Sometimes, however, it contains a small quantity of albumen, and the precipitate formed by nitric acid may be soluble in an excess of that acid. The researches of Schutzenberger with the tannin process for estimating the quantity and kind of albumen have, however, thrown great doubt on these conclusions, and by the same means I have quite satisfied myself that M. Kœberlé's conclusions are not to be accepted. At my request my friend Dr. McMunn, of Wolverhampton, undertook to investigate the possibility of determining the source of fluids by means of the spectroscope. I furnished him with a number of specimens of fluid, the sources of which were absolutely known, but the results of his researches were entirely negative. They are given in detail in his valuable work on "The Spectroscope in Medicine" (London, 1880). There is an impression abroad that these cysts are occasionally cured by tapping, but I am bound to say I have never met with an instance of it. I have tapped many of them, and I have seen them remain quiescent for a time—as long as three years—and then require to be tapped again. In my recent practice I have altogether discontinued tapping, and I invariably remove them, the operation for their removal being simple and easy, and in my hands it has been uniformly successful.

A further point of great importance in recognizing mere ascites from an ovarian or parovarian tumor, is that in the former condition there is generally an appearance in the patient's face of suffering from serious functional disturbance, whereas in the latter the patient often looks in perfect health. Sometimes we find the walls of a parovarian tumor very thin and flaccid, in this way closely resembling the appearance of ascites.

This class of tumors it is which has given rise to a great many different beliefs in connection with the history and treatment of ovarian tumors which Dr. Mathews Duncan has very properly designated delusions. Among these was the belief, originated by M. Boinet, that ovarian tumors had been cured by tapping, by injection with iodine, by what Mr. Baker Brown called a formation of a false oviduct by the insertion of setons, and by a variety of other more or less barbarous and unscientific proceedings.

The walls of these cysts are nearly always very thin, consisting of little more than a thin basement-membrane and a lining of columnar epithelium. This epithelium undoubtedly undergoes alterations such as I have described as occurring in ovarian cysts, for I have seen all the appearances on the lining of a parovarian cyst that I have seen in an ovarian tumor. They undergo malignant degeneration, they suppurate and become gangrenous just as ovarian tumors do. Sometimes the basement-

membrane of their walls, which always contains some muscular fibre, becomes enormously thickened, and I have removed a parovarian cyst with walls more than half an inch thick, the greater part of which was composed of fusiform muscular cells.

They are therefore not matters to trifle with. Their early removal is always simple and safe. They should never be tampered with by tapping, but ought to be removed by abdominal section in their early stages, just as should ovarian tumors. Sometimes they burst and seem to disappear spontaneously, and this again has given rise to the statement that this result is obtained occasionally for ovarian tumors. When this fortunate accident takes place early in their history it will probably do no harm, but if it occurs during the advanced stages it is just as likely to result in cancerous implantation of the peritoneum as if the cyst had been ovarian. A few months ago I removed a large parovarian cyst which had several times been tapped, and which had ruptured into the abdominal cavity. On removing it I found the peritoneal surface studded with papilloma, of which the patient has since died.

I have now to speak of that variety of cystoma to which I have frequently referred as "Rokitansky's tumor," or the multiple cystoma. I am quite aware that both of these names are open to objection, but I have failed to find any other more appropriate or descriptive. To Rokitansky is clearly due the credit of having first described the tumor as a special variety of ovarian cystoma, and to Ritchie must be accorded the priority of discovering ova in its cysts; though, as I have already shown, the observation led him into a too hasty generalization. I think that I may claim for myself the position of having first arranged the various contributions into their proper positions, and from two specimens I can now confirm and extend the observations of the two authors I have cited.

These tumors are always double, no case having yet been described as having occurred on one side only. They are always of very slow growth; their cysts are uniformly small, rarely reaching the size of an orange, and generally being little bigger than grapes. The tumors are never large, and it is only the fact that both ovaries are always affected that makes them objects of surgical interference. The contents of the cysts are invariably limpid, and the ovum may nearly always be found, and in these two respects, as well in the immense number of the cysts, the tumors differ absolutely from ordinary cystoma.

The first case occurred in the person of a hospital patient from whom I removed both ovaries. Both tumors were multilocular, and had one or two major with innumerable minor cysts, gradu-

ating down to the most minute size. The fluid contents of all were limpid, and what was evacuated from three or four cysts at the time of the operation, together with the solid masses of both tumors, did not weigh quite ten pounds. The right tumor seemed to be about one-fourth larger than the left, so that they were probably four and six pounds in weight respectively—small-sized tumors. Both pedicles were included in one clamp, and the patient made an uninterrupted recovery.

