zin. When heated on a water-bath, storax becomes more fluid, and if it be then agitated with warm benzin, the supernatant liquid, on being decanted and allowed to cool, will be colorless, and will deposit white crystals of cinnamic acid and cinnamic ethers. This balsam consists principally of an amorphous substance named *storesin*. It also contains several *cinnamic ethers* and *cinnamate of cinnamyl* (styracin), which can be prepared in rectangular prisms, and *cinnamic acid* and *styrol*.

Storax goes principally to the East, very little being used in European pharmacy; in its action it varies very little from a number of other balsamic substances; internally it has been used in bronchitis and similar conditions with but moderate success. As an ingredient of liniments, ointments, etc., it is quite useful. The compound tincture of benzoin contains eight per cent. of storax. Dose of storax, from three to five drops.

ALLIED PLANTS.—The Sweet Gum Tree, *Liquidamber Styraciflua* L., resembles the above species and supplies a non-drying sticky balsam resembling storax in medicinal properties, although not in color or opacity.

Henry H. Rusby.

STORM LAKE MINERAL SPRING.—Buena Vista County, Iowa.

POST-OFFICE.—Storm Lake. Good hotel accommodations.

This spring is located one mile from the village of Storm Lake, at an elevation of 900 feet above the Mississippi River. The surrounding country is level, and not especially interesting. The temperature ranges from about 70° F. in summer (average) to zero in winter. The following analysis is by Walter L. Brown, analytical chemist, of Chicago: One United States gallon contains (solids): Sodium chloride, gr. 0.18; potassium sulphate, gr. 3.02; sodium sulphate gr. 3.22; calcium sulphate, gr. 35.12; magnesium sulphate, gr. 3.40; magnesium bicarbonate, gr. 10.78; silica, gr. 3.56; iron oxide and alumina, gr. 0.18; organic matter, a trace. Total, 59.46 grains. There is also present a large amount of free carbonic-acid gas. The water is said to be efficacious in diseases of the liver, bowels, and kidneys.

James K. Crook.

STRABISMUS, or **SQUINT,** is that condition in which the visual axes are not both directed toward the point looked at. It causes diplopia, and the eyes may be seen to be turned in different directions.

Diplopia arising from strabismus is binocular, and is noticed only when light from the object looked at forms a sensible image on each retina; and when the visual centres are so related to each other as to possess the power of binocular fusion.

Normally, when a certain point is looked at, its image in each eye falls on the fovea; and the two produce the idea of a single point. When, however, the point looked at makes its impression on the fovea in one eye, but on

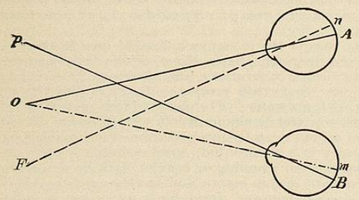

FIG. 4557.

some other portion of the retina in the other, it generates the idea of two distinct points some distance apart, the impression on the fovea being referred to a point directly in front of the eyes, while the impression on another part of the retina is referred in a different direction. Thus, in Fig. 4557, representing a case of convergent strabismus, the visual axis of the eye *A* being directed to the object *O*, the visual axis of the eye *B* is directed elsewhere, to *P*.

In the eye *A* the impression of the point *O* will be made at the fovea; but in the eye *B* the light from *O*, entering in the direction of the broken line *O m*, will make its im-

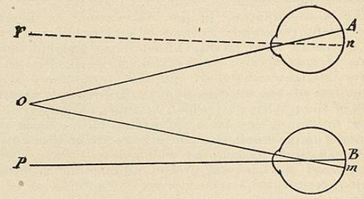

FIG. 4558.

pression on the point *m*, some distance from the fovea. Since the impression is made on *A* at the fovea, it will be correctly referred to the object looked at. But in *B* the impression made at *m* will be referred to a point to one side of the object looked at; its position relative to *O* being in the direction *n F*, which makes the same angle with the visual axis of *A* as *O m* makes with the visual axis of *B*. The image of the point received on *A*, and referred to its true position *O*, is called the *true image*. The image received at *m*, and referred to *F*, in the direction *n F*, is called the *false image*.

In Fig. 4558, representing what occurs in divergent squint, the eye *A*, turned toward the object *O*, receives on its fovea the true image, which is referred to its proper source; and the eye *B* receives at *m* the false image, which, with reference to the true image, is referred in the direction *n F* to *F*.

In general, *in whichever direction the squinting eye deviates, its false image appears to be situated to the opposite side of the true one.* When the image on the right belongs to the right eye, it is called *homonymous diplopia*. It occurs when the visual axes are crossed as in Fig. 4557. When the image on the right belongs to the left eye and the image seen to the left belongs to the right eye, it is *crossed diplopia*. This is represented in Fig. 4558, and occurs in divergent squint. To determine which image belongs to the right eye, and which to the left, cover one eye and the image belonging to it will instantly disappear. Or place before one eye a piece of colored glass, when the image belonging to that eye will appear colored.

