

Viewed in the stereoscope Fig. 3702 is seen as two discs, the one vertically above the other, but lying in two different planes at different distances from the observer; the more distant of the two discs appearing also to be the larger. Inverting the slide in the stereoscope, the relative distances and sizes of the discs appear reversed. Fig. 3703 shows a circle and an ellipse, which may be considered as two different perspective views of another, larger ellipse; when the two images are combined in the stereoscope a horizontally elongated ellipse is seen rotated about its vertical diameter as an axis; inverting the slide, the ellipse is seen rotated in the opposite direction. In Fig. 3704 the ellipse is seen to tip backward or forward, according as the slide is placed in the stereoscope in the position shown in the plate, or inverted. Fig. 3705 shows a combination of a ring with a white centre and a black disc of the same diameter; the effect is that of a mirror or of a shining surface polished with plum-bago.

John Green.

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- ⁶ Test-letters contributed by J. Green to Recent Advances in Ophthalmic Science, by H. W. Williams, Boston, U. S. A., 1866.
- ⁷ J. Green: Transactions of the American Ophthalmological Society for 1867; Report of the Fourth International Ophthalmological Congress, London, 1873.
- ⁸ Monoyer (1877).
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- ¹⁰ Masson: Annales de Chimie et de Physique, 1845.
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- ¹⁴ Donders: On the Anomalies of Accommodation and Refraction of the Eye, p. 337. New Sydenham Society, London, 1864.
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- ²² Javal and Schiötz: Annales d'Oculistique, lxxxvi., 1881; *ibid.*, lxxxvii., 1882.
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- ²⁵ W. Thomson: Transactions of the American Ophthalmological Society, 1873.
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- ²⁷ Porterfield: On the Eye, Edinburgh, 1759.
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ORANGE, SWEET AND BITTER.—(See also *Citrus*.)
I. *Citrus Aurantium* L., the sweet orange, is a familiar plant in all warm countries. It is a small, rather slow-growing tree, with hard wood, an upright, much-branched trunk, bearing a well-rounded, rather close head. Leaves numerous, thick, evergreen, smooth, and shining, oval; the blade articulated to the distinctly winged petiole. Flowers axillary, perfect, regular, large, fragrant, white; calyx short; petals five, long, fleshy, spreading; stamens numerous; ovary free, eight- or more celled, several ovules in each cell. The leaves and petals are fragrant, and show by transmitted light

pellucid spots indicating the large oil reservoirs in their parenchyme.

II. *C. vulgaris* Risso, the source of the bitter or Seville orange, is a smaller tree, with a closer head, larger, more fragrant flowers, and a rougher, darker, sour, and bitter fruit. This plant is also rather more spiny than the other, and propagates more truly from seed.

The official products and preparations are as follows:

Sweet Orange Peel. *Aurantii Dulcis Cortex.*

"The rind of the fresh fruit of *Citrus Aurantium* L." The preparations of this are the five-per-cent. syrup, used wholly as a vehicle and for flavoring, and the twenty-per-cent. tincture, chiefly used like the last, but a stimulant in doses of 2-8 c.c. (fl. 3 ss.-ij.).

Bitter Orange Peel. *Aurantii Amara Cortex.* "The rind of the fruit of *Citrus vulgaris* Risso."

Preparations, the fluid extract, dose 2-4 c.c. (fl. 3 ss.-i.) and the twenty-per-cent. tincture, dose 2-8 c.c. (fl. 3 ss.-ij.). It will be observed that this peel may be used dry, while that of the sweet orange must be used in the recent state. The bitter principle of this peel makes it an important aromatic bitter, as well as a flavoring agent.

Oil of Orange Peel. *Oleum Aurantii Corticis.* "A volatile oil obtained by expression from the fresh peel of either the sweet or the bitter orange." This is purely a diffusive stimulant, but is almost wholly used for flavoring. Its preparations are the five-per-cent. spirit and the twenty-per-cent. compound spirit, made with five per cent. of oil of lemon and two per cent. of oil of anise. This latter enters into the aromatic elixir.

Oil of Orange Flowers. *Oil of Neroli.* *Oleum Aurantii Florum.* A volatile oil distilled from the fresh flowers of the bitter orange. (The flowers themselves are no longer official.) This is used purely as a perfuming and flavoring agent. The following are the preparations: *Stronger Orange Flower Water* (*Aqua Aurantii Florum Fortior*) is obtained as a by-product in the distillation, being the water so used, saturated with the oil. From this is made the *Orange Flower Water* (*Aqua Aurantii Florum*) by mixing it with an equal volume of distilled water. From this, in turn, is made the syrup, by adding to 850 grams of sugar enough of the water to make 1,000 c.c.

Oil of Petit Grains, not official, is distilled from the unripe fruits of the bitter orange, and is very similar to oil of orange flowers, but much less agreeable.

The use of orange fruit is like that of other laxative fruits, with the special effect of citric acid. It is to be borne in mind that, while a moderate use of oranges is wholesome, the excessive use can bring on very stubborn and severe dyspepsia, especially in tropical countries.

Henry H. Rusby.