After removal, the most careful examination of the tumors failed to discover any remnant of the ovaries outside them, nor did I find any trace of either of the Fallopian tubes, as I had not removed them. The tumors were pearly white and glistening; but the thin parts of the major cysts had a peculiar transparency that I had never noticed in any other tumors before, and columnar bands stood out here and there in relief on the walls. I may say that the tumors had been of extremely slow growth; for I had had the patient under notice for nearly a year before the operation, and had not discovered any increase in the size of the tumors, though they had been in existence probably five or six years.

The interiors of the large cysts were lined with regular columnar epithelium, and the wall seemed composed of fibrous tissue with some nucleated almond-shaped cells. The smaller cysts were densely packed together, and at some places, where they were of a uniform size, the tumors had much the appearance of huge white raspberries. I was struck with the resemblance the tumors presented to what I recollected of those in which Rokitansky and Ritchie had found ova, and I at once turned to Dr. Ritchie's admirable monograph, and found that the tumors answered the descriptions completely. I therefore examined the contents of as large a number of the cysts as I could, and in every one—I think without exception—I found more or less distinct evidence of an ovum.

It will serve my purpose best to quote at length from Dr. Ritchie's book—for our experiences are almost identical—and he also gives the observations of Rokitansky.

"In the first volume of the *Wochenblatt der Zeitschrift der K. K. Gesellschaft der Aerzte zu Wien*, Rokitansky describes the appearances observed in the post-mortem examination of a woman, twenty-six years of age, who died with diseased ovaries. Both ovaries were affected. The tumor on the right side was as large as a child's head, that on the left as large as a man's fist. Both ovaries were composed of a number of cysts as large as a cherry, which for the most part lay closely packed together, here and there had become flattened by mutual compression, and occasionally even projected into each other. The surfaces of the tumors were thus slightly lobulated, and between the protuberances were seen, at intervals, cysts as large as a barleycorn, a pea, or a bean. These latter cysts, on being punctured, gave exit to a greenish-colored fluid containing membranous flocculi, and in all of them the ovum was found. In each of them, however, the ovum was softened, very dull-colored, easily disintegrated. The zona pellucida had for the most part lost its sharp contour, and, except in one case, no germinal vesicle was discoverable.

"As far as I am aware, this observation of Rokitansky was never publicly confirmed until July, 1864, when the reporter to the *Medical Times and Gazette* of four cases of ovariotomy, performed by Mr. Spencer Wells in the Samaritan Hospital, mentioned that, in two of the tumors removed, Dr. Webb and myself had been fortunate enough to discover many ova.

"The patient from whom the tumors in question were removed was fifty-four years of age, and had been for some time suffering from double ovarian disease. The tumors were easily extirpated, and the patient recovered. Each tumor was of the size of the head of a child four years of age. Each contained several large central cavities, and a number of smaller ones in the wall of the central cavity, the wall itself never exceeding one inch in thickness. In the *Medical Times and Gazette* for August 6, 1864, Mr. Spencer Wells wrote as follows:

"'The two tumors in question were examined directly after their removal by Dr. Ritchie, who pointed out to me, in each of them, a number of small cysts, which were evidently enlarged Graafian follicles. Knowing the great and long familiarity which Dr. Woodham Webb has had with the ova of various species of animals since his researches in conjunction with Barry, I asked him to examine some of the cysts, in order to ascertain whether they did or did not contain ova, knowing that on this point no higher authority could be appealed to.

"'As one friend has suggested that we may have mistaken a blood-corpuscle for an ovum, there was evidently some reason for my caution; but I trust that the following note from Dr. Webb will set all such doubts at rest:

"' "Both the tumors you sent me, after their removal from a woman fifty-four years old, were growths in excess of true ovarian structure. The multilocular character was produced by clusters of ovisacs of various sizes. Ova, with the other natural contents, were to be found in all the small sacs. The fibrous coats of the larger sacs were thickened, and had many other secondary sacs developed in them. The interior was lined with

epithelium, which in some instances had, by parthenogenetic enlargement and successive budding of the cells, given rise to bunches of grape-like growths, repeated generations of imperfect ova."

