On the origin, structure, and mode of development of the cystic tumours of the ovary / by Wilson Fox, M.D.

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ORIGIN, STRUCTURE, AND MODE OF DEVELOPMENT

OF THE

CYSTIC TUMOURS OF THE OVARY.

BY

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Notwithstanding the increased attention which has of late been bestowed upon diseases of the ovary in consequence of the success which has attended the improved operative procedures adopted in this country for the relief of the cystic tumours of this organ, the pathology of these affections has still remained involved in considerable obscurity.

Believing, however, that an accurate knowledge of pathological anatomy will at all times contribute to the true advance of medical science, and feeling especially desirous, as a teacher in this department of knowledge, to be able to impart clear views on this important class of diseases, I have been led to an investigation of their nature, the results of which I now venture to lay before the Society.

For the means and opportunities of conducting these researches I am almost entirely indebted to the extreme

courtesy and kindness of Mr. Spencer Wells, who has most cordially responded to a request for assistance in procuring specimens, by liberally furnishing me with numerous instances of this class of tumours removed by him by operation, and has aided my investigations by every means in his power.

I have also to thank several other gentlemen for assistance most kindly furnished me in the investigation of the fœtal conditions of the ovary, and I have especially to mention the names of Dr. Graily Hewitt, Dr. Priestley, Dr. Randall, Mr. Squire, Dr. May, of Tottenham, Mr. Bennett, of St. Giles, and Mr. Roberts, the late clinical assistant in the midwifery department of University College Hospital.

I shall, I believe, avoid some confusion in the account which I have to give of my own researches, by first alluding briefly to some of the leading opinions which have been hitherto entertained with regard to the origin of ovarian cysts, more especially as I believe that some of them are capable of explanation by the phenomena which I have observed.

There is, however, one difficulty which occurs at the outset of an attempt to classify the opinions of the different authorities on this subject, and which arises in great measure from the want of a uniform nomenclature, and from the variety of terms in which diseases of the ovary, all characterised by the production of cysts, have been described by various writers. Since Dr. Hodgkin's[1] admirable description of these tumours, all those forms of cysts which do not contain secondary cysts or other growths in their interior, have usually been termed "simple," whether the cysts thus found be one or many, "simple" or "multiple" (Farre); but in the description of the more complex forms a great variety of terms have been employed—as "multilocular" (Farre); "cystoid" (Virchow); "compound cystoid" (Müller); "proliferous" (Paget); "composite" (Graily

[1] 'Med.-Chir. Trans.,' vols. xv, xvi; "Lectures on the Morbid Anatomy of the Mucous and Serous Membranes."

Hewitt). Kiwisch,[1] again, who has given a further classification of these formations, in terms which imply varieties in their mode of origin, and which have been pretty closely followed by Dr. Graily Hewitt[2] and Dr. Wilks,[3] distinguishes them as—(1) simple, (2) multiple, (3) multilocular, cystoid, or compound,[4] (4) alveolar disease of the ovary, (5) cysto-sarcoma of the ovary, (6) cysto-carcinoma of the ovary; and to these Mr. Spencer Wells[5] has added that of another variety, as "fibro-epithelioma, or alveolar adenoid tumour."

The views hitherto expressed by pathologists with regard to the origin of these cysts may be classified under the following heads:

I. That which attributes *all* cysts found in the ovary to a morbid alteration of the Graafian vesicle or corpus luteum, a view which has received the support of Carswell,[6] Andral,[7] Lebert[8] (who, however, is in some doubt whether a secondary cyst formation does not occasionally take place), Dr. Seymour,[9] Cruveilhier,[10] Dr. Hughes Bennett[11] of Edinburgh, Negrier,[12] and of Dr. Arthur Farre,[13] who has also given the best possible summary of the arguments in favour of this view.

[1] 'Diseases of Ovaries,' by Clay, 1860.

[2] 'Diagnosis and Treatment of Diseases of Women,' 1863.

[3] 'Pathological Anatomy,' 1859.

[4] These terms, according to a note appended by Dr. Clay to his translation of Kiwisch's work (p. 182), appears to be convertible, Dr. Clay adopting Dr. Farre's limitation (art. "Uterus and its Appendages," 'Cyc. Anat. Phys.') of the term "multiple," to cases where many simple cysts are developed simultaneously; "multilocular," to those which contain other cysts or growths.

[5] 'Path. Soc. Trans.,' vol. xiv, p. 205.

[6] 'Illustrations of Elementary Forms of Disease,' *Analogous Tissues.*

[7] 'Path. Anat.,' ii, p. 207.

[8] 'Physiologie Pathologique,' ii, p. 65.

[9] 'Illustrations of the Principal Diseases of the Ovaria,' p. 45.

[10] 'Traité d'Anatomie Pathologique Générale,' viii, 1856, p. 395.

[11] 'Ed. Med. Surg. Journ.,' vol. lxv, p. 400.

[12] Quoted by Dr. Tilt, 'Lancet,' 1849.

[13] 'Cyc. Anat. Phys.', art. "Uterus and its Appendages."

II. That which attributes the origin of the *simple* cysts, whether *single* or *multiple*, to the Graafian vesicles or corpora lutea, but regards such an opinion as untenable for the more complex forms, for which other modes of origin must be sought. This view has been maintained by Rokitansky,[1] Frerichs,[2] Bruch,[3] Virchow,[4] Führer,[5] Förster,[6] Scanzoni,[7] Bright,[8] Wilks,[9] West,[10] Graily Hewitt,[11] and Paget.[12]

Some of these authors, though regarding the secondary cysts as of new formation, believe that they are produced from the wall of the Graafian vesicles, which thus stand in the relation of parent structures to the secondarily formed cysts; Dr. Hodgkin, Mr. Paget, and M. Lebert support this opinion.

By far the larger number of observers, however, ascribe both the primary and secondary cyst-formations of this latter class to a new development taking place independently of the Graafian vesicles in the stroma of the ovary. Of the nature of such a process the most conflicting accounts are given. Thus, Dr. Bright (l. c.) regarded these growths as being of a "malignant" nature. Some authorities, again, as Müller[13] and Dr.

[1] 'Path. Anat.,' 1855, i, 230; iii, 412, 425. 'Wochenblatt der Zeitschrift der Gesellsch. der Aerzte zu Wien,' 1855.

[2] 'Ueller Gallert und Colloid Geschwülste,' 1847, p. 50.

[3] "Zur Entwickelungs-Geschichte der Path. Cysten;" 'Zeit. Rat. Med.,' 1849, p. 131.

[4] 'Verhandlungen der Gesellschaft für Geburtshülfe in Berlin,' 1848, pp. 220, 224; also 'Die krankhaften Geschwülste,' 1863, pp. 259, 260.

[5] 'Deutsche Klinik,' 1852, pp. 200, 201.

[6] 'Path. Anat.,' ii, p. 266.

[7] 'Lehrbuch der Krankheiten der Weiblichen Sexual Organe,' Wien, 1859, p. 355.

[8] 'Guy's Hosp. Rep.,' iii, pp. 180, 182.

[9] L. c., p. 411.

[10] 'Lect. on Diseases of Women,' 1858, vol. ii, p. 70.

[11] 'Diagnosis and Treatment of Dis. of Women,' 1863, pp. 383 et seq.

[12] 'Surg. Path.,' ed. 1863, p. 411.

[13] 'Ueber den feinern Bau und die Formen der krankhaften Geschwülste,' p. 55.

Wilks (l. c.), either express themselves as unable to account for their origin, or give no further account of the process.

Many of the more definite theories which have been brought forward to account for these formations, appear to be hypothetical applications to the cysts of the ovaries of more general views entertained by their authors on the subject of cystic growths, but some of them are of sufficient importance to deserve especial notice.

(A) That which has perhaps attracted the most attention in later years has been the opinion which has attributed the formation of cysts to a development from single cells ('Independent and Primary Anatomical Elements,' Rokitansky), by a process consisting in the enlargement of the cell, which, receiving a fibrous investment externally, then remains either a hollow cavity, or has a secondary formation of cells in its interior, which give rise to colloid substances by their metamorphosis. This view, supported as it has been by some of the most illustrious observers and philosophers in pathological science, has obtained a dignity among the theories of pathology which renders any detailed criticism impossible within the limits of this paper. Propounded originally by Dr. Hodgkin[1] in relation to the ovary, it has further, in regard to these tumours, received the support of Mr. Paget[2] and Professor Scanzoni,[3] while by Mr. Simon[4] and Rokitansky,[5] it has been held to explain the cystic formations in the kidney, and to it also has been attributed by Frerichs (l. c.) and Rokitansky[6] the origin of cysts in the thyroid gland.

It must be enough for me in this place to indicate that in many of the organs in which it was held to explain the origin of cystiform structures of new formation, other and simpler modes of development from pre-existing structures have been discovered. Thus, of the kidney it may at least

[1] 'Med.-Chir. Trans.,' vol. xxvi.

[2] L. c.

[3] L. c., p. 360.

[4] 'Med.-Chir. Trans.,' xxx.

[5] 'Ueber der Kyste,' p. 3, "Zur Anatomie des Kropfes;' and 'Path. Anat.,' ed. 1855, part i.

be stated that, after the researches of Gairdner,[1] Johnson,[2] and Otto Beckmann[3] on the origin of cysts in this organ from the renal tubules, the number of cases in which we have to resort to the cell theory to explain their formation must be extremely small; while those in the thyroid have been fully elucidated by Dr. Billroth,[4] and referred by him to the same type of formation (viz., the constriction of portions of tubular structures, through a return to the same embryonic conditions of growth[5]) as that by which the primary structures of the gland were first formed; and though opinions may still be divided on the nature of the so-called hydated mole, those given by Gierse,[6] Dr. Graily Hewitt,[7] and Virchow,[8] appear more in accordance with the facts of the case than the view of the origin of these structures from individual cells, as propounded by Mettenheimer,[9] and accepted by Mr. Paget.[10]

I must confess that I have never met with any facts tending to support this theory of cyst formation; and with regard to the ovary, I shall have shortly to give an entirely different account of the origin of the greater part of the cysts found in it, both in the more complex forms, and also of the small cysts occurring in the secondary papillary and dendritic growths which spring from the interior of large cysts, and which latter, though at first sight appearing most strongly to bear out Rokitansky's views of this mode

[1] 'Ed. Med. Surg. Journ.,' 1853.

[2] 'Med.-Chir. Trans.,' vol. xxx.

[3] 'Virch. Arch.,' vol. ix.

[4] "Ueber Fœtales Drusengewebe in Schildrusen Geschwülsten;" 'Müller's Archiv,' 1856, p. 144.

[5] Remak, 'Untersuchungen ueber die Entwickelung der Wirbelthiere,' 1853, p. 122; Kolliker, 'Microscop. Anat.,' vol. ii, p. 332; 'Entwickelungs-geschichte,' 1861, p. 392.

[6] 'Verhandlungen der Gesellsch. für Geburtshülfe,' 1847, p. 126 et seq.

[7] 'Trans. Obst. Soc. Lond.,' vol. i.

[8] 'Die Krankhaften Geschwülste,' 1863, p. 410 et seq.

[9] 'Müller's Archiv,' 1850.

[10] 'Lect. Surg. Path.,' 1863, p. 420.

of origin of cysts in such structures,[1] are, I think, susceptible of a different explanation.

(B) Another view, which has received the support of Vogel[2], Henle,[3] Velpeau,[3] Bruch,[4] Gierse,[5] Wedl,[6] and in a doubtful manner of Rokitansky ('Path. Anat.,' i, 230), regards cysts as spaces formed in areolar tissue, either pre-existing or of new formation, which spaces become filled with fluid either from serous effusions or fibrinous exudations, and subsequently become encapsuled by denser layers of areolar tissue, while an endogenous formation of epithelium takes place on their inner wall. This method, according to Wedl (l. c.), prevails both in the papillary growths occurring in the interior of, and also in the septa between the cysts.

