a definite series of explosive symptoms—sensori-motor irritation followed by sensori-motor paralysis—the occurrence of such symptoms, apart from indications of intracranial tumor, implies that the same motor region is irritated, though in some other way than by a neoplasm. Many cases of epilepsy, hitherto considered a functional disease,* have therefore been trephined, and in many of these, organic lesions, as cicatrices, have been removed from the surface of the brain or meninges, with the result of allaying or arresting the convulsive attacks. Finally, even in the absence of all visible lesion, portions of cortical tissue, containing the centres of motor representation corresponding to the limb segments whose spasm initiates the attack, have been excised.

It is not within the province of this article to discuss this latest and most interesting development of surgical method, which began with removing the tangible organic causes of epilepsy. We may observe, however, that the signal symptom of the attack (the felicitous expression is Seguin's), which is held to localize the lesion, because indicating the point of earliest and most intense irritation, does not necessarily show that the irritation originates at this point. It is quite as possible that the nerve tissue has received an irritation propagated from some distant region, but not manifest until it has spent itself upon a motor centre and thence determined a nervous discharge. Excision of the motor centre, therefore, would remove, not a cause of the spasm, but only the first effect of some possibly inaccessible cause.

From the frequent failure of the operation as a cure for epilepsy, one may suspect that some such condition of things often exists. The difficulty in these non-organic cases is paralleled in cases of tumor, when, though the convulsions are immediately initiated by irritation of the cortical motor area, the causal lesion is situated in some other part of the brain and cannot be found.

Another parallel has a more hopeful aspect. It has sometimes been found in cases of inoperable tumor that the symptoms due to pressure—vomiting, headache, and convulsions—could all be relieved when the pressure was lessened by trephining or removal of large pieces of cranial bones.† It seems therefore possible that in cases of epilepsy without gross or focal lesion, and before irremediable degeneration had set in, similarly afforded relief of intracranial pressure might arrest the disease.

Traumatism, even when not more severe than that of a fall on the head, has always been recognized as an important factor in the etiology of brain tumors. Out of the 85 cases of operation on record, there is a history of a fall or a blow in 20.‡ Morbid symptoms rarely develop very soon after the accident; months, sometimes years, intervene. In the light of the experience now accumulated, it is indicated to operate very early after the appearance of symptoms indicative of intracranial neoplasm; and the indication is especially formal if there is a history of previous traumatism. It is possible, as Seguin's case shows, to operate so early that the tumor has not yet grown large enough to be found at the operation. This is, however, the only case on the list in which the operation failed from this cause; only when the tumor is situated entirely on the surface of the cortex is it liable to excite convulsive twitchings while yet very small; but in such a situation the tumor should be easily found.§ The danger of delay in operating is well shown in the first case of Starr and McBurney (Case 81). Eleven months intervened between the establishment of the diagnosis (when the operation was first proposed) and the time when the patient's consent to the operation was secured. In that time the tumor grew to such a size that its removal was followed by death from shock in a few hours.

The development of optic neuritis is not always proportioned to the size of the tumor, but much more to its situation. Hence, as has long been known, optic neuritis appears early and advances rapidly with tumors of the cerebellum, where the intracranial pressure is at its maximum. An early operation is often indicated to relieve this pressure before the optic nerves should have atrophied, in which case the patient would remain blind, even though he survived the operation and were relieved of other urgent symptoms.

An important decision formulated by Horsley is that syphilitic tumors should be operated on, and not left to the uncertain influence of internal treatment. Bergmann, on the other hand, maintains the sufficiency of this treatment, and the superfluous risk of the operation.

If it be assumed that all tumors of the cortex and centrum ovale are conceivably operable, the proportion of operations to cases would be 41 per cent., since 266 out of 644 cases of tumor are situated in these two localities. If to these be added 162 cases of the cerebellum, the proportion would rise to 65 per cent.

The special difficulties surrounding tumor of the cerebellum have already been emphasized. The general diagnosis is relatively easy, that is, it is usually easy to diagnose a tumor of the posterior cranial fossa and subtentorial. It is often difficult to distinguish between the middle lobe of the cerebellum and a lateral lobe; and usually impossible to distinguish between tumor of the bone compressing the cerebellum and tumor of the organ itself. A precious aid in diagnosticating tumors of the occipital lobe from those of the cerebellum is the existence of hemianopsia in the former, as against optic neuritis in the latter. Case 41 (Keetley) shows how a tumor of the pons may be mistaken for a cerebellar tumor, when by exception the paralyses of cranial nerves, so characteristic of pontine tumors, are lacking. The prognosis in cerebellar tumors, however, is rendered bad far less by the difficulties of diagnosis than by the special dangers of the operation which have already been mentioned. In the centrum ovale and cortex, on the contrary, the dangers of the operation are at the minimum, provided the tumor can be found. The difficulty of finding it depends upon: 1st, whether it lie in a latent zone or in one whose symptomatology has been determined; 2d, upon its proximity to the surface; 3d, upon the differentiation of its consistency from that of the brain.

