EYE, EAR, NOSE AND THROAT

THE NERVO-MUSCULAR MECHANISM OF THE EYES*

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In the study of the motility of the eyes, there are fundamentals that must be known and appreciated in order that the subject may be clearly understood. These fundamentals may be briefly stated as follows:

1. The image of the object on which the vision is to be fixed must lie on the macula.

2. The line connecting this image and its object must be a straight line passing through the center of the retinal concave.

3. Every other object in the visual field and its image must, likewise, be connected by a straight line passing through the center of the retinal concave.

4. All visual lines, whether direct or indirect, are radii of the retinal curvature prolonged, and hence each visual line must cross all other visual lines at the center of the retinal concave.

5. Any two objects in viewable space bear the same relationship, in degrees, as do their retinal images.

6. The direct or primary line of vision is the visual axis which starts from the central part of the macula, while all other visual lines are indirect or secondary.

7. Any secondary point in space may become the point of direct view by a shifting of the visual axis into the position of the secondary visual line which connected that point with its image before the rotation began, which is possible only because the rotation is around that point through which all visual lines pass, the center of the retinal concave, which is the center of rotation.

Only on the conceptions stated above can be formulated the true mental law of visible direction. "*All lines of direction are radii of retinal curvature prolonged.*"

In the light of this law all ocular rotations can be understood; but, before studying these rotations and the means by which they are accomplished, some essential physical properties of the globe must be set forth. The poles of the eye must be correctly located; the meridians must be properly constructed; and the equator must be fitly related to the poles. The fatal mistake of Helmholtz, in his chapter on "Movements of the Eyes," was in his not making the central point of the macula always the posterior pole of the eye. He fell into this error because he chose, as the location of the anterior pole of the eye, the center of the corneal curve. His optic axis he constructed by carrying a line from his supposed anterior pole back through the center of rotation to the retina, and named the retinal end of that line the posterior pole. Confessing, as he did, that in ideal eyes the posterior pole and the central point of the macula were one and the same, he gave himself the opportunity to rid himself of his error in locating the poles. That he did not do this is explainable only on the ground of his false conception of the law of visible direction which may be expressed in these words: "*All lines of direction are axial rays of light and cross each other at the nodal point.*" His conception of the law of visible direction and his location of the poles of the eye made his location of the equator incorrect and his construction of the corneo-retinal meridians wrong.

With the center of the macula as the posterior pole of all eyes, the anterior pole may, or may not, be the center of the cornea. It is the center of the cornea only in ideal eyes. Through the true posterior pole of the eye all retinal meridians pass. Therefore, the center of the macula is common to all the retinal meridians. The only other point through which these meridians can pass is the anterior pole,—the second common point for all meridians. The only line common to the planes of all the meridians is the line connecting the two poles, the visual axis which, in all eyes, is the true optic axis.

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The equator of the eye is that circle which passes around the eye, equally distant, everywhere, from the two poles. Its plane cuts the center of rotation and is at right angles to the planes of all the meridians. In the plane of the equator there lie as many diameters as there are meridional planes; but only two of these demand any study. These two diameters lie, respectively, in the planes of the vertical and horizontal meridians, as well as in the plane of the equator. It is around one or both of these diameters, as axes, that all possible ocular rotations must take place. The line to be guided by the muscles and nerves of the eye, in any rotation, is common to the planes of both the vertical and horizontal meridians, which has already been shown to be the visual axis,—the true optic axis,—around which rotations are denied, except in natural or artificial oblique astigmatism.

