a very chronic course. In mercurial poisoning the parotids and submaxillary glands become enlarged and tender and the flow of saliva is excessive. Bilateral enlargement of the parotids following the administration of potassium iodide has been reported by Comby, Miss Bradley, Requier, and Villar. In these cases there were also œdema of the eyelids, coryza, lachrymation, and salivation.

After the withdrawal of the poison the affected glands usually recover their natural size and function.

Secondary Parotitis.—Next to mumps this is the most common form of inflammation of the parotid. It is associated with many local and general infections, such as maxillary osteitis, inflammation of the temporo-maxillary joint, abscesses, erysipelas, typhoid fever, typhus fever, cholera, diphtheria, smallpox, bubonic plague, yellow fever, cerebrospinal fever, relapsing fever, pneumonia, syphilis, influenza, and gout. Paget has collected 101 cases of parotitis complicating various infectious and functional disturbances of the peritoneal and pelvic organs. Of these, 50 occurred in cases of injury, disease, or temporary derangement of the generative organs, without suppuration. In this list were included cases of pregnancy, childbirth, abortion, pelvic cellulitis, hæmatocele, and operations on the vagina and uterus. In 10 instances the disease developed after the introduction of catheters and sounds in male patients and after blows on the testicle; in 18 the disease was associated with injury or disease of the alimentary tract, involving the stomach, pancreas, etc.; and, finally, in 23 there was disease or injury of the abdominal wall. In these cases the course was, as a rule, rapid and suppuration occurred on the fourth or fifth day. Donkin has reported three cases of unilateral parotitis complicating gastric ulcer, and Pepper has also reported a similar case. Debout d'Estrées has collected the reports of twelve cases of parotitis in gouty subjects.

The route of infection is in many cases obscure, but it is probable that in some cases, as in typhoid fever, it is through Stenson's duct, while in others the metastasis takes place through the blood-vessels and lymphatics. Hanau studied the genesis of five cases of suppurative parotitis which occurred as a secondary process in septic infections. In all these instances the organisms present were staphylococci; they were always found in the abscesses and ducts, while the blood-vessels and lymphatics were free. In one fatal case Dietrich found the staphylococcus pyogenes aureus in the ducts, but not in the blood-vessels. The mouth is, without doubt, frequently the direct source of the infection, for in many diseases it offers conditions peculiarly favorable to bacterial multiplication.

In *typhoid* fever parotitis occurs in a variable percentage of cases. Osler reports the complication as occurring 45 times in 2,000 cases in Munich; of 2,000 patients with typhoid fever in the London Fever Hospital, 13 had parotitis; at Basle, of 1,600 cases of typhoid fever there were 16 complicated by suppurative parotitis. Infection is usually through Stenson's duct, and when arising in this manner it is probably not so serious a form as when it occurs as a metastatic process (Osler). Keen has reported two cases in which Eberth's bacillus was recovered from the pus in the glands; in one case there was a mixture of staphylococci. This complication generally begins during the third or fourth week; one case is reported as appearing on the tenth day. It is usually unilateral, but sometimes both glands become infected, coincidently or successively. Suppuration almost invariably ensues.

As a rule, parotitis is seen only in severe cases of typhoid fever; it is in itself a serious complication, the mortality being placed at about thirty per cent. Seven of the Basle cases ended fatally. The complication is said to be less common since the introduction of antipyretic treatment, but it seems to the writer that the attention which has been paid to the care of the mouth in recent years may be the more important prophylactic measure.

In *typhus* fever parotitis occurs in many epidemics to the extent of even twenty per cent. of the cases, being a more frequent and more dangerous complication in this disease than in typhoid fever. Both glands may be affected, but the disease is more commonly unilateral. Suppuration is usual, and the gland breaks down and is discharged in small necrosed fragments. Extensive infiltration and burrowing have caused fatal exhaustion. Pepper has seen death from parotitis after all danger from the original attack of fever seemed over.

Finkler reports 12 cases of parotitis in 55,263 cases of *influenza*. He thinks that in these cases there is probably mixed infection.

Pneumonia is occasionally complicated by parotitis, which is then usually suppurative. Pneumococci have been found in the resulting exudate by Testi and by Fitz. It is a dangerous complication, and the prognosis in these cases is bad.

Parotitis is a rare sequel of *relapsing fever*, *cholera*, *bubonic plague*, *yellow fever*, and *epidemic cerebrospinal meningitis*.