The accessible regions of the cerebrum whose lesions have so far been connected with sufficiently definite differential symptoms are: The frontal lobes, the central convolutions, the parietal lobes, the occipital lobes, the left temporal lobe, and the left insula. The differentiating signs have been sufficiently emphasized in the text. Tumors of the centrum ovale are always latent as to their locality—being indicated by general symptoms alone, unless they come near enough to the surface to irritate the cortex. In Gray's case (86), Table I., the position was made out with great precision, but the failure was due to the third operative difficulty which has been mentioned, namely, the extremely soft consistency of the tumor.

This difficulty can never be foreseen in advance, and seems to be as much to be feared with large as with small tumors.* Possibly some future therapeutic resource will enable the surgeon to prepare his patient for operation by the ingestion of some food or drug which should change the consistency of the tumor.

Medical resources at present are extremely meagre—after we have mentioned the use of mercury and iodide of potassium in cases of syphilitic tumor. An energetic inunction treatment is required. 4 to 5 gm. mercurial ointment daily for six weeks—followed, after a pause, by a course of iodide of potassium, 5 to 10 gm. to 200 gm. of water, of which a tablespoonful three times a day.

For vomiting, pain, and convulsions, morphine, chloral, and bromide of potassium are the three remedies, and the greatest of these is morphine. For details of craniotopography, operative procedure and technique, and the special dangers incident to the operation for brain tumor, the reader is referred to the article on *Brain, Surgery of*, by Dr. Keen, in the present volume.

Mary Putnam-Jacobi.

* According to the present view, non-localizable, i.e., generalized epilepsy depends upon a diffused microscopic sclerosis (Féré, "Les epilepsies") or a degeneration and vacuolation of ganglion cells (Dana, "Treatise on Nervous Diseases").

† Horsley (see Case 45) removed first one half, then the other half of the occipital bone, "and the patient lived in comfort two years."

‡ Cases 1, 3, 5, 16, 18, 24, 31, 37, 38, 41, 49, 55, 58, 68, 74, 75, 76, 80, 82. Case 38 is particularly interesting. It is that of a little girl in a Swiss school who was struck on the head with a ruler by the teacher.

§ In Case 50 (Church) the tumor was a spider-like, filiform growth, extended on the surface of the central and frontal gyri.

* It is characteristic of gliomata.

BRANCHIAL CYSTS.—Branchial cysts are cystic tumors of the neck and some parts of the head, originating from congenital defects of development, their matrix being composed of fœtal epiblastic or hypoblastic tissue which remains in its embryonal state for an indefinite time, and later, by proliferation of its epithelial elements, gives rise to a distinct and characteristic type of cystic tumors. They have been variously designated as branchial cysts (Roser), dermoid cysts of the sheath of the internal jugular vein (Langenbeck), deep-seated atheromatous tumors (Schede), tumors of the branchial clefts (Virchow), hydrocele colli congenita (Maunoir), hygroma colli (Luschka), and atheromatous cysts of the lymphatic glands (Luecke), in accordance with the nature of the contents of the tumor or the peculiar etiological views entertained by the different authors. It appears to me, however, that "branchial cysts" is the most appropriate term, as it expresses at once both the location and the character of the tumor.

Toward the end of the first month of fœtal life we see, under the frontal process, open in front and bounded on the sides by four plates, the pharyngeal cavity. The upper pair of plates constitutes the first branchial arch. The next three pairs of plates make up the second, third, and fourth branchial arches, which decrease in size from above downward, so that their median interspaces in front are narrow above and wider lower down. Between any two individual branchial arches, on each side, remains a transverse cleft, and, during early fœtal life, these branchial clefts, with the exception of the first one, from which the external auditory canal, the cavity of the tympanum, and the Eustachian tube are developed, unite. The neck is thus built up of continuous lateral walls. From the second branchial arch are developed the styloid process, the stylo-hyoid ligament, and the lesser cornua of the hyoid bone; the third arch forms the large horns and the body of this bone; the fourth arch assists in forming the soft tissues of the neck. The larynx, trachea, and adjacent glands are developed from other centres of fœtal growth. The primary origin of these tumors necessarily must correspond to the location of one of these branchial clefts, and clinical experience has demonstrated that they are most frequently found in the region of the second and third branchial clefts, in the vicinity of the larynx and pharynx, and in intimate relation with the sheath of the large vessels of the neck, in contradistinction to dermoid cysts about the orbits and in the scalp, which are more superficially located. In the case of a young lady, Langenbeck observed a cyst situated on the left side of the epiglottis and pharynx, which occupied one-half of the floor of the mouth, and which projected from underneath the chin on that side in the shape of a smooth tumor of the size of a fist. Respiration, deglutition, and the motions of the tongue were greatly impeded. The cyst contained eight ounces of atheromatous matter. The same author states that he has frequently found these tumors attached to the greater horn of the hyoid bone or to the thyro-hyoid ligaments, localities which plainly indicate that they originated from remnants of former branchial clefts.