Objective Symptoms.—If the squint be well marked, inspection will reveal the defect, and show which eye deviates. But there is a possibility of error. We judge of the direction of the visual axis by the direction of the cornea. Usually the visual axis pierces the cornea near its centre. But sometimes the visual axis deviates, so that, when properly directed, the centre of the cornea will be turned considerably to one side, and the eye will appear to squint.

To determine whether the eye really does squint, direct the patient to gaze steadily at a certain object, and cover first one eye and then the other. If both eyes are properly directed, there will be no change of position when either one is covered. If one eye have its visual axis turned elsewhere, covering it will not cause any change of position; but covering the eye which has been directed toward the object will cause the eyes or head to be turned, so that the eye which had looked elsewhere may now fix on the object. If, however, both eyes have been fixed on the object, but only by an undue effort, the covered eye will deviate and take such position as can be preserved without the undue effort. The test should be repeated until the observer is satisfied as to the presence or absence of squint. Having ascertained that squint is

actually present, the first point to be settled is whether it is *comitant* (concomitant) or *paralytic*.

COMITANT STRABISMUS is a wrong, and usually variable, co-ordination of the movements of the eyes with reference to each other, without marked limitation of these movements in any particular direction. It commonly appears in early childhood; but may exist from birth, and more rarely begins during adult life.

Convergent squint is the most common form of comitant strabismus. In it the visual axes converge to a point nearer the eye than the one looked at, as in Fig. 4557. In it the diplopia is homonymous, and on covering the eye which is fixed on the object it turns in toward the nose, while the other turns from the nose and fixes the object.

Divergent squint comes next to the convergent in frequency. In this form the visual axes do not converge enough, either meeting at some point beyond the object looked at, or remaining parallel or even divergent. The diplopia is crossed. When the fixing eye is covered it turns out, and the other eye turns toward the nose and fixes the object. When the visual axes remain always divergent, the squint is said to be *absolutely divergent*. When the visual axes can be made to converge, but not enough, as in Fig. 4558, the squint is *relatively divergent*.

Parallel squint is applied to those cases in which the visual axes remain parallel when they should converge.

Vertical squint, in which one visual axis is directed more upward or more downward than the other, is rare, except as complicating one of the other forms of comitant squint.

Constant squint is always present, the visual axes never assuming normal relations. Opposed to it is *periodic* or *intermittent squint*, which is only present part of the time.

Periodic squint is apt to be most marked when the general tone of the nervous system is low, or at times of great excitement, or when the eyes are particularly taxed. A form of convergent squint, appearing only during strong effort of the accommodation, is called *accommodative squint*. Squint due to clonic spasm is *convulsive squint*. Closely allied to convulsive is *hysterical squint*.

Monolateral or *monocular squint* is the form in which it is always the same eye that fixes on the object looked at, while the other eye always deviates. If the fixing eye be covered it will deviate, while the ordinarily deviating eye fixes; but, upon uncovering, the deviation is soon transferred back to the eye which habitually presents it. The large majority of cases of comitant strabismus are in this sense monolateral. But it must not be supposed that only the deviating eye is at fault. The squint is a faulty co-ordination of the motions of the two eyes, and one eye deviates because the fixing eye has better vision, or sees with less effort.

Alternating squint is the variety in which the deviation is sometimes presented by one eye, and sometimes by the other; either of them becoming the fixing eye when the other is covered, and continuing to fix after the other is uncovered again.

Absence of Binocular Fusion.—Most persons with squint do not experience double vision. In some cases it is quite obvious why there is no diplopia, as where corneal opacity, or a high degree of ametropia, prevents the formation of a retinal image in the deviating eye. In other cases the reason is less obvious, yet not hard to understand; as here, although the deviating eye presents no abnormal appearance, the acuteness of vision is very low. But there is still another class of cases in which, although each eye is used, it is as an independent organ. What is called the power of binocular fusion or association is lacking.

Amblyopia with Squint.—In many cases of squint there is great defect of vision in one eye without any visible cause for it. This may be due to invisible defects in the cerebral connections of the eye, in which case it may be a cause of squint. It may also be due to failure to develop visual power through disuse, *amblyopia ex anopsia*. Or there may even have been deterioration of vision, by suppression, to prevent annoyance from diplopia.

Causes of Comitant Squint.—When binocular fusion is especially difficult or impossible, or the tendency to it unusually feeble, as where the vision of one or both eyes is very imperfect, the orbital muscles never attain that normal development which enables them to keep the visual axes properly directed to the point looked at. Anything which impairs the development of the visual centres or the acuteness of vision—as hereditary anomalies, convulsions, prolonged nutritive disorders, injury of the eyeball, keratitis, or high ametropia—becomes a cause of squint. But ametropia has an especial share in the causation of squint, as was first pointed out by Donders. Normally, the exertion of the power of accommodation is accompanied by convergence of the visual axes; the full power of the accommodation cannot be exerted without strong convergence. Hence in hyperopia, where the accommodation must be exerted more strongly, there is a special tendency to excessive convergence.