The *symptoms* of secondary parotitis are often masked by those of the primary disease. The parotid region at first becomes hard and swollen; associated with this there is pain on moving the jaw and in swallowing. The area then becomes œdematous, later softening somewhat, and the surface becomes red. At the end of three or four days there is an elastic non-fluctuating tumor. At this point the swelling may begin to subside, but more often it goes on to suppuration. The inflammation may be limited to the gland or it may spread to the surrounding tissues, involving the muscles and the periosteum. The pus burrows beneath the strong fascia for some distance before it points at the skin. The pus may pass downward into the chest, backward along the pharyngeal wall, upward along the sheath of the blood-vessels to the meninges, to the articulation of the jaw, or backward into the middle ear. The blood-vessels may be injured by ulceration, and the facial and jugular veins or the cavernous sinus may become thrombosed. There may be a neuritis with or without destruction of the facial nerve. Rarely the process terminates in gangrene. The pus may discharge spontaneously through the cheek, mouth, or external auditory meatus, more rarely into the œsophagus or anterior mediastinum.

The *prognosis* depends largely upon the condition of the patient at the onset of the complication. In cases in which the patient is much reduced, as in the third week of typhoid fever, a superimposed parotitis is an exceedingly grave matter; in a series of collected cases of this nature the mortality was thirty per cent. If the disease develops after convalescence has been well established, the prognosis is much less grave. Early recognition and evacuation of pus may obviate extensive infiltration and burrowing and distinctly lessen the gravity of the situation. Common sequelæ are induration and enlargement of the glands; less frequently there remains a facial palsy. Death results from general exhaustion, septicæmia, meningitis, or cerebral thrombosis.

The *prophylactic treatment* of secondary parotitis consists in diminishing the danger of infection through Stenson's duct. In typhus, typhoid, and other infectious diseases care should be taken in keeping the mouth clean and as free as possible from bacterial growths. When infection of the gland has occurred, an attempt should be made to obtain resolution or prevent suppuration by the application of ice, leeches, iodine, or mercurial ointment. One should be on the outlook for the formation of pus at all times, and as soon as its presence is recognized it should be evacuated. The gland should be drawn forward and an incision made parallel with the main branches of the facial nerve; the incision should be made well forward so as to avoid injury to the carotid vessels. An efficient drain should be kept in place so that the abscess may heal from the bottom.

VI. Xerostomia, or dryness of the mouth, is caused by a deficient secretion of saliva. It may be physiological in infancy. It occurs in neurotic individuals, particularly in women suffering from hysteria or hypochondriasis. Sometimes a fright may appear to be the main etiological factor, and frequently the cause is entirely unknown. Excessive loss of water by the kidneys, as in diabetes and chronic nephritis, rapid evaporation in mouth-breathers, and febrile diseases often cause a similar condition. It is not infrequent in the aged. Chronic inflammation of the salivary glands and obstruction of their ducts may result in an insufficient supply of saliva and consequent xerostomia. The mouth becomes dry and glazed, and it presents the color of raw beef. The tongue may be parched and deeply fissured, and speaking, mastication, and deglutition become difficult.

In cases due to obstruction of the ducts, relief may be obtained by expressing the tenacious plugs of mucus. In the neurotic cases pilocarpine and the galvanic current have been found helpful; in these cases also general tonic treatment is always of importance, and any causes of reflex nervous irritation should be looked for and removed. Temporary relief may be obtained by moistening the mouth with hot water or with a solution of albolene. Cabot has found that the eating of small pieces of oatmeal cracker gives considerable temporary relief in some cases of xerostomia complicating diabetes.

VII. Ptyalism.—(Synonyms: Salivation, Sialorrhœa.) Ptyalism may be defined as a pathological increase in the secretion of saliva.

In the adult the normal amount of saliva secreted in twenty-four hours is from two to three pints. Pathologically the amount may be increased to ten pints in the twenty-four hours. Such saliva is viscid and glairy; its specific gravity varies from 1.000 to 1.059; it contains little sulphocyanide of potassium and less ptyalin than normally.

Physiologically, the secretion of saliva is increased by the reflex stimulation caused by the taking of food and, in children, during dentition.

Ptyalism is caused by a pathological reflex stimulation of the secretory fibres of the nerves supplying the salivary glands. It is met with in women during pregnancy and at the menstrual period; in psychic disturbances such as hysteria and insanity; in infectious diseases, particularly in rabies and smallpox; in lesions of the medulla and pons. It follows the ingestion of certain drugs, such as mercury, gold, silver, copper, arsenic, lead, pilocarpine, jaborandi, muscarine, potassium iodide, and tobacco. Bohn describes instances, in children, in which the excessive flow of saliva occurred only in the daytime and ceased at night; the cause was unknown, but he believed the ptyalism to be a form of neurosis. Sialorrhœa has been met with in affections of the liver, spleen, pancreas, and genital organs; it is believed to be due to reflex irritation from these parts.

