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CONSIDERED.

BY

CHAS. W. STEARNS, M.D.



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PALATINE FISSURE:

ITS REMEDY BY ARTIFICIAL MEANS CONSIDERED.

BY CHAS. W. STEARNS, M. D.

SEVERAL years ago I devoted considerable time to the treatment of cases of Congenital Fissure of the Palate, by the application of an artificial elastic *velum*, made of the then newly-invented vulcanized Caoutchouc. My success, as often happens with new things, was quite remarkable in one or two of my first subjects, so that I was advised by several medical men of eminence to make the matter a specialty. I then passed nearly two years in Europe, and while there published several papers in the London Lancet, (August and September, 1845,) from which considerable extracts may be found in Braithwaite's Retrospect, (Part 12, Art. 117, page 194, Scribner's Am. reprint,) and in Harris' work on the Practice of Dentistry. But my success on the whole was not sufficient to warrant me in continuing to devote my whole time to that one subject in a foreign country; and, in the meanwhile, some changes had taken place in matters at home, which made it prudent for me to return. After which I dropped the subject for several years, but can give, in a few words, the net results of my first experience.

Altogether some eight or nine cases came under my hand for treatment at that time. The *first* was a young man of twenty-six years; the roof of the mouth was entire, but the fissure through the soft parts was very large, as two surgical operations had been performed in childhood. This first case occupied a great deal of my time for two years, and the result, I may be allowed to say, was astonishingly successful, as I shall directly have to confess my ill-success in other cases that followed close upon it. The *second*—a young man under thirty—was a very bad hare-lip case, with a large fissure extending through the roof of the mouth. He was considerably benefited; and, I am told, he continues to wear the instrument, and has been enabled to take some part in public business.

The *third*, also a young man, was a more favorable case, as the

fissure extended only through the soft palate, and which had been closed for half an inch at the apex by an early surgical operation, but leaving an oval aperture just below the margin of the palatine bones. This case, I doubt not, would have proved as successful as the first one, but the patient was obliged to leave and return to his business, in the southern part of the country, without allowing me time enough to finish my work. The remaining cases were treated in London and Paris. The first was that of a girl, about sixteen,—with fissure of the soft parts only. This was wholly unsuccessful! Although it presented no formidable or peculiar difficulties as to the proper adaptation of the instrument, yet the speech was but little, if at all, improved, owing, as I think, to the entire inability of the patient to move and place her tongue in the manner required to articulate certain consonant letters,—though she received daily instructions to that end for some two months. She seemed wholly unable to subject the movements of her tongue to the will, so as to place it as she was directed; and all her efforts to do so were quite at random. As may be supposed, the result of this case was quite discouraging.

The next was a young gentleman of eighteen, of good education, and with him the fissure was limited to the soft palate. He had for a year or two previously worn an ingeniously-contrived instrument, consisting of several gold plates, joined and lapped, like the scales of a fish, so as to move a little with the surrounding soft parts, and which was made by Mr. Nasmyth, then dentist to the Queen. He began to improve at once from the day I finished the instrument for him; and the last I saw of him he had progressed so as nearly to equal the result of my first eminently successful case.

The *third* case was that of a man over forty, where the fissure was not congenital, but caused by syphilis. The result in this was successful from the first, as might have been anticipated, as he required no instruction as to the movements of the tongue necessary for articulation.

The next was a lady over thirty, highly educated, whose case was of the hare-lip class,—the fissure being very large, and extending quite through the roof. My efforts with her case were, in great part, unsuccessful, though the patient herself seemed to be better satisfied with the result of my endeavors than I was. She also seemed, in great part, unable to subject the movements of the tongue to her will, so as to place it as instructed to do. I believe I now understand why this lady was not more materially benefited, though at the time it was to my mind inexplicable, for the features of this case exactly resembled the next one,—that of a lady, about twenty-five, of high respectability. Here, also, the fissure was very large, extending also

through the roof and alveolar sockets, so that the nares and fauces presented one enormous, irregularly-shaped cavity, and requiring a most formidable-looking piece of mechanism to fill it. This lady very soon improved under vocal tuition, so that within the first fortnight she found that, when out "shopping," whatever she called for was instantly shown to her; and she had before this been greatly annoyed by not being able to make herself understood by the shop-people.

The last case hardly needs be mentioned,—that of a young lawyer's clerk, with fissure extending forwards about half-way through the roof. He got impatient under my manipulations before the end of a fortnight, and gave up the undertaking without allowing me time to complete the instrument.

This ends my *earlier* practical experience in undertaking to remedy defective palatine formations by artificial contrivances; and the result on the whole not being satisfactory to me, I ceased to seek further subjects, and soon became otherwise occupied, so that I was obliged to decline giving my time to them when offered, and therefore avoided any further publicity in the matter. A subject, however, which had for years interested me greatly, could not but continue to occupy my thoughts from time to time. The result of my reflections in the interval tended to make me aware in what points the instruments as at first constructed might be improved, and so afford a chance of more uniform success. The instruments, as at first made, were defective. 1st. By the use of flattened spiral springs, of great delicacy. These, though made of fine drawn gold wire, coiled three deep, and then rendered perfectly elastic by hammering and burnishing, were yet liable to accidental derangements by careless handling, and which at once impaired the efficient action of the instrument. 2d. The method of fixing the instrument in its place in the mouth was objectionable, (being the same that is much practised by dentists,) by clasps to the teeth. The consequence was, that the whole apparatus hung to the teeth forwards, while the velum behind had a tendency to droop and fall away, instead of remaining, as it ought, closely in contact with the surrounding fleshy parts. 3d. The form of the artificial velum was not perfectly adapted to the shape of the parts *out of sight*, that is, *behind* and above the edges of the fissure. The adaptation of the velum at those points being only approximate and casual.

