditorium at the home of the Royal Medical and Chirurgical Society of London, a very distinguished company.

Back of the stage was a life-size portrait, still veiled, but its identity not unknown to the audience. At exactly noon, all eyes were directed to a venerable figure approaching from the side, and as he mounted the platform and took his seat in the appointed chair, he was greeted with enthusiastic applause. The man was Manuel Garcia, who was this day celebrating his one hundredth birthday, and who was being honored as the inventor of the laryngoscope. He came to this meeting direct from Buckingham Palace, where as was stated by Sir Felix Semon, physician extraordinary to the King, he had had conferred upon him the Royal Victorian Order.

The Marquis of Villalobar announced that he had been instructed by his King to confer upon Garcia the Royal Order of Alphonse XII; and Dr. Frankel, of Germany, announced that he was there in the name of his Emperor to confer upon Senor Garcia the Great Gold Medal for Science.

It all made a beautiful scene—the kind it does the heart good to dwell upon, and that it seems a pity to have in any way marred; but if someone should be prompted to ask the familiar question, "What is wrong with this picture?" the answer would be, "Everything is wrong; they were honoring the wrong man." No one can be rightfully called the inventor of something that had previously been invented.

A little over 24 years before this, *viz*., on March 18, 1829, Benjamin Guy Babington had described before the Hunterian Society of London an instrument for examining the larynx that was essentially the same instrument. A report of the event is to be found in the *London Medical Gazette* of 1829, Vol. III, p. 555. "Dr. Babington submitted to the Society an ingenious instrument for the examination of the parts within the fauces not admitting of inspection by unaided sight. It consisted of an oblong piece of looking glass set in a silver wire with a long shank. The reflecting part is placed against the palate whilst the tongue is held down by the spatula, when the epiglottis and upper part of the larynx becomes visible in the mirror. A strong light is required and the instrument should be dipped in water, so as to have a film of fluid upon it when used or the latitus of the breath renders it cloudy. The Doctor proposed to call it the 'glottiscope.'"

Babington was thus the first to devise an instrument capable of affording a view of the larynx, and he employed it for clinical purposes. Garcia reinvented a similar instrument, which he successfully used for the observation and study of the vocal cords. It is to be presumed, being a non-medical man, that he was unaware of the previous invention of Babington, since medical men themselves were generally unaware of it.

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John Avery (1807–1855) was an English physician and surgeon. He completed his initial training in England and received his qualifications. Perhaps his greatest advancement was in adapting a Palmer's lamp (or miner's lamp) to be used when viewing the larynx.

After qualifying he went to Paris and took the MD degree, but did not use the title. From Paris he travelled through different countries and continued his studies. He possessed ample means, but was never tempted to become an idler. While he was in Italy there was war in Poland, and he conceived the idea of entering the Polish service, where he was at once appointed Surgeon-in-Chief to the 5th Polish Ambulance. He was made prisoner, lost his papers and baggage which were seized by the Russians and, being unable to communicate with his friends, lived for many months on an allowance of tenpence a day. After his release he began practice as a consultant in London, and was appointed Surgeon to Charing Cross Hospital in 1841.

At the time of his death, he had accomplished much that was original in practice, particularly in the treatment of cleft palate with large deficiency of bone, in the treatment of urethral stricture, and in the inspection of the internal canals of the body. By means of his lamp, tubes, and reflectors he was able to examine the ear, urethra, bladder, esophagus, and larynx, as probably no surgeon had ever examined them before him.[11]

George Duncan Bibb (1821–1876) tells of firsthand experience with observing Avery's device.