As they are often in intimate connection with the sheath of the large vessels of the neck, it is very important to study their anatomical relations to these important structures. The jugular vein is surrounded, throughout its whole course in the neck, by a distinct and separate sheath of areolar tissue which, on the outer side of the artery, penetrates into the deep tissues of the neck, thus completely separating the two vessels. The jugular, enclosed in its sheath, may be easily drawn over the artery toward the median line without producing any change of location of the artery. The vein being in front of the artery and covering half of the lumen of the latter, it can be readily understood that when the vein is drawn forward, with its sheath, it can be injured, while the artery is not exposed to the same danger. Branchial cysts of the second and third clefts are always observed in the sheath of the large cervical vessels, usually in the carotid triangle above the omo-hyoid muscle. They appear to occur more frequently on the left side of the neck. Their shape is invariably round or oval, with a smooth surface. The contents of these cysts being either fluid or semifluid, fluctuation can be felt, more particularly if the tumor is palpated between two fingers, one of which is placed in the pharynx or on the floor of the mouth, and the other on the external surface. Only lateral motion of the tumor is possible, on account of its peculiar attachments to the deep tissues of the neck. If the tumor is of only moderate size the pulsations of the carotid artery can be felt on its inner margin. If it is large it overlaps the artery, in which case the pulsations of the vessel are communicated to the tumor. Smaller tumors can be made to pulsate by bending the head backward and in a direction opposite to the tumor.

Branchial cysts should be classified according to their contents. The cyst walls being lined with epithelium, the only histological elements in the contents are epithelia. In most instances the epithelia lining the cyst belong to the tessellated variety, but Rehn discovered, in a blind congenital fistula ending near the mucous membrane of the pharynx, ciliated epithelium; and Neumann found cylindrical and pavement epithelium in two cystic tumors of the neck, one of which was congenital while the other was developed in later years. The physical and chemical properties of the cyst contents will depend largely on the amount and degree of activity of the retrograde processes which may have taken place in the epithelium.

Clinical experience and pathological examination have shown that these tumors, according to the physical properties of their contents, may be divided into the following four principal varieties:

1, Mucous cysts; 2, atheromatous cysts; 3, serous cysts; 4, hæmato-cysts.

Variable as the contents of these varieties may be, more uniformity is observed in the structure of the cyst wall. In the primary stage of the affection it consists of a connective-tissue capsule with an epithelial lining on its inner surface, and a delicate layer of a loosely connected reticulum of connective tissue (pericystium) which is very vascular, and covers the outer surface of the cyst. A high degree of intracystic pressure may cause atrophy of the epithelial lining and thinning of the walls of the sac, and, on the other hand, inflammatory proliferation produces great thickening of the cyst walls. While dermoid cysts contain the characteristic secretions of the skin and its appendages, the branchial cysts contain only the products of the epithelial cells, because their walls do not contain any hair follicles, sebaceous or sweat glands, as the branchial clefts close before these appendages are formed.

1. Mucous Branchial Cysts.—As a primary formation, this form of branchial cyst is usually found in the upper branchial clefts. Their origin is attributable to an imperfect closure of the upper portion of the branchial tract; consequently the cyst wall may derive its lining from the mucous membrane of the pharynx, and the retention of the physiological secretion produces a mucous cyst. Many of the so-called ranular cysts, about the base of the tongue, belong to this variety of tumors.

2. Atheromatous Branchial Cysts.—This form of branchial cysts has been described by some authors as deep-seated atheromatous cysts of the neck (Schede), and dermoid cysts of the sheath of the large vessels of the neck (Langenbeck). They are usually located in the second and third branchial tracts in the region of the hyoid bone, and are intimately connected with the sheath of the large cervical vessels. These cysts contain an atheromatous material resembling the contents of an ordinary retention cyst of the skin, with this difference, however, that they never contain anything which would

indicate the presence of hair follicles, as lanuginose hair or sebaceous material, or any of the more complicated products of a dermoid cyst. For the purpose of furnishing a clear clinical picture of this form of branchial cysts, I will give a synopsis of two cases which have come under my observation.