" 'The whole, then, was nothing more than a reproduction in the human subject of conditions which are natural in some of the lower creatures. I suppose the description, in your orthodox pathological terms, would be, "hypertrophy of the ovaries, with arrested development of the contents." '

"This letter, coming from a gentleman of Dr. Webb's known experience, is of great interest. Dr. Webb evidently inclines to the belief that the ovum is only an altered epithelium-cell. He also seems to believe that the grape-like growths—those described farther down as dendritic growths—are repeated generations of imperfect ova."

Dr. Ritchie's unfortunate death, and my want of acquaintance at that time with Dr. Webb, hindered me from becoming acquainted with their method of manipulation; but that which I devised for myself answered my purpose completely. It consists in slitting open the cyst freely with a cataract-knife over a conical glass, collecting the whole contents, and afterward syringing out the cavity of the cyst gently with a solution of sulphate of magnesia in distilled water of a density something near that of the cyst contents. The fluid with which the cyst is syringed out is allowed also to fall into the vessel, and the whole to stand for a few hours, at the end of which time a little flocculent sediment will have collected at the bottom of the vessel. This is to be carefully lifted by a pipette, deposited in a clean watch-glass, and the ovum searched for under the microscope. What I found in every case I could not, of course, assert was an ovum; but having found one or two specimens about which there could be no doubt, and in every case something that was more or less like one, I am perfectly satisfied that in those tumors every cyst was a dilated ovisac. The smaller the sac, the more perfect the ovum seemed to be, and consequently I assumed that these were the more recent growths. Not only were these dilated ovisacs in the periphery of the tumors, but they were found throughout its substance. In fact, it seemed to me as if, for a long period of her ovarian history, the ova had been garnered up in cysts instead of being shed in the usual manner. Her youngest child was six years old, and if we were to assume that an ovum is shed from each ovary monthly, then we should get the number of ova so retained as about one hundred and fifty. The number of cysts was, however, much greater, probably two or three times as many; so that we may choose between two explanations—either

that the tumors had existed before her last pregnancy, or that more than two ova are shed in the month. My own belief is, that both these suppositions are correct; for, when speaking of ovulation at the beginning of the essay, I gave reasons for my belief that ovulation and menstruation had only a connection of concurrence. I am of opinion that ovulation takes place far more frequently than menstruation does.

It is a somewhat singular fact that the observation of Rokitansky has not been confirmed, as far as I have yet seen, by any others than Ritchie and Webb, and by my own cases. Still more curious is it that all four cases are almost identical, presenting small multilocular tumors of slow growth, and that in all four cases both ovaries were affected. This inclines me to believe that in these cases we have to deal with a special kind of ovarian tumor, occurring rarely and differing from the ordinary adenoid growth. Whether this be so or not, further experience alone can show. Dr. Ritchie says, immediately following the quotation I have given above, that he subsequently succeeded in finding ova in some of the loculi of a large number of ovarian cysts, but never in a loculus larger than a cherry, nor in one that had jelly-like contents. This observation I cannot confirm; for, though I have made many searches in the endogenous and subjacent secondary cysts of ordinary polycystic tumors, I have never found an ovum or anything resembling one. Perhaps my method is defective. Dr. Ritchie further says that, when no ovum is to be found, a single minor cyst is to be seen, embedded in one part of the wall, and he has thought himself justified in concluding that this appearance represents dropsy of the blastodermic vesicle. I have certainly seen such vesicles in the walls of small cysts, but I have as often found them multiple as single, and I have never seen reason to interpret them as Dr. Ritchie has done.

The second case of the occurrence of this peculiar form of tumor was that of a patient sent to me by Dr. McVeagh of Coventry in December last. The tumor had been noticed for two years, and had been increasing somewhat rapidly for seven months. I had no doubt as to the diagnosis of an ovarian tumor, but there was something in the examination that made me fear it was malignant. The patient was thin and looked very ill, but yet had no particular symptoms, and the distention of the abdomen was not great—that is, the tumor was not very large. I operated on December 7th, and when I opened the abdomen I found a large mass of glistening cysts of a pearly white lustre, varying in size from a pea to a small orange. The omentum was inextricably mixed up with them, so that at first sight

I was under the impression I had made a mistake and had to deal with a case of hydatids of the peritoneum. I found, however, that the mass was removable and that the cysts were pediculated upon a common stem. To get the mass out of the abdomen was a matter of no small difficulty, and to accomplish it I had to make an unusually large incision, nearly seven inches long. Then I found that the stalk of the tumor reached toward the left cornu of the uterus, and that as the left ovary could nowhere be found the tumor must represent it. I tied the pedicle and removed the mass; I then looked for the right ovary, but could nowhere find it, but loose in the abdomen I found a smaller mass of cysts which I think must have been the missing gland. How it came to be separated from its stalk I do not know. During the operation several of the cysts had become detached from the common stem by rupture of the slender petioles, and I had to hunt carefully about among the intestines to make sure that I left none of them. The patient made an excellent recovery, and is now in perfect health.