(C) Closely allied to the foregoing is that described by Rokitansky[7] as the most common method of origin of the more complex forms of multilocular tumours of the ovary, consisting, according to him, of the breaking up of the stroma into a trabeculated structure ("Fachwerk," or panel-work), composed of membranous bands, uniting at their angles, and enclosing spaces or loculi filled with colloid or gelatinous matter, and giving rise to the peculiar *alveolar* texture seen on section of some of these tumours; these spaces which communicate with one another being, according to Rokitansky, the source of the peculiar complex formations met with in these cystoid growths. He explains the increase in the number of cysts by the continuous growth of these alveoli, which may either take place within the wall of the parent cyst (which then covers the secondary growth, giving rise to dense masses), or free in the interior of other

[1] 'Ueber die Kyste,' and 'Path. Anat.,' 1853, part i.

[2] 'Path. Anat.,' transl. by Day, p. 240.

[3] Quoted by Rokitansky, 'Ueber die Kyste.'

[4] "Zur Entwickelungs-geschichte der Path. Cysten.;" 'Zeitsch. Rat. Med.,' 1849, p. 131.

[5] 'Verhand. der Gesellsch. für Geburtshülfe,' ii, p. 182.

[6] 'Pathological Histology,' 'Syd. Soc. Trans.,' pp. 84, 460.

[7] 'Path. Anat.,' i, p. 109, fig. 48; p. 234, fig. 92.

cysts, when the growth presents a vesicular, loculated, or porous appearance ('Path. Anat.,' i, p. 236, fig. 95).

Scanzoni's[1] description of the origin of some of these tumours agrees very closely with Rokitansky's. As far as I can judge, Kiwisch[2] believes the condition described by him as "alveolar degeneration of the ovary" to originate in a very similar process; he says (l. c.) "that it appears as a breaking up of the stroma of the ovaries into cellular cavities, closely aggregated together. . . . . The cellular spaces do not apparently proceed from the follicles. Besides, the number of cellular spaces is so considerable . . . that we cannot easily trace their origin to the degenerated follicles; on the contrary, in general degeneration of the ovaries, the follicles appear to be mostly destroyed, so that they cannot be found as such. . . A partial alveolar degeneration of the stroma not unfrequently occurs in the intermediate tissue in cystoid disease."

Dr. Wilks describes, in similar terms, "alveolar degeneration of the ovaries" (l. c., p. 413), but he does not give any further account of the mode of origin of this disease. With great respect for the illustrious authors who have expressed these opinions, I have been led by my own investigations to believe that their descriptions apply rather to the appearances observed on section than to the mode of origin and *nature* of the process by which the secondary cysts are formed, a process which, indeed, Rokitansky admits (p. 234, l. c.) to be very difficult to discover. The relation of my observations to Rokitansky's views will be more fully detailed hereafter.

(D) Another opinion, also somewhat allied to the foregoing, and of considerable importance, is that expressed by Professor Virchow,[3] and which has been supported and further expanded by Professor Förster.[4]

[1] L. c., p. 355 et seq.

[2] L. c., p. 189 et seq.

[3] 'Verhandl. der Gesellsch. für Geburtshülfe zu Berlin,' 1848; "Das Eierstocks Colloid."

[4] 'Path. Anat.,' ii, p. 267 et seq.

Both these authorities agree in attributing a different origin to the "colloid" or "cystoid" disease of the ovary to that in which the single or multiple cysts take their rise.

Virchow, being struck with the prismatic or columnar appearance assumed by the colloid matter in the interior of these cysts, the columns being bounded by lines of fattily degenerated cells, attributes their formation to an *alveolar* origin, the lines of fattily degenerated cells representing the walls of alveoli, the other structures of which have wasted in consequence of the gradually increasing pressure of the colloid matter (*vide* fig. 1, l. c.). He says that spaces lined by epithelial cells are continually appearing in the stroma or walls of the cyst, and that the cells lining them may be seen in all stages of "colloid" change; but he expresses his inability to account for their mode of origin (p. 201, l. c.). He further explains the more fluid contents of some of these cysts as due to the further softening of the colloid matter thus formed.

Professor Förster gives a further account *of the mode of origin* of this process, of which I venture here to give a short summary, as I shall have hereafter to allude specially to his views; and it will, I think, be productive of less confusion if I introduce them in this place. He says that the cysts proceed from cells and nuclei of new formation in the stroma of the ovary, and independently of the Graafian follicles, which latter are destroyed during the formation of the cysts. "The neoplasm begins with an hypertrophy of the stroma of the ovary and a new formation of connective tissue, accompanied with a growth of cells and masses of cells in an embryonic connective tissue; while the latter is developed into a mature connective tissue, the cells and masses of cells become enlarged, and undergo a colloid transformation, the outer layers of these become epithelial cells, and the compressed layers of the connective tissue of the stroma represent the fibrous wall of the small cysts."

These views, both of Professor Virchow and also of Professor Förster, are undoubtedly minute and accurate descrip-

tions of the appearances observed. It is only with regard to the mode of origin of these spaces and masses of cells that I have to differ from Professor Förster.

(E) Another mode of origin of cysts of the ovary has been described by Rokitansky[1] as a "cysto-sarcoma uterinum ovarii." In the paper quoted below he describes one case in which glands similar to the uterine glands were found in the stroma of the ovary, and associated with small cysts; but he does not describe this as a general appearance of ovarian cysts. This condition corresponds very closely with that which I have quoted from Mr. Wells as forming a variety of these tumours, and termed by him "alveolar adenoid tumour."

(F) Of cysto-carcinoma of the ovary I have seen but few examples. In one case (which, through the kindness of Mr. Spencer Wells, I had an opportunity of examining), removed from a young woman, there were several small cysts in the cancerous mass, and others appeared to be forming. In two of these I could trace the remains of a membrana granulosa, which pointed to their origin from the Graafian follicles. Into others, a little larger, villous projections of cancerous matter were taking place through the partially invaded wall of the follicle. I could find in these cysts no traces of ova.

There is, I believe, no occasion for me in the present day to point out the distinctions or to dwell on the confusion which formerly existed between "colloid disease of the ovary," as this multilocular cystic formation has sometimes been termed, and the so-called alveolar or colloid cancer. The two structures have nothing in common beyond a certain amount of resemblance between the gelatinous matter contained in the ovarian cysts and the colloid or gelatinous intercellular substance of the cancer, a material which, however, is common to a large class of pathological products.

[1] 'Path. Anat.,' ii, p. 423; 'Zeitsch. der Gesellsch. der Aerzte zu Wien,' 1860, No. 37, Sept. 10; "Ueber Uterusdrüsen Neubildung in Uterus- und Ovarial Sarcomen." (I am indebted for the perusal of this paper to the kindness of Mr. S. Wells.)

It will be seen from the foregoing short and necessarily very imperfect summary of the views hitherto entertained on the origin of these cysts, that they involve the application of the most varied theories of cyst formation to account for the appearances observed; and, further, that the processes described are, if not incompatible with, at least perfectly distinct from, one another, and in no respects referable to one common type. It is only in the hope of being able to show that a comparatively uniform process does obtain for all these cysts, and reconciles and explains the opinions held by other observers, that I have ventured to occupy so considerable a space with a criticism of their opinions.

Although it is not improbable that aberrations in the formation of the corpus luteum may occasionally give rise to cysts, and instances of this have come within my own observation—yet I do not think either that this is a frequent occurrence, or that cysts thus originating attain a large size, or give rise to secondary growths; and it may, I think, be regarded as an established fact that both the *simple* and the *multiple*[1] cysts of the ovary do, in the majority of cases, take their origin from the Graafian vesicles. The weight of evidence which I have already quoted would be almost of itself sufficient to establish such an opinion, which has been supported further by direct observations of Lebert[2] on mares, Seymour[3] and Frerichs[4] on birds, and, finally, with an absolute proof by Professor Rokitansky,[5] who found altered ova still within the dilated cysts. The Graafian vesicle is, to all intents and purposes, a cyst with peculiar contents.

[1] I use the term "multiple" here, as elsewhere, in the sense defined at the commencement of this paper.

[2] 'Anat. Path.,' i, 243.

[3] L. c., p. 45.

[4] L. c., p. 50.

[5] 'Wiener Wochenblatt,' 1855.

In the calf they often attain a considerable size in the natural condition, and in the human fœtus of the eighth or ninth month they may sometimes be found of the size of a pea; and in the walls of these follicles, which are considerably distended with the liquor folliculi, numerous other follicles, in a less developed state, may often be found. The discovery of the ovum within certain of these follicles, when thus distended to cysts, is not always a matter of certainty, as recent observers, particularly Professors Grohe[1] and Pflüger,[2] have shown that the ova frequently disappear under circumstances unattended at least with any other pathological conditions. I have lately had an opportunity of observing, in the case of a female dying in Dr. Reynolds's wards, aged forty-two, both ovaries filled with cysts; in the left there were two large ones, each the size of two fists, another the size of an orange, and from this a series, in a descending scale, to those which only measured 0·01 of an inch in diameter. They were all lined with a partially flattened hexagonal epithelium, with distinct nuclei, and, with the exception that the epithelium in the larger cysts was flatter than in the smaller, they perfectly resembled each other, while the correspondence of the smallest with the walls of small Graafian follicles was complete. The other ovary did not contain any cysts larger than a pea, but these had a similar structure. I could only find in one instance (though there were from twenty to thirty cysts in each visible to the naked eye, and many more which were disclosed on examination with the microscope) any trace of an ovum, and this was somewhat uncertain in its characters, but the age of the patient in which they occurred might well explain their disappearance, as it is very probable, except in cases of protracted menstruation, that ova which remain in the follicles after the climacteric period in the female has been attained

[1] "Ueber den Bau und das Wachsthum des menschlichen Eierstocks;" 'Virch. Arch.,' xxvi, p. 302.

[2] 'Ueber die Eierstöcke der Säugethiere und des Menschen,' 1863, p. 76.

do undergo a process of atrophy probably analogous to the fatty degeneration of the epithelium of the seminal tubes in the male.

It is very certain that a *multiple* cystic tumour of the ovary may arise in this manner, and, further, that the distinctions between these and the compound cystoid forms are at times only to be separated by the artificial distinctions dependent on the number of cystic cavities produced; for there seems no absolute difference to be found in the structure of the cysts, and but little in the nature of their contents, which latter vary greatly, even in the same tumour, between the firmer colloid and the more fluid mucous or serous fluids, with their various other modifications arising from hæmorrhage or fatty degeneration of the epithelial lining or of the walls of the cysts themselves. If, therefore, any mode or modes of formation of secondary cysts can be shown to exist giving rise to the varied types of structure found in the multilocular or compound forms, and if the origin of these can be referred to cysts differing in no respect from those which arise from distension of the Graafian follicles, the conclusion may, I think, be fairly drawn that all the cystic diseases of the ovary take their origin in these structures. But although no precise limit has been established between what may be considered as constituting a multiple cyst, arising from the simultaneous dilatation of many Graafian vesicles, and those compound forms which have been hitherto referred to other modes of formation, (though the highly marked forms of the latter are at once distinguishable, as also are cases in which secondary or tertiary cysts arise from the interior of primary or secondary cavities), there is one point at once deserving of remark, viz., that although some varieties may be traced, yet that they all present essentially the same structure, viz.—(1) a wall of fibrous or connective tissue, corresponding more or less according to its thickness with the chief characters of the stroma of the ovary; (2) an epithelial lining, which presents many variations (to which I shall further allude) in the size and character of its cells; and (3) contents

which have been already very fully described by other observers.[1]

Both the simple and compound cysts have an external wall of the expanded and more or less altered stroma of the ovary; and I shall now proceed to describe such cysts, or parts of cysts, as have this both for their outer and inner boundary, though they may have in other portions of their interior groups or masses of clustered and compound cysts collected at various parts of the cavity.

The *peritoneal* surface of ovarian tumours may be perfectly natural, or it may present a considerable variety of appearances, according to the action, more or less inflammatory, which had existed externally, leading to roughness or adhesions. I shall not dwell further upon this, beyond remarking that it has occasionally small villous growths upon the surface, and that it is sometimes roughened by the opening, externally, of small cysts contained in the stroma, and a growth of their contents free into the cavity of the peritoneum. Perforation of the external wall by large papillary growths, such as Rokitansky and Mr. Hutchinson[2] have described, have not come within my observation, though I have seen minor degress of this condition.