"In the year 1848 Mr. Avery showed me some cases of cleft palate at the Charing Cross Hospital, and at that time used instruments for looking at the throat and larynx, the posterior nares, interior of the bladder, and other cavities, with which he had been experimenting for some years. He used a laryngeal mirror attached to a stem, and employed artificial light with the flame of a candle in front of a concave, polished metal reflector, attached to the head by means of a frontal pad holding a double spring passing backwards to a counter pad beneath the external occipital protuberance. The reflector was perforated, so that when placed before the eye it allowed of vision through the opening. When the light was thrown into the throat, and the proper focal distance regulated, the mirror was introduced with the right hand, and the larynx was examined. Here were all the elements of laryngoscopy as now employed. Artificial light was used, although none of the best; the throat was illuminated by means of a fixed reflector perforated in the centre, and a laryngeal mirror was employed pretty much the same as now used. In his first attempts the laryngeal mirror was placed at the end of a large tube or speculum, on the principle of his other instruments for examining the urethra and bladder—the modern endoscope. This mode he abandoned for seeing the back of the nose and larynx, and used a mirror such as is figured in Dr. Yearsley's book.

"Unfortunately, Avery never published any description of his laryngoscope; but as it was well known to a number of persons, amongst others to his relative Dr. Yearsley, who has ably advocated his claims on the matter, and as it was supplied to one of the large London hospitals by Weiss, his merits in the question both of priority and history are not likely to be overlooked."[12]

Additional accounts of Avery's work:

"In the 1840's [*sic*], John Avery in London designed a laryngoscope that consisted of a new perforated concave mirror used to reflect light from an external source. This method revolutionized oto-laryngologic examination and is still in common use today."[13]

"In 1844, John Avery, a surgeon at London's Charing Cross Hospital developed a head-mounted mirror that reflected candlelight onto a mirror housed within a speculum. He didn't report his findings because he wished to first perfect a method of photography."[14]

"The endoscope (urethroscope) Avery introduced in 1840 was designed as an illumination device for urethroscopy and laryngoscopy. Avery's main innovation seems to have been his addition of a large head reflector as a supplementary light source. This modified reflector (called a Palmer's lamp, used by miners for years) intensified and redirected the candle light toward an attached Bozzini-inspired speculum."[15]

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Horace Green (1802–1866) is considered the Father of Laryngology in America.[16] He was committed to the treatment of the pharynx, larynx, and trachea. His name is included here because he was the first (documented) to visualize the larynx *directly* through a device.

"Horace Green was born in Chittenden, Vermont on December 24, 1802. Green's grandfather was a Massachusetts physician, who had four sons that fought in the American Revolution. Green's father was the only son who survived while his three brothers all died in combat. Green was the youngest of four sons and graduated from Castleton Medical College in 1824. In 1830, he attended further lectures at the University of Pennsylvania. After practicing for a few years in Vermont, Green moved to New York City in 1835. He traveled to Europe in 1838 to advance his studies and initiated his investigations in throat diseases upon returning to New York, where he practiced most of his career."[17]

Unfortunately, Green's accomplishments were considered unachievable by physicians of the day, and his results were questioned. Like Bozzini, he was ridiculed and slandered by those who did not believe it was possible to view the larynx *in vivo*.

"With such high failure rates, those who did achieve any degree of success were often referred to as either virtuosos—or charlatans. Horace Green of New York surely fell into the former category. Considered by many as the 'father of laryngoscopy in America,' Green's work was significant because he was the first to achieve *direct* visualization of the larynx, rather than relying on reflected images from mirrors. Contrary to other historical accounts, it was Green—and not Kirstein or Tobold—who was first to achieve this. This change to direct viewing anticipated modern laryngoscopic methods and required fairly sophisticated manipulation of light sources for inspecting what had been generally considered inaccessible. Retrospectively, American laryngoscopists also credit Green for establishing the field of laryngoscopy, since he was also one of the first to limit his practice to diseases of the throat.

"Green gave new meaning to the word industrious, and his unwieldy list of 'firsts' bears witness to the prolific outpour that was his life work. Perhaps of most significance, Green was one of the first ever to perform what must be considered the first successful laryngoscopic *operative* procedure. His case involved an 11-year old girl who suffered from severe sleep apnea, caused in part by a mass obstructing her glottal aperture. At the time of this procedure, *laryngotomy* had been successfully achieved in only one adult patient. Green therefore decided to instead try excising the mass *transorally*; in other words, in a minimally invasive manner. Under direct visualization, using his whalebone laryngoscope and reflected sunlight as his source of illumination, Green removed the polyp, thus curing the patient.