ORBIT, DISEASES AND INJURIES OF THE.—These affections have great interest and importance, not only with reference to the preservation of sight, but also on account of the close topical and vascular connection of the contents of this cavity with other parts, particularly the brain, and the difficult and serious problems in diagnosis and prognosis which they frequently offer. They are, comparatively, not very common. The one most frequently met with is

ORBITAL CELLULITIS.—This is not generally difficult to recognize. It is usually an acute disease, and often of a violent inflammatory character. Pain, which is a prominent symptom, is in proportion to the degree of swelling and consequent pressure, and, when this is ex-

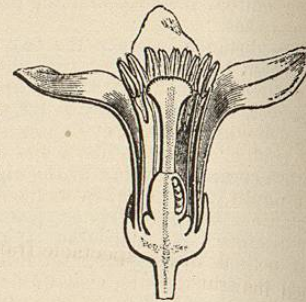


FIG. 3706.—Sweet Orange Flower. (Baillon.)

cessive, it is very intense. It is referred to the ball and orbit and to the parts of the face to which the ramifications of the ophthalmic branch of the fifth nerve are distributed, and is always increased by the slightest backward pressure of the globe. The conjunctiva is congested and soon becomes chemosed, and the lids are swollen and oedematous and have an erysipelatous appearance.

The most striking symptom is the exophthalmus, which is decided, even in slight cases and in the early stages. The diplopia resulting from displacement of the eyeball is sometimes among the first symptoms, and may even occur before the exophthalmus attracts attention. In severe cases, particularly if an abscess is formed, the protrusion of the ball may be so great that the lids can no longer cover the cornea. The movements of the eye are, of course, restricted and painful, or it may be completely fixed in its unnatural position.

More or less constitutional disturbance is to be expected, and the formation of pus is usually announced by well-marked rigors. Suppuration is the rule, but a few cases end in resolution, a result said to be much more frequent in children than in adults. This form of the disease is sometimes called "oedematous cellulitis." When an abscess is evacuated spontaneously, the pus escapes through the skin of the lids, near the superior or inferior orbital margin, or sometimes behind the lids, through the palpebro-ocular fold of the conjunctiva. In the latter case the disease is sometimes mistaken for purulent conjunctivitis. In rare cases orbital cellulitis assumes a chronic form, and ends by the escape of pus only after the lapse of months or years. There may be little or no pain, and no decided symptom except the exophthalmus. There is likely to be periostitis or caries in such cases.

Etiology.—Idiopathic cellulitis is so rare that Pagensteher is disposed to deny its occurrence, and to maintain that cases described as such have been due to the extension of inflammation from a focus which had escaped the attention of the observer (*Arch. of Oph.*, vol. xiii.). Primary cellulitis in healthy adults must be considered, to say the least, a very unusual affection, but its occasional occurrence in delicate children is generally admitted. Perhaps the most frequent causes are direct injuries of the orbital tissue and extension of local inflammation from neighboring parts. Operations upon the appendages of the eye, or even upon the ball itself, are sometimes followed by this complication. Bull (*Jour. Med. Sci.*, July, 1878) reports a case following excision of a prolapsed iris, and one after iridectomy for glaucoma. The most frequent cause of orbital abscess is empyema of the accessory cavities of the nose with caries of their walls. Phlegmonous erysipelas of the face has extended to the orbital tissue in a number of cases. Finally, orbital abscess may be the result of a metastatic process in puerperal fever, phlebitis, typhus, carbuncle, etc. While thrombosis of the orbital vein necessarily occurs in orbital phlegmon, and may extend to the cavernous sinus, orbital cellulitis may have its origin in suppurative phlebitis of the ophthalmic vein. It is well known that suppuration may be communicated to the ophthalmic vein and cavernous sinus from abscesses of the lids or lips, operations about the face, the extraction of teeth, and especially from facial erysipelas. In a fatal case of suppurative phlebitis of the ophthalmic vein and cavernous sinus, following malignant abscess of the tonsil, Professor Panas (*Arch. d'Ophthal.*, t. v.) thinks that the disease was communicated through numerous anastomoses which have been shown to exist between these vessels and the sphenopalatine vein. Cases of orbital cellulitis following diphtheria are reported by Knapp and Heyl (Nettleship, "St. Thomas' Hospital Reports," vol. xi.). Knapp (*Arch. of Oph.*, xiii.) has shown that orbital cellulitis is present in all cases in which blindness results from facial erysipelas.