In space, just as in the eye, there are points and lines, both straight and curved, to be known in order to arrive at a correct understanding of ocular rotations. One of these lines is the visual axis extended, on which must lie any object to be looked at fixedly. The location of such an object or point is the spacial pole of the eye. While the anterior and posterior poles of the eye have a fixed distance between them and can not vary their distance from the center of rotation, the spacial pole may be at any distance from the two ocular poles and from the center of rotation. Through the spacial pole of an eye pass spacial meridians, which are great circles concentric with the retinal meridians. The planes of the vertical and horizontal retinal meridians prolonged into space become the planes of the vertical and horizontal spacial meridians. The planes of all oblique retinal meridians bear a like relationship to the oblique spacial meridians. No point can be in viewable space which does not lie on some spacial meridian, and the eye is so constructed, as to its refractive power, as to compel the image of that point to fall on the retinal meridian having a common plane with the spacial meridian. Such a point in space, if secondary, is just as far removed, in degrees, from the spacial pole as its image is removed from the central point

of the macula. The line connecting the secondary point and its image forms its two angles with the visual axis at the center of rotation, which angles are equal because opposite.

The spacial equator is in the plane of the equator of the eye, but the former varies in size, always corresponding with the spacial meridians both as to size and as to its distance from the center of rotation. Any number of small spacial circles may be constructed parallel with the spacial equator and between it and the spacial pole, their diameters growing shorter and shorter as they proceed from the equator toward the pole, reaching zero at the pole. For convenience of study, these spacial parallels may be placed 10° apart, the point of starting being the spacial pole. Likewise retinal parallels might be constructed 10° apart, the smaller one being 10° from the posterior pole of the eye. Since the spacial meridians correspond with their respective retinal meridians, point with point everywhere, a spacial parallel at a given distance from the spacial pole must correspond everywhere with a retinal parallel located the same number of degrees from the posterior pole of the eye.

With the foregoing facts fixed in the mind, monocular rotations ought not to be difficult to understand. In monocular rotation every rotation plane is a meridional plane extended, and in the spacial part of this plane lie both the first and second points of view, while, in its retinal part, lie the images of the two points. The first point of view must be at the spacial pole and its image must be on the central point of the macula; the second point of view must be just as many degrees from the spacial pole, on a given spacial meridian, as its image is removed from the retinal pole, on the corresponding retinal meridian. The change from the one point of view to the other is but a shifting of the visual axis in the plane common to the following five points: the first and second points of view, their two retinal images, and the center of rotation. In the shifting the spacial end of the visual axis moves from the primary to the secondary point, while the retinal end moves from the primary to the secondary

image, the motion being around the central point of the retinal concave, which is also the central point of the spacial concave.

Every pair of eyes, endowed with the possibility of binocular single vision, can be made to fuse their respective spacial fields into a single binocular spacial field, with a binocular pole, meridians and parallels. The fundamental fact of binocular single vision is common brain cell connection; that is, each visual cell is diaxonic, one axone going to a point in one retina, while the other axone goes to a point in the other retina; and thus is created corresponding retinal points. Without such common brain cell connection, the binocular spacial pole, meridians and parallels would be impossible, for there could be no corresponding retinal points. This condition is not uncommon, and over such eyes the law of binocular rotations has no power.

Ocular rotations, whether monocular or binocular, can not be understood except in the light of the two planes of reference shown in Fig. 4 of Chart 1. These two planes are the fixed vertical and horizontal planes of the head, the one, *g-h-i-j*, being half-way between the centers of the two eyes, the other, *a-b-c-d*, cutting the centers of the two eyes. As their names imply, these two planes are at right angles to each other. The other plane, *k-l-m-n*, shown in Fig. 4, is Listing's plane, which is neither a plane of reference nor is it a plane containing the axes of rotations, as was once taught. The line *e-f* is made by the intersection of the two planes of reference. From the point *f* may be studied the four cardinal directions, *c* and *d*, directly to the left and right, in the horizontal plane; and *i* and *j*, directly above and below, in the vertical plane. Points not in one or the other of these planes are obliquely related to the line of their intersection. The shifting of the visual axes in either one of these planes is the result of a cardinal rotation; when the visual axes are made to move out of these planes, the rotation is oblique. Fig. 1 in Chart 1 represents a horizontal cardinal rotation; Fig. 2 represents a vertical cardinal rotation; while Fig. 3 represents an oblique rotation. To this chart

and these figures reference will again be made after a study of the ocular muscles and the nerve centers controlling them.