About three years since, two important cases of palatine fissure were brought to my notice, and I was strongly urged to undertake their treatment. This afforded me a chance of trying such expedients as had occurred to my mind in the interval, for avoiding the three especial imperfections of my earlier work. Instead of the delicate

flattened spiral springs used at first, I now employed an elastic alloy of gold wire, made very thin and hard by hammering. This form of spring has answered the purpose so well as to leave nothing else to be desired. To support the instrument, and keep it snugly in its place, I now depend but very little upon clasps to the teeth, *but almost wholly upon the form of the artificial velum at its upper end*; at which point the flexible rubber is molded pretty thick, so as to have considerable firmness, and of such a form (that is, much broader at its upper end, than the width of the fissure) as to slide behind and hook on over the projecting shelf or edges of the imperfectly-formed maxillary and palatine bones, so that the use of the clasps to the teeth (and these clasps may be quite loose) is merely to steady the instrument, and prevent it from being carried backwards and downwards with the food in the act of deglutition. To place the instrument in its position in the mouth, it is necessary to thrust it gently backwards and downwards as far as possible, so as to pass the broad upper end of the velum behind and above the fleshy edges of the fissure, and then it is drawn forwards and upwards, so that its upper end finally rests upon the superior surface of the bony shelf; and, lastly, the clasps are slipped over the teeth, and the whole apparatus is thus firmly secured in its place without pressing or binding too hard at any one point, so as to be uncomfortable to the patient.

With this general account as an introduction, I will now proceed to consider the whole subject more in its practical details.

Cases of Congenital Palatine Fissure may all be classed under two species. 1st. Those in which the fissure extends only through the velum or soft palate, and leaving the palatine or maxillary bones forming the roof entire. 2d. When the fissure extends quite through the roof and alveolar sockets, and usually complicated with hare-lip; but, as happens in other malformations, these two classes often run into one another. Thus, I have seen several cases of the first class where the fissure extended from one-eighth to three-quarters of an inch into the posterior margin of the bony roof;—one case where the roof was entire, but yet there had been a double hare-lip. Another case, I recollect, where the lip was full and perfect, yet the roof was widely fissured quite up to the alveolar sockets, but leaving the teeth straight and regularly developed.

The late Doctor Arnott, of London, told me of a case he once saw, of a laboring man, whom he noticed was much given to the luxury of eating figs. Upon inquiring the reason of his thus indulging his appetite, he learned that the poor man had a large congenital opening through the bony roof, while the velum was entire, and he used the

skin of the fig to close the opening, as he found that by so doing he could speak much better!

In cases of the first class, the fissure through the velum is a symmetrical parabolic arch of muscular tissue, having its apex at the margin of the palatine bones; and, on each side, about an inch below, a small fleshy nipple-like process, and which are obviously the remains of the imperfectly developed uvula. Continuing downwards, as far or below the tonsils, the muscular fibres join and interlace with those of the pharynx, and in part with the base of the tongue, or are inserted into the bone.

This class of cases I regard as offering by far the most favorable chances for relief by the use of an artificial velum; and it is the only sort that the surgeon is ever justified in attempting to close by suture. These cases differ greatly from each other in the volume of muscular tissue forming the sides of the fissure, being in some subjects so thin and tense as to have but little muscular movement; in others they are round and thick, so that when in a state of relaxation or repose, they are seen to approach very near together. These are the rare cases where surgeons have succeeded by a masterly effort of operative skill in closing the opening by suture. They have also attempted numberless other cases, where, from scantiness of material, the operation has failed to result in a union. Dr. Arnott (author of *Elements of Physics*) told me of a case he had seen where the imperfection of speech was very considerable, yet, on looking into the mouth, the velum at first sight appeared perfect. By the slightest movement of the palatine muscles, however, as in speaking, the two halves of the velum were instantaneously contracted and drawn to each side so as to show a very considerable opening, which allowed the voice to escape by the nasal passages. In a state of rest the edges of the fissure were closely in contact, the effort to speak drew them to each side as one would a window-curtain. Such a case would not only offer no chance for the introduction of any artificial appliance, but plainly invite a surgical operation.

A great many of the less favorable cases of this class have been operated upon by eminent surgeons with various results. In two that I have seen, a firm union, with some degree of mobility, had been secured for a short distance below the palatine bones. In one, that Mr. Liston described to me as occurring in his own practice—a well-grown girl at the London (University) Hospital—he succeeded in getting a union for the whole length of the fissure; but after the parts were healed he found that, instead of a serviceable velum or muscular valve, capable of closing, narrowing, or opening the nasal passages at will, he had a rigid, fleshy septum stretched across from side to side;

and this septum was not only in the way of the ordinary movements of the tongue, so as to interfere with deglutition, but it also had the effect to divide or split the column of sound as it issued from the glottis, and so turn a part of it through the nasal passages. He was so dissatisfied with this result, that with one stroke of his bistoury he slit down the newly-formed velum, and undid, in a moment, all that a long and skilful operation, followed by patient attendance, had achieved.

Other cases that have been operated upon are to be met with, where, by dissecting off and freeing the soft parts, to some extent, from their attachments to the palatine bones, the surgeon has sought to overcome the difficulties caused by the want of material, and consequent rigidity of the parts. In this way a union at the lower part of the fissure has been secured; but there remained an oval-shaped hole above and just below the margin of the bone, where the edges presented scarcely more than a duplicature of the mucous membrane to be scarified and forcibly drawn together by suture.

There will usually be found a great uniformity in the shape and general appearance of the fissure in cases ranked under this first division, and the two sides of the opening are quite symmetrical.

In cases of the second class, where the opening extends through the palatine and maxillary bones, and usually accompanied by a hare-lip, which has been closed by a surgical operation in early childhood, a great diversity in the form and size of the opening will be met with. Upon first looking into the mouth, a large, shapeless cavity will be seen; but the fleshy part of the fissure is more symmetrical than that of the bony part, resembling, in this respect, the cases of the first class, excepting that the gap is usually much broader. The irregularity of shape is owing to the malformation and malposition of the bones forming the roof. Though the fissure through the bones may be nearly on the median line, yet, in the great majority of instances, the vomer or septum nasi is brought down so as to meet and articulate on one side with the plate of one or the other of the superior maxillary bones, thus forming one tolerably perfect *naris*, generally the one on the right side, while the other *naris* has no floor, but makes one continuous cavity with the fauces, extending upwards to the base of the cranium. In some cases of this second class, the opening will be found more symmetrical, having the septum or vomer incomplete, and which is seen dependent from the base of the cranium on the median line, but not reaching down far enough to intersect and unite with the plate of either maxillary bone, so that neither *naris* is completely inclosed, but both together form one continuous cavity with the mouth, the incomplete plates of the maxillary bones making a pro-

jecting ledge or shelf on each side, continuous with the fleshy edges below. And it is these firm projecting ledges, on one or both sides, that I make available for supporting the instrument, and keeping it firmly fixed in its place. The opening of the fissure through the alveolar sockets may be so wide as to equal the space occupied by two, four, or even six of the front teeth, but commonly the edges of the bony fissure at the region of the teeth are closely in contact, so as to seem, in fact, united, but any thin substance, like a quill tooth-pick, may be passed freely between them, showing that there is no continuity, but only close contact.