The excessive secretion of saliva necessitates constant swallowing and may interfere with speech, or the fluid may flow from the mouth. In pregnancy it may persist until delivery has occurred. In mercurial poisoning the patient becomes emaciated, the bowels are constipated, and the amount of urine is diminished; the parotid and salivary glands are enlarged and tender. The ptyalism may persist for from one to three weeks after the removal of the drug.

Diagnosis is difficult only when a paralysis exists which interferes with swallowing and thus simulates ptyalism; actual measurement of the amount of saliva will definitely settle the question.

The *prognosis* depends upon the cause and the possibility of its removal.

Treatment consists in the removal of the underlying cause, the use of an astringent mouth wash containing alum, gallic acid, or tincture of myrrh, and the administration of atropine, one-sixtieth of a grain every four hours until there is a sensation of dryness of the throat. In cases of nephritis, the administration of mercurials is especially liable to cause sialorrhœa. During the administration of mercury salivation can be prevented in many cases by keeping the mouth and teeth carefully cleansed; if soreness and tenderness of the gums, tenderness of the teeth on striking, or the "mercurial fœtor" of the breath arises, the administration of mercury should be stopped at once.

T. Stuart Hart.

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PAROVARIUM. (ANATOMICAL.) See *Sexual Organs, Female*.

PAROVARIUM, DISEASES OF.—The term parovarium is applied to a series of from six to eight closed tubules which lie between the two layers of the broad ligament. They radiate out from the ovary toward the Fallopian tube, terminating in a large tubule which runs parallel to and beneath the Fallopian tube.

The pathological changes to which it is liable consist practically of only two varieties, viz.: cystic disease and carcinoma, the latter being secondary to similar disease elsewhere, and so rare as not to merit consideration in so short an article as this.

Parovarian Cysts.—These arise from dilatation of one of the tubules of the parovarium, and are therefore intraligamentous. Frequently they remain so, in which case their removal is an exceedingly grave proceeding, but at times they stretch the ligament to such an extent that they become abdominal with a well-formed pedicle. In the latter case they are freely movable and ovoid in shape, while in the former they are fixed in the pelvis and have often an irregular outline. When pedunculated these cysts have a complete covering of peritoneum; while at the point where they split the layers of the broad ligament only the upper surface is covered by this membrane. This peritoneum is smooth and glistening, and the blood-vessels may be seen beneath it. These cysts are nearly always unilocular and contain, as a general thing, a very thin and limpid fluid; but in the case of older cysts this fluid may be thicker and turbid, especially if any hemorrhage has taken place into the cyst.

The inner surface of the cyst is lined by ciliated columnar epithelium which may be accompanied by some cells of the cylindrical variety. Next comes a layer of connective tissue and unstriped muscular fibres, and lastly comes the peritoneal coat.

Symptoms may be absent in the pedunculated variety until the cysts become sufficiently large to interfere with the heart and respiration, when dyspnœa and palpitation, as well as the swelling of the abdomen, will be complained of. When the cyst is sessile, however, one early gets pelvic discomfort or even pain, and the action of both bladder and bowels will be interfered with.

An abdomino-pelvic examination of the patient, in a case in which the tumor is pedunculated, will give the signs of an ordinary unilocular ovarian tumor, except that the fluidity of the contents will not be so evident in the latter. When the tumor is sessile, however, a fixed and fluctuating mass is felt to one side of the uterus, which is displaced to the opposite side of the pelvis. No hard nodules are to be felt in this mass.

The tumor may rupture, and this may be followed by refilling and repeated rupture, by cure, by hemorrhage, or by sepsis and death.

The *treatment* is removal. In the case of the cyst with a pedicle this is very simple, but when the broad ligament has been split up and the tumor has reached the pelvic floor, the treatment is a difficult matter. Here there is such risk of hemorrhage when one tries to remove the tumor by itself that a clean sweep of the pelvis is advocated by most operators. Hall taps the cyst after hav-

ing opened the abdominal cavity; he then ligates the ovarian arteries—that of the affected side to the outer side of the tumor, and that of the opposite side on the uterine side of the ovary if that is to be left, to its outer side if it is to be removed. The peritoneum is divided across the top of the bladder, which is separated from the uterus. The uterine artery on the healthy side is tied and divided, after which the cervix is divided across. The other uterine artery is then clamped, ligated, and cut. The tumor capsule is incised in front and behind, and the tumor is then shelled out and removed with the uterus. The peritoneal flaps are united by a continuous catgut suture. *F. A. L. Lockhart.*

PAROVARIUM, TUMORS OF. See *Ovaries, Diseases of.*

PARTHENOGENESIS.—(Gr. *παρθένος*, a virgin, and *γένεσις*, production.) Parthenogenesis is reproduction by means of unfertilized eggs.