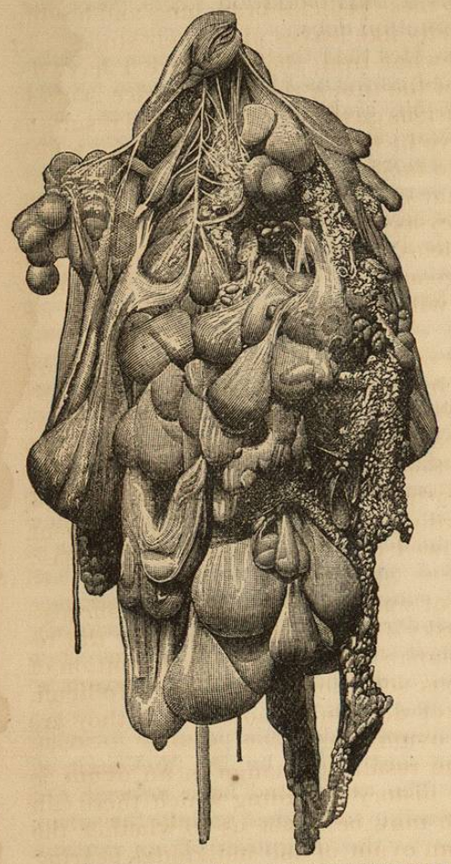

FIG. 28.—Rokitansky's Tumor, each cyst containing an ovum; from a photograph by Thrupp, about one-third of actual size. Preparation in Hunterian Museum of Royal College of Surgeons.

The adjoining illustration, which is taken from a photograph, will give a better idea of the appearance of the tumor than any description. On the right side and hanging down from the mass may be seen the omentum, nearly the whole of which was removed with the tumor, and through the meshes of which many of the cysts seem to have grown. It is adherent

here and there, but its association with the tumor seems to be more that it is involved with the growth in a sort of mesh-work, than as having the ordinary form of adhesion. Everywhere the curious small cysts with their slender pedicles may be seen hanging like grapes upon their stalks, and at the upper part of the tumor may be seen some of these pedicles branching and having cysts attached to them exactly like leaves upon their stalks. In this respect it differs somewhat from the first case I have described, but at other parts of the tumor the resemblance is close, and microscopical investigations gave exactly the same results as those above described. Save in the very largest cavities which had been emptied in order to facilitate the removal of the tumor, I found a normally columnar epithelium, and normal or nearly normal ova. In the small cysts the appearances were precisely those seen in Graafian follicles. The tumor is now in the museum of the College of Surgeons, and I trust that any one meeting with a similar example will secure for it a most careful examination.

Partaking of the nature of the cysts last described, to some extent and in some way yet inexplicable, are the mysterious productions known as dermoid cysts. The term "dermoid" is not a good one, for it by no means gives expression to a constant character of these tumors. Sometimes there is no trace of any epithelial products at all; while we find bones, muscle, and brain-substance even, according to Beneke, in some of them. The name, however, is hallowed by tradition, and it is not easy to coin a better one.

I have already explained at some length, and I hope successfully, my view that Rokitansky's tumor is produced by the retention of the ova in the Graafian follicles and the distention of their cavities by a continuous secretion of the liquor folliculi. My theory of the production of dermoid tumors is that they are the result of a growth of the ovum itself.

That these tumors are the result of change in an ovum is about the only part of their history regarding which there can be any certainty. But there may be doubt as to whether the abnormality takes origin in an ovum of the individual bearing the tumor, or in the ovum from which she herself was developed; in other words, whether the tumors are abnormally developed ova or are due to inclusion. That they have any origin in impregnation, we may at once dismiss as excluded from serious consideration, since they have been frequently found in newly born children, and their most common seat is in the ovaries of young women, chiefly, according to Mr. Spencer Wells, of fair complexion.