The *external wall* of the cysts varies greatly in thickness. It may, in large and much distended cysts, be as thin as one twelfth of an inch, but more generally it is about a quarter to half an inch in thickness, and in portions corresponding to bands and trabeculæ, which cross the interior, it may considerably exceed this measurement. On section it is very commonly found to be more or less separable into two layers—an outer one, very firm and resisting, not easily torn with needles, and which is composed of a dense layer

[1] In this account I shall limit myself to the descriptions of cysts with "serous," "colloid," or "mucous" contents. I have been unable, while making these investigations, to procure any specimens of the dermoid cysts of the ovary.

[2] 'Path. Soc. Trans.,' xiv, p. 198.

of broad fibres running longitudinally in a direction parallel to the circumference of the tumour; and an inner one, having more the characters of areolar tissue, being softer, more easily torn, more fleshy and vascular looking, and seen under the microscope to be composed of a finely areolated network of fibres, in which are a large number of elongated nuclei and fibre-cells. These are sometimes thickly placed, and so arranged as to form a continuous tissue, in which the enlargement of each cell fits into the depression between the elongated portions of adjacent ones. The number of these nuclei and fibre-cells varies considerably in different preparations, probably in a direct ratio to the more or less rapid growth of the tumour, and the extent to which they are found in the deeper layers of the stroma, as compared with the external, points to its growth taking place chiefly in the former portion, while the latter must be considered as the older and more fully formed. This conclusion is not without interest in relation to some other facts, which I shall have shortly to adduce. (*Vide* Plate VIII, figs. 1, A, B.) The thin-walled secondary cysts also contain these elongated nucleated cells in large numbers. (Fig. *c* represents some of these.) The stroma of the wall contains very numerous vessels. The veins are particularly large, and are seen in great numbers in and immediately under the peritoneal surface. The arteries appear to lie more deeply in the stroma; they are of large size, and the larger ones have very thick walls. One notable peculiarity which they possess is that they retain in many cases the same twisted, corkscrew-like appearance which is seen in their course in the stroma of the ovary.[1]

Deeply imbedded in the wall, or projecting more or less either on its inner or outer surface, are frequently seen small cysts in various stages of development, and other elongated crypt-like processes, which I shall shortly describe more in detail.

[1] Grohe, loc. cit., p. 278.

The *inner surface or lining membrane of the cyst* presents a great variety of appearances. Leaving out of consideration for the present all the changes produced by secondary cysts on this inner surface, we find that two structures chiefly demand attention:

I. The epithelial lining.
II. Alterations in the innermost layers of the wall.

I. *The epithelium* presents many varieties. It naturally covers the whole of the inner wall, and in the greater part of its extent it presents a single layer of flattened polygonal cells, approaching more or less the circular form, but altered by mutual apposition. (Plate VIII, fig. 2, *c*, represents a typical specimen of such an epithelial lining.) The cell-walls are distinct; in the interior of each is a nucleus and nucleolus, and the cells appear as if imbedded in a clear or finely granular intercellular substance. They separate, in most cases, without much difficulty, and then assume a rounded form by imbibition. In other cases they strip off as a uniform membrane. Plate VIII, figs. 2, *c* and *e*, represent similar cells from smaller cysts, and others are seen in Plate X, fig. 42, G. In other cases the epithelium has a much flatter character, and is hardly distinguishable from the elongated cells of the connective tissue beneath, the nuclei of which, on addition of acetic acid, may be seen to form an almost continuous series of layers from parts of a section a short distance below the surface, until the surface itself is reached. It might almost be thought that the lining membrane had been denuded of its epithelium, and that on a vertical section we were only looking at the upper layers of the connective tissue, but I am satisfied that this is not the case, first, because these epithelial cells may be slipped off in many cases in an elongated form, and when isolated may swell up by imbibition and present rounded forms. Figs. 2, B, *b*, *b*, represent these appearances.

In other places the epithelium assumes a stratified character, and forms several layers. These may all continue of

a polygonal or rounded form, but more commonly this is retained only by the deeper strata, while the superficial ones assume a columnar shape, thus repeating a condition similar to that seen in the mucous membranes of other portions of the genito-urinary tracts. (*Vide* fig. 2, A.) At *a* is seen an isolated cell from the same object with two nuclei.

On making vertical sections with a Valentins knife through the epithelium into the layers of connective tissue beneath, the nuclei of the inner portions of this latter structure are seen gradually to enlarge and to become rounder as the epithelial surface is approached. The cell-walls corresponding to these nuclei in the connective tissue cannot be clearly made out, but at the line where the cells of the epithelium can be distinctly traced and immediately below this, there seems every form of transition between the nuclei or cells of the connective tissue and those of the epithelium, thus giving rise strongly to the impression that the cells of the connective tissue pass by insensible gradations into those of the epithelial structures in a manner probably similar to what Dr. Lionel Beale has described in the structures of the corium and submucous tissue of the papillæ of the tongue.[1] I have never seen anything like a membrana limitans by any methods of research which I have employed between the epithelium and the stroma of these cysts. (Fig. 2, *a'*, represents the appearance here described.) According to the character of its epithelial lining, the inner surface of the cyst has a glistening or velvety appearance. The latter character increases in direct ratio to the amount of stratification of its epithelium. When the wall has lost this covering, but without undergoing further changes, it

[1] 'The Structure of the Simple Tissues,' 64, 65, 109. It would be beyond the scope and foreign to the purpose of this paper to enter into minute histological details. I therefore think it best to confine myself to the terms already in use in the description of minute structures, only pointing out in a cursory manner such facts as I have clearly observed, though I abstain purposely from entering into a full discussion of their bearings on minute anatomy.

has a shining, more or less translucent, and semi-cartilaginous look.

Different portions of the wall of the same cysts vary in the nature and arrangement of their epithelial lining. Thus, in one part of a large cavity the epithelium may be stratified and columnar, in another spheroidal, and consisting of one or more layers, and in another portion it may present the flattened character already described, and which is with some difficulty distinguished from those portions which are already destitute of this covering. Further changes in the appearance of the inner membrane are due to fatty degeneration of the epithelium. This change may take place *in situ*, giving to the lining membrane the appearance of a thick, perfectly opaque, *uniform* layer, of an ochrey tint of various shades, spread over portions of the surface. It then appears chiefly to affect the spheroidal or flattened forms. The stratified layers, especially when they have assumed the character of a columnar epithelium, are usually cast off and float in the fluid as soon as the fatty change has commenced in them.

There appears to me to be in many cases a continual regeneration of the epithelial cells from below, attended with a shedding of the superficial layers into the contents of the cysts, which then give rise to the variously coloured contents found in them. When the epithelium is not regenerated the most internal layers of connective tissue are left bare, and they may then become the subject of further changes, the commencement of which may possibly have been the cause of the failure in the reproduction of the epithelial structures.

II. *These alterations in the innermost layers of the wall* consist in a fatty degeneration of the cells of the connective tissue, leading to calcification, which takes place in stripes and patches, and is so closely analogous to similar changes occurring in the aorta and cardiac valves that any further description of them here is unnecessary. I know few anatomical structures, however, where this change can be so

exquisitely observed. The appearance produced in the inner wall by this process is that of a series of ochrey patches, which differ from those produced by analogous changes in the epithelium by being more striated and less uniform.

To avoid repetition I would remark here that precisely the same change (at least as regards the fatty degeneration of the cells of the connective tissue) takes place in the walls of the thin-walled and secondary cysts, and leads to their rupture, either into each other or into the cavity of the parent cysts. Sometimes a convincing proof of this is afforded by finding a collapsed and empty thin-walled bag, which has ruptured, and the walls of which present an almost uniform fatty degeneration, affecting the enlarged cells of the connective tissue, in which all traces of nuclei have disappeared. The depth to which either the atheromatous or the calcifying changes may take place is very various, but presents nothing worthy of special remark. (*Vide* Plate X, fig. 41, and description of this figure.) Besides these changes the lining membrane presents other peculiarities, owing to the rupture of cysts into the interior of the parent cyst, or to the fusion of several into a single cavity. The septa and walls of these (the remains of which can sometimes be distinctly seen) gradually waste or become blended with that of the common cavity by continuous stretching, until no traces of them remain, except in the form of bands traversing the wall in various directions, giving rise to lines of elevation, of various thickness, in its interior. In addition to this there is very commonly seen, on the interior, a network of fine lines interlacing with one another, and forming a delicately areolated tissue, often with ochrey lines crossing it, and looking as if a fine piece of muslin net had been flattened into and incorporated with the wall. These are caused by the dehiscence of microscopic cysts into the cavity of the parent structure, the boundary wall of which has probably lost a portion of its vitality and powers of expansion. I shall allude further to this subject when these cysts come to be described.

Still continuing the description of the larger parent cysts (whose external wall is the stroma of the ovary covered by peritoneum), I have now to describe certain growths which take place from their interior, and which have earned for them the title of proliferous cysts. These are—

III.—Papillary or cauliflower or dendritic growths.
IV.—Villous growths.
V.—Glandular growths.

III. *The Papillary growths* have been most admirably described by Rokitansky and Dr. Hodgkin; but, as my observations have led me to form different conclusions with regard to their minute structure, and their relations to cysts which occasionally form in connection with them, I think it best to give an account of what I have myself observed with regard to them. They do not appear to be of very frequent occurrence. Thus, out of fifteen large ovarian tumours which I have minutely examined in all their parts, I have only found them in two, and both of these were removed in one operation, from the same patient, by Mr. Spencer Wells. The number of cysts discoverable by the naked eye in the ovaries in which they occurred was comparatively limited. In one there were only four or five large cysts, none exceeding a large turnip, and eight or ten smaller ones, from a crab apple to a hazel nut in size. In the others there were two cysts, one large, and capable of holding the head of a newly born child; the other, which was no larger than a Tangerine orange, was completely filled by one of these growths; while a few others, hardly observable by the naked eye, were seen under the microscope to contain similar structures.

The simplest form in which these occur are seen in Plate VIII, fig. 4, *a*, *b*, and fig. 5, *a*, as small, elongated, club-shaped elevations, from the inner lining of the wall of the parent cyst. The mode in which such a growth commences is seen at Plate VIII, figs. 13 and 14 (fig. 14 being a more advanced stage of fig. 13). The epithelium, closely adjoining, may be polyhedral or columnar (more commonly

the former), but presenting an approximation to the latter form; instead, however, of forming a uniform layer, the cells appear tilted up, and grow at an angle to the inner surface of the cyst, assuming an increasingly elongated form, containing large round nuclei in the deeper layers, while in the most superficial the cells are columnar. The growth, therefore, evidently appears to be one from the superficial strata of the stroma of the cyst-wall, and the connection of the epithelium on the surface with the deeper layers which belong to the connective tissue bears a great resemblance to that described by Dr. Billroth[1] in the epithelium of the frog's tongue, though I have not been able to find here the elongated spindle-shaped processes which he has described as forming a connection between the two kinds of tissue in the latter situation. Each of these papillæ have a rounded extremity; they contain a large loop of vessels; their stroma, as seen in Plate VIII, fig. 11, *b*, is of a delicate, hyaline, finely striated, membranous character, interspersed with numerous elongated nuclei. (This figure was taken from a specimen from which the epithelium had become separated in manipulation.) Plate VIII, fig. 12, shows a structure similar to those in figs. 4 and 5, *a*, *b*, but more highly magnified, to show its epithelial covering. The cells are all either of the spheroidal or columnar variety, most commonly the latter. They may swell by imbibition, and assume very large sizes (*vide* fig. 2, *d*), and they have a considerable tendency to undergo early and rapid fatty degeneration. These growths tend to form large composite masses through a simple repetition of the process by which their original growth took place, ensuing from the sides or extremities of those already formed, while at the same time each papilla or growth, whether of the primary or secondary variety, tends to enlarge in all directions. Various modifications of this process are seen in figs. 5, *d*, *d*, *d*; figs. 6, *a*, *b*, *b*; and in fig. 7. At fig. 11, *b*, is the stroma of one of these growths denuded of its epithelium,

[1] 'Müller's Archiv,' 1858, p. 159.

and consisting of a delicately fibrous network, with a clear intercellular substance and large nuclei. Some elongated nuclei, arranged in lines, mark the course of the vessels.