Diagnosis.—The conditions with which orbital cellulitis is most likely to be confounded are periostitis of the orbital walls and new growths in the cavity. In periostitis the progress of the disease is usually less rapid, and the pain, though perhaps less severe, is an earlier symp-

tom and may even be the first. Except in cases in which only the deeper parts of the orbit are affected, a tender spot can frequently be detected by passing the finger as far back as possible and pressing against the wall. While in cellulitis the eye is usually protruded directly forward, and its motions are limited equally in all directions, it is likely to be given a special direction by the more localized swelling of periostitis. These two lesions may, however, sometimes appear together, the inflammation extending from the periosteum to the orbital cushion. The acute course of cellulitis will usually distinguish it from orbital growths. The eye is rarely protruded directly forward by a tumor, and the latter may often be felt with the finger. The diagnosis is, however, sometimes extremely difficult, and may prove a stumbling-block to the most skilful and careful observer. This is well illustrated by a case which occurred some years ago in the experience of no less an authority than Professor Jaeger. He was sent by the Emperor to Milan to examine Marshal Radetzky, who had been suffering for three months with a high degree of exophthalmus and its accompanying symptoms. He reported that the patient, who declined any operative interference, was affected with scirrhus of the soft parts of the orbit, which would probably soon end his life. Not long afterward, under homœopathic treatment, there was a copious discharge of pus, and the eye returned to its normal position (*Annales d'Oculist.*, xxiii., p. 14).

Prognosis.—Though a large proportion of cases of orbital cellulitis recover without serious injury to the eye, the disease is a dangerous one and places not only sight but sometimes life in peril. The most frequent causes of loss of sight are injury to the optic nerve from pressure and stretching, and interference with the circulation in the central vessels of the retina. The tense chemosis may cause the cornea to slough, or panophthalmitis may result from interference with the circulation of the choroid or from direct extension of the inflammation to that membrane. The movements of the ball are sometimes permanently impeded by cicatricial contractions or atrophy of the external muscles, or their paralysis from injury to the nerves. Life is threatened by direct extension of inflammation to the meninges, through the sphenoidal fissure or optic foramen, by flow of pus into the intracranial cavity, or by thrombosis of the ophthalmic vein. According to Berlin (Graefe-Saemisch, vol. vi.), fatal pyæmia may result without extension of thrombosis beyond the orbit, or the thrombosis may extend to the brain sinuses. He thinks that the latter condition may be diagnosed positively if exophthalmus occurs suddenly in the other eye. Exophthalmus frequently results from venous obstruction only, with little or no inflammation of the orbital tissue, and is a constant and important symptom of phlebitis of the cavernous sinus.

Treatment will necessarily vary with the violence of the local inflammation and the general condition of the patient. In traumatic cases, and others occurring in persons in fair health, leeches may be applied to the temple in the early stages of the affection before suppuration has commenced. Even this kind of depletion, however, is to be condemned in the large proportion of cases in which the inflammation of the orbital tissue is a complication of some exhausting disease. Hot stupes will promote resolution while there is hope of that termination; but warm fomentations or poultices should be applied when it is desirable to encourage suppuration. Extract of belladonna applied to the temples and brow is useful in relieving pain, but most cases will require the liberal exhibition of anodynes. When suppuration is evident, there is no question about the propriety and urgency of free incision, and when it is doubtful it is often prudent to make an exploratory puncture. When great swelling inflicts intense pain and threatens the integrity of the eyeball and optic nerve, deep and free incisions should be made without waiting for indications of suppuration, and with a view to relieving the tension of the parts. A narrow, straight bistoury or a long Graefe cataract knife

is entered near the upper or lower margin of the orbit, and its point kept near the roof or floor, while it is passed toward the apex of the orbit. It is well to keep the wound open by a tent of carbolized or borated lint. Curetting of the inner wall of the orbit and drainage through the nose may be necessary when the accessory sinuses are involved (see Transactions of the American Ophthalmological Society, 1900).

TENONITIS.—The capsule of Tenon is a fibrous envelope of the ball, derived from the dural sheath of the optic nerve, and lined by a serous membrane which, according to some authorities, is continuous with the arachnoid. The eyeball moves in this envelope like the head of a bone in its articular capsule. The recti muscles pass through this capsule at the equator of the ball, where it is intimately connected with their sheaths, and in the neighborhood of the corneal margin it is merged in the conjunctiva and subconjunctival tissue. While it forms a barrier to the extension, within the eye, of inflammatory processes when they commence in the orbital tissue, its direct connection, by means of the anterior ciliary vessels with the intra-ocular circulation makes this danger greater when the capsule itself is inflamed. On the other hand, it probably rarely entirely escapes participation in very acute and intense intra-ocular inflammation, and is the cause of the protrusion of the ball in panophthalmitis. In enucleation in such cases the extensive and firm adhesions of the capsule and the muscles and connective tissue about the ball often considerably complicate the operation. Tenonitis is said to occur occasionally after facial erysipelas or as a rheumatic affection, but is usually the result of extension of inflammation from the ball, or of direct injury. It has sometimes followed operations, especially those upon the external muscles. I have met with two cases: one after simple division of a muscle for strabismus, the patient recovering in the course of a few days, without injury to the eye; and one after the advancement of the internal rectus. In the latter case the disease ended in disorganization of the ball.

The symptoms are conjunctival and subconjunctival congestion, sometimes with chemosis, moderate exophthalmus, restriction of the movements of the ball, and pain, greatly increased by pressing the eye backward. The lids are less affected than in cellulitis, and if pus forms it escapes on the surface of the ball.

Treatment will, of course, depend upon the cause and the intensity of the inflammation. Rheumatic cases require hot stupes, cotton compresses, anodyne applications, and the appropriate internal medication. In the early stages of traumatic tenonitis leeching at the temple, the local application of ice, and calomel internally may be needed.