In myopia the need for complete relaxation of the accommodation, even when a near object is looked at, may lead to deficient convergence of the visual axes, or divergent squint. In myopia of high degree there is also antero-posterior elongation of the globe, which is often very marked. This makes the eyeball an oval, fitting in an oval socket, in which it cannot be turned without changing the shape or direction of the socket, by actual displacement of the orbital tissue. Hence convergence of the myopic eye requires excessive effort, while myopia, restricting the range of distinct vision, requires that the convergence should be especially great. In the highest degrees of myopia, the effort at convergence is abandoned, and a divergent strabismus permitted. This is at first relative and periodic, but, if associated with deficiencies of muscular development, is very likely to become absolute and constant.

Treatment of Comitant Squint.—The preventive treatment would include all measures favoring the normal development of the general nervous and muscular systems, or calculated to improve the acuteness of vision. Both to influence the acuteness of vision, and to give the normal accommodation and range of distinct vision, *errors of refraction are to be corrected*. In convergent squint with hyperopia, the convex lenses fully correcting the latter should be worn constantly. They should be carefully determined and put on at the earliest date possible. Children of two or three years will wear accurate correcting lenses with the greatest benefit. To make the necessary measurements for lenses, and to enforce their use, it is advisable to place the eyes under the influence of a *mydriatic*, as: Atropine sulphate, gr. i.; distilled water, ʒ ij.—one drop to be placed in each eye three times a day. This should be kept up for some time after the squint has disappeared, or for some weeks, until it is clearly demonstrated that the deviation is not being favorably influenced by it.

The mydriatic acts by paralyzing the accommodation, and so preventing any attempt to use it which may bring about excess of convergence. Care must be taken that the solution used is strong enough, and is efficiently applied. If only enough of the mydriatic is instilled to somewhat weaken the accommodation, the effect will be not to prevent, but to increase the accommodative effort, and therefore the accompanying convergence.

In myopia concave lenses, correcting it, may be used to prevent divergent squint; or, if the squint is already established, to bring about convergence.

As aiding in the proper development of the muscles concerned, what are called *orthoptic exercises* are recommended. They consist usually in looking through some form of stereoscope at lines, letters, or figures, a part of each being seen by one eye, and the remainder being presented to the other eye; by an effort these are to be fused into one picture. A reading bar or a ruler may be placed vertically between the page and the eye. The ruler cuts off a part of the page for each eye, but by using both eyes all parts may be seen. The reading of each line

necessitates the alternate use of both eyes. The fusion tubes of Priestley Smith may be used for children who cannot read. Orthoptic exercises are mainly of use to cultivate the faculty of binocular fusion where that exists, but is deficient in comparison with the obstacles it has to overcome.

As a palliative of comitant squint, prisms may be worn in rare instances. They are so used as to cause the rays to enter the squinting eye in the direction of its visual axis and thus avoid diplopia, while the squint remains unchanged. Or they may be used as a sort of orthoptic apparatus, to bring the rays so nearly in the direction of the visual axis of the deviating eye that, by a little additional effort, the visual axis will be brought to coincide with their direction and the squint thus lessened. In either case the strength of prismatic effect required is to be determined by trial, and secured by placing prisms of equal strength before both eyes, with the refracting angle or thin edge of the prism in the direction in which the eyes deviate.

Operative measures are intended so to change the connection of the muscles to the eyeball that the visual axes may assume approximately their proper positions. Division of the tendon of the muscle toward which the cornea is turned allows the eyeball to be turned toward the proper position by its opponent. This is called *tenotomy of the rectus*, or *strabotomy*. *Advancement of the tendon* of the muscle which has exerted too little influence on the direction of the eye allows it to acquire a new insertion closer to the cornea, and to exert a relatively greater influence in determining the direction of the visual axis. Operative procedures should only be resorted to after other means have been carefully tried and have failed to give relief.

In determining the operation to be done the amount of deviation is to be considered. This may be measured in degrees on the arc of a perimeter, by placing the deviating eye at the centre of the arc, making the visual axis of the fixing eye parallel to the axis of the instrument, and noting the number of degrees from the axis of the perimeter to the visual axis of the deviating eye. In place of the perimeter arc, the deviation may be measured on a metre stick or tape, held one metre from the eyes. It can also be measured by placing a scale along the edge of the lower lid of the squinting eye, covering the good eye so that the other may fix, and then uncovering it and watching the deviation. As a rule, the inward deviation that can be remedied by a tenotomy of the internal rectus is greater than the outward deviation that can be overcome by a tenotomy of the external rectus; and the effect of the former operation tends to increase for a certain time after its performance, while the effect of the latter rather tends to diminish.