The cases belonging to this second class, as just described, will be found to require, from any one undertaking to relieve them by artificial appliances, all the skill in manipulation that he is master of, both in copying the malformation by impressions taken with plastic substances, and, after that, making an instrument from his models thus obtained that will correspond to the shape of the parts to be fitted at points *not visible*, as well as those in plain sight. *Hoc opus hic labor.*

The conditions required to be fulfilled in any successful attempt to construct an artificial palate, or "obturator," as it has been more briefly named, are a nearly perfect adaptation to the irregular shape of the opening, and a combination of the properties of elasticity and durability in the material of which the instrument is constructed. The vulcanized '*soft rubber*' possesses these in a remarkable degree, and which, added to its highly plastic quality, leaves hardly any better material for the purpose to be desired. In fact, the vulcanized "soft rubber" may, with some propriety, be termed, in this connection, *artificial flesh*, and the vulcanized "hard rubber," now much used by dentists, may, with even greater reason, be called *artificial bone*. The properties of the vulcanized soft rubber, in respect to durability, are quite remarkable when we reflect that, placed in the mouth, it is there subjected to the combined action of *five* destructive agents, viz: animal heat, moisture, motion, the salivary acids, and the oils of the food,—all acting together and incessantly upon it. When this is molded to the shape required, and, with a high degree of elasticity, it is yet flexible and soft as the finest kid, we may say that we are supplied with just the right material; and it only remains for us to make a good use of it. The *degree* of elasticity is a point that must be carefully attended to in manipulating the rubber, for, if the velum is made too hard and stiff, it will cause pain, and otherwise embarrass the action of the soft muscular parts with which it is in contact. If, on the other hand, it is too soft and yielding, it will not react or expand quickly enough, but will be liable to be clogged by food and the viscid fluids of the mouth; nor will it long sustain, as it

must do, not only the ordinary pressure upon it in speaking and swallowing, but also the more violent and spasmodic efforts of coughing, sneezing, vomiting, etc.

I will now proceed to explain, as clearly as I am able to do in words, the plans and methods I have used in adapting artificial vela to relieve the different forms of palatine fissure already described; and trust, by the aid of the accompanying drawings, to make myself understood by those who may happen to be especially interested in the subject.

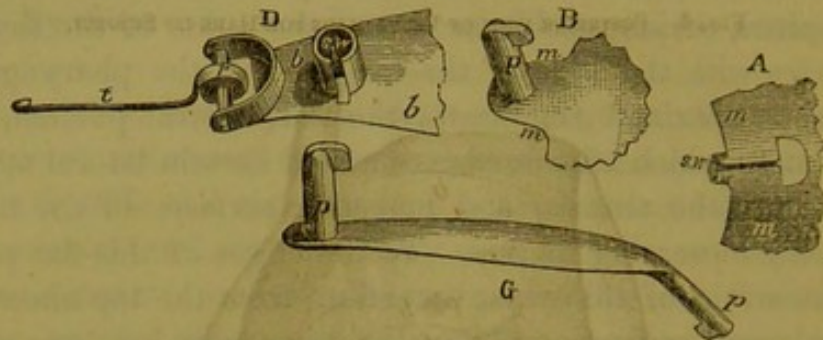
All cases require, in the first place, a plate or roof of gold, or some other convenient substance to be prepared, to the posterior margin of which the flexible and elastic velum is to be attached. Where the fissure does not extend into the bony roof, as in cases belonging to the first class, a narrow arch of gold plate from the molar teeth on one side to those on the other, will be sufficient for our purpose. But when, as in cases of the second class, the opening reaches far forward, then an artificial roof has also to be supplied; and plates made of gold are found too heavy; but the vulcanized hard rubber, by its combined lightness and strength, is much to be preferred. The plate or artificial roof having been properly fitted to the bony surface, the making of the velum is next to be proceeded with.

As the velum is to be fitted to the fleshy, and therefore mobile region of the fissure, its shape and size must be determined by a resort to some expedients other than what are used to get a cast of the bony portions; for it is manifest that however soft and plastic the wax or other substance might be, the sensitiveness of the fleshy parts would cause them to retract instantly from contact with a foreign substance; so that the form of the fissure must, for the moment, be changed to something different from what it is while in a state of rest. Added to this, the degree of pressure, however slight, required for taking an impression of parts that in fact have no more solidity than the lips or the tongue, must of necessity cause some displacement; I therefore resort to other means for getting the shape of the lower portion; but for the upper portion, say half or three-quarters of an inch above and below the point where the muscular fibres are attached to the bones, I am enabled to get pretty accurate plastic impressions. I have always found much greater irregularity in the form of the soft parts, *behind* the edges of the opening, and which are out of view, than is seen on the anterior surfaces, which are pretty symmetrical. This irregularity of the shape of the posterior surfaces is caused by the abnormal position and form of the palatine bones, to the edges of which the long slender muscles forming the columns of the soft palate are superiorly attached. The artificial roof being extended backwards to a point