"In 1838 Green also was the first to introduce other forms of operative laryngoscopy, using his endoscope to deliver a sponge saturated with a cauterizing solution of 10% silver nitrate. Remarkable for his time too, Green was also apparently able to reach his treatment as far down as the lungs. Green's ability to perform such difficult procedures defied the medical understandings of his day. In fact, few others could repeat his procedures. One professor of anatomy refused to believe his results, brashly declaring his work to be an 'anatomical impossibility.' As a result of such skepticism, Green was repeatedly accused of fabricating his data and fellow colleagues demanded his expulsion from the New York Medical Society. A committee was even formed to investigate his claims, which were condemned as an 'unwarrantable innovation into practical medicine.'

"Yet Green possessed uncommon fortitude, for despite such hostility, he boldly continued his research and clinical practice, producing prolific volumes of work, including two textbooks, as well as groundbreaking articles. Ultimately, he was vindicated of all charges, as eventually other pioneers were able to understand his work and achieve similar results. Like so many innovators, Green had simply been too far ahead of his time."[18]

"Green was the first physician to apply topical medication to the larynx using a probang, and his claim in 1846 caused an international controversy. His method was to soak silver nitrate in a sponge attached to the tip of a 10-inch, curved whale bone, and apply the sponge directly to the larynx. Because so few physicians believed that the larynx could tolerate the presence of a foreign body, Green was accused of fraud. He suffered disrepute for a decade until he demonstrated his technique on patients in 1855 before a committee appointed by the

New York Academy of Medicine. In a private autobiography, he described the circumstances:

> *After my return from my second trip to Europe in 1851, I entered with more spirit than ever into the practice of my "specialty," the employment of local treatment of the air passages. My practice had greatly increased. My patients came from all parts of the world, but with this came also an increase of opposition from my professional brethren. Those who were unfortunate in business or from some other cause were envious of my success. They evinced a very unkind spirit and denied the possibility of my doing what I was doing in my office every day. But I would not quarrel with them, trusting that the truth would ultimately be known, and my word vindicated. For several, years now I have heard nothing of this opposition.*"[19]

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Now Manuel Garcia enters the laryngoscope timeline. Indeed, he was not the first to "invent" the laryngoscope. Why, then, is he credited as the forefather of the device that made it possible to observe the larynx *in vivo*? Jonathon Wright suggests the following:

"Garcia was entirely unaware of the previous attempts to accomplish his purpose with devices, some of which were identical with his own. His invention, great in utility as it was in the hands of medical men, was merely an incidental contrivance in those of the earnest teacher of singing, who desired to see the apparatus which produced the sounds he was endeavoring to train into harmony and the remainder of his communication is largely devoted to the conclusions he drew from what he saw in his own throat of the various laryngeal movements during the act of musical phonation. The announcement, therefore, was chiefly a demonstration of autolaryngoscopy.

"Garcia was called the Father of Laryngoscopy and in the sense that his independent discovery of the laryngoscope resulted in its utilization in founding the specialty of laryngology the title is deserved. Yet we have seen how long before him the conception of laryngoscopy and the actual invention of the laryngoscope had preceded his own. He had the rare fortune to live long enough to see the enormous consequences of the attention which his studies attracted. He lived to be more than a hundred years old, dying in 1906 in his 102d year. In 1905 delegations of laryngologists from all parts of the civilized world gathered in London on the occasion of his centenary to do him honor."[20]

Nezhat goes further and states the following:

"Despite the priority by many others in the field, medical historians conventionally date the beginning of laryngoscopy to 1854, when the Spanish voice professor, Manuel Garcia, demonstrated to London's Royal Society of Medicine an endoscopic method for indirectly viewing his own larynx. Noted for his charisma and persuasive communication skills, Garcia was able to capture the medical community's attention even without formal medical or scientific training. With his unique blend of personality and persistence, Garcia earned the title as one of the "fathers" of laryngoscopy.