To perform *tenotomy* of one of the recti muscles the instruments required are a pair of scissors with fine but slightly blunt points, a pair of strabismus forceps (a form of fixation forceps with narrow-toothed jaws), a strabismus hook, and a lid elevator or speculum. A drop of a four-per-cent. solution of cocaine is to be placed over the insertion of the tendon to be cut. This is repeated every two minutes for ten minutes. The lid elevator or retractor is then introduced beneath the upper lid and confided to the assistant, who may stand behind the patient, steadying the head against his own breast. The operator with the forceps seizes a fold of conjunctiva 5 mm. back from the margin of the cornea, and over the tendon to be divided. With the scissors this fold in the conjunctiva is snipped so as to make an opening which, when stretched out, will be from 5 to 8 mm. in length. The forceps then drop the conjunctiva, are introduced through the cut, and made to grasp the subconjunctival tissue. This is also divided freely with the scissors. The hook is then introduced, the point in contact with the sclerotic, and pushed under the tendon. The forceps are now removed and the hook depended upon to fix the eyeball. The points of the scissors are introduced, one beneath the tendon and close to its insertion, the other over the tendon and immediately beneath the conjunctiva. The blades being brought together, the tendon is divided and the hook can be pushed forward without hindrance to the margin of the cornea. The point of the hook is then turned and the remaining part of the tendon taken up and divided in a similar manner. When no bands remain to prevent the hook from freely slipping forward to the corneal margin, it is removed and the motility of the eye is tested. If motion is not decidedly limited in the direction of the cut tendon, the hook is to be introduced again and other bands searched for and divided. The effect of the operation can be enhanced by freely dividing the subconjunctival tissue around the tendon.

For *advancement of the tendon* of one of the recti muscles, there are required, in addition to the instruments used for tenotomy, fine needles and silk sutures, and a needle-holder. It is better to have the patient recumbent, and, after the use of cocaine, an incision is made with the scissors in the conjunctiva, parallel to the corneal margin, 5 mm. from it and 10 mm. in length. The tendon is now to be isolated and raised on the hook. A needle armed with the silk should then be passed through one margin of the tendon from without inward, some distance back from its insertion; and, having been drawn through, is to be introduced beneath the conjunctiva near the corneal margin opposite the middle of the tendon insertion, where it is to be carried for 2 or 3 mm., in the firm scleral tissue but not through it. Then the needle is carried beneath the other edge of the tendon, and brought out opposite the first point of entrance, and the loops of suture drawn aside. The tendon is then severed at its insertion, and a small piece of it may be cut off if a decided change of the direction of the eyeball is desired. The suture is then tightened and tied, bringing the tendon forward to the desired position. The eye is closed and bandaged. The stitches are allowed to remain several days, unless it is feared that too great an effect will be produced. Tenotomy of the opposing muscle is combined with advancement to produce a marked change of direction.

In a large proportion of cases, the *result* of operative interference is only an approximate correction of the deformity, which may sometimes be improved by the subsequent use of glasses, or orthoptic training. Only where good binocular fusion can be obtained may a perfect result be hoped for.

Paralytic Squint is a lagging behind of one eye when the patient attempts to look in a certain direction; it is due to loss of power in the muscle or muscles which should turn the eye in that direction.

Such palsies may arise from lesions of the muscle itself, of the centres governing its action, or of the connecting nerve tracts. Usually they have the latter origin. Early, in a case of uncomplicated paralytic squint, movements which do not depend on the muscle or muscles affected may be normal; and, so long as no demand is made on these muscles, no diplopia or inconvenience results. The squint and diplopia appear only when the eyes are turned in a certain direction. In periodic comitant squint the squint is sometimes absent, but when present it is so irrespective of the direction of the object fixed; in paralytic strabismus the squint, though sometimes absent, is always present when the eyes are turned in a certain direction, and always absent when they are turned in another. After paralysis of one of the muscles has existed for some time, its elastic tension is no longer sufficient to balance the elastic tension of its opponent. The latter turns the eye toward itself, so that it cannot assume the normal position, even when the muscles are relaxed as much as possible. When this occurs the deviation becomes more or less constant, and if some power of voluntary contraction be recovered by the paralyzed muscle, the case assumes somewhat the character of comitant strabismus. It is convenient to classify paralytic strabismus by the nervous supply of the muscles involved.

Paralysis of the abducens nerve, or *external rectus muscle*, causes a most frequent and simple form of paralytic

squint. Strabismus occurs when the patient tries to look toward the side on which the affected muscle is situated. If the paralysis be complete, diplopia begins as soon as the object fixed passes the median line; if it be but partial, it may not appear until the eyes have been directed somewhat toward the affected side. Congenital paralysis of both of the abducens nerves, causing a constant convergent squint with inability to turn the eyes to either side, has been occasionally observed.