PERIOSTITIS of the orbital walls is sometimes difficult to distinguish from cellulitis, and indeed the two conditions may exist together, or phlegmonous inflammation of the orbital connective tissue may originate in periostitis. The usual seat of periostitis of the orbit is near the margin, where it can be detected by pressure with the finger. The exophthalmus is not directly forward as in uncomplicated cellulitis, and the movements of the ball are limited more in the direction of the seat of the disease than in other directions. When the disease is at the apex, paralysis of some of the muscles of the ball is likely to ensue from involvement of the nerves at their entrance into the orbit. Periostitis usually, though not invariably, ends in suppuration. Sometimes there are more or less permanent localized thickening of the periosteum and consolidation of the neighboring tissue, which closely simulate a tumor. I have met with several such cases. In one there was a distinctly localized hard swelling in the upper inner wall of the orbit, extending as far back as the finger could reach. An exploratory incision was made, and when the finger was introduced into the wound it was found that the swelling was much less clearly defined than it had appeared to be—in fact, that it was merely a localized engorgement of the periosteum and neighboring orbital tissue. The part was freely

scarified and the wound was kept open with a tent. The case soon ended in complete recovery without suppuration. In another case there was such a decided resemblance to a tumor in the region of the lachrymal gland that extirpation had been advised by two experienced surgeons. As the patient was known to have been under treatment some months previously with an aggravated attack of syphilitic pharyngitis, periostitis was diagnosed, and a rapid cure followed the administration of heroic doses of iodide of potassium.

Prognosis.—A large proportion of cases end favorably. The bone may become involved in the disease. In a few cases death has resulted from direct extension of inflammation from the periosteum to the meninges of the brain, or from the escape of pus into the intracranial cavity. The danger is, of course, much greater when the deeper parts of the orbit are affected. In the chronic form the progress of the disease is very slow, sometimes extending over months or even years.

The cause may be traumatic or rheumatic, or the disease may be due to an extension of inflammation from one of the neighboring cavities, but it is most frequently syphilitic. The local treatment is the same as in cellulitis, and when suppuration is suspected or when excessive swelling endangers the eye or brain, early and free incision should not be neglected. Iodides and tonics are generally needed.

CARIES AND NECROSIS of the orbital walls are usually the result of periostitis when not due to disease of the accessory sinuses. The seat of the disease is, fortunately, most frequently near the margin of the orbit, where the danger of injury to the eye or of extension to the brain is much less than when the deeper parts of the orbital cavity are involved. The adherent cicatrix of the skin, however, which invariably forms, is likely to cause serious deformity of the lids by its excessive contraction. This cannot be prevented, but must be remedied by operation, as best it may, after the affection of the bone has run its course. Abscesses should be promptly evacuated and a free opening maintained. When they discharge spontaneously the resulting sinuses will frequently need to be enlarged. The cavity should be frequently syringed with antiseptic solutions. The danger of reckless probing should be borne in mind, and no forcible attempts to remove sequestra should be made. Acute cases, which are often mistaken for erysipelas of the lids and face, may need local treatment. Iodide of potassium is always in order, and should be given in large doses if syphilis is suspected. Many patients require a long course of treatment by quinine and iron and cod-liver oil, and careful attention to diet and hygiene.

HEMORRHAGE IN THE ORBIT is extremely rare from other than traumatic causes. It has occasionally occurred in scorbutic subjects, in sudden suppression of the menses, and from violent coughing or muscular straining. Permanent hæmatomata have been formed by repeated hemorrhages.

When hemorrhage occurs in the orbit after serious injuries of the head, it is an almost certain symptom of fracture of the walls of the cavity; though intracranial hemorrhage may find its way into the orbit without fracture. In a few cases of injuries bleeding has resulted from rupture of vessels within the orbit. The symptoms are exophthalmus and ecchymosis of the lids and conjunctiva. The ophthalmoscopic appearances are those resulting from sudden pressure.

Treatment.—Iced-water or pounded ice should be applied while there is probability of further hemorrhage, and afterward absorption may be hastened by a compressive bandage.

EMPHYSEMA of the orbit is still more rare than hemorrhage. The symptoms are exophthalmus and the characteristic crepitation on pressure upon the puffy lids. The causes are rupture of the lachrymal sac, or communication between the orbit and the frontal sinuses, ethmoidal cells, or nasal cavity. This communication with neighboring air spaces is generally traumatic, but may be the result of ulceration. Rampoldi reports

a case in which the emphysema developed, without injury, from chronic coryza. Exophthalmus, with diplopia, appeared whenever the patient sneezed or coughed, until he learned to prevent it by supporting the eye with his hand. The story is told of a convict who produced exophthalmus by introducing a pin at the root of a molar tooth and forcing in air from the mouth; and malingerers are said to have produced the same result by making a puncture beneath the eyeball and blowing in air through a tube. French jockeys have been accused of resorting to the latter expedient to give a youthful appearance to old horses with sunken eyeballs. No treatment is likely to be of much use. The patient should be cautioned against blowing his nose and encouraged to wait for the rent to close.