The vessels are very large in these papillæ, so that the growths are exceedingly vascular. If, when in a recent state, a fine stream of water is made to play upon them, they present a fine villous appearance, from the small secondary growths with free ends arising from their surface. Simple growths, or more or less multiple ones, may cover large tracts of surface in the interior of the cysts, or their formation may be limited to particular parts or patches. The size they may attain is considerable. One which stood alone in the interior of a single cyst was, when fresh, of the size of a Tangerine orange. This consisted of nine or ten lobes, some of which reached almost to its base, which rested on the floor of the cyst, while others were more superficial. The base was almost as broad as the free end of the tumour, the surface of which was very irregular. There was no pedicle. Around the base of this mass were scattered a group of smaller ones, varying in size from that of a hemp-seed to that of a bean. These growths were all distinctly solid. The inner and central parts were fibrous, but the outer and most superficial were delicately hyaline, and contained a few scattered nuclei; though here and there traces of striation, with fine loops of vessels and rows of nuclei marking the growth of new vessels into them, gave evidence of their solid nature. Further, there was no line of division between the hyaline ends and the more fibrous portions; and though they could be flattened by pressure, no fluid escaped on this operation, nor could any trace of a cavity be seen in them. The extremities represent newly forming and immature conditions of fibrous or connective tissue, as it is here that fresh additions to the growth take place from the deeper layers, which latter, being older and more mature, have acquired a more fibrous character. An illustration of this is seen in Plate VIII, fig. 11. Both in the base and also in the more superficial parts of these growths small cysts were seen, but usually these were but little dis-

tended; and on the mode of formation of these cavities I now wish to offer some remarks.

As adjacent growths approach one another the spaces between them, covered by the same secreting epithelial surfaces as the papillary growths themselves (which, in fact, constitute the boundaries of these spaces), become narrowed, so that two epithelial surfaces may be in perfect apposition or more or less separated at different parts.

Numerous illustrations of this condition are seen at Plate VIII, figs. 4, *c*, *c*, *c*; figs. 5, *e*, *e*, *f*; figs. 6, *c*, *c*, *d*, *e*; figs. 8, *a*, *a*, *c*, *d*, *e*. Further, a series of these masses, growing occasionally at the outset from narrow pedicles, bend over, and overlie the epithelial lining of the wall of the parent cyst, and, meeting at their sides or extremities, give rise to long, narrow, crypt-like spaces, of irregular shape and form, which are bounded by the adjacent papillæ and by the wall of the parent cyst. This is seen at fig. 7, where *c* represents the wall of the parent cyst; *a*, *a*, the narrow pedicles whence two adjacent papillary growths have sprung, which, giving off numerous irregular secondary growths, and at the same time overlapping the wall of the parent cyst, have produced the irregular spaces *b*, *b*, *b*. As these growths press against one another they adhere where the apposition is most complete, and grow together, according to well-known physiological and pathological laws (for though this is not the case ordinarily with surfaces covered with epithelium in a natural condition, it frequently takes place when such surfaces are in a high degree of irritation or abnormal nutritive activity), and we then get spaces more or less completely enclosed, and lined by an epithelium similar to that of the parent cyst. Such are seen at *d*, fig. 6, and *a*, *a*, fig. 10; while at *a*, *b*, *c*, *d*, *e*, fig. 9, all stages of this process may be seen in one preparation.

Further, it must be borne in mind that the secretion which is continually taking place into the interior of the parent cyst exercises an expansive force, which is tending continually to widen the area of the bases upon which these growths rest, by stretching the wall of the cavity.

This force, which would expand the wall until it became of excessive tenuity, is compensated for by a continual growth of the inner layers of the stroma, which appears to extend upwards into the bases of these growths themselves; and thus the spaces formed in the manner I have described tend constantly, not only to become elongated, but also are more and more removed, both longitudinally and vertically, from the site of their original production. Fig. 8, *c*, *d*, *e*, gives various illustrations of this process, which occurred in one preparation. The continuity between the forming cyst and the parent cavity is seen to be still partially maintained both at *d* and *e*. Fig. 6, *e'*, shows one of these cysts completely separated from the structures in which it took its rise.

I have thus attained, I believe, to a complete explanation of the mode of secondary cyst formation as occurring in these papillary growths. Each of the secondary cysts thus formed appears capable of having processes repeated in it identical with those which took place in the parent cyst; and the rapidity and facility with which this may ensue depends, in part, I believe, upon the amount of pressure to which they are subjected within the wall by the fluid contained within the parent cavity. I noticed in this preparation, before I had arrived at any clear comprehension of the process by which they had been formed, that nearly all the smaller secondary cysts in the wall were of peculiarly flattened and elongated forms, even after they had begun to expand by the secretion of fluid. Many of them contained secondary growths similar to the foregoing, springing from all parts of their walls, so as almost entirely, in some cases, to fill their cavity. I could not find in them any diverticula or offshoots, such as I shall have hereafter to describe in other cyst formations.

This mode of formation is, so to speak, an accidental one. It is only associated with irregular growths of these masses; and, as it requires peculiar combinations of position and growth of the surfaces which are to form the walls of the cyst-cavities, the production of cysts by means of it is not large. I have stated that they were few in number in both of

the tumours that contained these growths, and their position, whether at the bases or at the ends of the papillary masses, appears also in some degree to be a matter of accident. On section of the larger papillary tumours formed in this way, comparatively large areolar spaces may be seen, under the microscope, opening into one another, in all directions, and lined by epithelium, but they do not appear to be completely closed, although having much of the appearance of the alveolar texture described by Professor Rokitansky. I I do not, however, consider these as complete cysts, though any of them might become so. Plate VIII, fig. 15, represents a section made through such a growth.[1]

These papillary growths undergo various changes, mostly of the nature of a fatty degeneration, which give to the cysts containing them a very peculiar character.

The fluid found in their interior was, in all cases, of the consistence and appearance of very thick pea soup, but wanting in the tenacity and mucous character of other specimens in which these formations do not occur. Under the microscope it was seen loaded with free fat-granules, oil-globules, and the remains of fattily degenerated epithelial cells. Granule-cells and granule-masses were also frequent. I could not find in it any crystals of cholestearine. On looking for the source of these products, I found that many of the larger masses were more or less completely degenerated, the cells still adhering in some as ragged masses of an ochrey colour, which could be easily stripped from the subjacent structures. These curdy masses, which in some places have a great resemblance to rotten cheese, are found to be the secondary growths, or papillæ, which have degenerated *en masse;* and every gradation can be traced between the simple change of the epithelium on the surface to the destruction of the whole of the growth. When the change has once set in it generally extends through the whole thickness of the papillary growth, into the lining

[1] The appearances here described correspond very closely with those met with by Billroth in a polypus removed from the nose. 'Ueber den Bau der Schleimpolypen,' 1855, pp. 9—12.

membrane of the parent cyst, which is variously mottled by spots and patches of an ochre colour, slightly elevated, and which can be stripped off in parts (though with some difficulty) from the stroma beneath. The depth to which the wall of the cyst is invaded varies considerably; but while that process is taking place a great thickening ensues on the peritoneal surface, giving rise to patches of cartilaginous hardness, both externally as well as in the deeper parts of the wall. The size of these spots on the inner and outer walls of the cyst corresponds to the area of the base of the growths which have been affected. In one of the cysts which I have described there were three such patches, having each a diameter of rather more than an inch.

In one the layer of degenerated stroma had separated, leaving a depressed and intensely red surface, which was covered in spots with a film of amorphous exudation matter. The tissue surrounding all these was also intensely congested with spots of capillary hæmorrhage, and there was considerable ash-gray pigmentation in the immediate vicinity of the affected areas. The process appears to have been in all cases a somewhat acute one, depending, in all probability, though I could not trace this, upon some obstruction to the circulation in the growth, which had given rise to an almost necrotic action, while an inflammatory process was set up in the adjacent tissues, one effect of which, at least, as seen in the thickening of the wall beneath, was of a salutary kind, in preventing its perforation and the escape of the contents of the cyst into the peritoneum.

IV and V.—*Villous and Glandular Growths.*[1]

These processes are so closely allied, and, though distinct from one another in some respects, are of such frequent, I might almost say constant, occurrence, in conjunction with

[1] In the accounts of glandular formations I am compelled, for the reasons before stated, to omit all mention of those found in dermoid cysts, and which have been fully described by Steinlin, 'Zeitsch. Rat. Med.,' 1850.

one another, that I shall be obliged in a great measure to describe them together. In the glandular formations which occur in the interior of the parent, as well as in the secondary cysts, lies, I believe, in great measure, the clue to the explanation of the great variety met with in the multilocular or compound cystoid growths; though, in addition to these, I shall have yet to describe one other process by which this multiplication may take place.

The occurrence of villi in the lining membrane of ovarian cysts has been not unfrequently noted, and cases are given by Dr. Wilks,[1] by Luschka,[2] and by Friedreich,[3] where these have been covered with ciliated epithelium. This latter structure has never come under my notice in connection wtth these growths.

These villi commonly occur in patches of greater or less extent over the lining membrane of the cyst. They then give it, from their considerable vascularity, a delicately injected and at the same time a finely velvety character, which is very characteristic of their presence. They may occur scattered or in dense clusters; when in the latter condition, they are usually associated with glandular growths, in the formation of which their appearance constitutes the first stage.

When scattered, they do not commonly attain a large size, and appear to have little of the tendency to multiply by branching, which characterises the cauliflower growths last described. They rarely in such cases attain a greater length than from one twentieth to one sixtieth of an inch, and they differ markedly from the papillary and cauliflower growths in structure. While these last named are formed chiefly of a thick stroma of connective tissue, the villous growths contain but little of this, seeming, when denuded of their epithelium, to consist of little more than a loop of vessels, supported by a very small amount of connective tissue. Plate IX, fig. 16, represents such a growth of a few

[1] 'Path. Soc. Trans.,' vol. vii, p. 280.

[2] 'Virch. Archiv,' xi, p. 469.

[3] Id., xiii, p. 498.

scattered villi. They are covered more or less thickly with several layers of epithelium, which always seem to tend to assume the columnar form.

When more closely clustered, however, they lead to the formation of glandular structures of a nature allied to the crypts of Lieberkühn, the mucous glands of the stomach, or the glands of the uterus. I have carefully studied the mode of formation and growth of these glands, of which I shall now proceed to give an account. The first change which is noticeable in the immediate neighbourhood of a part of a cyst-wall in which a glandular formation is proceeding is, that a change takes place in its epithelial lining. Whereas in most parts this may consist of one layer of polygonal cells, it gradually becomes, as we approach the glandular growths, more stratified, and the superficial layer assumes a columnar character.[1] Into this stratified mass of cells delicate papillæ, with a fine loop of vessels, shoot from below; and, as these increase in length, a further growth of epithelium takes place at their free ends. We have thus a series of elevations, with corresponding depressions, formed in the epithelial lining, and these latter are converted into small tubular pits or hollows, at their bases, by a growth of the connective tissue of the stroma between the papillæ and around the enclosed masses of epithelium.