Occurrence.—This means of perpetuating the species occurs normally in several widely separated groups of animals and in a few plants. It was really discovered first in the plant lice, aphids, by Bonnet through a series of experiments begun in 1740; although Albrecht had recorded a single case of parthenogenesis in the silk-moth as early as 1701. In the Aphidæ the eggs which have lasted through the winter hatch in the spring, giving rise to parthenogenic females, which in many species are winged, and in others are without wings. These are viviparous, the eggs developing within the oviduct. After a number of parthenogenic generations sexual individuals are produced, the males being winged, the females always without wings. After copulation the females lay fertilized eggs, which remain dormant during the winter and hatch into asexual individuals in the spring. In this group parthenogenesis is thus combined with an alternation of generations. But sometimes some of the parthenogenic individuals live through the winter, thus producing two parallel cycles of development. In some of the aphids the life history is complicated by the fact that the sexual and asexual generations inhabit different host plants.

Parthenogenesis occurs normally also among the worms—in the liver flukes, larvæ of *Distomum hepaticum*, and in the rotifers. In the Crustacea it is found in certain genera of the Entomostraca, namely, Cypris, Daphnia, Polyphemus, Artemia, Apus, Lepidurus, and Limnadia. The phenomenon is widely distributed among the insects, being especially characteristic of the Hymenoptera—sawflies, gall-flies, ants, bees, and wasps; the Thysanoptera; and the Aphidæ and Coccidæ,—plant lice and scale bugs. It is found rarely among the moths, as in the genera Apteronia, Psilura, and Solenobia; and in one genus of gnats, Chironomus.

Among plants parthenogenesis is described as occurring in *Chara nitida*, *Thalictrum fendleri* and *purpurascens*, and some fungi, as Saprolegnia.

Classification.—The forms of parthenogenesis have been classified by Geddes and Thompson, and later by Delage according to their mode of occurrence into several groups. Of these the most important are: (1) *Occasional* parthenogenesis, of which the only authentic example appears to be the silk-moth. It has been known for a long time that once in a while a female silk-moth may be found capable of laying eggs, some of which will develop without fertilization. Geddes and Thompson include in this group a form of parthenogenesis that they also call *partial* and that Delage distinguishes as (2) *facultative*. This form is characteristic of the bees, ants, and wasps. The queen bee, for example, as was first shown by Dzierzon, appears to be able at will either to fertilize the eggs as they are laid by means of spermatozoa stored in the sperm sac or else to withhold fertilization. The eggs develop equally well in either case, but fertilized eggs always develop into workers or queens, while the unfertilized eggs invariably give rise to drones. This is proved partially by the fact, noted by Hensen, that when a queen bee has been impregnated by a drone of another variety, the female offspring, workers and queens, will all be hybrids, while the young drones will show purely the characters of the maternal race. Moreover, queens that have been prevented from receiving the male, old queens whose sperm sacs have become exhausted, and the workers that occasionally can produce eggs but have no copulatory organs, all produce male offspring only. Finally, von Siebold was unable to find any spermatozoa in eggs from drone cells.

(3) *Seasonal* parthenogenesis accompanied by an alternation of generations is common with the Entomostraca and Aphidæ. In the Aphidæ the parthenogenic young are born alive as already described. That this process is dependent upon seasonal conditions is shown by the experiment of Réaumur and Kyber, who, by maintaining artificially summer conditions in a glass case, were able to obtain fifty continuous parthenogenic generations extending through four years. In the Entomostraca the summer eggs which develop parthenogenetically are smaller, have less yolk, and thinner shells than the fertilized winter eggs, which are well provided with food yolk and covering to withstand drying and cold. This form of parthenogenesis is also characteristic of the gall flies, but in most of these there is but a single parthenogenetic generation between two sexual ones.

(4) *Juvenile* parthenogenesis has been taken to include the summer reproduction of the aphids. But that view no longer prevails, for the parthenogenetic females appear to differ from the perfect forms chiefly in the absence of certain accessory reproductive organs. So the only real case seems to be that of a species of the gnat, Chironomus, in which the pupa produces parthenogenetic eggs. In a closely related group, the gall-midges, Cicidomya, there is a form of pædogenesis that appears to be distinct from parthenogenesis. While the larvæ may contain rudimentary ovaries or testes, the offspring are produced from clumps of cells formed in connection with the fat body. This appears to be a sort of internal budding.

Finally, we have (5) total, or *exclusive*, parthenogenesis. That is, in many rotifers, some of the Entomostraca, and a few insects, no males have ever been found, and it is inferred that in these cases there is perpetual reproduction by unfertilized eggs only.

(6) *Artificial* parthenogenesis, which may be quite a different thing from the normal process, will be discussed in another paragraph below.

