GIVE LIGHT TO THEM THAT SIT IN DARKNESS

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Ear, nose and throat surgery began to emerge as a separate discipline only in the second half of the nineteenth century. The first Englishman to specialise in laryngology was Morrell McKenzie (1837-1892). Amongst his achievements were the foundation of the Throat Hospital in London 1866, the major textbook on "Diseases of the Throat and Nose" (the standard textbook up to about 1960) and the founding of the *Journal of Laryngology* in 1887. His counterparts in otology were James Yearsley (1805-1869) who founded the Medical Directory, Toynbee (1818-1866) and Sir William Wilde (1815-1876), founder (1841) of what is now the Dublin Eye and Ear Hospital and father of Oscar Wilde.

The first English clinics devoted to ear disease were probably the Ear Dispensary, opened in 1816 in London (later the Royal Ear Hospital) and the Metropolitan ENT Hospital (founded 1838). Provincial centres were also founded in Shrewsbury (1818), Leeds (1829), Liverpool (1841), Birmingham (1844), Manchester (1855), Bradford (1857), Newcastle (1877), and Brighton (1878).

I would like to address the question of why the speciality emerged at the time that it did and show how technological developments in the delivery of light (reflected and transmitted) both created and shaped this discipline.

DAYLIGHT

Reflected Light

The first successful use of reflected daylight was that described by Hoffmann in 1841. He set a mirror perforated in the middle to reflect daylight into the ear canal. This method presented difficulties: the examination could only be done during the day, beside a window free from curtains, the surgeon had to stand between the light and the patient,

risking obscuring the view with the shadow of his head, and finally "in a climate so rich in clouds and rain as that of Germany and England, we must often wait weeks to find daylight enough to make an examination of the ear" (von Troeltsch, 1864).

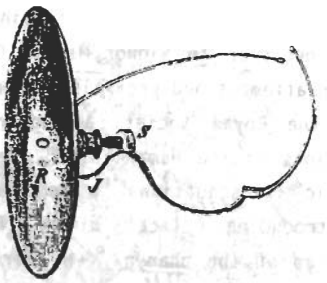
Nearly fifteen years earlier, in 1827, Senn, of Geneva, "had a little mirror constructed for introduction to the back of the pharynx; with it he tried to see the upper part of the larynx - the glottis". In 1829, Dr Benjamin Guy Babington exhibited at the Hunterian Society an instrument closely resembling the modern laryngoscope. Two mirrors were employed, the smaller for receiving the laryngeal image, the larger for concentrating the solar rays on the first. The patient sat with his back to the sun, and whilst the illumination mirror (a common hand looking glass) was held with the left hand, the laryngeal mirror was introduced with the right.

Use of laryngeal mirrors was further described by Baumès (1838) and Liston (1840) and in 1844, Warden, of Edinburgh, conceived the idea of employing a prism of flint glass for obtaining a view of the larynx.

In 1854, "the idea of employing mirrors for studying the interior of the larynx during singing" occurred to Signor Manuel Garcia, who was quite unaware that any similar attempts had previously been made. The following year he presented to the Royal Society an admirable paper, entitled "Physiological Observations on the Human Voice", reporting the important results of laryngoscopic investigations he had made on himself. His method consisted of introducing a little mirror, fixed to a long stem, suitably bent, to the top of the pharynx. He directed that the person experimented upon should turn towards the sun, so that the luminous rays falling on the little mirror should be reflected into the larynx, but he added, "if the observer experiments on himself, he ought, by means of a second mirror, to receive the rays of the sun, and direct them on the mirror which is placed against the uvula".

Signor Garcia's communication to the Royal Society, though causing little stir at the time, was destined to create a new era in the physiology and pathology of the larynx. Treated with apathy, if not with incredulity, in England, his paper passed into the hands of Professor Türck, of Vienna, and soon effected a revolution in the investigation and treatment of laryngeal disease. In 1857, during the summer months, Türck endeavoured to employ the laryngeal mirror in the wards of the General Hospital. In November of the same year, Professor Czermak of Budapest began to work with one of Türck's laryngeal mirrors, and in a short time overcame all difficulties. Artificial light was substituted for the uncertain rays of the sun, the large ophthalmoscope mirror of Ruete was used for concentrating the luminous rays, and mirrors were made in different sizes. Thus it was that Garcia's reinvention of the laryngeal mirror led Czermak to create the art of laryngoscopy.