EXOPHTHALMIC GOITRE, often called Graves' disease or Basedow's disease, is a complicated affection in which, in its typical form, protrusion of the eyeball is associated with enlargement of the thyroid gland, functional disturbance of the heart, and marked nervous and nutritive derangement. Though cases presenting this association of symptoms had previously been reported by Parry and others, the first systematic description of the disease now known as exophthalmic goitre was given by Graves in 1835, and his name is associated with it by English, American, and some French authors; while the Germans claim that Basedow was the first to describe it accurately (Casper's *Wochenschrift*) in 1840, and they always speak of it as Basedow's disease.

The exophthalmus is not usually so excessive as that met with in cases of abscess or tumor of the orbit, but in a few instances it has been so great as to prevent the lids from closing over the cornea. The effect of the protrusion of the ball is, in a large proportion of cases, heightened and the deformity much increased by an associated affection of the lids, a symptom to which attention was first called by von Graefe. The upper lid does not follow the movements of the ball as its axis is directed upward or downward, but remains fixed and more or less retracted, exposing the sclerotic and giving a staring and startled expression to the patient. This is due to contraction of the small, flat muscular fibres, extending from the lid back into the orbit, which were discovered by Müller and are known by his name. They are of the unstriated kind and are under the control of the sympathetic nerve. Sometimes, also, reflex contraction of the orbicularis from irritation of the eye is diminished, and winking is absent or incomplete. These lid symptoms are not constant, but are sometimes found when the disease is but slightly developed, and may be valuable indications in doubtful cases. The ball can be forced back nearly or quite to its normal position by pressure with the fingers, but it projects immediately when the pressure is removed. Vascular bruit has been detected with the stethoscope by Snellen. Diplopia from displacement of the visual axes may occur, even as an early symptom, and, in some advanced cases, continued stretching produces paresis of the external muscles of the ball. There has been much discussion about the condition of the pupil: some cases have been reported in which it was dilated, and a few in which it was contracted, but, without doubt, it is usually unaltered. Vision is not generally impaired. The ophthalmoscope has occasionally shown retinal hemorrhages, and Becker (*Klin. Monatsblatt für Augenheilk.*, 1880) has observed pulsation of the retinal arteries in some cases, but, as a rule, there is little or no change in the fundus beyond a dilatation of the retinal veins, and even this is not constant. Both eyes are almost invariably affected. Cases have been reported in which one only was involved, but this is so rare that Eulenbergh thinks that some suspicion must remain in respect to the diagnosis. Slight keratitis, with conjunctivitis, is common in severe cases, but blindness from ulceration of the cornea is a rare occurrence. Some authorities attribute this ulceration to simple exposure of the cornea from excessive exophthalmus, while others believe it to be an instance of so-called neuroparalytic keratitis, due to a disturbance of nutrition resulting from the obscure neurosis

that lies at the bottom of all the manifold symptoms of this disease. The latter is the view taken by von Graefe and others, who consider the corneal affection a result of paralysis of the "trophic" fibres of the ophthalmic branch of the fifth nerve; the corneal sensibility being lost or retained according as all the fibres of the nerve, or the trophic only, are involved. Some authors, among them Charcot, are disposed to think that the corneal inflammation is produced by irritation of the nerve (see "Neuroparalytic Keratitis," Harlan, *Am. Jour. of the Med. Sci.*, April, 1874).

In nine cases out of ten the subjects of the disease are females, usually adults under thirty years of age, but a few instances in children under ten have been recorded. Male patients are generally older and their attacks are likely to be more severe. Most cases of corneal ulceration have occurred in males.

The exophthalmus usually disappears entirely after death, and no constant lesion is discovered by post-mortem examination of the orbit. Fatty degeneration of the muscles, from disuse and stretching, has been noted; and hypertrophy of the orbital fat has been found in some cases, but it may be considered an accidental result of the vascular engorgement which seems to be the cause of the protrusion of the eyeball.

The pathology, symptomatology, and treatment of exophthalmic goitre will be discussed in a separate article in THE APPENDIX.

PULSATING EXOPHTHALMUS, a comprehensive term based on convenience rather than on scientific accuracy, is now quite generally used to include a large class of cases which are dependent upon different pathological conditions, and which in the present state of our knowledge it is always difficult and generally impossible to distinguish positively during life.

Symptoms.—There is protrusion of the eyeball, and pulsation is evident to the touch and sight. Above the eye, and beneath the upper and inner margin of the orbit, is a rather firm, elastic tumor, also pulsating. The patient complains of a puffing or whirring noise in the head, and an aneurismal bruit is heard, on auscultation, over the eye and temple, and sometimes over the whole side of the head. In some cases this sound has been audible at a distance of several feet from the patient. There are usually distention and pulsation of the supra-orbital vein, and sometimes of the infra-orbital also. When the carotid is compressed in the neck the pulse and bruit cease, the tumor becomes soft, and the eye can be pushed back into the orbit. The hollow between the ball and the orbital arch is obliterated. The conjunctiva is congested, and in many cases a tumor is formed by intense chemosis of its lower fold, which projects beyond the lid. There may be no decided ophthalmoscopic changes, but the retinal vessels are usually congested, and the disc is sometimes found swollen as a result of pressure upon the optic nerve in the orbit. Pain may be slight or severe.