where the fleshy tissue begins, I first get the form and breadth of the opening from that point as far down as the little pendent nipple-like processes, by using a lamina of wax, not softened, attached obliquely to the end of a stick, paring the edges with a knife until the wax can be passed backwards and forwards through the fissure, and is seen to correspond in shape. This lamina of wax, thus brought to the required shape, I afterwards extend downwards by the addition of another and broader piece, which reaches as low as the union of the slender palatine muscles with the base of the tongue and the pharyngeus. The pattern thus obtained represents the flat, central portion, or *velum-proper*, but to which afterwards are added certain lateral appendages, covering both the anterior and posterior surfaces of the fissure, and considerably increasing its size. To the edges of this flat pattern are added two wings of thin wax, extending from the top about one inch downwards, and projecting obliquely forwards, and so bent and shaped as to cover the anterior surfaces of the fleshy sides of the fissure. These wings are indicated by the letters *ww*, in figures 2, 3, and 4, representing the rubber velum. The lower margin of the wax pattern very nearly touches the muscular surface of the pharynx, and its rounded corners enter the narrow cavities made by the junction of the long palatine muscles with the pharyngeus, by which I ascertain the whole length required for the velum-proper, and also its greatest breadth at its lower end. I now proceed with a wire probe, bent at right angles half an inch from the point, and which is guarded with a pellet of wax, to sound the depth and shape of the cavity behind the columns or edges of the fissure for some distance upwards. Lastly, I take a small stick of soft wood, with a handle shaped on one end, and a flattened bulb-shaped head, carved obliquely, on the other end. This bulb is to be covered with softened wax or warm gutta percha, and then by passing it through the fissure, and drawing it forwards and upwards, I am able to get an impression of the shape and size of the cavity above, and which is hidden from view by the projecting edges of the fissure. The head of the stick must have a broad, deep notch cut in its upper margin, so as to clear or admit the septum when taking the impression. By this last process we gain a knowledge of the shape of parts not visible to the eye, and where it is of great importance to have the artificial velum well fitted. By the aid of this impression I proceed to attach to each side of the wax model, and behind the wings, a longer and thicker lamina of wax, projecting obliquely backwards, so that when placed in the mouth it will cover the posterior surface of the fleshy edges of the fissure, and also prolonged upwards half an inch or more beyond the upper end of the velum-proper, so as to lie upon the projecting bony shelf. This pos-

terior appendage is indicated by the letters *q q* in the drawings, and it will be seen that by the two on each side a groove (*c c*, Fig. v.) is formed along the edge of the velum, adapted to receive the edges of the fissure. This wax model then, with its lateral wings, and also the velum to be made from it, comes to be of a size very much larger

FIG. 1. GOLD ATTACHMENTS.—VIEW CONSIDERABLY ENLARGED.



A and *B*, portions from posterior margin of roof-plate; *p*, toothed pin or pivot; *s w*, slotted tube or swivel; *r*, chonchoidal spring, with hooked tail-piece *t*.

FIG. 2. POSTERIOR VIEW OF RUBBER VELUM, FOR CASE PARTIALLY CLOSED BY SURGICAL OPERATION.

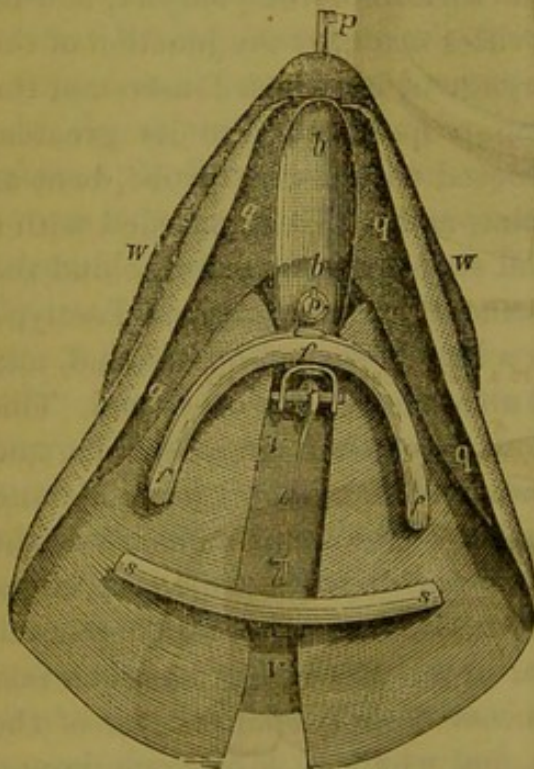
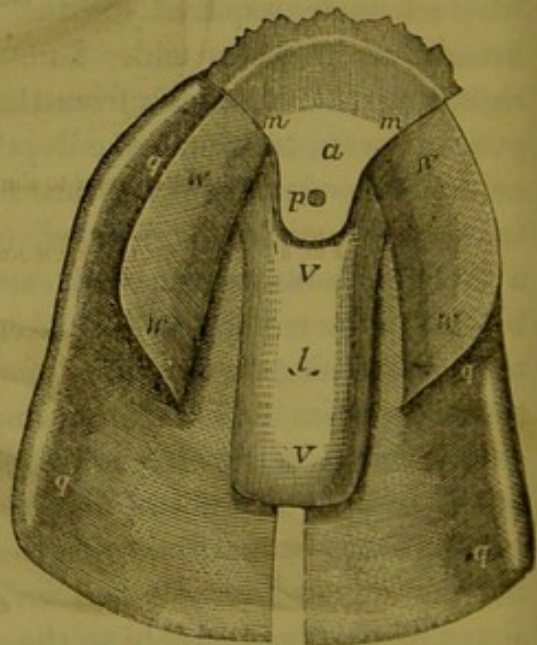


FIG. 3. ANTERIOR VIEW OF VELUM FOR SIMPLE FISSURE OF SOFT PALATE.



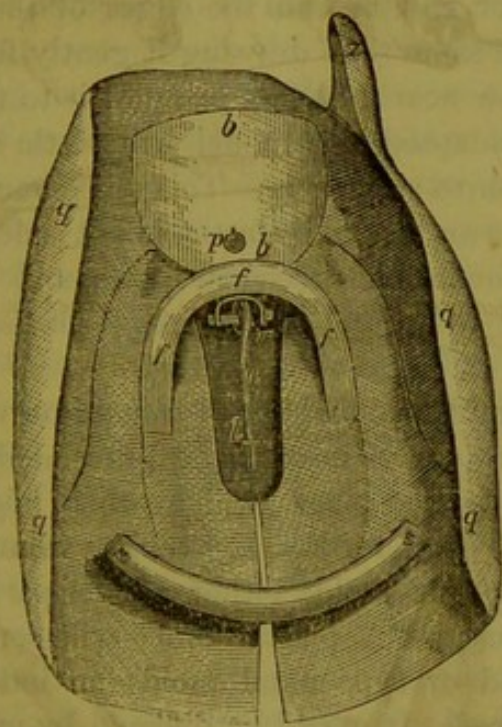
W W, anterior wings; *q q*, posterior do.; *f f f*, upper bow or spring; *s s*, lower do.; other letters same as in Fig. 1.