Paralysis of the Patheticus, Fourth Nerve; the Superior Oblique Muscle.—The deviation and diplopia appear mainly when the eyes are turned toward the affected side and downward. The false image is lower, and appears so inclined that its upper end is close to the upper end of the true image.

Oculomotor Paralysis.—The involvement of all the extra-ocular branches causes drooping of the lid (ptosis), and leaves the eye unable to move in any direction except outward and a little downward. On attempting to look toward the sound side, or upward or far downward, deviation and diplopia appear, and increase *pari passu* with the effort to turn the visual axes in either of these directions. The same thing occurs when any attempt is made to converge for a near object. According to the movements attempted does the squint assume more the character of a divergent or a vertical strabismus.

When the affected eye participates in the act of vision there is experienced a great uncertainty as to the position of objects, which amounts to a kind of vertigo. If the palsy has lasted more than a few days, a permanent outward deviation of the visual axis is usually established. Oculomotor palsy may involve only a part of the muscles supplied by the nerve, or may even be limited to a single one.

Recurrent attacks of oculomotor paralysis, usually attended with intense headache, may occur. The earlier attacks are followed by recovery, but later the paralysis becomes permanent.

Ophthalmoplegia externa is the term applied to a paralysis of all the muscles attached to the eyeball.

Treatment of Paralytic Squint.—The largest number of these palsies come from some syphilitic new growth, involving the sheath of the nerve or adjoining structures, or from syphilitic disease of the nerve itself. A few come from rheumatic disease in the course of the nerve trunk, and a considerable number arise from a focus of disease in cerebro-spinal or spinal sclerosis. If there is a clear history of rheumatism, or collateral evidence of the rheumatic nature of the attack, anti-rheumatic remedies should be carefully tried. But in other cases it is best to assume that the lesion is syphilitic, and to treat it with increasing doses of potassium iodide until there is improvement, or until symptoms of iodism appear.

It is scarcely practicable to pass through the affected muscles electric currents powerful enough to have much effect on them, without endangering the optic nerve and retina.

Prisms and tenotomy are not generally of any use. Where the deformity is very great, cosmetic improvement may sometimes be obtained by making an advancement of the tendon of the paralyzed muscle and the neighboring portion of the capsule of Tenon, with a tenotomy or exsection of the opponent. The immediate effect, obtained in this way, should be a deviation toward the paralyzed muscle. In cases of incomplete recovery passive motion has been used with apparent benefit. Cocaine having been applied to the eye, the insertion of the paralyzed muscle is seized with the fixation forceps and the eyeball dragged back and forth in the direction in which the muscle would act, so that the muscle is alternately stretched and relaxed to its utmost. This is continued for about two minutes, and repeated every two or three days.

Heterophoria or Latent Squint.—The perfect coordination of the movements of the two eyes, called *orthophoria*, is only effected by the demand for single vision. In a large majority of persons the withdrawal of the influence of binocular fusion leaves a perceptible squint. Such squint is called latent or dynamic, or is spoken of as an *insufficiency* of the weaker of the opposed muscles, or as *hetcrophoria*, a tending of the visual axes toward different points. If not great, the latent deviation will cause no trouble to a person with a well-developed musculo-nervous system. But in persons of inferior development and small reserve of nerve force, even moderate degrees of insufficiency may give rise to the symptoms of eye strain, especially if the eyes are required to do large amounts of work, or to work under unfavorable conditions.

Diagnosis of Heterophoria.—On covering one eye so that it can no longer take part in binocular vision, if there is heterophoria the excluded eye will deviate. Upon uncovering the eye, it quickly assumes again the position in which its visual axis will pass through the point fixed. In this way, by repeated trials and close watching of the eyes, quite low degrees of latent squint can be detected. The Maddox rod test is still more delicate. A glass rod held before one eye causes a distant point of light to appear as a streak. If this streak seems to go directly across the light as seen by the other eye, orthophoria is present. If the streak does not cross the light, heterophoria is present, and the direction in which the streak is displaced tells the variety of heterophoria.

To test the muscle balance at a near point a dot or figure, like that shown in Fig. 4559, is viewed through

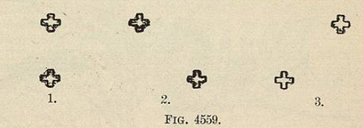

Fig. 4559.

a 10° prism with its base up, causing a vertical diplopia. If the balance be perfect, the false image will be exactly below the true one, as in 1, otherwise the false image will be displaced to the right or left. With the prism before the right eye, 2 will indicate esophoria, and 3, exophoria.

Varieties of Heterophoria.—*Exophoria*, or insufficiency of the interni, occurs with high myopia, and from excessive near work, or as an inherent deficiency of convergence power. *Esophoria*, excessive tendency to convergence, is more often seen in hyperopes, but not exclusively. *Hyperphoria*, or vertical insufficiency, generally goes with one of the other varieties. It is right or left, according to the eye which tends to turn higher than its fellow.