Vision is not generally much affected in recent cases, but the eye has often been destroyed by long-continued and excessive pressure. The symptoms usually appear suddenly, after direct injury to the orbit or a severe blow upon the head in traumatic cases; or during violent effort, as in childbirth, in cases of spontaneous origin. They have not been noticed, however, in a number of traumatic cases until some weeks or months after the injury.

In several spontaneous cases the patients have been roused from sleep by a loud sound like the report of a pistol.

Progress and Termination.—The deformity and inconvenience are so great, and the danger to the eye and to life is so decided, that few cases have been allowed to pursue a natural course, uninterrupted by more or less active treatment. As a rule, the character of the affection is chronic, and some cases have undergone little or no change in the course of years. In others the eye has been destroyed by sloughing of the cornea and general ophthalmia. The causes of death include erysipelas, complications of brain and heart, and hemorrhage. Of

the last class, in the cases of Hussey and Critchett ("Ophthalmic Hospital Reports," vol. ii., p. 127; *Med. Times and Gaz.*, December, 1854), the patients died of hemorrhage directly from the orbit, and in one of Nélaton's cases (*Lancet*, 1873), profuse epistaxis, resulting from fracture of the body of the sphenoid bone and rupture of the carotid, was the cause of death. In 1876 (Trans. Internat. Med. Cong.) I reported a case of spontaneous

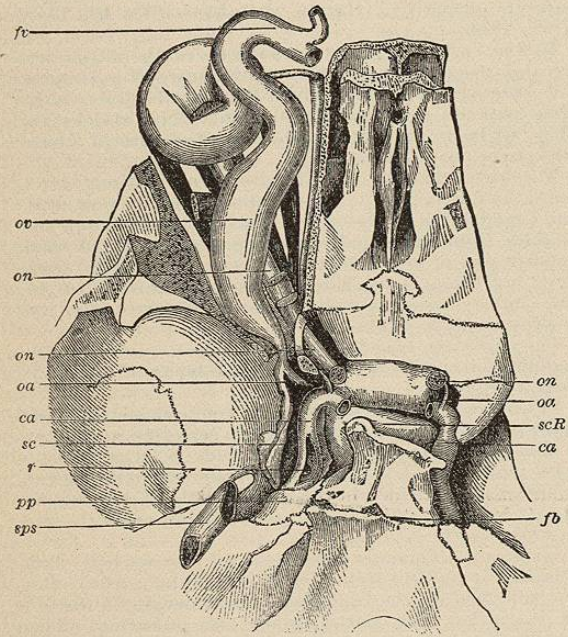


FIG. 3707.—sc, The dilated cavernous sinus, opened from above. Within this, the internal carotid (ca), which is cut open above to show the perforation in the under and outer side of its wall (fp); fb, the fracture in the sphenoid bone; pp, detached spicula from the point of the petrous bone; scR, sinus circularis Ridley; sps, a part of the dilated superior petrosal sinus; oa, dilated ophthalmic vein; fr, vena frontalis; oa, ophthalmic artery; on, optic nerve. (After Delens.)

cure, and gave abstracts of six other cases recorded in literature up to that time, and I find three others which have been reported since:

1. Bitsch (*Klin. Monatsbl. f. Augenhk.*, xvii., 1879): Exophthalmus, murmur, pulsation. Probable spontaneous rupture of carotid in cavernous sinus. Cure by extra- and intra-ocular inflammation.

2. Gauran (*Gazette des Hôpitaux*, October, 1883): Aneurism of both orbits, caused by a fall upon the head, cured spontaneously.

3. Glascott (*Brit. Med. Jour.*, November 25th, 1882): "Arterio-venous aneurism of orbit," lasting two years. Spontaneous cure in the course of phlegmonous inflammation of the face and head.

This makes a total of ten cases, to which might be added several others in which the effect of remedial measures was doubtful.

Pathology.—The typical symptoms of "pulsating exophthalmus" are protrusion of the eyeball, pulsation, and aneurismal bruit, and all cases presenting these symptoms were formerly classed as "orbital aneurism." Following the view maintained by Travers, in his report of the first case in 1809 (*Med.-Chirurg. Trans.*, vol. ii.), for thirty years writers generally held that these cases of so-called aneurism of the orbit were all of the anastomotic variety. Then Busk's paper (*ibid.*, vol. xxii.) threw a doubt on this, and most authors thought that they were of the ordinary spontaneous or traumatic kinds, affecting the ophthalmic artery, until Nunneley, in 1864, maintained that in the great majority of such cases of protrusion of the eyeball there is no disease whatever in the

orbit, but that the symptoms depend on obstruction to the return of blood through the ophthalmic vein. Though there is no positive proof that such a thing as an aneurism of the orbit has ever existed, it is, of course, not an impossible condition.