W W, wings covering anterior surface; *q q*, parts of velum lying behind the fissure; *V V*, valve covering the central opening; *m m* and *p* are the same as in Fig. 1.

than the mere width and length of the gap which it is designed to close. Many of those I have made, when held in the hand and examined, appeared truly formidable from their great size, but when

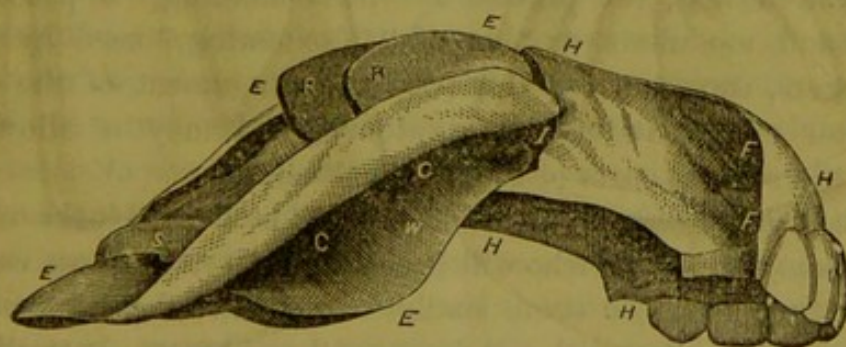
looked at in the mouth, appeared small enough; in fact, I never yet had to alter my models to make a velum smaller, but have often had to enlarge them. From this it will also be understood that an artificial velum must be something more than a mere curtain suspended in the plane of the fissure, and just touching its fleshy edges when at rest. Such an appliance could effect no improvement in the speech,

FIG. 4. POSTERIOR VIEW OF VELUM MADE FOR HARE-LIP SUBJECT.



Same letters refer to similar parts as in Figs. 2 and 3.

FIG. 5. SIDE VIEW OF VELUM JOINED TO A HARD RUBBER ROOF-PLATE.



EEEE, Velum; *HHHH*, the hard rubber roof-plate; *CC*, the groove at side of velum to receive the edges of fissure; *RR*, rubber processes rising vertically each side of the vomer; *s*, lower rubber bow or spring.

and would be liable to very frequent displacement by coughing, sneezing, or even the ordinary act of swallowing. But if the velum is made as large as the surrounding parts will possibly admit, it is then acted upon with force by the muscles in contact with it, and, what is

also of great importance, it is, in great part, self-supporting, and even aids to bear the weight of the solid roof to which it is attached; so that in fact the only real necessity for an artificial roof is to fill up the gap in the bones, if there is one, and also to keep the velum from being carried backwards in swallowing.

If the wax model, as thus completed, is attached obliquely to the end of a slender stick, like a penholder, or held in a port-crayon, it may be tried in the mouth, by passing it far down into the pharynx, so as to get its upper end behind the edges of the fissure, and then raising it, and at the same time drawing it gently forwards, when the operator may see how nearly he has brought it to the required form. If it is pretty well adapted, the model will settle into its place, and show some disposition to stay there. This trial should be made slowly and gently, for the wax, being inelastic, is not suited to yield to the spasmodic contraction of the muscular parts, and therefore patients should be cautioned to control themselves for a few moments during the process.

From this wax model, the making of a mold on which to vulcanize the elastic rubber velum, is next to be proceeded with. This mold consists of several detached pieces, which, when laid together, inclose a hollow space of the same form as the rubber velum to be vulcanized in it. For making this mold, either plaster-paris, hard wood, or type-metal may be used. A plaster mold will serve for only once, but from hard wood or type-metal molds an indefinite number of vela may be vulcanized. It would be difficult, by mere verbal description, to specify both the number and exact shape of the several pieces of which the mold consists; nor, perhaps, is this necessary, as any one acquainted with the process of "piece-molding," as practised by sculptors and modellers, or that of "false coring," used by bronze-figure casters, can contrive the proper arrangement of the several pieces after understanding the anatomy (if I may be allowed the word) of the several parts of the artificial velum.

Though I have carved most of my molds from blocks of close-grained mahogany, those who will hereafter undertake these cases had better use type-metal or some similar compound; for wood can only be used for vulcanizing with a "dry heat," and most, if not all, of the rubber compounds now made by the manufacturers, require to be vulcanized by a "steam heat," and will not vulcanize in the old way, by a dry heat. The molds consist chiefly of three pieces, if made of wood, or more conveniently of four pieces, if made of metal, viz: one large piece for the base, on which the posterior surface of the velum is formed; two lateral or cheek-pieces to form the wings *ww*, *qq*, and the groove *cc*; and a top-piece or cope, as broad as the base, which

closes over the other three pieces, and gives form to the anterior surface of the velum. Thus all the pieces of the mold, which placed in their relative position and locked together, will inclose a vacant space of the shape required for the rubber velum to be vulcanized in it.

Having explained thus generally my methods of proceeding, applicable alike to all artificial vela, it now remains for me to illustrate the subject in a still more particular and practical manner, by taking cases from each class, and describing minutely and as intelligibly as I am able, what I regard as essential to the purpose.

Let us begin with a case where the natural roof is entire, or nearly so, the lesion being limited to the soft parts or natural *velum palati*. For this an arch of gold plate or "hard rubber" is first to be fitted to the roof of the mouth, and secured by clasps to the teeth, or by atmospheric pressure. This plate should extend backwards so far that its posterior margin may be about on a line with the apex of the fissure (*B*, Fig. 1). Just at this middle point a strong *tongue-like process*, about one-quarter of an inch wide and three-eighths long, projects from it obliquely downwards and backwards in the plane of the fissure. On the back, and near the end of this process, is inserted at a right angle to it, a pin or *pivot*, *p*, of thick gold wire, about one-fourth of an inch long, and with a small tooth-like process at the extremity. A short gold tube, *sw* (*D*), with a slot in one side, is then made to be slipped on to the pin, so that, if turned either way, it is held there by the tooth at the end of the pin. This slotted tube, or *swivel*, *sw*, is then soldered on to the upper side of a *back-plate*, *bb*, which is a small gold plate bent or swedged to correspond to the posterior surface of the rubber velum at its upper end—the velum to have a hole through it corresponding to the position of the pin on the back of the tongue-piece and the swivel on the back-plate. By passing the pivot through the hole in the velum, and the swivel of the back-plate laid on above it, and then turning it a quarter round, the velum will then be held between the two plates, and thus securely attached to the roof. The velum can turn on the pivot but very little while in the mouth, but taken out, it can be turned a quarter round, so that the tooth on the end can pass through the slot, and the two plates be detached.