Either of the above may cause headache, a "drawn feeling about the eyes," or other symptoms of eye strain. But such symptoms should not be ascribed to this cause until errors of refraction have been accurately corrected.

Treatment.—All remedial measures for squint may be resorted to. On account of the lesser extent of the deviation, prisms are particularly available. On the same account tenotomy and advancement require more accurate and delicate adjustment to the needs of the case, and are to be resorted to only after a thorough and prolonged acquaintance with those needs. Reduction of the amount of trying eyework, and hygienic measures calculated to improve the condition of the nervous system generally, are of the utmost importance in such cases.

Mixed Forms of Squint.—While nearly all cases of strabismus are readily referred to one or the other of the foregoing classes, and while it is of the first importance to have clear conceptions as to the special characteristics of each class, it should not be forgotten that many cases present the peculiar features of more than one class. In strabismus, therefore, each case is a subject for individual study.

Edward Jackson.

Bibliography.

Bull, C. S.: Passive Motion in the Treatment of Paralysis of the Ocular Muscles. Medical Record, August 6th, 1887.
Cuignet: L'Appareil antistrabique. Recueil d'Ophthalmologie, October, 1887.

Donders, F. C.: The Anomalies of Accommodation and Refraction of the Eye, London, 1864.
Dyer, E.: Asthenopia not Connected with Hypermetropia. Transactions of the American Ophthalmological Society, 1865, p. 28.
Harlan, G. C.: Congenital Paralysis of both Abducens and both Facial Nerves. Transactions of the American Ophthalmological Society, 1881, p. 216, and 1885, p. 48.
Landolt: Refraction and Accommodation of the Eye. Translated by C. M. Culver, Edinburgh, 1886.
Noyes, H. D.: A Treatise on Diseases of the Eye, New York, 1881.—On the Tests for Muscular Asthenopia, and on Insufficiency of the External Recti Muscles. Transactions of the Eighth International Medical Congress, held at Copenhagen, 1884.
Prince, A. E.: Operation for the Advancement of the Rectus with the Capsule. Ophthalmic Review, 1887, p. 249.
Schweigger: Handbook of Ophthalmology. Translated by Porter Farley, Philadelphia, 1878.—Clinical Investigations on Squint, edited by G. Hartridge, London, 1887.
Stevens, G. T.: Terms for the Designation of So-called Muscular Insufficiencies. New York Medical Journal, December 8th, 1886.
Theobald, S.: The Amblyopia of Squinting Eyes, with Discussion. Transactions of the American Ophthalmological Society, 1886, p. 279.

STRAMONIUM LEAVES AND SEED.—(*Stramonii Folia*, U. S., Br.; *Folia Stramonii*, P. G.; *Stramonii Semen*, U. S. P.; *Stramonii Semina*, Br.; *Stramoine* or *Pomme epineuse*, Cod. Med.; *Jamestown Weed, Thorn-apple, Apple of Peru, Stinkweed*, etc.). The two drugs are defined respectively as the dried leaves and the dried seeds of *Datura Stramonium* L. (fam. *Solanaceæ*). The stramonium plant is probably a native of Southern Asia, but it has become abundantly naturalized in nearly all subtropical and temperate regions. It is very common in rich soil of waste places in the Eastern United States. It is a coarse, smooth annual, from one to six feet high, with an upright tri- and dichotomously branched, smooth, green, more or less hollow stem, branching at, say, a foot from the ground, and forming a spreading crown. The habit of the flowering and fruiting branches, and the structure of the large, white, fragrant flowers, and of the fruit, are shown in the accompanying illustrations.

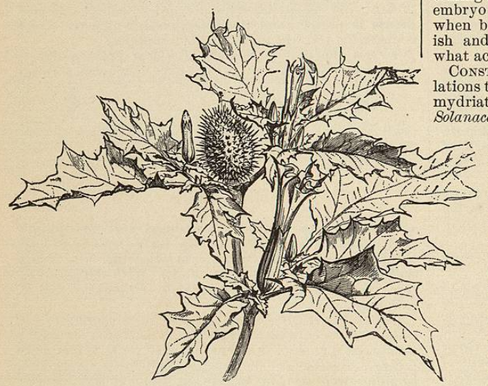

FIG. 4560.—Flowering Branch of Datura Stramonium, with Fruit. (Baillon.)

DESCRIPTION.—*The Leaves.*—A much-wrinkled, deep or somewhat grayish-green, rarely very slightly brownish mass, consisting of petioled leaves, the blades from 12 to 25 cm. (5–10 in.) long, and about two-thirds as broad, inequilaterally ovate, very oblique at the base, acuminate and acute at the apex, very coarsely dentate or sublobed, the large teeth few, acute, with rounded sinuses, thin, smooth; the principal veins few and coarse; odor slight, narcotic when bruised; taste bitter and disagreeable.