"Despite his acclaim, Garcia's method appears to have been no more sophisticated than Babington's work from twenty years earlier. Relying solely on the most rudimentary principles of endoscopy, Garcia utilized a simple dental mirror (which he warmed beforehand to decrease condensation) and a second hand-held mirror to reflect sunlight.

"Though his ideas were not entirely original, Garcia nevertheless deserves mention in the history of endoscopy based on his tireless advocacy and persistent desire to perfect his technique. Famous for being the singing teacher to the opera stars of the day and filled with uncanny vigor, Garcia enjoyed a colorful and long life, living past the age of 100; and he was said to have maintained his sprightly spirit right until the very end."[21]

"Though highly acclaimed, Garcia's technique appears to have been no more sophisticated than Babington's work from twenty years earlier. Relying solely on the most rudimentary principles of endoscopy, Garcia utilized a simple dental mirror and a second hand-held mirror to reflect sunlight.

"Though his ideas were not entirely original, Garcia nevertheless deserves mention in the history of endoscopy based on his tireless advocacy and persistent desire to perfect his technique."[22]

In my opinion, there is one glaring difference between the stories of earlier discoveries and that of Garcia: Garcia was a teacher of singing, not a physician. Garcia's interest was in improving the singing voice. His entire purpose was to witness the larynx and to satisfy a curiosity. For voice pedagogy, the difference is significant. When I first studied anatomy and physiology, I was not

genuinely aware of the importance of the "physiology." I assumed I would only be memorizing parts of the human body. But the physiology, or how the anatomy works, is far more important. Garcia knew the anatomy but wanted to know how the larynx worked. He had questions. How do you achieve a richer tone? Why can one tenor reach a higher note than another? Why is there a break in some voices? These were the type of questions in which Garcia strived to find an explanation. To me, this desire for understanding should perhaps lead Garcia to be the "Father of Voice Pedagogy" instead of the "Father of the Laryngoscope."

I leave you with Garcia's own words. You may draw your own conclusions, but the importance of Garcia's work to singers cannot be denied. His discoveries opened a door through which many researchers have walked, allowing for the next "big question."

ON THE INVENTION OF THE LARYNGOSCOPE.

SIGNOR MANUEL GARCIA, M.D. (HONORIS CAUSA), LONDON[23]

To make a suitable reply to the flattering expressions addressed to me by our Chairman, and sanctioned by your approbation, would require a habit of speaking and an eloquence that I do not possess. *Parvus inter magnos*, I can but assure you how highly I appreciate the honour you have done me, and hope for your indulgent acceptance of my simple, sincere, and humble thanks.

In compliance with the desire which Dr. Semon was good enough to express in your name, I will tell you how the idea of the laryngoscope presented itself to me, and what were the results to which it led me. I fear, however, that this fragment of autobiography may prove a greater tax on your patience than you anticipate.

When I began to teach singing, the physiological explanations I was obliged to give to my pupils were purely empirical, and did not inspire me with any confidence as to results. At that time the vocal phenomena had been very imperfectly studied; thus, the number of registers, their extent, their individual characteristics, were not identical in the minds of all musicians. The timbres were often confounded with the registers; for no treatise of singing had yet appeared based upon anatomical and physiological considerations. In all cases instinct alone, sometimes happy, sometimes erroneous, was the only substitute for accurate knowledge.

Desirous of finding a more trustworthy guide, I began a course of anatomical and physiological studies, and the information thus acquired, added to the results of experience, were published in a method of singing; but some of the deepest and most interesting questions of physiology remained to me still unsolved.

I was especially anxious to find out what was the actual rôle played by the glottis in the production of the voice; but where to find the necessary information?

The authors who wrote on the voice took their ideas of what the action of the healthy, living glottis might be from glimpses they caught of it through wounds, or from experiments on dead bodies, or from vivisectional researches. As for the acoustic laws that govern the movements of the glottis, every writer on the subject explained them by analogies found in musical instruments of different kinds. Thus, the stringed instruments, the reed instruments, the appeau, &c., have all served as means of comparison.