Another classification of the phenomena of parthenogenesis is that of Taschenberg, who distinguishes three divisions: (1) *Thelyotoky*, when the unfertilized eggs give rise to females only, as in the summer generations of the aphids; (2) *Arrhenotoky*, when males only are produced, as in the case of the queen bee; and (3) *Deuterotoky*, when the offspring are of both sexes, as with the gall-flies.

Cytology.—It was first suggested in 1877 by Minot on theoretical grounds that parthenogenesis might be due to a failure of the egg to produce polar bodies (see articles *Ovum* and *Reduction Division*). Balfour in 1880 and later Van Beneden maintained that the extrusion of the polar bodies in eggs destined for fertilization is a special provision to prevent parthenogenesis. Theory also led Weismann to investigate the question of parthenogenesis, and he observed in 1885 that in the parthenogenetic eggs of Polyphemus, one of the Daphnidæ, but one polar body is formed. In 1888 Blochmann made the important discovery that in the plant-lice, aphids, parthenogenetic eggs produce but one polar body, while the fertilized eggs produce two. Weismann subsequently found this to be true of the eggs of ostracodes and rotifers, and was led to infer that the differences observed in these forms is one that distinguishes all parthenogenetic eggs from those destined for fertilization. But doubt was thrown upon this view by the observations of Blochmann (1888–89) and Platner (1889), who discovered that in the honey-bee and in the moth Psilura (Liparis) the parthenogenetic eggs produce two polar bodies. The difficulty has been met by Brauer's brilliant research, in which he discovered that there are two types of parthenogenesis. Both

types occur in the eggs of Artemia. In each case the first maturation spindle contains eighty-four chromosomes in the form of typical tetrads (Fig. 3742), which divide so that eighty-four dyads are removed in the first polar body and eighty-four remain in the egg (Fig. 3743). There are indications of an attempt to form a second polar spindle, but no division takes place, and the eighty-four dyads give rise to a reticular cleavage nucleus (Fig. 3744).

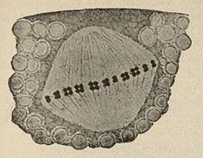

FIG. 3742.—First Maturation Spindle in Parthenogenetic Egg of *Artemia salina*. × 1060. (After Brauer.)

In the second type, which is less frequent, a second polar spindle is formed and the eighty-four dyads divide, producing two groups each containing eighty-four single chromosomes (Fig. 3747). Ordinarily these remain in the egg, producing two small reticular nuclei (Fig. 3748). Preparatory to division two centrosomes appear, whether by the division of a single one or not is not known. But, at any rate, they form a single spindle in which the one hundred and sixty-eight chromosomes arrange themselves in two distinct equatorial plates (Figs. 3749 and 3750). In rare cases, however, Brauer observed that the second polar body is actually extruded, and then its nucleus returns into the egg and presumably undergoes the changes just described. This furnishes an explanation of the appearances observed in the bee and Psilura, suggesting that further investigation will show that the nucleus of the second polar body reunites with the egg nucleus to form the cleavage nucleus in a manner similar to the union of the sperm nucleus with the egg nucleus (see *Impregnation*). If this be true, it will be established as a general fact that the parthenogenetic egg contains the same amount of chromatin as the ordinary egg does after union with the spermatozoon. The formation of the second polar body appears to reduce the amount of chromatin to a point where under ordinary conditions the egg is unable to undergo further division. But if the amount of chromatin be restored by the entrance

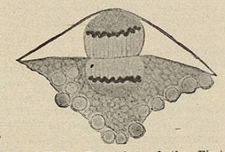

FIG. 3743.—Extrusion of the First Polar Body of the Same. × 1060. (After Brauer.)

FIG. 3744.—Egg Nucleus Derived from Half of the First Spindle Remaining in the Egg. The centrosome has divided. × 490. (After Brauer.)

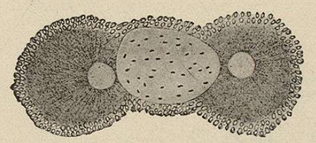

FIG. 3745.—Egg Nucleus of the First Type at the Beginning of the Formation of the Cleavage Spindle. × 490. (After Brauer.)

of the spermatozoon or by the return of the second polar nucleus, then the egg may start upon its new cycle of development.

Brauer made the further observation, which is of considerable importance for the theory of the individuality of the chromosomes (see *Chromosomes*), that so far as he was able to trace them through the first few cleavages, the chromosomes reappear in subsequent cell divisions in the same number that was present in the first cleavage nucleus. That is, he found eighty-four when no second polar nucleus had been formed and one hundred and sixty-eight of half size when a second polar nucleus had been formed (*cf.* Figs. 3745 and 3749).