The question of their origin, then, lies between the hypothesis of an effort on the part of some over-active ovum in the direction of parthenogenesis, which has been based by Dr. Ritchie on Blumenbach's less scientific and more scholastic expression of "excess of formative nisus," and the equally hypothetical process of inclusion. As far as we know anything about inclusion, it follows the usual law of teratology, that any attached individual, whether developed or blighted, is symmetrically connected. Thus the Siamese Twins and the Millie-Christie monstrosity have the attachment in similar and identical structures, the one to the other (see Vrolik, Von Baer, etc.). I have seen nowhere on record that any fetal remains have been found attached to an ovary, or situated in an ovary in any way which could find them a classification under this law. The tissues met with are always rudimental, and such as, while they are the product of the ovum after conception, have no anatomical analogy whatever to the tissues of the ovary. I am disposed, therefore, to set aside entirely the view of their origin by inclusion, as the ovary is about the most unlikely structure in the embryo for such a process; and, if they had their origin in such a way, we ought to find dermoid cysts in the testicles of the male quite as often as in the ovaries of women.

There is only left, then, the explanation that dermoid cysts are the result of an altered nutrition of one or more ova; and, if I may lay down a dogma from my own dissections, I should say, of one ovum only. Dermoid cysts are generally unilocular, and, when they are not so, it is not difficult to show, as has been done by Dr. Ritchie, and has been evident in one or two specimens that I have examined, that the secondary cysts are formed by the mother cyst being partitioned off by the growth of ridge-like walls on the inside of the cyst.

The occurrence of cysts having a structure somewhat resembling the dermoid cysts of the ovary in other parts of the body, especially in the neighborhood of the orbit, has led to confusion in the discussion of the origin of the ovarian cysts. In the orbital cysts we have only aberrations of the normal process of the involution of epithelium from which the structures are developed, and there is no mention, as far as I can find, of these extremely small congenital cysts, which never enlarge in after life, having been found to contain anything but purely epithelial products, such as hair, dead epithelial cells, and fat. In dermoid cysts of the ovary, however, the variety of products is so great, as to put all analogy between them and inclusive cysts out of the possibilities. Thus, in one ovarian cyst which I examined under the direction of my friend and teacher, Dr. Grainger

Stewart, many years ago, in the substance of a wall between two loculi, were spread out flat bones which were undoubtedly some of the bones of the skull, and near them could be felt the representatives of the bones of a limb arranged in order. True bone is frequently found in ovarian cysts, and often in those that have no dermoid structures at all.

Sir James Paget refers to a remarkable specimen in the museum of St. George's Hospital, which exhibits a mass of fatty matter and a lock of dark hair, one and a half or two inches long, attached to the inner surface of the dura mater at the torcular Herophili, found in a child two and a half years old, in whom it appeared to be congenital. He adds, in a foot-note, that Dr. John Ogle, who had carefully examined the specimen and described it to the Pathological Society, was of opinion that the cyst was originally of extracranial formation, but that, at an early period of fetal life, before ossification of the occipital bone had taken place, the cerebral membranes and scalp had become adherent, and that, as the development of the bone went on, the outer integument was drawn in by retirement of the cerebral membranes. In this way some of the cutaneous structures had become included within the cranium. He considers that the cyst possesses characters which warrant the above supposition, and he adds that, in a similar manner, cysts within the orbit may extend into the cranial cavity. No such explanation could include the phenomena of the ovarian tumors which contain such structures as teeth, bone, cartilage, striped muscular fibre, brain and nerve tissue, etc. The true solution can be found only in a hypererchetic development of an ovum, a cell which has in it the power of formative origin for all these structures. The process of growth of the ovum after impregnation can be followed only after the assumption, either expressed or unconsciously accepted, of such a hypothesis as is contained in Mr. Darwin's "Pangenesis." The germ contributed by the male contains, we knew only too well from pathological experience, gemmules having certain powers and functions; and we may therefore assume, as indeed we also know, that the female germ contains also such gemmules. It may be that the ovum has in it the origin-buds of certain tissues, and that, under exceptional hypererchetic action, they may go on to the rudimental formation of these tissues without a fusion with the male germ. More careful and accurate description of what is found in dermoid cysts may help to solve this riddle; still better, perhaps, a careful consideration of what tissues are not found in them.