A review of the now very extensive literature of the subject makes it seem probable that pulsating exophthalmus may be produced by true arterio-venous or anastomotic aneurism of the orbit; by aneurism of the carotid artery, or of the ophthalmic at its origin; by aneurismal varix between the carotid and the cavernous sinus; by thrombosis of the ophthalmic vein or cavernous sinus; by dilatation of the sinus; or by obstruction of the return of venous blood by growths at the bottom of the orbit or behind it. The protrusion of the ball is the result of venous engorgement; while the pulsation and bruit are communicated from the carotid, or are produced by the rush of blood into dilated vessels confined in a bony cavity and with obstructed outlets, or are symptoms of an aneurismal varix of the orbit due to a communication between the carotid artery and the cavernous sinus. From a study of the comparatively few post-mortem records, and the histories of a large number of cases in which the patients have survived, I am convinced that marked pulsation and bruit have most frequently been produced by aneurismal varix of the orbital veins. In three traumatic cases direct communication between the carotid artery and the cavernous sinus was found after death; and in three spontaneous cases post-mortem examination showed that there had been rupture of diseased carotid arteries in the cavernous sinus. In a number of cases the diagnosis of arterio-venous communication in the cavernous sinus has been made, with more or less confidence, during life.

In a traumatic case, reported by Knapp, this diagnosis was subsequently confirmed as positively as it could have been by a post-mortem examination. Ligature of the carotid gave partial relief, but, nearly two years afterward, there was a recurrence of the orbital disease, with great increase of the pulsating tumor, enormous protrusion of the eye, and sloughing of the cornea. After extirpation of the eyeball, the orbit was found to be filled with an irregular pulsating mass, which was removed entire, and was found to consist chiefly of an aneurismal varix (*Arch. Ophthalm.*, vol. xii.). The accompanying illustration (Fig. 3707) shows the condition found, post-mortem in one of Nélaton's cases (Sattler, Graefe and Saemisch "Handbuch," vol. vi., p. 848). There was a fracture of the sphenoid bone and of the petrous portion of the temporal, and a small hole in the carotid communicating with the cavernous sinus. The sinus and the ophthalmic vein were dilated and tortuous.

It must be confessed that serious objections can be urged against the use of the terms "pulsating exophthalmus" and "vascular protrusion," and perhaps it may be well to discard them when accurate and definite diagnosis is possible. It is quite true that, as Mr. Curling said in opposing the introduction of these terms, "to class affections of very different character under one common head, taken from a prominent symptom, is not calculated to advance surgical pathology and practice"; but it is equally true that such advance is not promoted by feigning a positive knowledge when we have it not, and giving a definite name to indefinite conditions. Confession of ignorance is an essential preliminary to the acquisition of accurate information, and the lesions producing the prominent symptoms of protrusion of the ball and pulsation may be conveniently and profitably classified with reference to these symptoms, until the accumulation and study of post-mortem records throw more light upon the subject.

In 1875 (Trans. Am. Ophthal. Soc.) I published abstracts of fifteen cases, including the imperfectly reported one of Guthrie, in which post-mortem examinations had been made. As in two of these cases (Lenoir's and Hamilton's) the symptoms had been produced by vascular malignant growths of the orbit, this number should be reduced to thirteen. In the papers since published, of

Rivington (*Med.-Chirurg. Trans.*, vol. lviii., p. 282) and Sattler (Graefe-Saemisch, vol. vi.), are quoted the following two cases that escaped my search:

1. Hirschfeld (*Gazette des Hôpitaux*, 1859, p. 51; *Lancet*, 1873): Traumatic; post mortem, a blood-clot found in the cavernous sinus, and this clot covered a small circular hole in the carotid, which looked as if it had been punched out and was occupied by a string of decolorized clot about two inches long passing into the mass of coagulum.

2. Oettinger (Sattler, *ibid.*): Spontaneous; post mortem, no change in the arteries, but traces of inflammatory processes in the retrobulbar tissues, and obliteration of the ophthalmic vein.

I can find only the three following reports of post-mortem examinations recorded since 1875:

1. Blissig, 1876 (Sattler, *ibid.*): Traumatic; post mortem, "decided dilatation of the internal carotid in the cavernous sinus." As the common carotid was tied eight weeks after the injury, and the patient lived five weeks after the operation, Sattler seems to think that the cause of the dilatation may have been a wound in the artery that had closed.

2. Schlaefke, 1879 (*Arch. für Ophthal.*): Traumatic; post mortem, dilatation of the cavernous sinus and aneurismal enlargement of the cavernous portion of the carotid artery; all the orbital veins enormously distended and the frontal and supra-orbital dilated.

3. Coggin, 1883 (*Arch. of Oph.*): Spontaneous; post mortem, marked aneurismal dilatation of the cavernous portion of the carotid artery, ophthalmic vein not much enlarged. In this case the pulsation and bruit seem to have been communicated from the carotid aneurism.

This makes a total of eighteen post-mortem records, an analysis of which gives the following result:

True aneurism of both ophthalmic arteries in the orbits (doubtful), 1; post-orbital aneurism of ophthalmic artery, 1; aneurism of carotid in cavernous sinus, 1; dilatation of carotid in cavernous sinus, 4; wound of carotid in cavernous sinus, 3; thrombosis of cavernous sinus and ophthalmic vein, 5; dilatation of cavernous sinus and ophthalmic vein by new growth, 1.