These two systems, one of induction the other of comparison, though the only systems then possible, inevitably led to different theories on the part of observers, and could not fail to keep the mind of the student in a state of perplexity. To dissipate my own doubts, I could think of but one method—it was, to see a healthy glottis exposed in the very act of singing; but how could the mysteries of an organ so well hidden be unveiled? One September day, in 1854, I was strolling in the Palais Royal, preoccupied with the ever-recurring wish so often repressed as unrealizable, when suddenly I saw the two mirrors of the laryngoscope in their respective positions, as if actually present before my eyes.

I went straight to Charriere, the surgical-instrument maker, and asking if he happened to possess a small mirror with a long handle, was informed that he had a little dentist's mirror, which had been one of the failures of the London Exhibition of 1851. I bought it for six francs. Having obtained also a hand mirror, I returned home at once, very impatient to begin my experiments. I placed against the uvula the little mirror (which I had heated in warm water and carefully dried): then, flashing upon its surface with the hand mirror a ray of sunlight, I saw at once, to my great joy, the glottis wide open before me,

and so fully exposed, that I could perceive a portion of the trachea.

When my excitement had somewhat subsided, I began to examine what was passing before my eyes. The manner in which the glottis silently opened and shut, and moved in the act of phonation, filled me with wonder.

From what I then witnessed, it was easy to conclude that the theory which attributed to the glottis alone the power of engendering sound was absolutely confirmed, from which it followed that the different positions taken by the larynx in front of the throat have no action whatever in the formation of sound; although, combined with divers elevations of the soft palate, they change the shape and the dimensions of the pharynx. In these changes we find the means of varying the qualities of the voice known as *timbres* or *Farbenklänge*.

I also perceived that vocal sounds are the results of explosions, not of communicated vibrations. This is proved by the fact that each separate lip of the glottis is incapable of producing any kind of sound. Besides, the lips do not protrude sufficiently to form vibrating reeds; and, if protruding, how could they vibrate in spite of recurring contact with each other?

Having thus seen the vocal organ in action, I next began to study the mechanism of the scale. This mechanism has two aspects—an exterior movement, visible with the mirrors; and an internal cause of that movement, which anatomy alone can explain. The exterior movement becomes manifest in the development of the scale.

Beginning from the lowest note, the glottis is put in motion throughout its whole length; but as the voice rises, the anterior apophyses are gradually pressed closer by a movement which spreads from back to front, and they are alternately in close contact. These continuous encroachments diminish the vibrating portion of the glottis until it becomes reduced to the ligaments alone.

The internal cause resides in the intrinsic muscles; and, among these, that which coats the outer surface of the crico-thyroid membrane—namely, the thyro-arytenoid muscle—was to me of the greatest interest. The fibres of which it is composed, although all starting from the anterior and lower cavity of the arytenoid cartilage, are not all of equal length. The most internal are the shortest. Each successive fibre becomes progressively longer and terminates in a more distant point of the ligament; the longest and most external only reaching the thyroid cartilage.

From this remarkable disposition, it follows that only the shortest fibres contract for the deepest notes, and, as the voice ascends, successive fibres come accumulatively into play.

To complete the subject, I ought to speak of the action of the other intrinsic muscles; but that has been already treated in the pamphlet read at the Royal Society in 1855. In the same paper I have also expressed my ideas as to the formation of the registers.

If I have spoken somewhat in detail of the thyro-arytenoid muscle, it is that its special characteristics—the unequal length of its fibres and their insertion in the ligaments—have been disputed. But before venturing to represent as fact this result of my observations, I wished to make sure that I had not been mistaken; and, therefore, consulted Professor Thane, who, with a cordial interest for which I cannot sufficiently thank him, not only examined the contested point, but presented me to Mr. Shattock, begging him to assist me with his experience.

This is the drawing which that most skilful anatomist has been good enough to make for me. It entirely confirms the view which I have had the honour to place before you. I will not trouble you with further details.

The laryngoscope in itself is not an invention—it is a simple idea; and when I suggested to Dr. Mandl and to Dr. Segond that they should test its usefulness in the practice of healing, I was far from anticipating the brilliant future your science and skill reserved for it.

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