The ocular muscles, as to their origin, course and insertion, or attachment to the eye, are too well known to require study here. The six muscles of each eye are divisible into three pairs as follows: (1) the externus and the internus; (2) the superior and the inferior recti; and (3) the superior and inferior obliques. If there were but one eye, the posing of the head would make it unimportant to study the first and second grouping; but the third grouping, even then, should not be ignored, for the reason that no posing of the head would greatly help them, if unbalanced in tonicity, in their work of always keeping the vertical axis of the eye parallel with the median plane of the head.

In this grouping the two muscles of a pair are related to each other as to tonicity and not as to contractility. Hence each pair should be studied when neither muscle is under the active control of any brain center. Such study is impossible, if there is but one eye. Fortunately it is a matter of no consequence, when there is but one eye, whether the first or the second pair are equal or unequal in tonicity. In binocular vision it is of immense importance to know if the two muscles of any one of the three pairs are of equal or unequal tonicity; that is, are they orthophoric or heterophoric? This, as to the recti, best can be answered only when the two eyes are dissociated in action by means of the monocular phorometer; and as to the obliques, when they are dissociated by means of the cyclophorometer. The oculist who neglects such a study of the ocular muscles is unjust to himself and cruel to his patients.

Great as is the temptation to enter here into a full study of this feature of muscle problems, I must not yield, as time will not allow. I have heard otherwise well-informed men boast of their ignorance of heterophoric conditions; but that boast would not now be a badge of respectability.

In our study of Chart 2 we will see the wonderful provision in the brain for the

Fig. I.

Fig. III.

Fig. II.

helpfulness of eyes, in the work of binocular single vision, whose muscles, in one or all of the three pairs, are heterophoric.

In the next grouping of the ocular muscles in pairs, the one muscle of every pair will belong to one eye while the other mus-

Fig. IV.

cle of the pair will belong to the other eye. In this grouping the muscles will be studied in action and not in a state of rest. There are nine pairs: (1) the two superior recti for rotating the two eyes directly upward; (2) the two inferior recti for rotating the two eyes directly downward (these two rotations will be around the horizontal axis of the eye, but with torsion which must be prevented by associated action of two pairs of the obliques); (3) the two interni for converging the eyes on an object near by (without torsion if the near point be in the extended horizontal plane of the head); (4)

the right externus and the left internus, for effecting the right cardinal rotation; (5) the left externus and the right internus, for effecting the left cardinal rotation (these two rotations will be around the vertical axis of the eye without torsion); (6) the two superior obliques for aiding the two inferior recti in the downward cardinal rotation, their chief work being to maintain the parallelism of the two vertical axes with the median plane of the head; (7) the two inferior obliques to aid the two superior recti in the upward cardinal rotation, their chief work being to prevent the loss of parallelism between the vertical axes of the eyes and the median plane of the head; (8) the superior oblique of the right eye and the inferior oblique of the left eye to maintain parallelism of the vertical axes of the eyes with the median plane of the head, in every rotation obliquely up and to the right or down and to the left; (9) the superior oblique of the left eye and the inferior oblique of the right eye to prevent loss of parallelism of the vertical axes of the eyes with the median plane of the head, in every rotation of the eyes obliquely up and to the left or down and to the right. Of these nine pairs, five are of recti muscles and four are of oblique muscles.

In the grouping of the ocular muscles into active pairs, as above, each pair is under the volitional control of one conjugate center. These centers, nine in all, can be studied in Chart 2 in connection with any one of the several plates, but preferably in connection with that plate not numbered. In orthophoric eyes no other brain centers are needed in the four cardinal rotations and in convergence. In every oblique rotation of orthophoric eyes other centers are needed in the interest of binocular single vision. These centers are necessary for all heterophoric eyes, whether at rest or in motion. These centers are at the base of the brain, and each is connected with only a single muscle. They are, therefore, twelve in number, six being on each side of the brain. The fusion faculty of the mind—not volition—presides over these centers and they are made to serve in the interest of binocular single vision and correct orientation.