At the lower end of the back-plate, (*D*), *bb*, is a delicate *conchoidal spring*, *r*, of flattened gold wire, terminating in a straight portion or *tail*, *t*, which passes through an eye or *loop* of wire, *l*, which is baked or vulcanized into the rubber. The necessity for this spring will be explained further on, when describing the parts of the rubber velum.

In those cases that will sometimes present themselves, where the fissure has been closed by a surgical operation for a distance of one-half or three-fourths of an inch from the bone, I connect the velum

to the roof by a method differing somewhat from that just described, that is, by a *flexible* attachment. At the middle or highest point on the posterior margin of the roof-plate, (*A*), *m m*, I insert a slotted tube or swivel, *sw*, horizontally from before backwards. I then take a piece of gold wire, about one-twentieth of an inch in diameter (*G*), and solder a tooth to one end, so that it may be passed into and held by the horizontal swivel in *A*. The middle portion of this wire is then flattened, by hammering very thin, so as to make of it a delicate and elastic spring, and somewhat flattened, also, quite to the lower end. On the back and upper side of the flattened lower end I solder an upright toothed pivot, *p*, similar to that described on foregoing page, and which passes through a hole in the velum proper, near its apex, and then through the swivel on the back-plate, as before described. Thus it will be understood that in these cases two swivels are used—one horizontal, the other vertical. The spring formed by the flattened wire connects the velum to the roof-plate, and accommodates itself to the limited muscular movement from before backward, which may result from the partial union of the soft parts previously effected by the surgeon.

I come now to the more formidable class of cases, where the fissure extends quite through the maxillary bones, and sometimes includes two or more of the alveolar sockets. In all cases of this sort I would advise the use of the "hard rubber" for the roof-plate, gold being quite too heavy for so large an artificial roof as is required in these cases to fill the opening. The substance of the roof-plate is continued backwards to a point a little beyond that where the hard bony edges of the fissure end and the soft edges begin. No tongue-like continuation, nor any spring of flattened wire, as described in the preceding cases, is required for these; but near the posterior margin, and at the middle, a vertical toothed pivot is to be firmly vulcanized into the substance of the hard rubber, and which is to pass through the velum and socket on the back-plate, in the same manner as before described. The greater difficulty met with in getting good casts of these cases, where the opening is so extended and irregularly shaped, requiring to be filled and fitted by an instrument of corresponding size and irregularity of shape, adds considerably to the labor. Figure 5 is a side view of an instrument made for a very wide fissure of this class. The "hard rubber" roof-plate, *H H H H*, was made and several front teeth attached to it by a skilful dentist of this city. In adapting the elastic velum, *E E E E*, I proceeded on the same plan as in other cases, excepting that the vomer, which was incomplete and pendent from the base of the cranium on the median line, was somewhat in my way. The letters *R R* indicate two pretty thick and firm rubber pro-

cesses, on the upper or back side of the velum (admitting the vomer between them), and through which passed two horns, made by soldering a piece of gold wire across the back-plate. This latter feature I have never before found it necessary to adopt; but in order to give the velum firmness, without at the same time impairing its elasticity, I thought it desirable to steady it from a point as high up as possible.

In this figure the letters *C C* indicate the lateral groove adapted to receive the fleshy edges of the fissure; and also at the letter *s* may be seen a portion of the bow or inferior rubber spring, on the back surface of the velum, connected with it only at its ends. This lower spring or bow is particularly necessary in vela of very large size, to insure their permanent elasticity.

In this class of cases it will be found necessary to mould the under surface of the artificial hard rubber roof much deeper or more concave than is seen in the well-formed natural roof, and from the upper surface to carry up two walls or ridges of the material toward the base of the cranium, one on that side where the vomer articulates with the maxillary bone, to be inclined a little inwards towards the median line, the other to be inclined a little outwards, so as to overhang the projecting edge of the imperfect maxillary on that side. By looking at the drawing (Fig. 5) it will be seen that the upper or forward end of the elastic velum at *I* projects considerably forwards, so as to overlap, for half an inch or more, the posterior margin of the hard rubber roof, and also that it is much broader on the side than the roof-plate. It is by this arrangement that the instrument is firmly held in its place at the middle and posterior region of the fissure, while the clasps and atmospheric pressure keep up the plate anteriorly. This is a very important point to be attended to, as giving an equal and easy support to the whole apparatus, which cannot be done *permanently* by clasps to the teeth, or any jointed mechanism in the artificial roof.

Having now described the solid and metallic parts composing the roof and the attachments of the velum to it, I will now proceed to the different essential parts of the artificial soft rubber velum. The vela are all constructed on essentially the same plan for each of the different varieties of fissure, but will differ greatly in their shape, size, and proportions. Thus in a case where the fleshy parts have been partly united by a surgical operation, the general shape of the velum will be that of an equilateral triangle (vide Fig. 2). For a case of fissure extending through the bony roof, the velum will have more the shape of an oblong quadrilateral (vide Fig. 4); and for simple fissure of the soft parts the velum will have a shape somewhat between the two other forms (vide Fig. 5). The engravings, Figs. 3, 4, 5, are views of the three forms that will be found adapted to all forms of *congenital* fis-

sure, the same letters referring to similar parts in all.* The lower or posterior margin of the velum is curved, to adapt it to the shape of the pharynx, with which it comes in contact. The corners are rounded so as to enter and lie in the deep narrow spaces made on each side by the meeting of the lower extremity of the slender palato-pharyngeus muscle with the pharyngeus, and a little lower down than the tonsils which lie in front of them. The surface of the velum-proper at its lower third is slightly concave in front and convex behind, to adapt it to the shape of the pharynx, in which it is placed. Through the middle of the velum is a slit, extending from its lower margin upwards to one half or more of its length. Above this slit (see the posterior views, Figs. 3 and 4), and continuous with it, is an opening about one-eighth or three-sixteenths of an inch wide, extending quite up to the junction of the velum with the roof-plate. In front of this opening, on the anterior surface of the velum (see Fig. 3), is a tongue-piece of rubber, half an inch wide, *V V*, attached to the velum at its upper end, so that it acts as a valve to close the opening through the middle just described; thus the two halves of the velum proper are allowed to slide freely one over the other by the compression of the surrounding muscles, and the whole forms, in fact, *a valve within or upon a valve.*†