For throwing a light on the laryngeal mirror, and thus into the larynx, a circular mirror about three inches and a half in diameter was used, with a small hole in the centre (McKenzie). The mirror might be attached in some way to the operator's head (either by a spectacle-frame (Semeleder), or by a frontal band, as recommended by Kramer, and first employed by Bruns), or fixed to a horizontal arm, which was connected with the body of the lamp (Tobold) (in which case the reflector need not be perforated). The mirror

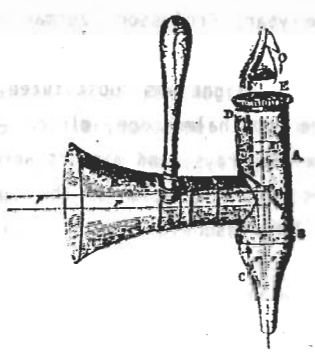


REFLECTOR ATTACHED TO SPECTACLE-FRAME, FROM WHICH THE UPPER HALVES OF THE RIMS HAVE BEEN REMOVED.

might be worn either opposite one of the eyes (Czermak), in front of the nose and mouth (Bruns), or on the forehead (Fournie, Johnson, etc.). Looking through the hole of the reflector offered the great advantage of entirely protecting the observer's eyes from the glare of the light.

Transmitted Light

The first method using transmitted daylight for the examination of the ear canal was Brunton's otoscope. Light was admitted through a bell-shaped lateral orifice and reflected by a prism mirror occupying half the lumen of the tube. The observer could thus look down the unobstructed half of the tube.



In 1832, Bennati, of Paris, used an instrument made by one of his patients named Selligue. It consisted of a double tubed speculum, one tube of which served to carry the light to the glottis, and the other to bring

back to the eye the image of the glottis reflected in the mirror, placed at the gutteral extremity of the instrument.

CANDLELIGHT

Few improvements in candlemaking were introduced until the early 19th century, when Chevreul's production of stearin exerted its impact on the industry. From this beginning, new processes for producing pure candle stock appeared in rapid succession, culminating by the mid-nineteenth century in the use of a combination of paraffin wax and stearic acid.

Candles were not used as a source of illumination in medicine until the 19th century. Bozzini was the first to use them in this 'Lichtleiter', described in 1807. His invention consisted of two essential parts: a kind of lantern and a number of hollow metal tubes (specula). In the sides of the lantern there were two round holes, a larger and a smaller one, opposite each other. To the smaller one an eye-piece was fixed, to the larger, the speculum. The flame of the candle was situated just below the level of these two apertures. In employing reflected light, Bozzini had the speculum divided by a vertical partition, so that there were, in fact, two canals and two mirrors. One of these mirrors was intended to convey the light, the other to receive the image.

The figure given in Morrell MacKenzie's textbook as 'Bozzini's laryngeal speculum' is clearly not from the original. This mistaken description has been copied by several later authors, such as Scott Stevenson & Guthrie who say that 'it is highly unlikely that Bozzini ever saw any part of the larynx with his speculum'. This statement is very likely to be true but for the wrong reasons. Bozzini's original article shows that his device was intended mainly for physiological experiments on animals and was not intended for the examination of the larynx. Nor did Bozzini describe the use of his instrument on a single patient. Clearly, the authors had not read the original article.

A successful use of candles was that proposed by Avery, a surgeon to Charing Cross Hospital in 1844, who was seeking to examine the various

canals of the body with the aid of a speculum and reflector, 'as probably no surgeon before him has ever examined them' (Lancet, 1853). In principle, Avery's laryngoscope was very similar to that now in use and Avery had his champions after the success of Garcia's experiments.

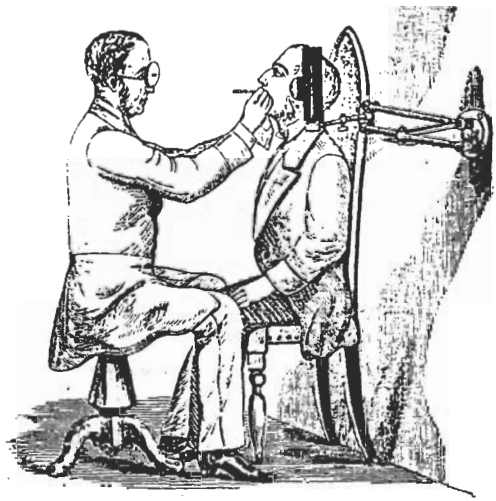
GAS LIGHTING

It was at Newcastle, about 1760, that the first fully authenticated attempt was made to light a room by coal-gas.

The idea of distributing gas throughout a district from a central generating station first presented itself to the mind of the German immigrant, F.A. Winsor (formerly Winzer), who from 1806 onwards was trying to secure a parliamentary charter to illuminate London. In 1807 he was allowed to advertise his project by lighting part of Pall Mall, and, in spite of war-time conditions and the bitter opposition of Boulton & Watt and other interested parties, by 1812 he had secured a charter for The Gas Light and Coke Company. By December 1814 London had 26 miles of gas mains.

Gas light was already seen to have many advantages to outweigh the expense of installation; besides its greater convenience, the supply cost only one third or even one quarter as much as the same amount of light derived from oil.