Cardinal rotations of orthophoric eyes are easier than oblique rotations, for the reason that basal or fusion centers have nothing to do in the former, while two of these centers are necessarily in action in every oblique rotation. In heterophoric conditions, two or more of the basal centers are constantly in a state of activity, whether the eyes be in rotation or at rest—unacted on by any conjugate center. The brain centers that are chargeable with the “wear-and-tear” of eye strain are the basal or fusion centers. The conjugate or volitional brain centers neither cause heterophoric conditions nor do they attempt to correct them.

All the brain centers controlling the ocular muscles belong to one of two groups: First, the cortical centers, which are under the control of volition. The cells of all these centers are diaxonic, one axone going to one muscle of a pair, while the other axone goes to the other muscle of that pair. The second group consists of centers located at the base of the brain, all the cells of which are monaxonic, each center having under its control only one muscle. These centers are all presided over by the fusion faculty of the mind.

The cortical centers are properly called conjugate centers, since each directs the rotation of the two eyes. They are also called verting centers, since it is neuricity from one or other, or at most three, of these, that causes the turning of the two eyes from one point of view to another. Since the point of view is changed only as one wills to do so, another appropriate name is volitional centers.

These centers can best be studied in the plates collected in Chart 2, in which they are shown schematically. Take the uncomplicated plate, unnumbered, at the left in the lower row, for this purpose. Eleven cortical centers are shown on each side of the brain. The centers 10 and 11 do not belong to the extrinsic ocular muscles, but to the sphincters of the iris and the ciliary muscles. That leaves nine centers for the recti and the obliques. This number corresponds precisely with the number of pairs into which we have found the muscles of the two eyes grouped. There is, therefore, one conjugate center for each pair. These centers and their

respective pairs of muscles are numbered in harmony in order to make their study most easy.

A glance at the unnumbered plate will show eighteen conjugate centers, nine of which are represented by large circles, while the remaining nine are represented by small circles. Eight of the nine large circles (1 to 9, except 5), in this and in all the plates in Chart 2 are in the left side of the brain, while the remaining large circle (5) stands alone in the right side of the brain. The large circles represent the active conjugate centers in control of the nine pairs of extrinsic ocular muscles. The other nine circles, eight of which (1 to 9, except 4), are in the right brain, while the other one (4) is in the left brain, represent the conjugate centers that would have controlled the nine pairs of the extrinsic ocular muscles, if the cause determining which group of nine centers should be active, had been in their favor.

At birth every one of the eighteen conjugate centers (1 to 9 on each side) stands equally ready for action, and the diaxones of all the cells of all these centers enter into the formation of the three pairs (third, fourth and sixth) of motor nerves, by means of which the muscles are connected with their respective centers. One-half of these axones are to be forever inactive, as if dead wires, for the nine centers from which they go will never become generators and dischargers of neuricity.

The cause that determines which nine conjugate centers shall have control of the extrinsic ocular muscles (also determining whether the right or left tenth and eleventh conjugate centers shall control the ciliary muscles and the pupil contractors) is anatomic. If the diaxonic visual cells connected with the two maculas are located in the left cuneus, all the active conjugate centers, except the fifth, will be in the left brain, as shown in all the plates of Chart 2. The same condition also predetermines the location of the active speech center in the left brain. Such a person is predestined to be right-handed; and the higher faculties of his mind will use only the left side of the brain. The reverse of all this would be true if the diaxonic visual cells connected with the two maculas were located in the right

cuneus. In such a person the only active conjugate center in the left brain would be the fourth. The left fourth and the right fifth conjugate centers are always active, whether the person be right- or left-handed.