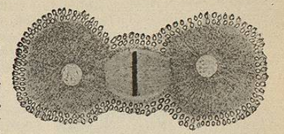

FIG. 3746.—Cleavage Spindle of the First Type. × 490. (After Brauer.)

Very recently (1902) Petrunke witsch has studied the maturation of the winter eggs of Artemia, and he failed to find Brauer's second type, but further investigation is necessary to throw serious doubt on the positive results of Brauer's very careful work.

Heredity.—We are indebted to Dr. Ernest Warren for the only observations made so far upon heredity in parthenogenesis. The forms that he studied are Daphnia (1900) and an aphid, *Hyalopterus trirhodus* (1902). From 23 individuals of Daphnia he obtained 96 young, and from 60 aphids he reared 455 offspring. Measurements were made of parents and offspring of both species, and the coefficients of heredity were calculated by the methods described in another place (see article *Heredity*).

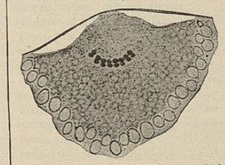

FIG. 3747.—Second Maturation Spindle of the Same. × 1060. (After Brauer.)

The results of direct inheritance were found not to differ very much from those obtained in sexual reproduction; taking the mean of Daphnia and the aphid, the coefficient for parental inheritance was found to be 0.41, and for grand-parental 0.24. But in collateral inheritance there seems to be considerable difference. The mean fraternal correlation for the two species is 0.66, considerably higher than the average for sexual reproduction, which Pearson places at 0.49 or 0.50. It is generally supposed that sexual reproduction tends to increase the variability of the race, but Warren found no significant difference in that particular between these species and sexual forms. But the whole subject of heredity and variation of asexual forms needs much more investigation before generalizations of importance can be made in regard to the different effects of sexual and asexual reproduction.

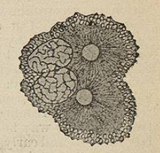

FIG. 3748.—Two Egg Nuclei Derived from Halves of the First and Second Spindles. × 490. (After Brauer.)

Artificial Parthenogenesis.—It has been known for a long time that the ova of animals that reproduce by the sexual method only will sometimes undergo an irregular segmentation. R. Bomet (1900) has given an exhaustive review of these phenomena as observed in vertebrates, and concludes they are pathological in character. The seg-

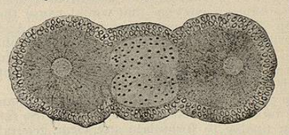

FIG. 3749.—Egg Nucleus of the Second Type at the Beginning of the Formation of the Cleavage Spindle. × 490. (After Brauer.)

mentation observed is a fragmentation of the cell leading to dissolution. He places in this category the early experiments of Dewitz (1887), who found that frogs' eggs treated with corrosive sublimate would undergo segmentation. Similarly Tichomiroff (1886) was able to induce the development of unfertilized eggs of the silk-moth by treating them for a few minutes with sulphuric acid, but this is a species in which occasional parthenogenesis is known to occur.

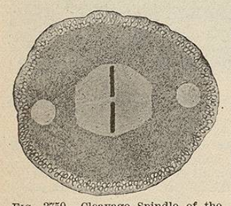

Fig. 3750.—Cleavage Spindle of the Second Type. × 490. (After Brauer.)

In 1899, however, Loeb made the remarkable discovery that by the use of a solution of magnesium chloride of a certain strength (a mixture of $\frac{2}{3}$n $MgCl_2$ and sea-water in equal parts for two hours) he could induce development in the unfertilized eggs of a sea-urchin (Arbacea), a group in which normal parthenogenesis is unknown, so that the egg not only divided but continued through the blastula and gastrula stages, and eventually formed normal pluteus larvæ (Fig. 3751). At first he attributed this result to the specific effect of the magnesium ions. But later researches showed (1900) that other salts and such organic substances as urea and cane-sugar could produce the same result. Loeb then concluded that the cause of development was not the specific effect of certain ions, but that it was due to an increase of osmotic pressure. Especially he noted that the reagents used seemed to cause a liquefaction of the nuclear membrane, and he regarded that as a prerequisite for cell division.

This idea was taken up by Mathews (1900), and he found that various agents that caused the liquefaction of protoplasm, such as lack of oxygen, slight increase of temperature (from 32° to 33° C. for two to four minutes), ether, chloroform, and alcohol would all induce segmentation in sea-urchin eggs. Later Mathews (1901) found that the eggs of a starfish, *Asterias forbesii*, could be caused to develop by shaking or by simple removal from one dish to another by means of a pipette, provided the eggs are taken at the right time, namely, from two to four hours after they have been shed, when "both polar globules have been extruded and the female pronucleus has re-formed and reached a considerable size." From eggs treated in this way he was able to rear some larvæ to the late gastrula and early bipinnarian stages. Loeb (1901) has been able to obtain artificial parthenogenesis also in an annelid, Chætopterus. By treating the unfertilized eggs with solutions of sodium, magnesium, and calcium chlorides and with cane sugar he obtained development into swimming trochophore larvæ. Fischer (1902) has obtained swimming larvæ from unfertilized eggs of two other annelids, Amphitrite and Nereis. From the former by treatment with calcium nitrate, and from the latter by using solutions of potassium chloride having considerably higher osmotic pressure than the sea-water.