By the last quarter of the century gas-light was in common use as a light source which was then reflected by a head-mirror. Morrell McKenzie in his textbook of 1880 tells us that "an argand gas burner will be found very convenient especially if constructed on the reading lamp principle so that it can be fixed in different heights.... The power of the light is increased by a lens placed in front of the flame. My lamp is used in nearly every hospital in this country where laryngoscopy is systematically employed".



ELECTRIC LIGHT

The principles on which electric lighting is based had been established at the very beginning of the nineteenth century. (Sir) Humphrey Davy, as early as 1802, had remarked the brilliant light that was emitted when an electric spark was struck between two carbon electrodes. It was also known that the passage of electricity through a conductor caused the latter to become heated: this is the principle of the incandescent filament lamp, in which a conductor is heated to so high a temperature that it glows and emits light. Not until the latter half of the century (1870s-80s), however, did these two discoveries reach a state of development where they could be turned to practical account.

By 1900 the supremacy of incandescent lamps over all others for domestic use was fully recognised: they were convenient, clean, safe, and reliable. Their adoption was, however, controlled by the rate of the development of public electric-supply services. Electric lighting was an accepted feature of urban life by 1900.

The advent of electricity made possible endoscopy. Since Kussamaul's momentous experiment just over 100 years ago, endoscopy had achieved

considerable importance. Failure to exploit the full potential of this method has always centred round the limitations of optics and illumination and the difficulty of obtaining good photography for permanent records. The restricted visual field seen through the distal end of a small tube was readily recognised as a significant factor. In 1879 Nitze introduced the first telescopic cystoscope which when adequately illuminated (with a platinum wire in the beak) would transmit the image from a deep hole to the examiners' eye.

The distally lighted telescope immediately became practical for use, not only in the cystoscope, but also in esophagoscopy, gastroenteroscopy, bronchoscopy and laryngoscopy. Telescopes for these purposes were rapidly developed. These telescopes, with minor modifications and improvements, have remained essentially unchanged, and consist of a series of small lenses separated by air spaces. They served to increase the viewing angle, but the image remained small. An even greater deficiency of these early endoscopic telescopes was the enormous amount of light absorbed by the lenses.

The development of tiny incandescent light bulbs led to the replacement of the rather unsatisfactory proximal reflected lighting. Small guide tubes incorporated into the walls of the endoscopes were designed to guide the light carriers to the distal end of where the tiny globes provided improved but uneven illumination.

The application of a rigid quartz rod for transmission of light from a powerful external source was a significant if short-lived advance. Montreynaud, Edwards and Gladu used an instrument designed by Vulmier and Fourestier to provide a practical method of illumination of sufficient intensity to obtain colour photos through conventional lens systems. The early obsolescence of the quartz rod system was speeded up by the development and application of fibreoptics to endoscopic instruments.

The current exciting advantages in endoscopy centre around the development and application of two relatively new discoveries. It was Lamm, who, in 1930, discovered the principles of the transmission of an image through

multiple small flexible fibreglass threads that were carefully sorted and held tightly together in a coherent bundle. The second recent advance of importance in endoscopic instrumentation has come about with the discovery and application of an entirely new telescopic rod lens system developed by an English optical physicist, Hopkins. In essence the air containing spaces between the conventional series of lenses has been replaced with glass rods with polished ends separated by small "air lenses".

The advantages of this new design are considerable, not least of which is that the light transmission is between eight and nine times that of the conventional system, where the amount of light could not be increased without endangering the patient. The principle of conducting light along a curved glass tube had been known for a long time and in 1927 while experimenting with television Baird had patented a method of transmitting an optical image along glass fibres.

Light is provided by a high intensity source which contains two quartz halogen projection lamps, one to be kept in reserve in case of failure and both cooled by an axial fan. The intensity is controlled by a solid state resistor: for normal practice half the maximum intensity gives sufficient light for a satisfactory examination of the urethra or bladder. The light is conveyed to the telescope by a cable made up of bundles of incoherent fibres about 2m in length with a protective covering to prevent unnecessary damage. It is important that the cable terminal attached to the telescope light pillar is made to precise tolerances so that the gap between the fibres in the cable and those in the pillar is as little as possible because any undue separation results in light loss: as much as 20% of the light can be lost at any interface where the gap is too wide.

The final development, which has revolutionised many branches of surgery is the introduction of the operating microscope, now used in many types of surgery, but first developed in ENT.

In 1921 Nylen, then Assistant Oirector of the Stockholm University Ear Clinic, used a monocular microscope for surgery, and Holmgreen, Nylen's teacher, used a binolular microscope in 1922. Shambaugh in 1942 developed

the prototype of the current models in which illumination was provided by a prism arranged between the objectives. The very latest advance thus depends on the principle of beam splitting, first realised by Brunton and used in his otoscope, designed in the middle of the nineteenth century.

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