Case I.—Mrs. H——, aged thirty six. German. Family history reveals no tendency to congenital malformations. About one year ago the patient discovered a small tumor on the right side of the neck, between the angle of the jaw and the larynx, which slowly increased in size, and after a few months became the seat of an acute inflammation which terminated in suppuration, requiring an incision for the relief of urgent symptoms. The fluid which escaped consisted of pus mixed with a gruelly substance. Prompt relief followed the incision. The inflammatory symptoms subsided and the tumor diminished in size. In a few weeks the opening closed, leaving a small and painless swelling. The same symptoms were repeated about four months subsequently. When the patient came under my observation, during the summer of 1883, I found a tumor about the size of a hen's egg, located between the angle of the jaw and the larynx, resting directly upon the large vessels of the neck, as was evident from the distinct pulsations which it received and which could be seen and felt. The posterior portion was under the sterno-cleido-mastoid. Over its centre was seen the scar which had resulted from the previous incisions. The swelling presented a regular, smooth surface and an oval outline, with the long diameter parallel to the cervical vessels. It was only slightly movable from side to side, and perfectly immovable from above downward, showing that it had a firm point of attachment to the deep tissues of the neck. Fluctuation could be detected on the outer surface and also through the mouth. The original location corresponded to the third branchial cleft. As it had on two different occasions undergone acute inflammatory changes without any benefit resulting from them, the extirpation of the cyst was deemed the only measure which promised a permanent result. The operation was done under antiseptic precautions. A straight incision was made over the tumor, parallel to the sterno-cleido-mastoid. The cyst was firmly adherent to the surrounding tissue, as the result of antecedent inflammatory infiltrations, and required much time and patience to effect its separation. After it had been isolated from all attachments on its sides, it was seized with a tenaculum forceps and drawn forward and toward the median line of the neck, while the sterno-cleido-mastoid was held in an opposite direction, so as to afford easy access to its base. The attachments here were very firm, and it appeared as though the base of the tumor and the large cervical vessels underneath were embedded in a mass of cicatricial tissue. Keeping as close to the cyst wall as possible, I carried out the dissection very carefully, proceeding mostly with blunt instruments. When nearly one-half of the pedicle had been separated in this manner, we were suddenly surprised by a tremendous gush of dark venous blood, which in a second flooded the whole field of operation. It was only too evident that the internal jugular vein had been torn, and, for the purpose of preventing further loss of blood, and to guard against instant death by admission of air into the vein, I made firm digital compression above and below the injured vein, while my assistant pushed a sponge into the wound. Hemorrhage was controlled in this manner, and, as soon as I could be relieved by an assistant, I carefully removed the sponge, and, after locating as nearly as possible the exact seat of bleeding, I seized the vein, with some of its adjacent tissues, with a stout pair of hæmostatic forceps. I was fortunate enough to grasp the bleeding point at the first attempt, and the hemorrhage was completely controlled. The tumor was now removed, and by making slight traction on the forceps I drew the vein forward and applied a catgut ligature without isolating the vessel. I was unable to ascertain the exact size or direction of the wound in the vein, but the ligature arrested the hemorrhage promptly and permanently. The wound was thoroughly irrigated, and, as in Langenbeck's case, the vein seemed to disappear underneath the deep tissues of the neck. In the wound could be seen the œsophagus, lateral wall of the larynx, carotid artery in its sheath, and the great horn of the hyoid bone. After suturing and draining the wound I applied a graduated compress. For the first twenty-four hours after the operation the patient suffered from intense headache on the corresponding side, which induced me to believe that the circulation in the vein had been completely interrupted, either by the ligature alone or by the formation of a thrombus at the point of ligation. After the first twenty-four hours the patient suffered no further inconvenience. The wound healed by primary union, and the recovery has been permanent and complete. There is no question that the adhesions of the cyst with the sheath of the cervical vessels were due to the attacks of acute inflammation which had preceded the operation on two different occasions. A microscopical examination of the contents showed flat epithelial cells, cholesterin crystals, fat granules, and a mass of débris, the product of epithelial degeneration. The cyst wall was composed of connective tissue, thickened and infiltrated with embryonal elements, and lined with epithelial cells.

The next case very nicely illustrates the oral variety of branchial cysts.

Case II.—Mary H——, aged twenty-five. German. Her family history is good, especially as regards congenital malformations, such as tumors or fistulæ in the cervical region. Patient has always appeared round and full underneath the chin, but during the last four years a tumor has been growing rapidly on the floor of the mouth, until at present it is considerably larger than a goose's egg. The mouth is completely filled by it, the tongue is pressed against the palate, its movements are limited, only the tip of it being visible at the upper border of the tumor, and speech and deglutition are greatly impeded. Laterally the tumor extends very near the angles of the inferior maxillary bone, and downward it overlaps the larynx and upper part of the trachea, entirely obliterating the round contour of the upper cervical region. It is painless and distinctly fluctuating to the touch, presents a smooth surface, and gives rise to no inconvenience except that which results from its mechanical interference with speech and deglutition. When the patient opens her mouth, the apertures of Wharton's ducts are plainly visible on each side of the median line, and, by exerting lateral pressure upon the submaxillary glands, the patient can expel a stream of saliva from them. Previous treatment, consisting of external applications of iodine, etc., had had no effect on the growth. Desiring to avoid any deformity resulting from an external cicatrix, I decided to remove the tumor through the mouth. A linear incision was therefore made in the median line, extending from above downward from the tip of the tongue to the symphysis menti, the ducts of the salivary glands being carefully avoided. Adhesions existing between the tumor and its surrounding tissues were easily severed, when it was seen that it would be impossible to remove the tumor in its entirety owing to its immense size. The sac was therefore opened and a large quantity of its gruelly contents removed by pressure. The operation was then continued without any difficulty until the entire cyst had been removed. It was now noticed that the cyst was constricted in its middle by the inferior maxillary bone, the upper and lower portions of it bulging out on both sides of the constriction. There was no hemorrhage worth mentioning. The body and great wings of the hyoid bone could be plainly felt in the posterior recess of the wound. The cyst wall was thin, and its external surface was quite vascular. The microscopical examination of the contents of the cyst, as well as the primary location of the tumor, revealed its branchial origin. The wound healed very kindly, and shortly afterward nothing in the looks of the young lady showed any traces of the deformity which had previously disfigured her face and neck.