The fusion centers, twelve in number, one for each ocular muscle, exist in the interest of binocular single vision. All these are ready for action at birth, and each one always remains ready to store and discharge neuricity to the muscle to which it belongs when that muscle must contract in order that diplopia may be prevented, and orientation may be correct. In orthophoric eyes oblique rotations could not be accomplished, and single vision be maintained, without the aid of two of the twelve fusion centers. In heterophoric eyes there would be diplopia whether the eyes were at rest or in motion, were it not for these fusion centers. The nature of the imbalance determines which of these centers shall be in constant action—in esophoria, the right and left fourth; in exophoria, the right and left third; in left hyperphoria and right cataphoria, the right first and the left second, and so on. Imbalance of each of the three pairs of muscles would keep in constant activity six of the twelve basal centers. Untreated heterophoria means perpetual action of two or more of these basal centers, during all waking hours, and in both distant and near seeing. Such centers and their respective muscles get no rest except in sleep, or when one eye is covered or voluntarily closed. In lateral heterophoria a posing of the head may bring rest to one basal center, but it will demand greater activity on the part of the other one, whether these centers be the right and left third or the right and left fourth basal centers.

It is no longer any wonder that many people, who have lost one eye, claim that the remaining eye is stronger than the two eyes ever were. Such people were heterophoric and their fusion centers had no longer any occasion for either storing or discharging neuricity, after the loss of one eye.

Conjugate centers, as already stated, are never called on for the correction of heterophorias, for this must be done by

the fusion centers. There are conditions, however, that make excessive demands on the conjugate centers. These conditions can only be named here: asthenic orthophoria and asthenic heterophoria of whatever kind. Sthenic orthophoria and the sthenic heterophorias make less than the normal demand on the conjugate centers.

In the following study of the structure of the three pairs of motor nerves of the eyes, these must be considered as belonging to a person who is right-handed, whose macular connections are all in the left brain. Plate 1 shows that conjugate centers 1, 2, 3, 7, 9, 10 and 11, in the left brain, send forth their fibers across the median line to help form the right third nerve, and that conjugate center 5 in the right brain sends direct fibers to help form this nerve. Only half the axones from these eight conjugate centers are thus directed. The other half of the axones from the centers named, except the fifth, enter into the formation of the left third nerve (See Plate 2), and in this nerve will be found half the axones from the left fourth conjugate center. None of the fibers, or axones, forming the left third nerve have crossed from the opposite side of the brain. The balance of the right third nerve is formed by all the single axones of right basal centers 1, 2, 3, 7, 10 and 11; and the balance of the left third nerve is composed of all the fibers from the left 1, 2, 3, 7, 10 and 11 basal centers. Thus, it will be seen, that each third nerve is composed of half the fibers from eight conjugate centers and all the fibres from six basal centers.

The construction of the fourth pair of nerves is very simple, as shown in Plates 3 and 4 of Chart 2. The right fourth has in it half the axones from the left six and eighth conjugate centers and all the axones from the right sixth basal center. The left fourth nerve is composed of half the axones from the left sixth and ninth conjugate centers and all the axones from the left sixth basal or fusion center. All the volitional fibers of the right fourth nerve have crossed, as shown in Plate 3; while none of those forming the left fourth nerve, as shown in Plate 4, have crossed.

The construction of the sixth pair of nerves is still less complicated. Plate 5

shows the right sixth nerve composed of half the axones from the left fourth conjugate center and all the axones from the right fourth basal or fusion center. Plate 6 shows the left sixth nerve composed of half the axones from the right fifth conjugate center, and all the axones from the left fourth basal or fusion center. All the voluntary fibers found in either of the two sixth nerves have crossed on their way from center to muscle. None of the fusion fibers of any one of the three pairs of motor nerves have crossed to the opposite side. All the fibers or axones entering into the formation of these nerves are insulated from their starting point, the central cell, to their termination in the muscles, so that the neuricity generated by these cells may not be dissipated when discharged to the muscles for controlling them in their action.