A series of tubular spaces is thus formed, the depth of which corresponds to the extent to which the stroma of the ovary has grown upwards. In its most superficial layers around these fossæ this latter structure is exceedingly delicate and transparent, so as to be seen with difficulty; but the hollow fossa at the base of the gland can be easily seen by separating the epithelial contents from the stroma, which can easily be effected after hardening the composition in chromic acid. The papillary loop of vessels, surrounded by a delicate stroma of connective tissue, rich in nuclei, can then also be distinguished, and the growth upwards of the stroma between the papillæ, and encircling the fossa,

[1] Somewhat similar appearances have been described by Steinlin, loc. cit., as occurring in dermoid cysts.

can be followed for a greater or less distance. (Plate IX, fig. 17, represents the first stage of the process; Plate IX, fig. 18, represents that last described.) As the growth of stroma proceeds upwards in the course of the glands, they become more and more completely enclosed, but at the extremities, when a further extension in length still seems possible, and when such an extension does actually take place, the projecting ends of the villi still retain their character as such. Plate IX, fig. 19, gives an accurate representation of two of a series of mixed villous and glandular growths, which occurred in a series of cyst formations, of which Plate IX, fig. 23, is a type, and which adjoined the one from which the figure now under consideration is taken. This figure is instructive also as showing a process by which these growths in some cases appear to be multiplied; for when these had acquired their tubular character, by the further growth from below, all the sinuses would represent diverticula from the gland. I have not, however, actually seen such a process completed.

We thus get a series of tubular glands with loops of vessels running in the delicate stroma between them, and which, as the glands become more deeply imbedded by the upward growth of the stroma, anastomose with other vessels which grow up in it (I believe, around their sides, or by means of other papillary loops), and form arches at various depths in the tissue. Such a structure is seen at fig. 20. These glands have an average diameter of $\frac{1}{100}$ to $\frac{1}{400}$ inch. They very commonly are lined by several layers of columnar epithelium, although occasionally they are found with only one layer in their interior. I have given this measurement from the centre of one papillary loop to that of another, as it is almost the only means of measuring the total diameter of the gland. The lumen, except under circumstances to be detailed hereafter, is very small, and not more than $\frac{1}{1500}$ or $\frac{1}{2000}$ of an inch. I find it therefore difficult to compare them with other glandular structures which are lined by only a single layer of epithelium, and of which the measurements are given by the various authorities on microscopic

anatomy. Their large size is, however, a very notable feature. I have never been able, either in the villous growths or glandular structures, to discover anything approaching the character of a membrana limitans. In recent specimens, and in those treated with Liq. Potassæ or acetic acid, no structure of the kind becomes visible; and in preparations hardened in chromic acid the epithelium may, as I have said, be stripped entire in a tubular form from the bases of the tubes without any such structure becoming apparent. I think it most probable that, in the more superficial parts of the tubes, the epithelium is supported, and the tube closed in the intervals between the papillæ, by some of the more delicate forms of connective tissue, but I have not been able to obtain distinct evidence of this with high magnifying powers (× 690 diam. of Powell and Lealand's microscope). I admit, however, that though I have carefully looked for it, I have not made it a subject of such minute and special investigation as to warrant a very positive and absolute expression of opinion on this point. Certainly, whatever the membrana limitans may be held to be, it is not seen with equal facility in these glands as in some others of the tubular kind.

The mode of formation of these glands differs, as far as I am aware, from that of any others, most of those of the skin or mucous membranes being described either as originating in the aggregation of rows of cells, or as formed from endogenous development in a single cell,[1] or as diverticula from the surface.[2] The peculiarity of those which I have described consists in their being primarily formed on the surface.

An increase in the number of these glandular tubes by lateral diverticula seems rare. One instance, however, of such a case is represented in fig. 24. As I said before, I have not seen such a process as is represented in fig. 19 completed. Another mode of multiplication is, however, very common; it is best seen in the glandular growths which

[1] Remak. [2] Kölliker.

fill the cysts of secondary formation, and which sometimes increase with exceeding rapidity. The process consists in an enlargement of the base of the gland, associated with the upward growth in its centre of a loop of vessels, forming, with a surrounding layer of stroma, a papilla similar to that with which formation of the primary glands first commenced. This may be continually repeated at the base of the same gland, which may thus be divided, inferiorly and for a certain portion of its length, by a series of septa, and so give rise to three or four divisions or tubes, all having a common outlet. This process may be well seen at Plate IX, fig. 21, *a*, *a*, and at figs. 23 *a* and 27 *a*.

Cystic formations from these glands may take place in several ways.

(*a*) The first and simplest is when the orifice of a gland, the base of which may be dilated and divided by septa in the way which I have just described, is compressed by the growth of glands in its neighbourhood, until the sides, being brought into close apposition, grow together, and finally occlude the opening. There is thus produced a closed cavity, terminated by a villous tuft which represents the corresponding sides of two adjacent glands, and which growth may extend considerably, and form one of a series of septa across the parent cyst, in which this formation has taken place. Such a mode of origin of a cyst is seen in Plate IX, figs. 21 *b* and 23, *b*, *b*; and the further growth of the septa is seen in Plate IX, fig. 23, *c*, *c*, *c*. It would appear that in some cases these septa themselves consisting of fibrous tissue carrying vessels, and covered with stratified epithelium, may thicken and give rise again to tertiary glandular and villous formations, which, in their turn, may go through the same series of changes.

(*b*) Another mode in which these glands may be converted into closed cavities is by their gradual dilatation into a series of very large crypts or follicles, across which, in a line more or less at right angles to the longitudinal direction of this cavity, septa may grow from their now thickened walls. An example of such a process is seen at fig. 22.

(*c*) We now come to the explanation of a process, in the elucidation of which I long experienced great difficulties, viz., the case where secondary cysts are enclosed, and spring from the wall of the parent cyst.

The formation of cysts of this variety is a somewhat complicated process, but one which I have so repeatedly and minutely observed, that I feel great confidence in the accuracy of the details which I now desire to lay before the Society.

Still keeping in view the wall of the parent cyst, it will be noticed that various sized groups of small cysts, single, or far more generally compound, project from their walls in numerous places. These may form very large and compound masses; but in a gradually descending ratio of size, some may be found which hardly exceed that of a millet or poppy seed, partially projecting from, and partially imbedded in the wall;[1] and on vertical sections other still smaller ones are frequently seen in great numbers with the microscope.

The cystoid character of these may be at once apparent to the naked eye, or they may present the appearance and feel of small solid masses, and even the microscope will sometimes only reveal a few small cavities in their interior. The causes of this latter condition will shortly be apparent.

Further, on careful observation, it will be found that these cysts nearly always exist in or near spots in the wall where the glandular structures which I have just described are also present. They are for the most part very rare and scattered in other places where the epithelium presents only a single layer, though their occurrence even in such spots may shortly be explained. Further, they are also rare when the villi only occur as scattered singly, and not in clustered growths united with glands.

Their origin in the places to which I have alluded appears to depend on the growth inwards of the stroma of the ovary (which originally caused the glands to become

[1] A good illustration of this condition is given in Rokitansky's work, 'Ueber die Kyste,' taf. i, fig. 1.

imbedded in the wall), proceeding to a further stage, and, finally, enclosing and shutting off the orifices of the glands themselves within its layers.

The commencement and extension of this process is seen at Plate IX, figs. 26 and 27. When the line of glands is single, as at Plate IX, fig. 26, the process is quickly accomplished, and either from the stroma itself, or by extension from the epithelium in the neighbourhood, a fresh growth takes place over the new surface thus formed. In parts where the glands and villi present a more complex arrangement, as in Plate IX, fig. 27, successive series of glands may be constricted off and encapsuled within the wall of the parent cyst, until we get a series of structures, as in Plate IX, fig. 28, corresponding to single glands and masses of glandular structures, the latter enclosed by thickened layers of the connective tissue and deeply imbedded in the stroma. The process seems partly aided by the previous conversion of some of the glands into cysts by occlusion of their orifices (in the manner described under *a*). These glands may have many divisions by septa at their base (so that the masses thus enclosed appear at first sight to have a very complicated structure, until the mode of their formation is clearly understood), and it appears as if the growth of the septa may continue, both in a longitudinal and transverse direction, across the cavities of the original tubes, *after* their orifices have thus been closed, and the glands grown over by the wall of the parent cyst, and thus *de facto* converted into cystic cavities. Such compound growths may be seen in Plate IX, fig. 28, *a*, *b*, *c*, *d*, and fig. 29, *a*. In some cases the origin of the cystic growth may still be traced by a long tubular process, either still open for a greater or less extent, or of which the previous course may be traced by a fibrous cord through the surrounding stroma. Plate X, figs. 30 and 31, give illustrations of this condition.

The glands and glandular masses thus shut off may be found in various stages of conversion into cystoid masses, protruding through or still imbedded within the stroma.

When a single simple gland has thus been closed and shut off, and the process of secretion continues, it forms a simple cavity; when a gland which has become more or less completely divided by septa undergoes the same process, a cavity with highly marked alveolar structures is at once formed. Plates IX and X, figs. 27, 28, 29, 31, and 32, give numerous illustrations of this process. The cavities thus formed have, of course, the same lining as the glands from which they spring, and from the moment of their dilatation into cysts they appear to have the same tendency to a stratification of their lining epithelium, and to the formation of glands in their interior, which marked the parent structure. Thus, Plate IX, fig. 29, is a more highly magnified representation of the cyst *e* in fig. 28, and thus the most complicated structures may be formed, the clue to which can only be found in the discovery, in the simpler forms, of the mode of origin of these growths.

Before discussing these I wish, however, to add a few words of explanation on the variations observed in the conditions of these glandular structures thus imbedded in the stroma. If a few and simple glands are shut off, we get on section round or oval masses of epithelial cells, with a wall scarcely distinguishable from the stroma by which they are surrounded, and in which they are deeply imbedded. (Such a formation is seen at fig. 32.) These may remain long quiescent, or, instead of developing into cysts, and retaining their lining membrane, the cells contained in them may undergo a fatty degeneration *en masse*, and nothing be found in the stroma but small round groups of fat-granules in which all traces of the original structure has disappeared. Such a condition is seen at Plate X, fig. 33. I do not know whether these may ever harden into cheesy masses. The most common course which they pursue appears to be, that their contents gradually become more and more fluid, and the walls undergo some analogous form of change by which they make their way to the surface, and rupture. A series of irregular alveolar openings are then produced, with small pits or depressions in the inner wall, opening into an

irregular series of cavities, the walls of which are destitute of any epithelial lining, and thus giving rise to a structure closely resembling Professor Rokitansky's figures and descriptions of trabeculated structures (Fachwerke), as the mode of origin of these cysts. It is with great respect to this illustrious pathologist that I venture to give this criticism and explanation of the appearances which he has described, and which would, if my deductions are correct, represent an aberration from and failure in the termination of cystic development, rather than the usual course which this process follows. Plate X, figs. 34 and 35, represent such alveolar processes as I have last described.

The cysts in the wall of the parent cyst may rupture at a very early stage, either internally or externally. The latter form of rupture on the peritoneal surface is, as far as I have observed, rare. When it takes place, the villous and glandular growths in the interior of the cyst protrude into the cavity of the peritoneum, forming a slightly roughened surface, attended with small pits and depressions. The villous growths do not appear, however, susceptible of any further growth into the cavity of the peritoneum. They soon lose their epithelial covering, and appear as short villous fringes of connective tissue, thus resembling those which may grow from the surface of other serous membranes. Whether or not they may give rise to adhesions with other organs is a question on which I am unable to offer any information. When, on the other hand, they rupture on the inner surface of the parent cyst, the villi and glandular growths in their interior do not appear, in all cases, to have such a transient existence, but may continue to grow into the interior of the parent cyst; usually, however, this process does not proceed to any great extent. The rupture of the wall appears to be associated with a condition of fatty degeneration of its fibres, which extends more or less into the stroma of the ovary, so as to give rise to a series of little depressions, bounded by lines of an ochrey colour, and which give a polygonal marking to the part of the wall on which it occurs. The area of the spaces enclosed

by these lines rarely exceeds one-twentieth of an inch in diameter.[1]

I believe that the account which I have just given furnishes a correct explanation of the origin of the alveolar structures lined by epithelium, which have been described by Professor Virchow and by Professor Förster as the source of the compound cystic degenerations of the ovary. They correspond in all points to Professor Virchow's descriptions, and the only point on which I have presumed to differ from my former illustrious teacher is, that whereas he describes the condition as a primary disease commencing in the stroma, I have endeavoured to show that it is a secondary condition of a kind to be considered more in detail hereafter, and commencing in the wall of the parent cyst. The explanation I have here given differs considerably from that of Professor Förster, though I think that the appearances I have described are identical with those to which he alludes. I have looked long and carefully for any indications of such a process as he describes, but in vain; in fact, it was at the outset of my investigations, and while searching the stroma for any facts confirmatory of his opinion, that I discovered the glandular structures in question, though it was long before I could arrive at a full understanding of the whole course and nature of these cystic formations. The process seems to be repeated almost indefinitely, even to cysts of the second and third formation, so that in the septa between the alveoli, and in all parts of the diseased structure, such cysts, and glandular growths giving origin to cysts, may in favorable specimens be found imbedded in the stroma. The best part to look for them is, however, in parts of the wall of the parent cysts, where there are only small nodules of the size of a millet seed protruding among villi and glandular growths.