3. Serous Branchial Cysts.—This variety of branchial cysts is composed of thin cyst walls and serous contents, and may develop from any one of the branchial clefts failing to undergo complete obliteration. This affection has been described under the name of *hydrocele colli* (Maunoir), congenital hygroma of the neck (Wernher), congenital hydrocele of the neck, and congenital cystic tumor of the neck (Thomas Smith). Maunoir, under the name of *hydrocele colli*, described certain serous cysts occurring between the angle of the jaw and the mastoid process, and between the larynx and the anterior margin of the sterno-cleido-mastoid, a region which corresponds to the second and third branchial clefts, which were supposed not to have been obliterated at the time of birth. We have seen, however, that branchial cysts are not necessarily developed during intra-uterine life or soon after birth. All that is necessary is that the matrix for the cysts be present at birth, from which at some future time the tumor may be developed. These tumors appear as single or multilocular cysts with thin membranous walls; their internal surface is lined with pavement epithelium. Like cavities lined with a serous membrane, they contain a limpid, watery, or tenacious fluid, holding in suspension epithelial cells and cholesterin crystals. These cysts are formed anywhere in the neck, within the area of the branchial clefts, between the lower jaw and the clavicle. They are usually deep-seated, though occasionally they are superficial. They are painless, and give annoyance only from their size. Clinically they may be recognized from their location, their globular cystic form, soft fluctuating feel, and painless growth. The existence of tessellated epithelium upon the inner surface of these cysts has been demonstrated by Neumann and Baumgarten. When these cysts spring from the second or third branchial clefts they are usually deeply located. Hueter, in extirpating a tumor of this kind in a child two years of age, ascertained that it extended between the two carotid arteries back to the walls of the pharynx. When they are deeply situated they are usually in contact and connected with the sheath of the large cervical vessels, and receive a distinct impulse from the underlying artery. When thus located, they offer the same difficulties to extirpation as do those of the atheromatous variety. The following case may serve as an illustration of this type of branchial cysts:

The patient was a healthy, strong, male child, six months of age. No history of congenital malformation, especially branchial fistula, in the family. When the child was born, a small tumor the size of a pea was discovered on a level with, and somewhat to the inner side of, the sternal origin of the sterno-cleido-mastoid muscle. The tumor was painless and movable, but rapidly increased in size. When the child was brought to me, the tumor was as large as a walnut. The skin over it was natural in appearance and movable. The tumor itself presented a smooth surface. Fluctuation was distinct, but the cyst appeared to be somewhat firmly attached to the adjacent tissues. The cyst was readily enucleated, the adhesions not being very firm except over the most prominent point of the tumor, where inversion of the skin had undoubtedly occurred during the closure of the external opening of the fourth branchial tract. The adherent portion of the skin was excised with the tumor. The cyst was found to be oval in shape and smooth, and the outer layers were quite vascular. The walls being thin and the contents serous, the whole tumor presented a translucent appearance. The wound was closed with sutures, and healed by primary union under an antiseptic dressing. Similar cases have been reported by Smith, Vonwiller, Frederick Treves, and others.

Thomas Smith reports a case which would show that these cysts may occasionally disappear by spontaneous absorption of their contents. The patient was a healthy babe three weeks old. Immediately after birth a swelling was noticed in the neck, which rapidly increased in size. When the patient was first seen, a cystic tumor occupied almost the entire region of the left side of the neck, extending from under the lower jaw to the clavicle. The mother objected to any kind of treatment. Three months later the child was seen again, when the growth had greatly diminished in size. There was nothing to be felt but a loose, flabby, cystic mass, not much larger than a hen's egg. The skin over it was shrivelled, loose, and baggy. Three months later the tumor was still smaller.

4. Hæmato-cysts of Branchial Clefts.—In some instances of serous branchial cysts the fluid is discolored by an admixture of blood from minute hemorrhages into the sac, but when the contents are of such dark color as to resemble venous blood, they are properly called hæmato-cysts, and from a pathological, diagnostic, and clinical point of view they constitute a distinct and well-marked variety of branchial cysts. Albert remarks that two kinds of these cysts have been observed: 1. Such as may be emptied by pressure, and are in communication with blood-vessels. 2. Those which cannot thus be emptied by pressure, and which simulate the appearance of an ordinary serous cyst so closely that their nature is recognized only by puncture. The latter class, when they occur in the neck, usually belong to the branchial cysts, because they are observed during early life, and originate in places which correspond to the location of the branchial clefts. This variety of cysts has been called *hæmatocele colli* by Michaux and *hæmatoma* by J. P. Frank. Hæmato-cysts resemble the serous cysts in every particular, with the exception of the presence of blood in their contents. It is not an easy matter, however, to make a diagnosis of this variety of branchial cysts, and it should always be made by exclusion, due attention being given to the location of the cyst, the time of development, and the character of its contents.