This doctrine of hypererchesis is supported by many facts which have been observed in cases where the changes in the

ovum can be watched outside the body of the parent. Thus Bischoff and Leuckhart have both described partial development of ovules which have been placed beyond the possibility of impregnation. Dr. Moquin-Tandon has, more recently (1875), described analogous facts before the Academie des Sciences, among which he gives details of the process of segmentation in the ova of a frog which had been kept in confinement for four months.

There were first noticed two large vertical fissures in the ovule, followed soon by similar horizontal segmentation, and this process of division proceeded further, but in a less regular manner than usual, the yolk spheres multiplying irregularly, and becoming of unequal size, and it was more rapid than in fecundated eggs which were allowed to develop at the same temperature. Only a small number of the ova presented this evidence of commencing development, for the majority died without any sign of segmentation. Sometimes death occurred after the division into two or four segments, sometimes at a more advanced period, but the ovule never assumed the mulberry appearance. The author considers that this incontestably proves that the ova of vertebrata, not impregnated by spermatozoa, may pass through the earliest stage of development in certain conditions, the exact nature of which is at present unknown. It seems to me that we may take this process to be exactly what occurs in the development of the spore of the fern into the prothallus, and the tendency which these unfertilized ovules have to this primitive and ineffectual development is derived from the continuity of descent. In the insecta the process is carried much further, for Balbiani exhibited some eggs of the silkworm moth to the Société de Biologie (1873), which had been deposited before fecundation could have been effected. A certain number of these eggs remained sterile, but others showed signs of development, though in no instance had the larva escaped from the egg. The number of these developing eggs varied extremely according to the species of moth by which they were deposited. The largest number was met with in those which produce several generations per annum. Among 9,000 eggs of a polyvoltine race, 513 developed spontaneously; while of 50,000 of an annual race, 29 only were fertile. M. Balbiani thinks that this enormous difference is probably due to the feeble vitality of the egg in the annual races, a suggestion which cannot be considered in any way as an explanation; neither can his idea be entertained that the parthenogenetic development is to be accepted as proving the hermaphroditism of the egg, for there is no evidence whatever of such a condition. What has been observed by Balbiani is indeed only an attempt to fulfil the

conditions seen in the aphides, where the cell multiplication in the pseudovaria produce a new individual without any sexual congress. Putting these facts along with others observed by Agassiz and Burnette in fish, by Hensen in the rabbit, by Bischoff in the sow, and more especially the remarkable observation of Oellacher, that segmentation occurs in the eggs of fowls kept from the cold, while the eggs are still in the oviduct, I do not think that there is any difficulty in believing that the hypererchetic efforts of the human ovum which result in the formation of those so-called dermoid cysts, are parthenogenetic, and have originated in the early phases of our ancestry. In the human ovary these processes are carried further by an abundant blood-supply.

Sir James Paget has, it seems to me, struck the key-note of the pathology of dermoid cysts when he wrote, "It is, perhaps, only during the vigor of the formative forces in the fetal or earliest extra-uterine periods of life that cysts thus highly organized and productive are ever formed." A most important point in the pathology hangs on this sentence, and can be decided only by a determination of the age at which such tumors are most frequently found. It is, of course, evident that the ages at which these tumors are removed by the operating surgeon cannot be taken into account, as they are of slow growth, and have often been recognized as being present for many years without perceptible increase. They are quite unlike, in this respect, the ordinary adenoid tumors. Their contents even show that their existence must often have been contemporaneous with the life of their bearers; for we find large balls of hair, the result of the epithelial growth and shedding of a nipple-like process not bigger than the tip of one's finger; and in one sac over three hundred teeth have been found, resembling, in many respects, milk-teeth; so that we may reasonably suppose that they were the repeated products of a limited dentigenous area. In one of Mr. Spencer Wells's cases, the preparation of which is in the Hunterian Museum, a piece of bone was found resembling greatly a part of the upper maxilla and sphenoid bones, and containing mature molar teeth. In fact, inspection of the specimen almost carries conviction to the mind that the bone and tooth-sacs were produced at an early, perhaps intra-uterine, period of the life of the patient, and that they grew and matured as she did till the tumor was removed, at the age of thirty-nine.

Dermoid and dentigenous cysts have been so frequently found in children, that it may be suspected that if the histories of all such as are removed by operation could be traced, they would be found to be, as Paget suggests, either congenital or