The case considered doubtful is that recorded by Guthrie ("Operative Surgery of the Eye," p. 158, 1823). The following is his report: "I have seen one case of true aneurism of the orbit which terminated fatally. The symptoms were similar to those above mentioned (cases of Travers and Dalrymple), but no tumor could be perceived; the hissing noise in the head could be distinctly heard. On the death of the patient an aneurism of the ophthalmic artery was discovered on each side, about the size of a large nut. The vena ophthalmica cerebialis was greatly enlarged and obstructed where it passes through the foramen lacerum, in consequence of a great increase in size which the four recti muscles had attained, accompanied by an almost cartilaginous hardness, which had been as much concerned in the protrusion of the eye as the enlargement of the vessels." The description is so meagre and loose, and the post-mortem appearances reported are so very peculiar, that this case is not generally regarded as affording positive proof of the existence of true orbital aneurism.

An aneurism of the ophthalmic, the size of a hazelnut, just at the entrance of the artery into the orbit, was accidentally discovered in a cadaver by Carron du Villards (Sattler, *ibid.*, p. 846). There was no history of the case, and it is not even known that it was one of pulsating exophthalmus.

Finally, in one of Nunneley's spontaneous cases (*Med.-Chir. Trans.*, vol. xlviii., p. 28) a circumscribed aneurism of the ophthalmic artery, as large as a hazelnut at its origin from the carotid, was discovered. The post-mortem was made nearly five years after a successful ligation of the carotid. The arteries of the orbit are described as unusually small. These three cases comprise all the post-mortem evidence of any connection of the

ophthalmic artery with the symptoms of pulsating exophthalmus.

While the above was passing through the press, I met at last with a report of what seems to have been a veritable case of "orbital aneurism," carefully examined and treated during life and verified by autopsy—the only one, so far as I know, on record. The report was read at the last meeting of the British Medical Association by Dr. Alexander Dempsey, of Belfast, and may be found in the *British Medical Journal* of September 18th, 1886. The symptoms, which first appeared a few hours after childbirth during violent vomiting, differed little from those observed in the reported cases of carotid aneurism which have occurred under somewhat similar conditions. The common carotid was tied, and death resulted from secondary hemorrhage from the wound in the neck and from bleeding from the aneurism through the cornea.

There was an aneurism of the internal carotid artery, at the point of origin of the ophthalmic, which had no communication with the cavernous sinus. Its diameter at its widest part was from one-half to three-fourths of an inch. The orbital aneurism is described as follows: "The ophthalmic artery, from its origin, was also very considerably dilated, I should say to fully four times the size of the opposite one, and on tracing it into the orbit we found an immense sacculated aneurism developed on its superior aspect. The sac would contain easily a mandarin orange. In its centre there was a post-mortem clot, but around its circumference there was a firm, laminated fibrous ante-mortem clot which was a complete cast of the sac, except at its anterior part, where it was open and communicated with the eyeball by a large opening at the upper, back, and outer part of the globe. The contents of the globe had escaped, when hemorrhage had taken place, through the cornea. The superior petrosal sinus of the opposite side was distended, but the other sinuses of the brain appeared normal. The arteries of the circle of Willis were dilated, especially the anterior communicating. The veins of the orbit were all very much enlarged, especially those at the inner angle of the eye."

While it would seem that any obstruction to the return of blood by the ophthalmic vein may produce the symptoms of pulsating exophthalmus, even complete obstruction by thrombosis of the sinus does not, by any means, always do so. In a case reported by Lloyd (*Oph. Rev.*, vol. iii., No. 37) there was aneurism of both the basilar artery and the internal carotid, and the cavernous sinuses of both sides were blocked with firm fibrinous red thrombi; yet there had been but slight exophthalmus, which lasted only a few days, and never any pulse or bruit. Lloyd attributes the recession of the globe to the establishment of collateral circulation; and Sattler says that when an intracranial aneurism is formed gradually it may completely compress the ophthalmic vein and cavernous sinus without producing either pulse or exophthalmus.

Though aneurism by anastomosis was formerly the favorite diagnosis in cases of so-called "orbital aneurism," it has never been verified by post-mortem observation, and more recently its occurrence has been doubted. The following congenital case (Harlan, Trans. Am. Ophthal. Soc., 1875, and Internat. Med. Congress, 1876) seems scarcely to admit of any other probable view than that of aneurism by anastomosis, or cirsoid aneurism. The patient was a healthy man, twenty-five years of age. The left eye had always been prominent and the left side of the head larger than the right. From his earliest recollection there had been a rushing sound in his eye and head. The left eye was enormously protruded and forced downward and outward. No useful vision. Whole left side of face hypertrophied. Above the eyeball, and lying more to the nasal side, there was a distinct tumor of almost cartilaginous density. Pulsation was strong enough to communicate an evident motion to the head of the auscultator; and a loud aneurismal bruit was not only an annoyance to the patient, but could be heard by others some distance from his head. There was a doughy