Branchial cysts are of comparatively rare occurrence, and the statistics cannot be relied upon in estimating the frequency with which these tumors occur, as many of them have been classified and described under the generic and indefinite term "cystic tumors of the neck" without regard to their etiology. Guret, in 1855, compiled 44 cases of serous and 6 cases of atheromatous cysts. Since that time quite a number of new cases have been described by Volkmann, Billroth, Esmarch, Roser, Langenbeck, Luecke, and Bruns. The serous variety of cysts is more likely to develop early; they are often congenital, or appear during infancy or childhood, while the atheromatous cysts are the products of early adult life. Of 53 cases mentioned by Schede, 9 occurred between the first and tenth years of life, 21 between the eleventh and twentieth, 10 between the twenty-first and thirtieth, 6 between the thirty-first and fortieth, 5 between the forty-first and fiftieth, and 2 between the fifty-first and sixtieth.

Like the dermoid cysts, the branchial tumors show a tendency to develop during the period of puberty, at a time when the epiblast enters upon a new phase of development and becomes the seat of renewed and active tissue proliferation. The remnants of the branchial cleft may remain dormant, as a matrix for the future growth of the tumor, for an indefinite time, and may become the seat of tissue growth during puberty or upon the advent of any determining cause or causes. There are many instances in which remnants of fœtal tissue have remained latent in the branchial tracts throughout a lifetime, for want of an exciting cause of sufficient strength to call into morbid activity the slumbering forces inherent in the histological elements of the matrix.

Diagnosis.—The diagnosis is oftentimes no easy task. The importance of the tissues and organs which are in close and intimate relation with these tumors renders it imperative upon the surgeon to make a correct diagnosis before an operation is undertaken for their removal. The following conditions may simulate a branchial cyst: 1, Aneurism; 2, angioma; 3, dermoid cysts; 4, retention cysts; 5, affections of lymphatic vessels and glands; 6, struma cystica; 7, simple serous cysts.

1. *Aneurism.*—As most of the branchial cysts are in immediate contact with the large cervical vessels, and

usually receive the impulse from the underlying artery, it is always important to exclude the possible presence of an aneurism. At the age when branchial cysts are most frequent, aneurisms, except of traumatic origin, are exceedingly rare. Pressure does not affect the volume of a branchial cyst, and the pulsations are felt only in one direction, away from the artery. Auscultation furnishes another important negative symptom. An exploratory puncture, which should always be made in doubtful cases, will also furnish valuable information, as it will afford an opportunity to examine the contents of the tumor. In hæmato-cysts the contents may resemble venous blood, but a microscopical examination will show, in addition, the presence of epithelium or the products of epithelial degeneration.

2. *Angioma.*—Deep-seated angiomata are occasionally met with in children, and, as the skin may present a perfectly natural appearance, they might be mistaken for branchial cysts. If the tumor disappears under pressure it may be an angioma, but never a branchial cyst.

3. *Dermoid Cyst.*—As dermoid cysts may occur in the same localities and at the same age, they are frequently mistaken for branchial cysts, and *vice versa*. As both varieties of cysts require the same treatment, a positive diagnosis is not essential. A correct anatomical diagnosis can be made by examining the contents and the cyst walls. A branchial cyst contains only one constant histological element—epithelium,—as obliteration of the branchial tracts takes place long before the appendages of the skin are formed. A dermoid cyst, on the other hand, contains the products of secretion of the skin and its appendages. The walls of a branchial cyst are composed of a connective-tissue capsule lined with epithelium, while the sac of a dermoid cyst is composed of true skin.

4. *Retention Cysts.*—The only two forms of retention cysts which call for consideration in this connection are the true atheroma of the skin, the result of obstruction in the ducts of the sebaceous glands, and the retrotracheal cyst, which originates in a similar manner in the retrotracheal glands. Cysts arising from the second and third branchial clefts are always deeply located, and when first observed are distant from the skin, while an atheroma primarily develops in the skin, and usually grows in a peripheral direction. Lanuginose hair is sometimes found in the contents of an atheroma, the product of retained hair follicles; it is never seen in branchial cysts.

Virchow has called attention to a peculiar kind of retention cyst which is found between the œsophagus and the trachea, and which arises from an obstruction in the duct of one of the retrotracheal glands. These glands are situated between the trachea and œsophagus, but their ducts traverse the entire thickness of the tracheal wall and terminate upon the free surface of the mucous membrane. These cysts are so located that they give rise to distressing symptoms, referable to deglutition and respiration, before they attain any considerable size, differing greatly in this respect from the clinical history of a branchial cyst.