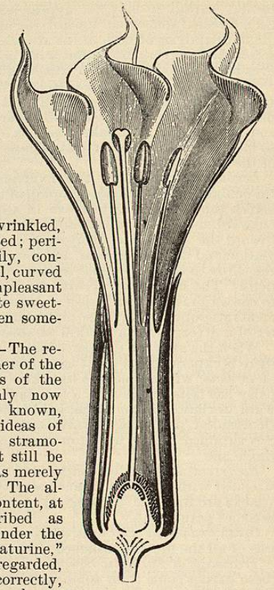

FIG. 4561.—Longitudinal Section of Flower of Datura Stramonium. (Baillon.)

The Seeds.—About 3.5 mm. ($\frac{1}{7}$ in.) long and two-thirds as broad, flattened reniform, the hilum at one side of the concavity; testa dull black or blackish, hard, coarsely and shallowly reticulate-wrinkled, and very finely pitted; perisperm whitish, oily, concealing a cylindrical, curved embryo; odor unpleasant when bruised; taste sweetish and bitter, then somewhat acrid.

CONSTITUENTS.—The relations to one another of the mydriatic alkaloids of the *Solanaceæ* are only now becoming known, and our ideas of those of stramonium must still be regarded as merely tentative. The alkaloidal content, at first described as distinct, under the name "Daturine," is now regarded, doubtless correctly, as being largely one of the *hyoscyamines* (see *Scopola*), but which one, and in what proportions, and how far, and under what conditions mixed with atropine, are matters largely of conjecture. Even the percentage of total alkaloid is not well known. It is generally considered that the seeds contain about one-fourth of one per cent., the leaves not more than one-third as much. Besides these, the leaves contain a large amount of ash (fourteen and one-half per cent.), nitre, asparagin, a trace of volatile oil, and other unimportant substances, and the seeds about twenty-five per cent. of fixed oil.

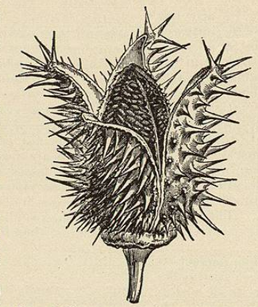

FIG. 4562.—Datura Stramonium; Ripe Fruit. (Baillon.)

ACTION AND USE.—From the above analysis it will be seen that stramonium can exhibit but little difference in action from hyoscyamus, and but little from belladonna. It is indeed capable of being used for exactly the same purposes, only it is more quieting and hypnotic than the latter, which may indicate the presence in it of some hyoscine or other alkaloid distinct from atropine or hyoscyamine. Custom, perhaps, as much as anything, has directed the leaves of this species, instead of those of the others named, to be used in the local antispasmodic treatment of asthma, for which purpose it is almost entirely prescribed. The common method is to administer it by smoking. The leaves may be burnt in a pipe or on the cover of a hot stove, or they may be made more inflammable by being soaked in a strong solution of saltpetre and dried, after which they will burn steadily, without flame and without requiring any apparatus: prepared in this way and flavored with aromatics and balsams, they are the foundation of most of the "asthma cigarettes" and "pastils," which are often better products than extemporaneous preparations are apt to be. The French Codex gives directions for making cigarettes of stramonium, containing 1 gm. each of leaves, without any admixture. For internal administration stramonium may be considered as about the equivalent of hyoscyamus. The following preparations are official, all made from the seed, the leaves being only used for smoking (1 or 2 gm.): Extract (*Extractum Stramonii*), strength about $\frac{1}{4}$; Fluid Extract (*Extractum Stramonii Fluidum*), strength, $\frac{1}{4}$; Tincture (*Tinctura Stramonii*), strength $\frac{1}{5}$; and the Ointment (*Unguentum Stramonii*), strength (of the extract), $\frac{1}{10}$ in benzoinated lard. All these have similar properties and uses to the corresponding preparations of hyoscyamus and belladonna, but are more hypnotic than the latter. Dose of fluid extract about 0.2 c.c.; of the other preparations, according to their relative strength.

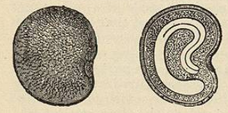

FIG. 4563.—Seed, Entire and in Section, of Datura Stramonium.

ALLIED PLANTS.—*Datura*, of which the present plant is a characteristic species, consists of a dozen, mostly large, rank herbs, most of which have similar medical properties to the above. *D. Tatula*, with purple stems and flowers, scarcely distinct from *D. Stramonium*, and *D. alba*, of India, are used for the same purposes.

Henry H. Rusby.

STRANGULATION AND HANGING, EVIDENCES OF DEATH FROM.—Suffocation is the name applied to both the act and the result of deprivation of atmospheric air. When this deprivation is due to mechanical interference the term *mechanical suffocation* is used.