The active fusion centers in the several forms of heterophoria are shown in five of the plates in the lower row of Chart 2. The unnumbered plate, to the extreme left in this row of plates, shows the fact that, in orthophoria, there is no excitation of either conjugate or fusion centers when the point of view is straightforward and, practically, at infinity. Both brain rest and muscle inaction are shown in this plate by the absence of all connecting fibers.

Plate 25 shows the two fusion centers that must be unremittingly active in left hyperphoria and right cataphoria. These are the right first and left second fusion centers acting, respectively, on the right superior and left inferior rectus. If the condition were right hyperphoria and left cataphoria, the excited fusion centers would be the left first and the right second, and the constantly contracting muscles would be the left superior and right inferior recti.

Plate 21 shows the excited fusion centers and the contracting muscles in exophoria, while Plate 17 shows the overworked fusion centers and their respective muscles in esophoria. Plate 36 illustrates the brain and muscle activity in plus cyclophoria, while Plate 37 shows the fusion centers and the two muscles which are in constant action in minus cyclophoria. These heterophorias successfully treated

by operation or other means would give to brain centers and muscles the restful state shown in the unnumbered plate. Untreated, the wear-and-tear of brain and muscles must go on to the end of life.

Before closing with the study of rotations, the muscles and brain centers concerned in each, the laws of motion must be given.

LAW OF MONOCULAR MOTION

The law governing monocular rotations may be formulated as follows:

"(1) *The visual axis, which is the line of intersection of the planes of all meridians, must be rotated in the plane of that meridian on which lie the first and second points of view and their retinal images.*

"(2) *In the plane of the horizontal, or that of the vertical meridian, the rotation must be effected around a single fixed axis, at right-angles to the rotation plane and cutting it at the center of rotation— if in the horizontal plane, around the vertical axis of the eye; if in the vertical plane, around the transverse axis of the eye.*

"(3) *In the plane of an oblique rotation, whatever the degree of obliquity, the rotation must be accomplished around two moving axes by two forces acting simultaneously, these axes being the transverse and vertical axes, both at right-angles to the visual axis, but neither one at right-angles to any oblique rotation plane; while a third force prevents any rotation around the visual axis."*

The law of monocular motion, since binocular vision is not in consideration, is accomplished without any demand on the fusion centers, just as in monocular rest there is no such demand.

In binocular rotations each eye must obey the law of monocular motion, but the two together must obey the law of binocular rest and motion. *"The twelve extrinsic muscles of normal eyes, under the control of the nine conjugate and the twelve fusion brain centers, must so relate the two eyes that their two visual axes and the two horizontal retinal meridians shall always lie in the plane of the primary isogonal circle, whether at rest or in motion, and that the two visual axes shall converge at some point on this circle, in*

the interest of both binocular single vision and correct orientation."

Binocular rotations can best be studied in the light of Fig. 4 in Chart 1. In this study the two eyes will be considered as orthophoric. The line *c-f* of intersection of the two planes of reference is the line on which every object or point must be located which is to be considered the primary point of view. If this point is at infinity, the conjugate and the fusion brain centers and all the ocular muscles are in a state of rest. If the point is near by, only two extrinsic muscles (the interni) and one conjugate brain center (the third) are in action.

Objects or points in space not on the line *c-f* are secondary points of view. If these points are in either the horizontal or the vertical plane of reference, they are cardinally related to points on the line *c-f*. Points not in either of these planes are obliquely related to their line of intersection, *c-f*.

The points *c* and *d* are in the horizontal plane with *f*. In moving the visual axes from *f* to *d*, the fourth conjugate center and the right externus and left internus are active, and each eye is rotated around its vertical axis. All other centers and muscles are at rest in this rotation. In moving the visual axes from *f* to *c* the fifth conjugate center sends neuricity to the left externus and right internus. In cardinal rotations, right or left, only two muscles are called into action by only one conjugate center. The right rotation is shown in Fig. 1, Chart 1.