5. *Affections of Lymphatic Glands and Vessels.*—A deep-seated, isolated, caseous, lymphatic gland might be easily mistaken for a branchial cyst, more particularly after the cyst had become the seat of inflammatory infiltration. It is seldom that we meet any such extensive pathological changes in a single lymphatic gland as to simulate a branchial cyst, without participation of one or more adjacent glands. Again, in cases of diseases of the lymphatics, the general condition of the patient usually indicates the existence of a serious affection, while a branchial cyst is a purely local condition, never affecting the general health except when it interferes with important functions of the neighboring organs. Cancerous or sarcomatous affections of the lymphatic glands would reveal themselves by the clinical symptoms characteristic of these tumors.

6. *Struma Cystica.*—Cystic degeneration of the thyroid gland proper can never be mistaken for a branchial cyst, as the connection of such cysts with the thyroid body can be traced without any difficulty; but recently it has been ascertained that not infrequently small accessory thyroid glands exist in the neck which may undergo cystic degeneration, and Madelung has made the assertion that the so-called hydrocele of the neck is only a struma cystica of a supernumerary thyroid gland. The possibility of a cystic degeneration of such an accessory thyroid body should always be borne in mind in examinations for branchial cysts.

7. *Simple Serous Cysts.*—Virchow asserts that many of the serous cysts develop without a particular matrix, as new formations, in the connective tissue. It is a well-known physiological fact that the connective-tissue cells are occasionally converted into endothelia, as during the formation of new synovial membranes; hence we should *a priori* expect that in simple serous cysts, developed from connective tissue, the inner surface of the sac would be lined with endothelia the existence of which would be sufficient to disprove their branchial origin.

In repetition I will enumerate the following points, which should be considered in the differential diagnosis of cystic tumors of the neck with special reference to branchial cysts: 1. Primary seat of tumor; 2, effect of pressure; 3, general condition and age of patient; 4, character of contents.

Prognosis.—Branchial cysts always remain purely local affections and manifest no tendency to destroy life, except when they are of sufficient size to interfere, by their pressure, with the performance of important functions of neighboring organs. On the other hand, it may be said that they manifest no tendency to spontaneous cure, and prove exceedingly obstinate to all forms of treatment short of complete extirpation.

Treatment.—The inner surface of branchial cysts being lined with epithelium, it is evident that obliteration of the sac can be obtained only after the destruction or removal of this epidermal lining. The radical treatment for the removal of these tumors must have for its object either the production of an artificial inflammation, in the inferior of the sac, of sufficient intensity to destroy the epidermal matrix, or complete extirpation of the cyst. The former procedure is exceedingly unreliable, and extirpation in many instances must be looked upon as a very formidable and dangerous operation. The following means have been employed in the treatment of branchial cysts: 1, incision; 2, actual cautery; 3, seton; 4, puncture, with subsequent injection; 5, extirpation; 6, antiseptic drainage.

1. *Incision.*—In all cases in which incision was practised, the relief from existing symptoms was prompt; the cyst collapsed, a certain amount of inflammation was established, suppuration followed, and in some instances the patient and surgeon were led to believe that a radical cure was obtained. Usually, after healing of the wound, a small nodule remained, which in a few months again became the seat of active tissue growth, and a speedy relapse was an almost constant occurrence. In infants the laying open of cysts is a perilous plan of treatment. Volkers relates a case in which a cystic tumor was laid open in a new-born child, who died sixteen days afterward in consequence of the operation. A branchial cyst cured by simple incision is reported by Billroth. In the case of serous cysts, in which the seton and iodine injections have occasionally been successful in producing obliteration, it seems to me that the same object would be accomplished more speedily and safely by incision and drainage practised in a similar manner as in Volkmann's operation for hydrocele.

2. *Actual Cautery.*—Dieffenbach employed the actual cautery in opening the cyst in one of his cases, after he had made an unsuccessful attempt at removing it by extirpation, and after incision had failed in producing obliteration of the sac. The use of the cautery met with no more encouraging result. It would seem to me that incision, combined with an energetic use of the cautery, would be most applicable in the most dangerous and formidable class of cases, viz., cysts which have become

firmly adherent to the sheath of the cervical vessels by repeated attacks of inflammation.

3. *Seton.*—This form of treatment proved successful in several of Thomas Smith's cases of serous cysts of the neck, but in some of them their branchial origin does not appear to be established. Smith uses a single thread of silk, and removes it before suppuration sets in. If the tumor is polycystic, he attacks only one cyst at a time. Gurlt very justly has entered his protest against the use of the seton. As in the case of hydrocele, the seton is an exceedingly uncertain agent in calculating with precision the amount of inflammatory action which will follow its use. The degree of irritation produced by it is very liable to be inadequate to produce adhesion, or it exceeds the desirable boundary, and induces suppuration with all its evil consequences. Butlin reports the case of a young child in whom a seton was passed through a serous tumor, and which was followed by death on the third day from the violence of the inflammation. For this and other obvious reasons the seton should never be used in the treatment of branchial cysts.