In the secondary and thin-walled cysts the glandular and villous formations may proceed to an enormous extent, entirely filling their interior. Such a condition is seen commencing at fig. 23; but it may proceed to a much

[1] The appearances then produced correspond to a great extent with that figured by Dr. Bright, 'Guy's Hosp. Rep.,' vol. iii, part iv, fig. 2.

greater extent than is figured here. The containing wall may sometimes give way, and then we have apparently a free growth of glands, villi, and cysts mingled in great confusion; or, on the other hand, the cyst may continue to grow while its wall gains in thickness, and in such a case the glands in its interior may all or in part dilate to large follicles,[1] or crypts (of which fig. 22 presents an example), while the stroma between them also thickens, and we get a dense tissue perforated in all directions by alveoli, in which, occasionally, the intervening tissue may grow out of proportion to the glandular; so that, according to the predominance of one or the other of these processes of growth, we may get a cysto-sarcoma of the ovary, or the condition described by Mr. Spencer Wells as adenoma. A drawing of a section of such a mass is seen at Plate IX, figs. 24 and 25. This is apparently the condition which Professor Rokitansky has described as cysto-sarcoma adenoides uternum ovarii, (l. c.); but whereas he has described it as occurring in only one instance, I have traced it as the condition out of which secondary cysts and all the consequent varieties of structures in these diseases originate, in nine out of fifteen cases of ovarian tumours which I have examined. It is a noticeable peculiarity, to which I have already alluded, that isolated and sometimes comparatively small portions of the lining membrane of large parent cysts may become the seat of these growths and masses.

There is yet, however, another class of cases in which neither these glandular structures, nor, as a general rule, small nodular semi-solid cysts, can be found in the wall of the parent cyst, and in which, nevertheless, there is evidently a very large growth of secondary cysts proceeding. I have met with three such examples, and had great difficulties in accounting for their mode of growth, most of the secondary cysts being very thin-walled and transparent, presenting a great confusion of structure on section, opening

[1] Dr. Hodgkin, in his first paper on the subject, 'Med.-Chir. Trans.,' vol. xv, noticed the resemblance between "the opened cysts" and "*mucous* follicles on a large scale."

into one another in all directions, and greatly altered in shape by mutual pressure. Though not so densely crowded as those formed under the conditions last described, they still presented the alveolar appearance figured by Professor Rokitansky (in figs. 93, 94, pp. 234, 235, 'Path. Anat.,' vol. i). When, however, I placed a large tract of one of these thin-walled transparent cysts under the microscope, and viewed it with a low power, I at once arrived at an explanation of the manner in which the secondary cysts had originated.

Plate X, fig. 36, represents the appearances then observed. Projecting from the inner surface of the cyst, into and through its outer wall, there were seen in the same field three crypt-like processes, which were distinctly hollow, and lined by the same polygonal epithelium (ascertained by a higher magnifying power than that by which they are represented here) as covered the interior of the (to them) parent cyst. The opening by which they communicated with the cyst from which they sprang was very narrow, but they at once expanded into large flask-shaped sacs, which protruded into the cavity of the cyst adjoining the one from which they took their origin. It will be evident at once how indefinite a multiplication of secondary cysts may ensue by means of such a process. The complexity of these structures is further increased by adhesions between the outer walls of secondary cysts thus projecting into other cavities, and the inner walls of the latter with which they come into contact. In another and similar structure I found, however, in the dense stroma of the wall of the primary cyst (which was expanded into a large cavity, with only a single group of cysts at one extremity), another series of somewhat analogous processes. In the portion of the thick wall which adjoined the group of cysts just mentioned, I found the appearances represented in figs. 37, 38, 39, 40. These small cysts gave off sometimes one, sometimes more processes or diverticula, which after extending for a variable distance in the growing stroma, had a series of portions constricted off, so as to form shut cavities. I

believe that this process commenced at once in the altered Graafian follicles; and I find a confirmation of this view in the fact that in the case of ovarian-cystic disease, previously mentioned as having occurred under the care of Dr. Reynolds, and when I was able to trace every gradation between the Graafian follicles and the large cysts, the same process had also commenced. Plate VIII, fig. 3, gives an example of the origin of this process, taken from that case, where a series of such cavities are united by short processes. In the case also whence Plate X, fig. 36, was taken, I found a similar condition to that just described existing in the wall of the parent cyst. The process here followed, therefore, seems to be equivalent to the growth of glands by diverticula or budding, so common in all the glandular structures (including the lungs), which originate from the gastro-intestinal mucous membrane. I have endeavoured carefully to follow the growth of these latter structures, but only give my opinion upon this point with a certain degree of hesitation. At Plate X, fig. 39, the extension of the process given off from the small cyst, *a*, is seen at *c* to run into two parallel rows of cells, but these seemed gradually to pass into a single row, and to be lost in the layers of the stroma. In two instances, however, of one of which Plate X, fig. 40, is an example, I noticed the following facts. In the first place, I could nowhere discover any membrana limitans intervening between the epithelium and the stroma beneath; secondly, at the end where the extension and growth appeared to be taking place, the stroma did not present its usual appearance; in fact, it did not appear to form any boundary line to the epithelium at all; but in place of the fibrous tissue which surrounded the long crypt at all other parts, there was here seen, in the immediate neighbourhood of the epithelium (which was here almost columnar), a series of round nuclei, to which, however, I could discern no outer cell-wall; a little removed from this, there were brought out by acetic acid a group of oval nuclei, arranged for the most part with their long diameters converging to an imaginary line prolonged vertically through

the long axis of the crypt. Billroth[1] has seen a somewhat similar appearance in the connective tissue around the ends of ducts of new formation in a glandular tumour of the parotid; and his description, which I quote, corresponds very much to the appearances seen by me, although I could see no central fibre, as observed by him. "In these tumours peculiar cylindrical and flask-shaped structures are found, which often give the impression of a glandular substance, except that there is often seen in their centre a white line, which can be easily taken for a canal. These formations, however, proceed from the connective tissue, and the central white line is a bundle (or fibres? Bindegewebs-Strang), in which the spindle-shaped cells hang like the needles on a twig of fir. . . . The spindle-shaped cells, as I have lately absolutely convinced myself, may become converted into an elongated columnar epithelium, which begins to secrete, and so causes the formation of a cyst in the gland proceeding from the connective tissue." Such a statement, from so accomplished and accurate an observer as Dr. Billroth, would go far to explain the mode of extension of many glandular growths, especially those glandular hypertrophies which take place in the midst of old and preformed tissue; and the observations which I have just recorded would appear to be confirmatory of his view of the mode of growth of glandular structures of new formation. It is a subject, however, on which I have no further knowledge from direct personal observation than the facts which I have here recorded, and which does not afford to my own mind a convincing proof of the conversion of the stroma of the ovary into gland-tissue; though the observations which I made on the growth of the cauliflower masses of the villi and of the glands on the surface, as well as of the epithelial linings of some of these cysts, have led me strongly to incline to the conviction, which Billroth's observations on the papillæ of the tongue of the frog further confirm—that the epithelium may be merely a series of

[1] 'Beiträge,' p. 78.

metamorphosed and superficial cells of the so-called connective or fibrous tissue.[1] Still, however, without pressing this conclusion to such a length in the case now under consideration, it may at least be concluded, from the crowd of nuclei seen at the end of the tube, that a process of growth was taking place at this spot; and it may be considered possible that the rounder nuclei proceeded from the old, and were about to represent new epithelial cells, while those which were elongated represented a new formation of ovarian stroma, hereafter to form a fibrous wall for the glandular tissue.

The process has, however, a further parallel in that described by Langer[2] as occurring in the growth of the ducts of the mammary gland. He refers their extension to a conversion of the stroma of the mamma into glandular tissue. His figs. 9, 10, correspond very closely to the appearances which I have described as occurring in the growth of these crypts.

I may further mention that I have been able to ascertain that the two processes which I have just described, viz., the constriction of tubular cavities, and the increase of cysts by diverticula from the thin-walled specimens, have occurred simultaneously in the same specimens. The similarity of the processes is so great that this might have been predicted, and in the preparation whence Plate X, fig. 35, was taken, such processes as are represented by Plate X, figs. 37, 38, and 39, were found in the thickened wall of the parent cyst; and if it be objected that such an appearance as Plate X, fig. 39, represents could be presented by a cyst flattened by pressure, and seen in profile on section, there is at least no fallacy possible in the observation of diverticula such as are represented in figs. 37 and 38; nor in that in Plate VIII, fig. 3, where the stroma of the ovary

[1] I have retained this term as a provisional one, though aware of the exceptions taken to its use by many eminent anatomists, because at present we have none in common use by which it appears to me that it can be replaced.

[2] 'Denkschriften der Wiener Akademie,' vol. iii, 1852, p. 26.

in which they were found was subjected to no pressure whatever. In one of these cases, although I could discover no glandular structures forming in the inner wall, there were found, in a few isolated cysts apparently of older growth, scattered villi, which here and there tended to become clustered, and in several others the epithelium was stratified. It is easily conceivable that the consecutive stages of gland formation might have ensued here, and thus have greatly complicated the structure. This is also further of interest, as showing that *any* cyst, and even those isolated in the midst of more complex masses, may become the nidus for a multiple cyst formation; a point of great interest in relation to the questions raised between the relative value of tapping and total removal of these tumours.

The formation of secondary cysts by the constriction of portions of longer ones by bands of fibrous tissue is well illustrated in Plate X, fig. 42, where the preparation was taken from a secondary cyst formed in the wall of one of the tumours containing papillary growths, before described, and where across a constricted portion of the elongated cyst, *e*, a band of fibres, *f*, is seen crossing. The cyst *c* seems to have been already constricted off by a similar process (*vide* description of figures).

The only other changes which I have to notice as occurring in these cystic growths is their fatty degeneration *en masse*. This process, which often can be followed in minute cysts at the edge of the larger portions affected in this manner, gives rise to large tumours, from the size of a man's fist downwards, converted into hard, semi-solid masses of a fatty character, in which all traces of structure seem lost. It is more commonly met with in those where the contents were previously of a dense colloid-like nature than in those where they have had a more fluid character. The determining cause of this condition must lie, I believe, in some obstruction to the circulation, but I am unable to offer any direct proof of this presumption. I have also observed, in one instance, a very intense inflammation arise in the interior of a compound ovarian cyst consecutive to

tapping. It was attended with an extensive layer of exudation into and upon the lining membrane, which, when it took place, entirely destroyed all traces of glands and villi, in the parts where it occurred, though these were numerous in other situations. One notable feature about this inflammatory action was, that it had extended to other cysts adjacent to that in which I presume it had originated, and where the trochar could not by any possibility have penetrated. The appearances connected with such inflammatory action have, however, been so well described by Professor Simpson, of Edinburgh,[1] and by Kiwisch,[2] that it does not appear necessary to give any further account of them here.

On the chemical nature of the contents of these cysts I have little to add to the facts given by Professor Scherer,[3] Professor Virchow (l. c.), Dr. Owen Rees,[4] and by M. Becquerel.[5]

The amount of time consumed in the anatomical investigation prevented my undertaking any quantitative analysis of the contained fluids. I made, however, some observations on the reactions of the fluids contained, which I append for the sake of comparison with the results obtained by other observers.