Points *i* and *j* are in the vertical plane of the head with point *f*. In rotation of the visual axes from *f* to *i* two pairs of muscles and two conjugate centers will be called into action by the will. One pair of the muscles is the two superior recti and the other, the two inferior obliques. The centers calling these muscles into action are, respectively, the first and seventh conjugate centers. This rotation is shown in Fig. 2. The rotation from *f* to *j* would be effected by the two inferior recti and the two superior obliques, under the influence, respectively, of the second and sixth conjugate centers. In both of these cardinal rotations of orthophoric eyes, all other ocular muscles and brain centers,

not named in that connection, are at rest. These rotations are around the horizontal axis of the eye.

A point anywhere above the horizontal plane and to the right of the vertical plane, obliquely related to point *f*, can be reached by the two visual eyes only by the harmonious action of three pairs of muscles—the two superior recti, the right externus and left internus, and the right superior oblique and left inferior oblique—and by three conjugate centers, respectively, the first, the fourth, and the eighth. All other muscles and conjugate centers are inactive. Two fusion centers, the right first and the left third, must aid in this rotation. This rotation, as shown in Fig. 3, and all other oblique rotations are effected around two moving axes, the vertical and horizontal axes, by means of three pairs of muscles acted on by their respective conjugate centers, aided by two fusion centers. The rotation shown in Fig. 3 is an example of all oblique rotations.

All oblique rotations are around the same two axes, each moving as the eye rotates around the other. These two axes are the vertical and horizontal axes of the eyes, and these are the axes of the four cardinal rotations, though in either of the latter there is but one axis and it is fixed throughout the given rotation.

The aim of the treatment of all forms of heterophoria is to make it easy for the eyes to obey the law of binocular rest and motion.

FOREIGN BODIES IN THE ESOPHAGUS AND AIR PASSAGES*

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Professor Gustav Killian, of Freiburg, was the first to remove a foreign body from the bronchus by upper bronchoscopy, and who through his writings and demonstrations made bronchoscopy available to every laryngologist throughout the civilized world. Dr. Ingalls was one

of the first Americans to adopt bronchoscopy. Of the Americans, Dr. Chevalier Jackson, through his ability as an author and skillful operator, has contributed most toward the development and advancement of per-oral endoscopy and laryngeal surgery, of which the progress made during the past ten years compares favorably with the general progress made in other branches of medicine and surgery.

The Killian tubes or modifications and Jackson's tubes represent the two types of tubes in general use. We have and use both tubes, as each has certain advantages. For more complete description of instruments, operative technique and bibliography we respectfully refer you to Jackson's "Per-Oral Endoscopy and Laryngeal Surgery."

Foreign bodies in the air passages and esophagus are most frequent in infants and young children, as they seem to have a natural desire to test all things with their mouths. Attempts to swallow, laughing, coughing or crying draw the foreign body into the air tract or esophagus. The smaller caliber of larynx tubes, etc., of children renders the liability to lodgment of foreign bodies greater in children than in adults with obstruction and danger correspondingly greater. The nature of foreign bodies may be limited in size (because of the mouth), but not in variety.

SYMPTOMS

Symptoms of a foreign body in the respiratory tract are those of obstructed breathing, laryngeal, tracheal, bronchial or pulmonary irritation and inflammation. The patient is suddenly seized with a fit of violent choking, coughing and suffocation, evidenced by cyanosis, aphonia, heavy perspiration, weak pulse, etc., all of which subside within a few minutes to return again in a few hours or days. In time the spasmodic symptoms cease, to be followed possibly by a constant cough or other evidence of bronchial or pulmonary involvement, and in this way may not infrequently lead to misdiagnosis of pulmonary tuberculosis. Negative findings upon microscopic examination and other laboratory tests may exclude T. B., but positive findings do not exclude the presence of a foreign body. Therefore, in all

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