By extracting the spermatozoa of sea-urchins Gies (1901) tried to obtain an enzyme that would cause the eggs to develop. But his results were negative. And he was led to criticise the positive results previously obtained by Piéri, which he attributes to carelessness in the non-removal of spermatozoa; and the results of Winkler, which he regards as due to osmosis.

After all, the physiologists have done little more than to establish the fact of artificial parthenogenesis. So far they have been unable to formulate any clear general statement as to the cause of the phenomenon, and they have told us next to nothing in regard to the internal conditions of the egg during this process.

The first one to approach this problem from the inside, as it were, was R. Hertwig (1896), who found that in unfertilized eggs of sea-urchins, Echinus and Sphærechinus, treated with dilute solutions of strychnine, the nucleus might give rise to a bipolar mitotic figure. Sometimes the chromosomes would divide, and sometimes two complete nuclei would be formed, and in a few cases irregular or incomplete cleavage stages were observed. Using mainly unfertilized eggs of Arbacea, T. H. Morgan has made a series of studies (1896, 1899, 1900) upon the effects of solutions of sodium and magnesium chlorides and also dilute strychnine upon the cytoplasm, his "principal discovery being that the eggs become filled with 'artificial astrospheres' (asters) containing deeply staining centrosome-like bodies, which may become connected with the nucleus and 'seem to act as anchors for the chromosomes and move out into the egg with the chromosomes attached to them.'"

Our principal knowledge of the internal phenomena of artificial parthenogenesis is due to the beautiful work of E. B. Wilson (1901), begun soon after the publication of Loeb's first paper. He completely confirmed Loeb's general result, finding that "unfertilized eggs of Toxopneustes (a sea-urchin), when treated with a mixture of equal volumes of sea-water and twelve per cent. $MgCl_2$ and then replaced in pure sea-water, may segment, give rise to actively swimming blastulæ and gastrulæ, and in many cases to plutei." The different stages, however, showed a large number of abnormalities and monstrous forms, and even the most perfect specimens were not exactly like those produced from fertilized eggs.

As to the internal changes observed in these eggs, we have space here for only the briefest possible summary of the most important results. The first change noticed in the eggs was the appearance of a vague primary radiation centring in the nucleus. In many eggs a varying number of secondary centres of radiation (cytasters) were formed at various points in the cytoplasm. Then after a reduction of the rays almost to the vanishing point and their reappearance nuclear division proceeds as in fertilized eggs; but the division of the cytoplasm may be delayed until several nuclei are formed. Serial sections showed that no sperm nuclei were present. The internal changes, while showing an interesting parallel to those occurring in fertilized eggs, were unmistakably different from the latter. During cleavage many of these eggs show but *one-half* the normal number of chromosomes, namely, eighteen instead of thirty-six, and most of the

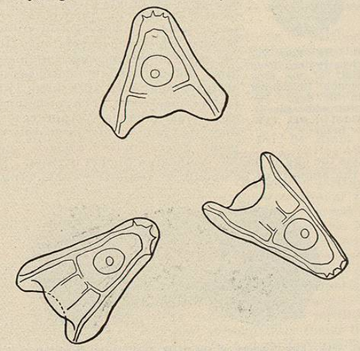

Fig. 3751.—Normal Plutei Reared from Unfertilized Eggs; treated with equal parts of a $\frac{2}{3}$n $MgCl_2$ solution and sea water. Magnified. (After Loeb.)

eggs failed to form any trace of a vitelline membrane, which in fertilized eggs is formed after the entrance of the spermatozoon. Both the primary and secondary asters are formed *de novo* and subsequently multiply by division; and both may act as centres of cytoplasmic division. But, as a rule, complete division does not take

place except when the asters are connected with chromosomes. Even in enucleated fragments of eggs, produced by shaking, asters may be formed in the magnesium solution, and these, like the others, may contain at their centres deeply staining bodies resembling centrosomes.

Delage (1901) has also investigated the internal phenomena of artificial parthenogenesis, using eggs of species of sea-urchins and starfish. He obtained development in the former after both polar bodies had been formed, and in the latter after only one polar body had been formed as is the case in normal parthenogenesis. He claims also that the number of chromosomes present is the same as in fertilized eggs. But Boveri (1902) has shown this to be an error, the number of chromosomes found by Delage in the sea-urchin being really half the normal number, thus confirming Wilson.