On the fluid obtained from a thin-walled cyst the size of a walnut, which was one of a few projecting into the interior of a large, comparatively simple cystic cavity, I made the following observations:—

I.—1. The substance was comparatively fluid, being somewhat slimy; it was limpid, and, with the exception of a few opaque flocculi, transparent.

2. The reaction was faintly alkaline.

3. Acetic acid produced in the cold a slight clouding, not removed by excess of acid, but removed by boiling.

4. Boiling, after the addition of acetic acid, caused the

[1] 'Obstetric Works by Priestley and Storer,' i, p. 252.

[2] Loc. cit.

[3] 'Chemische und Microscopische Untersuchungen,' 1843. 'Verhand. der Phys. und Med. Gesell. zu Wurzburg,' vol. ii, 1852.

[4] 'Guy's Hosp. Rep.,' vol. iii.

[5] Clay's 'Kiwisch.'

fluid to become exceedingly frothy, but gave no precipitate.

5. Hydrochloric acid gave a very faint clouding; soluble in excess.

6. Solution of ferrocyanide of potassium added to the last named caused a copious precipitate.

7. A solution of bichloride of mercury caused no precipitate.

8. Neutral acetate of lead caused a very slight precipitate.

9. Basic acetate of lead caused a copious precipitate.

II. In a multilocular cystic tumour, examined November 30th, the fluids contained in the different cysts varied somewhat in character.

A. In a large cyst, with thin walls and clear contents, the fluid was very viscid, but clear.

1. Reaction very faintly alkaline; but, after standing for a short time, this reaction became more marked. (Qy. From evolution of ammonia?)

2. Sp. gr. 1010; 60° Fahr.

3. Acetic acid gave no precipitate in the cold.

4. Boiled with acetic acid, both when faintly acidulated, and with excess of acid, it gave no precipitate.

5. Hydrochloric acid. No precipitate.

6. Solution of ferrocyanide of potassium, added to last, gave a very faint clouding of an opalescent tint, which became darker on standing, thus indicating the presence of iron. (I have no note of the fact, but I believe that I tested the hydrochloric acid used at the time.)

7. Solution of bichloride of mercury gave no precipitate.

8. Neutral acetate of lead gave no precipitate.

9. Basic acetate of lead gave no precipitate.

B. In a second cyst having the same external characters, the contained matter presented considerable varieties. While one portion was comparatively fluid, refracting, and transparent, another part, though also clear and refracting, was very dense and semi-solid, approaching a consistence between that of the vitreous humour and crystalline

lens; and between the more fluid and solid portions every gradation could be observed. The more solid part dissolved after a time in Liq. Potassæ. The fluid portion was of a very pale straw-yellow, with only a very few flocculi of fattily degenerated epithelium within it. It was so excessively viscid that the sp. gr. could only be taken with difficulty.

1. Sp. gr., 1010 (?).

2. Reaction very faintly alkaline, with same characters as that last mentioned.

3. Boiling produced in it a striated clouding, not uniformly affecting the whole mass, nor redissolved by excess of acetic acid.

4. Acetic acid produced no precipitate.

5. Boiling with excess of acetic acid—no precipitate.

6. Boiling the fluid faintly acidulated with acetic acid caused a faint precipitate.

7. Hydrochloric acid caused a marked precipitate, soluble in excess.

8. In the solution thus acidulated with hydrochloric acid, ferrocyanide of potassium produced a marked precipitate.

9. Bichloride of mercury caused only the faintest clouding.

10. Acetate of lead (neutral) gave no precipitate.

11. Basic acetate of lead gave a marked precipitate.

III. In a thin fluid, examined December 10th, there were also great differences in the fluid contained in the different cysts. In some it was very slimy, and could be cut with scissors or a knife; in others it was perfectly fluid, and between these all varieties could be found. The average fluid contents were limpid, slightly opalescent, and containing but a few flocculi.

1. The reaction was strongly alkaline.

2. Sp. gr. 1015.

3. Boiling gave a marked precipitate without the addition of acetic acid.

4. Acetic acid gave no precipitate, either in the cold or on boiling.

5. Hydrochloric acid gave a precipitate soluble in excess.

6. Ferrocyanide of potassium gave a precipitate in solutions acidulated both with acetic and hydrochloric acids.
7. Bichloride of mercury gave no precipitate.
8. Sulphate of copper gave a precipitate soluble in excess.
9. Neutral acetate of lead gave a faint clouding.
10. Basic acetate of lead gave a moderate precipitate.
11. Solutions of alkaline salts gave no precipitate.

Imperfect as these results are, they yet tend to show that in these fluids there is a considerable difference between the contents of the different cysts. In all, the reactions obtained are more akin to those modifications of albumen discovered by Professor Scherer, and termed by him metalbumin and paralbumin, than to any of the hitherto isolated members of this series. The non-precipitation with acetic acid seems to distinguish them from mucus, though in the first mentioned a faint indication of its presence was thus obtained.[1] The absence of precipitates with bichloride of mercury is a notable fact, thus marking a difference between the reactions obtained by me and some of the reactions obtained by Professor Scherer.

It would seem as if very great varieties were possible in the condition of these fluids, and their varying reactions may probably be accounted for in a great extent by differences in the amount of pressure to which the secreting surface is subjected. The subject is one which appears to me to require further investigation, not only in relation to these cysts, but also with regard to those found in other portions of the body.

Professor Virchow[2] is of opinion that the more solid matter is always the first stage, and that dropsy of the ovary, or cysts filled with more fluid contents, represents a later stage of the same process, the more fluid matter being only the result of the gradual softening of the colloid material. In many of the younger and commencing cysts I have found the contained matters to be very firm; in

1 '*Vide* ' Hoppe. Anleitung zur Pathologisch. Chemisch. Analyse.'

2 'Eierstock's Colloid,' l. c., p. 213.

others, again, presenting similar characters, it was already much more fluid; and in the larger cysts, of the size of an orange, there is the greatest possible difference in the contents of adjacent cysts, of apparently the same age and structure with regard to the solid or fluid characters of the contained material. The impression which I have formed during these examinations is, that although Professor Virchow is perfectly correct in attributing some of the fluid contents to the softening of portions that were previously more dense and semisolid, yet that this process will not account for the whole of the more fluid contents of the larger cysts is an impression which I believe that Professor Virchow would also entertain.

Various alterations are found in the contained fluid, from the admixture of the fattily degenerated epithelium and walls of the cysts, as well from rupture of blood-vessels and hæmorrhage into their interior. These need no further description on my part, as they have been already well and fully described, and are familiar to every one in the habit of examining these structures.

Conclusions and Summary.

It remains for me to make a few remarks on the position assignable to these structures in a pathological classification.

I stated, in my remarks upon the opinions of those who held that all cysts of the ovary proceeded from the Graafian follicles, that this could only be proved by the discovery of the mode in which secondary cysts may arise from these structures. Of such methods of secondary formation I have, I think, given convincing proof;[1] and I would only again refer to the opinion which I have expressed before,

[1] Of all the *forms* of these multilocular tumours figured by Dr. Bright ('Guy's Hosp. Rep.,' vol. iii), Lebert, and Cruveilhier, I have seen instances associated with the modes of secondary cyst-development now described.

that there is no difference between the simple cysts of the ovary, which are admitted on all hands to originate in the Graafian vesicle, and the parent cysts of the more compound type, beyond those alterations in the walls of the latter which depend on the structures which give rise to the cysts of secondary formation.

This mode of secondary cyst-formation follows, with certain deviations, the now well-known type of the formation of cysts from the constrictions of portions of ducts in glandular structures, associated with the hypertrophy and fresh growth of tubular formations.

Of the mode of formation of glandular structures which I have described I can find no pre-existing instances in the authors on embryology or pathology whom I have consulted. Even in the mucous polypi described by Dr. Billroth[1] the formation of new glands appear to originate in diverticula from the surface. Such a process in the tense wall of a distended ovarian cyst would appear almost impossible, and this may possibly account for the difference in the mode of growth.[2]

When once formed, they have many parallels, not only in the whole course of the gastro-pulmonary and gastro-intestinal tract, but also more especially in the uterus, which must be regarded, from its embryonic development, as part of the natural duct of the ovary. This fact, as well as the occasional occurrence of ciliated epithelium in the contents of these cysts is, when we remember that the first part of this duct in the Fallopian tube is also provided with a similar epithelium, of the highest interest in connection with the views recently put forward by Dr. Pflüger, of Bonn (l. c.), on the embryonic condition of the ovary itself, in which he describes the origin of the Graafian

[1] 'Ueber den Bau der Schleimpolypen.'

[2] I do not fully understand the whole mode of formation which Steinlin (l. c.) has described as ensuing in the sebaceous glands of such cysts as contain dermic structures. His account of the formation of papillæ corresponds very closely to that in which I have here described the growth of villi.

vesicles in the calf and kitten as resulting from a series of constricted portions of the tubes or crypts of which the ovary is primarily composed. I do not consider my own observations on the human embryo sufficiently complete to enable me to offer any criticism on the details given with so much precision as Dr. Pflüger has done, of facts observed by him during a long period of time, but these have been quite sufficient to convince me that the ovaries of the human female do at early periods of embryonic life contain tubular or quasi-tubular structures, which are intimately concerned in the development of the Graafian vesicle. Dr. Billroth[1] has come to similar conclusions, and, from the facts observed by him with regard to similar formations in the thyroid, he came to the brilliant induction (which has only become known to me since I had arrived at the results now communicated with regard to the ovary), that there was every probability of similar growths being found in cystic tumours of this organ. Of this induction I believe that the facts now brought forward furnish an experimental proof; and I think, therefore, that I am warranted in expressing the opinion that these tumours of the ovary should be classed with those which originate in other glandular organs, by an abnormal repetition of the processes of development observed in the fœtal condition, recurring with aberrations in the adult.[2] I use the term aberrations because the normal process of secretion in the ovary is attended with the formation of ova, as that of the testicle consists in the production of spermatic cells. I have carefully sought in the smaller cystic formations for any indications of these structures; but though I have occasionally found cells of dimensions equal to that of the early ova, and often reaching $\frac{1}{1000}$ inch in diameter without appearances of fatty degeneration, while in other cases, where the cells were fattily degenerated and

[1] 'Müller's Archiv,' 1856, p. 159.

[2] *Vide* Billroth's "Researches on the Thyroid," already quoted, 'Müller's Archiv,' 1856; also his paper on "Cystic Diseases of the Testicle," in 'Virchow's Archiv,' vol. viii; also 'Rokitansky,' vol. iii, pp. 104, 108, ed. 1855.

floated free, they were even larger than the above measurement, sometimes attaining a size of $\frac{1}{500}$ inch in diameter, yet, except in point of size, no further resemblance to ova was traceable in them. I was at first strongly inclined to believe that they might represent an immature or imperfect production of ova; but as I have never been able to find in them anything analogous to the distribution of the yolk-granules, or to the Zona Pellucida, nor in those containing large numbers of fat-granules, any trace of the germinal vesicle, I could not exclude the possibility of their being cells derived from the lining membrane, and swollen by imbibition, particularly as in many cases various stages in size could be traced between those lining and still adhering to the cyst-wall and the larger ones which floated free[1] (*vide* fig. 2, *c*, *d*).

The process of the formation of cysts by the constriction of long tubular processes, as I have described it, is an exact counterpart of that described by Pflüger in his account of the origin of the Graafian follicles, while the cystic formations in the glandular growths on the surface have their counterparts in the whole series of follicular glands, of some of which I have given a description in a previous communication to this Society.[2]

The only mode of cyst-formation which I have here described, and which does not come precisely within this category, is that which takes place in connection with the cauliflower excrescences found in the interior of these cysts. It is not, however, so widely different from some of the modes of formation of cysts from glandular structures as to invalidate the general law of these growths. It is, further,

[1] Since this paper was communicated to the Society similar observations have been made by Drs. Woodham Webb and Charles G. Ritchie. These gentlemen appear to consider that the evidence of these large cells, representing "imperfect ova," is more complete than my own observations seemed to warrant me in concluding. *Vide* 'Med. Times and Gazette,' Aug. 6th, 1864.