4. *Puncture, with Subsequent Injection.*—In the transactions of the Fourth Congress of German Surgeons, the treatment of branchial cysts by puncture and injection was fully discussed. Esmarch's experience appeared to be the most extensive, and his results were more uniformly favorable than the practice of any other surgeon. He claims to have cured about a dozen cases by puncture and subsequent injection of Lugol's solution of iodine (Iodi, pot. iod., āā 1.25; aquæ, 30.0). Whenever complete obliteration does not follow the first puncture, he repeats the operation. This method of procedure is as follows: By means of a fine hydrocele trocar the sac is emptied of its contents, when repeated injections of a one-per-cent. solution of carbolic acid are made to remove the masses of epithelium adherent to the cyst wall. These injections are continued until the water returns perfectly clear, then Esmarch injects from 10 to 20 gm. of Lugol's solution of iodine, which, after gentle pressure, to bring it in contact with the inner surface of the sac, is allowed to escape. The patient is then directed to return in six or eight weeks. Like a hydrocele, the cyst refills rapidly and becomes somewhat painful. If after the lapse of the time mentioned the tumor has not greatly decreased in size, the same operation is repeated, and in about six months the cyst will be found atrophied to a small tubercle. According to Esmarch, the cure in most cases has been permanent. From the discussion which followed Esmarch's remarks, it is evident that the majority of German surgeons have no confidence in the efficacy of iodine injections in obliterating branchial cysts. If we consider the numerous failures of iodine injections in cases of hydrocele, in which the anatomical conditions for success are so much more favorable, we shall be better prepared to appreciate the causes of its still more frequent failures when used in the treatment of branchial cysts. In infants, even simple tapping is not always devoid of danger, as one instance of death is recorded caused by puncture. The case occurred in the practice of Volkers, who tapped a cystic cervical tumor in an infant eight days old, the child dying of trismus on the third day.

5. *Extirpation.*—A positive diagnosis made, the best plan to pursue is to make an incision over the most prominent portion of the tumor, and, in case the adhesions can be separated without endangering the deep cervical vessels, the entire cyst should be removed. If inflammatory infiltrations obscure the field of operation at the base of the tumor, and after careful examination it is not deemed advisable to perform complete extirpation, the sac should be opened and the lateral walls excised; then the epidermal matrix which remains adherent to the sheath of the cervical vessels can be destroyed completely by a careful but vigorous use of the actual cautery. If an early diagnosis is made, and prompt treatment instituted, complete extirpation should always be attempted, and will, in the majority of cases, prove successful and comparatively free from danger.

6. *Antiseptic Drainage.*—In the case of infants and very young children suffering from large serous cysts, it would be imprudent to resort to any of the severer measures with a view to a radical cure. In such instances, drainage under antiseptic precautions should be resorted to as a temporary measure, and in some instances it may be followed by permanent results. The same course of treatment should be adopted in adults suffering from cysts which are inaccessible to any other operation, and in which irritating injections are contraindicated.

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BREAST, FEMALE.—The breast (L. *pectus*, Ger. *Brust*, It. *petto*, Fr. *sein*) is one of the two rounded eminences situated, in the human species, one on either side of the thorax, and in the female secreting the milk for the nourishment of the new-born. They constitute the mammary glands and associate structures, that is, the true gland tissue, the stroma, and integument including nipple and areola.

The presence of mammary glands (L. *mammæ*, Fr. *mamelles*, Ger. *Brustdrüsen*, It. *mamette*), zoologically considered, constitutes one of the most important considerations for grouping into one class (mammalia) all those animals possessing them. They are found in both male and female, but the size and development differ; the male gland as a rule remains throughout life in the embryonic condition, while the female breast passes through marked and important changes at puberty, at conception, after lactation, and at the menopause.

Embryology.—In very early embryos, there is observed on either side a slight streak, running from the root of the stump-like fore-limb to the hind-limb, and situated a little behind and parallel to the membrana reuniens inferior. This is observed in rats of 2.5 to 5.25 mm. (Henneberg) and in human embryos of from 4 to 8 mm. (Hirschland and Strahl), and was named by Schwalbe-Schmidt mammary streak (Milchstreifen). It is due to the cells of the ectoderm becoming deeper and more cubical.

From the mammary streak there is soon produced, by multiplication of the cells, a well-marked ridge, the mammary line (Milchlinie or Leiste) (*Ml*, Fig. 1035, A). This well-marked microscopic ridge was first studied by O. Schultze in the pig, and more recently by Kallius, Stahl, and Hirschland in human embryos of about 15 mm.

In this line the epithelium develops more rapidly at certain spots, corresponding in situation and number to the future mammary glands. The line becomes moniliform, and finally isolated, spindle-shaped enlargements are produced by atrophy of the portion of the milk line lying between the enlargements (Fig. 1035, B). Thus the mammary hillocks ("Milchhügel") of Bonnet are produced (Fig. 1036). The projection of the line of hillocks, above the surface of the skin, is only very transient. In human embryos, toward the end of the second month of intra-uterine life, the small tubercular thickenings, grad-