The anterior surface of the velum (Fig. 3), with the valve *V V* covering the central opening, presents a smooth and slightly concave surface, and therefore needs no particular demonstration. Referring to figures 2 and 4, a view is had of the posterior surface of the velum, *H*, and more is seen that needs to be explained; for it is on the posterior surface of the artificial velum, where there is plenty of room,

* For cases of syphilitic fissure no plan is here given, as I have never had but one subject, and in that one the opening was almost a full circle, about three-fourths of an inch across, the muscularity being much limited by cicatrices and attachments. The velum for this somewhat resembled a large flute key, both in its shape and action.

† I wish here to be understood as saying, in exact terms, that I consider the slit and opening through the centre, and its closure by a sort of valve on the anterior surface, as an essential feature of all artificial vela; and also, that I do not acknowledge the remotest obligation to any other person for this one idea; and which did not present itself to my mind until I had occupied myself with my first case (in '41 and '42) for more than a year. Previous to that, all my time had been occupied in futile attempts to mold the plastic rubber to a copy of the natural velum. The moment this idea of the middle opening and valve suggested itself, I felt confident that a great point was secured, and that contractility, if not muscularity, was attained; for to give muscularity to any work of human hands is manifestly as much beyond our reach as to make a glass eye that shall receive and convey impressions to the brain.

that we can place all the mechanism that we may wish to adopt for the purpose of attaching the velum to the roof-plate, and also for giving to it that delicate and permanent elasticity fitting it for the place it is designed to fill. Half an inch or more above the lower margin, on the posterior surface, is seen a rubber *bow* or spring, *s s*, about one-eighth of an inch thick, an inch long, laid across and attached to the velum only at each end, so as to allow the opposite halves or flaps of the velum to glide freely one over the other.

This *bow* or spring at the lower part I consider very necessary in all vela of large size, and perhaps useful in the smallest. A large velum without it will soon begin to lose some part of its original elasticity, and become warped out of its shape, so that the wearer will be suddenly conscious of not deriving so much benefit from its use as he has been accustomed to do; so I would advise those who may undertake the work, not to omit this lower spring, though it adds considerably to the labor.

Near the upper end, on the back side, is another rubber bow or spring, *fff*, also essential to the elasticity of the velum. The back-plate, *b b*, is seen to cover a part of the posterior surface of the upper end of the velum, and its lower end passes under the bow, *ff*, between it and the valve, *V V*, on the anterior surface. Here it receives the conchoidal spring, *r*, which terminates in a cue or tail, passing through an eye or loop of wire, *l*, which has been vulcanized into the substance of the rubber. The use of this spring is to keep the valve *V V* gently pressed against the anterior surface of the velum, and prevent it from drooping, so as to open the passage for the escape of sound upwards. The lateral attachments to the body of the velum proper, *q q*, covering the posterior surfaces of the edges of the fissure, and *W W*, covering in like manner the anterior surfaces, have already been referred to. That part of the upper end of the velum which is prolonged forwards so as to overlap the roof-plate, (see *I*, Fig. 5), and also widened so as to bear upon the superior surface of the projecting edges of the fissure, should be made considerably thicker and firmer than the body of the velum below.

From this description of the form, plan, and size of the elastic artificial velum, it will be understood that it is in no respect a copy of the perfectly formed natural organ, but an elastic valve acted upon and compressed by the surrounding muscular tissue with which it is closely in contact. The natural organ has muscular *vis insita*, which is a vital quality that no art can give to inanimate substance. The best substitute for this vital contractile power is the plan here detailed, of making the body of the velum to consist of three parts, joined at the top, and which can slide freely one over the other, and thus expand and

contract by the lateral pressure of the surrounding muscles. It was this idea of the three pieces that decided the success of my first case. Eighteen years have since elapsed, and I have not yet conceived any other possible way of constructing an instrument at once simple, delicate, and durable, than in this *triple* form; and though I trust and believe that others will hereafter improve upon my methods, I am confident that this one feature will be preserved in all successful "Obturator."

There is one physiological fact to encourage the operator who may undertake to remedy imperfect speech by his mechanical appliances: that speech, or articulated sound, is not a vital function, like the circulation, respiration, or digestion, but a mechanical function, performed by mechanical agents. The characteristic sound of several of the letters of the alphabet is constantly produced by certain familiar objects around us. Thus the rapid passage of steam or of air through a crevice produces a hissing sound which is identical with that of the letter S, which is also made by forcing the breath through the interstices of the teeth. The buzzing of the wings of insects, or the sound made by a flat splinter of wood tied to the end of a cord and then whirled rapidly through the air is simply the letter Z. On inverting a bottle filled with water so that the liquid may flow out by intermittent jets, the perfect sound of G (hard) is at once recognized. The sudden breaking of a stick will give the sound of X or K S. In short, the elementary sounds of all the letters of the alphabet have long ago been imitated more or less perfectly in automata made by patient and ingenious mechanics for public exhibition.

The object of the labor and skill bestowed in making and adapting an artificial velum is not attained when the instrument is completed, be it performed never so skilfully, for the speech remains almost unchanged; nor is there much involuntary improvement, but at first only a sufflated tone, like that of a person with a cold. There remains a course of *vocal practice* to be entered upon and patiently persevered in, before any great improvement in speech* is attained.

* Ever since my attention was first given to this subject, I have, from time to time, met with newspaper accounts of persons, with congenital fissure of the palate, "being enabled to articulate perfectly," &c., &c., by the aid of some piece of mechanism that some one had just made for them. Now, I wish here to take the responsibility of saying, in plain words, such a result is physically impossible; and all statements of that kind can only cruelly disappoint those who are confidently hoping for relief from a life-long infirmity. Only in cases of grown persons, where the soft palate has been partly destroyed by syphilitic disease, or in those very rare congenital cases where the fissure extends only through the bony roof, leaving the soft palate entire, will the adaptation of any artificial apparatus cause immediate and marked improvement in the speech.