Robert Payne Bigelow.

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PARTURITION. See *Labor and Gestation.*

PASSION FLOWER.—*Passiflora.* The rhizome of *Passiflora incarnata* L. or of *P. lutea* L. (fam. *Passifloraceæ*).

The herbage is also sometimes employed.

These are soft woody vines, climbing high over shrubbery and trees in the Southeastern United States, where the edible fruit of the first-named is considerably used under the name May-pop.

The elongated rhizome, usually known commercially as "Passion flower root," quite closely resembles menispermum in appearance, being elongated and cylindrical. It rarely reaches a fourth of an inch in thickness and the nodes are rather obscure. It is yellowish or light brown, often with a greenish tinge, and finely striated. It has a small hollow centre surrounded by a greenish or yellowish, finely radiated wood zone, and a moderately thick, purplish bark section. Both odor and taste are slight and indefinite, the latter somewhat fatty and disagreeable. The constituents have not been examined with any care. A trace of alkaloid has been reported.

Passion flower has been exploited by commercial interests, and most of its literature has been compiled with a view of creating a demand for it. *P. incarnata* has been considerably employed in eclectic and homœopathic practice. These authorities attribute to it mild sedative and even hypnotic powers, while larger doses are said to be emetic. Its use by these practitioners in numerous grave conditions, as well as their minute doses, involve obvious absurdities. Whatever benefit may be derived from its use may result from the administration of from 2 to 4 c.c. (fl. ʒ ss.–i.) of the fluid extract. *Henry H. Rusby.*

PATCHOULI, OIL OF.—*Oleum Foliorum Patchouli.*—A volatile oil distilled from either the fresh or the dried leaves of *Pogostemon Heyneanus* Benth. (*P. Patchouli* Pell.; *P. suavis* Tenore. Fam. *Labiatæ*).

The Patchouli plant is native and cultivated in the East Indies, especially in the Straits Settlements, and the drug or the oil distilled from it is mostly exported from Singapore. The oil ranges from pale yellow to brownish, usually with a greenish tinge, and is occasionally of a deep brown color. Its specific gravity varies from 0.97 to 0.99, even when pure. With ninety-per-cent. alcohol, it yields a clear solution which usually remains clear upon the addition of more alcohol (Gildemeister and Hoffman). The oil has a characteristic and very intense and persistent odor. Its composition is not well known, though it yields a peculiar camphor known as Patchouli camphor. This oil is little, if at all, used medicinally, though it has the ordinary aromatic stimulant properties of its class. It has very important uses in perfumery.

Henry H. Rusby.

PATELLA, AFFECTIONS AND INJURIES OF.—The patella is a sesamoid bone developed in the quadriceps tendon, and is therefore a part of the extensor apparatus of the knee. Some anatomists have considered the patella homologous with the olecranon process of the ulna; but there are serious objections to this view, and it is not indorsed by Poirier and Charpy in their recent work.

The first rudiments of the patella appear about the tenth week of fœtal life, and ossification usually begins from one centre about three years after birth; but the *x*-ray often fails to cast a shadow until the sixth year. The principal functions of the patella are to increase the leverage of the quadriceps muscle and to protect the knee-joint anteriorly. It seems to be, however, a luxury rather than a necessity, since its congenital absence may produce little or no disturbance of function. The kangaroo, which has no bony patella, is noted for its powerful posterior limbs.

Fractures and traumatic dislocations of the patella, and prepatellar bursitis are discussed in other sections of this work; there remain the congenital and developmental anomalies, and certain diseases, deformities, and painful affections which follow.

Absence and Retarded Development of the Patella is a not unfrequent accompaniment of congenital deformities involving the knee, especially of absence or imperfect development of one or more bones of the leg, and of congenital flexion, hyperextension, and ankylosis of the knee. Of these conditions the one which has attracted most attention is the so-called congenital dislocation of the knee, where the child is born with one or both knees in hyperextension, and the tibia luxated forward. In a large proportion of these cases no patella is discoverable in infancy; but in many, if not most, it develops later, and may reach normal proportions. Such a case, observed by the writer,[1] had no patellæ at seven months of age; but they could be felt as very small nodules six months later, and at three years of age were well developed. At thirteen years this boy was active, and had good functional use of the knees and perfectly developed patellæ.

Many of the cases in the literature are reported too young to determine the fact of permanent absence. Rectification of the deformity and orthopedic treatment seem to exert a favorable effect on the development of the patella in these young cases. Potel[2] has collected 78 cases of congenital knee luxation, of which about half were bilateral; in 50 of these cases the condition of the