Mechanical interference may occur through pressure on or obstruction within some portion of the respiratory tract. Suffocation by pressure on the neck is called *hanging* when the constricting force is the weight of the body itself, and *strangulation* in all other cases. The term suffocation is also used in a more special sense where breathing is prevented by pressure on the mouth, nose, chest, or abdomen; or by obstruction within the respiratory tract; or by pressure on the tract from the œsophagus; or through inhaling irrespirable gases.

Strangulation may therefore be defined to include all cases of suffocation by *pressure on the neck* whether by cords or the hand, but excluding hanging. The Germans distinguish strangulation by the hand as *Erwürgung*, and by ropes, cords, etc., as *Erdrosselung*. The words garroting and throttling are often used in place of strangulation. In this article the word ligature will be used to include the very varied forms of constricting materials. Hard substances are sometimes placed in the ligature to increase the pressure.

Strangulation is almost always homicidal, hanging almost always suicidal, and the other forms of suffocation usually accidental, but often also homicidal. Both suicides and murderers are usually more violent than is really necessary to destroy life; murderers more so than suicides.

Death from strangulation as well as all other forms of suffocation, including hanging, is mainly by asphyxia; to some extent by coma or syncope or both. The post-mortem appearances will vary somewhat, depending on whether the deprivation of air is sudden or gradual, partial or complete, and whether there is coincident pressure on the great arteries, veins, and nerves. According to Hofmann, a pressure of 2 kgm. on the neck stops the flow of blood in the jugular veins; one of 5 kgm., in the carotid arteries; one of 15 kgm. stops the movement of air in the air passages, and one of 30 kgm. the flow of blood in the vertebrals.

The *evidences* of death from strangulation are *external* and *internal*. The principal external evidence is the mark of the cord or hand on the neck. Tidy says that nothing short of distinct external marks would justify a medical jurist in pronouncing death to be due to strangulation, while on the other hand Taylor considers the condition of the lungs (see *infra*) as characteristic. Liman does not think there are any internal appearances which can distinguish suffocation, strangulation, and hanging from each other. This statement is made the more probable in view of the fact that death in each case is generally by asphyxia.

All marks on the body should be carefully noted; the cavities of the skull, thorax, and abdomen carefully examined; the possibility of death having occurred from other causes, even in strangulation, must be considered. In all cases the cord or strangulating ligature should be carefully examined for marks of blood, for adherent hair or other substances. The precise manner in which the cord has been tied should be noted. Putrefaction may cause external marks to disappear. In some fatal cases there are either no marks at all or they are but slight; this is more likely to be the case in suicide than in homicide, and is usually due to the ligature being soft and yielding. The victim of a homicide may, however, first be stunned and afterward strangled. A person while intoxicated or in an epileptic or hysterical paroxysm may grasp his neck in gasping for air and thus leave finger marks. Marks are said to be plainer after the body has become cold and when subjects have recovered from attempts at suicide.

The mark of the ligature in strangulation usually encircles the neck more completely and is more horizontal than in hanging. These conditions may, however, be reversed, because a body may be dragged by the neck after strangulation, and there have been suicides by hanging in whom the mark of the cord was horizontal. As a rule, however, a horizontal mark with the knot on the same level as the cord, especially if below the larynx, suggests strangulation rather than hanging; and if there are several marks the probability is even greater. In compression with the fingers the marks are not in a horizontal but in an oblique line. The mark of the ligature is usually circular, well defined, and corresponds closely to the breadth of the ligature; rather depressed and usually below the larynx. As a rule this depression is not deep; the skin at the bottom of the groove is usually very pale, while the adjacent parts are red or livid. Sometimes the bottom of the groove shows ecchymoses. Neyding says that suggillations in the groove made by the ligature on the neck are rare, but are oftener found in strangulation than in hanging, because the conditions favoring their formation are oftener found in strangulation. In most cases the skin and connective tissue of the groove and of the parts in the vicinity show, microscopically, hyperæmia and hemorrhages. Liman states that when we find suggillation in the groove or its vicinity we may know that some other form of violence has been applied at the same time as that of the ligature or hand. He had not seen suggillation in the furrow either in strangulation or in hanging, except when the injured persons had lived some time. The absence of suggillation and ecchymosis was due, he thought, to pressure on the capillaries. Bremme says that there is no hemorrhage in the subcutaneous tissues of the mark of the ligature, either in strangulation or in hanging, if death occurs at once and the cord is removed soon after death; but if the cord remains for some time after death there may be hemorrhages, or if death does not occur at once, whether the ligature is removed or not. It is impossible to distinguish ante-mortem from post-mortem hemorrhage. Different constricting agents may make quite similar marks. Taylor mentions a case in which a soft silk handkerchief was used and the appearance was the same as that of a narrow cord, due to the tightness with which it was tied. Marks may be made on the neck within a limited time after death similar to those made during life. Tidy's experiments led him to fix this limit at