The necessity for this instruction and training delays the beneficial results of the operation, and is what some patients are disinclined to undergo; and this delay and difficulty, presenting itself in the course of my experience, has had considerable weight with me in withdrawing my attention from the subject. But patients should be made to understand clearly, at the outset, that after the instrument is made, then *they* have something to do; that they must in some part "minister to themselves." To do this, they, of course, will need specific instruction; and I had proposed to explain a system of vocal practice, that I have arranged and made use of, for the development of the faculties of speech in those who, all their lives before, have never possessed the organs needed for perfect articulation. This plan or system of vocal practice I have, however, decided to reserve for a future essay, if what I have already written, to illustrate the mechanical part of the subject, should prove of sufficient interest to make any further publication desirable. My remarks already have covered more space than I at first anticipated; yet I must add some further observations, taken disconnectedly from written memoranda, copies of letters, &c., not originally meant for publication.

I. The pain or inconvenience to patients, on beginning to wear the instrument, is inconsiderable—surprisingly so; in fact, I have myself been astonished to find that they were not unwilling, on the first day, to walk home through the streets with a mechanical apparatus in the mouth, so long as to reach from the front teeth to the anterior process of the fourth cervical vertebra (which vertebral process can be seen and felt just under the mucous membrane of the pharynx), and so broad that the sides of the velum, near its lower end, touched the styloid processes of the sphenoid bone (which can also be felt with the end of the finger, behind the columns of the fissured velum), and so high, also, as almost to reach the base of the cranium; so that if I may, hereafter, be thought to have achieved very little, in comparison with what future years of experience and improved skill may bring to pass, I have at least demonstrated that a very large piece of artificial work can be worn in the throat, with ease and comfort, while eating, drinking, sleeping, coughing, sneezing, vomiting, &c. In a late case, the patient persisted, contrary to my advice, in sleeping at night without removing the instrument.

II. It will not be of much use to undertake the case of *uneducated* persons. I recollect that, while in Paris, Amusat sent for me one day. On going to his house, I found standing about the gateway quite a collection—a small crowd, in fact—of cases, of both sexes, of all ages. I was obliged to say to him that I could hardly hope to do them any good, for they have neither the time nor means to spare, and if supplied with the instrument, they would not take the proper care of it, nor be likely to improve by vocal practice; and, what is more to the point, they feel but very little want of anything of the sort.

III. Young persons, with palatine fissure, are often quite indifferent to the chances of getting relief; the reason of which is, that they are not fully aware of

the extent of their difficulty. They are, perhaps, conscious of a want of vocal power, but do not know that they fail to articulate the sound of a great many of the letters. They do not hear their own voices as others hear them.

IV. One of my patients was as much surprised and pleased as M. Jourdain (see Moliere's *Bourgeois Gentilhomme*), when taking a lesson from his philosophical teacher, on being instructed how to place and move the tongue or lips in order to produce the characteristic sound of any given letter, and that such a movement would invariably produce that sound, and no other. Of this necessity they have never before known, because they were without the complete natural mechanism. Sound is the natural stimulant of the action of the vocal organs, as much as the blood of the heart, the air of the lungs, the food of the stomach. If this stimulus of sound cannot be confined and controlled for a moment, but if, the moment it issues from the glottis, it is dissipated through the nasal passages, the tongue and lips do not fully get their appropriate stimulus, and fail to act only in a partial manner. In fact, if they were to act with the same rapidity and power as in persons with a normal state of the organs, the imperfection of speech would be thereby rendered more striking, because they force yet more of the sound through the nasal passages. The soft palate is the antagonist of the lips and tongue, in the same manner that the thumb is the antagonist of the four fingers. So the sound, or voice, or vowels of the alphabet, are grasped, impressed, and molded—stamped with consonant letters, as a coin is struck between *two* dies, or iron is shaped by the smith between the hammer and the anvil. If one die be wanting, or the iron should be held up in the air and struck, no impression could then be made upon it. So that a person with palatine fissure, instead of being instinctively stimulated to perform the act and function of articulation, is instinctively discouraged from such efforts, from finding that the sound supplied as the material of speech instantly eludes the muscular impact, and therefore receives no impression. I have reasons for believing, moreover, that in these cases the muscles at the upper part of the neck, just about the larynx, remain in a dormant and flaccid state, because that region, just below the jaw, usually has a lean appearance externally; and, in one case, where the instrument has now been worn for years, I know that the neck has acquired a more full and fleshy appearance.

V. I have been often asked, At how young an age may it be practicable or advisable to adapt an artificial instrument? and I have answered, Not younger than 16 or 17, probably. In this opinion I am by no means fixed, or, rather, I have changed to quite a different one, and will now answer, At as early an age as the patient has intelligence enough to handle the instrument, and take the proper care of it. The instrument, as made several years ago, being so delicate and complicated as to be liable to derangement, even in the hands of grown persons, and also fastened wholly to the teeth, so that it must interfere with the natural growth of the bone, was doubtless unsuited for the case of a very young subject; but as now made, without the spiral springs, and supported chiefly by the edges of the fissure, it may be adapted, in my judgment, with benefit to a child. The natural growth and enlargement of the parts would necessitate the making of a second and third instrument. The advantages of applying the instrument as early as possible, are: 1st. Present convenience and improvement, saving thereby several years of an embarrassing impediment. 2d.

The early natural use and action of the muscles concerned in speech would be promoted. Grown persons, with fissure, never, according to my observation, make the appropriate movements of the tongue for certain letters, as K, G (hard), D, R, and often P, B, V, and F; and, after adapting the instrument, it has taken a great deal of persevering instruction to make them place the tongue so as to utter a given sound. But a child of six years, with pretty large fissure, that I saw a few months since, when I gave her a word with K, did make precisely the necessary movement of the tongue that would have produced the sound of that letter, had there been no opening into the nasal passages. My deduction is, therefore, that as she grows up she will cease, instinctively, to make an effort which habitually fails of its purpose; but if she is supplied with something to close the opening, her tongue will continue to perform its functions effectually. Now she is like a person blowing a fire with a large hole in the leathern sides of the bellows. I have been requested by the parents to adapt an instrument to her case, and I shall proceed with it, if I can attach the artificial roof in such a way as not to interfere with the growth and expansion of the bones.