[2] "Contributions to the Pathology of the Glandular Structures of the Stomach;" 'Med.-Chir. Trans.,' vol. xli, 1858.

somewhat exceptional; and, as I remarked before, the cysts produced by this means do not appear to be very numerous; and some of them, as seen in fig. 42, are apparently subject to multiplication by constriction and division in a manner analogous to the other forms. In one respect they still maintain the glandular type, for they are not formed *within* solid structures, but external to them, and in connection with a glandular secreting surface, as these cauliflower and dentritic growths, equally with the Haversian fringes of synovial membranes,[1] must, I believe, be regarded as secreting surfaces, and equivalent to everted crypts or follicles.

I have not been able, while making these observations, to obtain any instances of multilocular tumours containing dermic structures. As, however, the presence of glands, both of the sebaceous and sudoriparous type, has been demonstrated in them both by Steinlin (l. c.) and by Kohlrausch,[2] I see no difficulty in entertaining the belief that in the cases where they occur, and where they must be regarded as the analogues, by a further aberration in development, of the structures which I have described, they will be found to be the origin of the secondary cysts found in connection with them, more particularly as these dermic glands have been proved by Sir A. Cooper,[3] Wernher,[3] Förster,[4] and Remak,[5] to be not unfrequently the source of cyst-formations of very complex structure. So that in these cases, also, the process will be in its essential characters similar to those which I have described.

With regard to the determining cause of this remarkable condition of growth and development, we must, I believe, as yet confess ourselves almost entirely in ignorance. Führer's[6] theory, founded on some facts which have come

[1] 'Quain and Sharpey's Anatomy,' ed. 1848, p. 301.
[2] 'Müller's Archiv,' 1843.
[3] Quoted in 'Paget's Lectures,' pp. 436, 437.
[4] L. c., vol. i, p. 191.
[5] 'Deutsche Klinik,' 1854, p. 170.
[6] Ibid., 1852, pp. 200-1.

under his observation, that the disease commences with obstructions to the Fallopian tubes, has, as he well points out, certain analogies in its support from similar conditions occasionally observed in the mamma; but the fact that in many cases of ovarian tumours the Fallopian tubes can still be found patent renders it difficult to accept this explanation as universally applicable.

It appears to me that the term "degeneration," which has occasionally been applied to these affections, is one which very inadequately expresses the true nature of the pathological process involved, and that it would be therefore better to restrict ourselves to the nomenclature more ordinarily employed, especially as the divisions of the cystic growths into "simple," "multiple," and "multilocular" or "compound," fully expresses their nature and chief characteristics.

In conclusion, I wish to add a few remarks on the mode of investigation which I have pursued in these researches. I have invariably examined all the preparations which have come under my notice by means of sections made in the fresh condition by a Valentin's knife, carried perpendicularly through the inner wall. It was by this means that I first discovered the true nature of the glandular structures which I have described. They can, however, be examined with much greater accuracy; (and this remark applies especially to the small cysts of secondary formation in the wall and stroma,) after being hardened for a few weeks in a solution containing 2 per cent. of chromic acid. Very fine sections can then be obtained; and, on the addition of Liq. Potassæ and glycerine, the structures, including even the nuclei of the epithelial cells, are seen to be entirely unchanged. The same method is also one that I can strongly recommend for the investigation of the cauliflower growths. I have, in the description of the drawings, in all cases stated the mode of preparation employed.

DESCRIPTION OF PLATES VIII, IX, X.

Plate VIII.

Fig. 1, A, B. Represents nuclei and fibres of the inner layers of the stroma of a parent cyst.

At B the nuclei are seen with one or more nucleoli. Nuclei measure $\frac{1}{1600} \times \frac{1}{4000}$ inch, nucleoli from $\frac{1}{7000}$ to $\frac{1}{8000}$ inch. Chromic acid prep. × 1200 diam.

C. Nucleated cells from wall of a thin-walled cyst. One is seen with two nuclei; all have a nucleolus. Length of cells from $\frac{1}{200}$ to $\frac{1}{250}$ inch. Nuclei average $\frac{1}{2250} \times \frac{1}{7200}$ inch. Recent prep. × 690 diam.

Fig. 2, A. Stratified layer of cells on interior of walls of "parent" cyst; the superficial layers are columnar; the deeper, polygonal.

At *a* a single cell of the superficial layer is seen, with two nuclei.

B. Vertical section through wall of ovarian cyst, where the epithelium was flattened. The nuclei of the fibres beneath are seen assuming a rounded form.

b, *b*. Show single cells removed by scraping from the upper layer. Recent prep. × 460 diam.

C. The ordinary character of rounded cells in apposition, or separated by a small amount of intercellular substance, which forms the lining of an ovarian cyst. Cells = $\frac{1}{3500}$, nucleus $\frac{1}{4000}$ inch in diameter. Recent prep. × 460 diam.

D, D. Large round cells from surface of smaller papillary growths. Some with one, some with more nuclei.

At *d* the nuclei are seen free, and in a state of fatty degeneration. Size of cells averages from $\frac{1}{1100}$ to $\frac{1}{1500}$ inch, of nuclei $\frac{1}{2250}$ inch. Recent prep. × 460 diam.

E. Lining of cells in close apposition which could be stripped as a membrane from a thin-walled cyst. Average diameter of cells $\frac{1}{1400}$ inch, of nuclei $\frac{1}{2250}$ inch. Recent prep. × 460 diam.

Fig. 3. Represents the commencing production of secondary cysts from Graafian follicles. In both *a* and *b* a narrow tubular process is seen connecting two follicles. It is a question whether two adjacent follicles have thus opened into one another, or whether one is a dilatation of a process given off from the others. The

PLATE VIII—(*continued*).

former view appears to me the most probable. The ovary was studded with microscopic cysts, showing every gradation in size, from that of a Graafian follicle upwards, varying from $\frac{1}{250}$ inch diameter upwards. With the exception of the figure here drawn, these were all distinct. Chromic acid prep. × 250 diam.

Figs. 4 to 15. Represent the structure of cauliflower growths, and the modes in which cysts are formed in them.

Fig. 4. Represents a series of small papillary growths, covered with epithelium, springing from the wall of a parent cyst.

a and *b*. Represent the earliest stages in which they assume a definite shape. They are seen by their irregular enlargements, and by overlying the wall of the parent cyst, partially to enclose spaces as *c*, *c*, *c*, covered with the same epithelium as the wall of the parent cyst. A loop of vessels was seen to shoot up into each.

Fig. 5. Represents at *g*, *g*, large rounded masses, formed by the enlargement of such growths as *a*, *b*, figs. 4 and 5. From these masses secondary small growths (*d*, *d*) are springing, having the same characters as *a*, *b*. They project into the cavity of the cyst, and give the larger masses a velvety appearance.

Between these masses are seen, at *e*, *e*, *f*, irregular spaces, already partially enclosed by the growth of the excrescences.

Fig. 6. Shows a view in profile of the mode in which the secondary dendritic growths spring from the parent stem. These are seen at *b*, *b*. Spaces bounded by the growths and by the wall of the parent cyst are seen already partially enclosed.

At *d*, *e*, similar spaces are seen to be forming between the secondary growths on the larger mass.

At *e'*, is seen a cyst formed in the wall by such a continuation of this process as is represented at figs. 7 and 8. Chromic acid prep. × 100 diam.

Fig. 7. Represents sections of two growths which have sprung by narrow peduncles (*a*, *a*), from the wall of the parent cyst. These have given off mucous offshoots in very irregular directions. Some of the offshoots have bent down, and again come in contact with the wall of the cyst, thus giving rise to the irregular spaces *c*, *c*, *b*, *b*, which latter are already almost enclosed. Chromic acid prep. × 100 diam.


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.

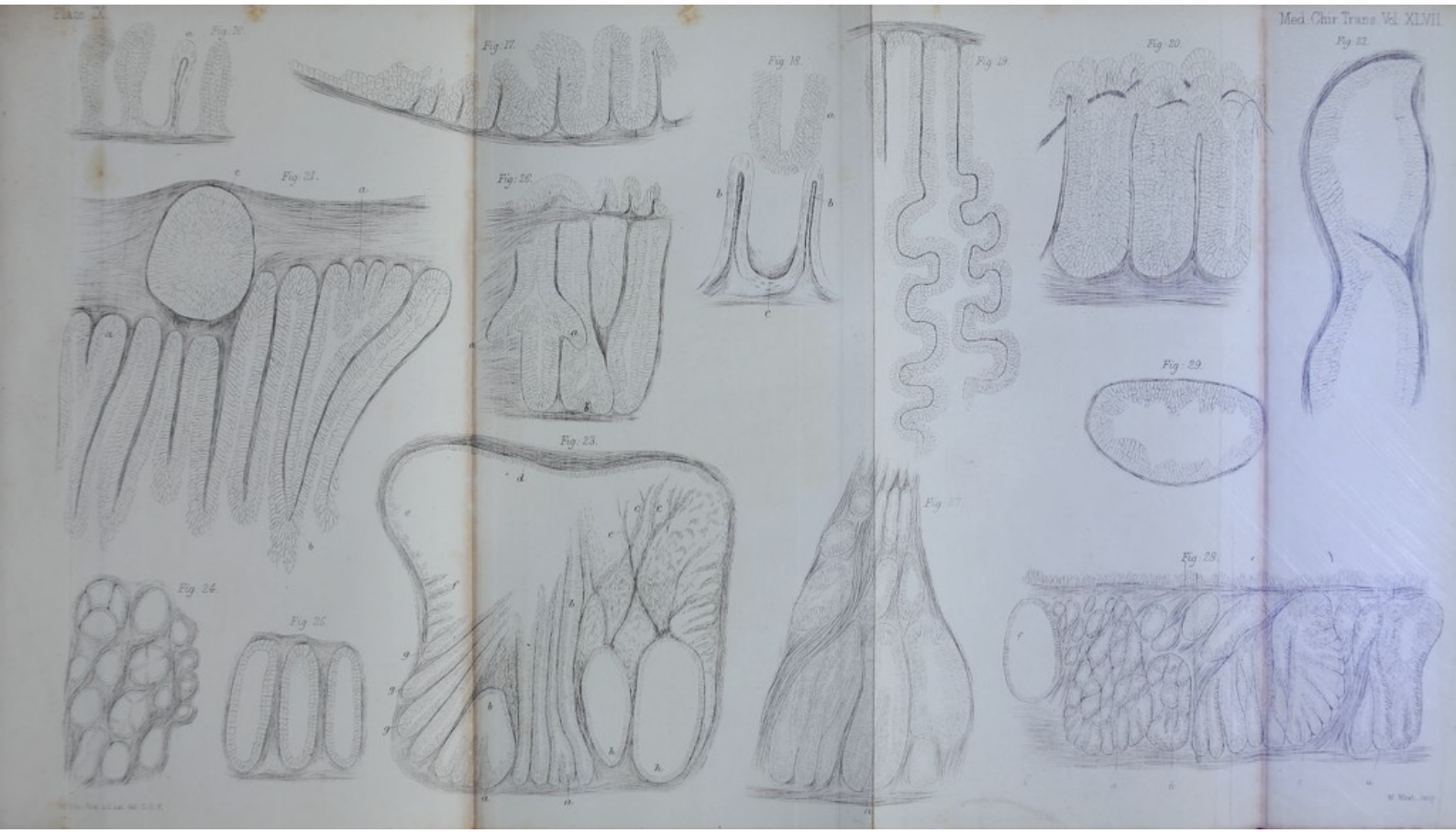
Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19.
Fig. 20.
Fig. 22.
Fig. 21.
Fig. 26.
Fig. 29.
Fig. 23.
Fig. 27.
Fig. 28.
Fig. 24.
Fig. 25.

Plate X.

Fig. 32.

Fig. 33.

Fig. 31.

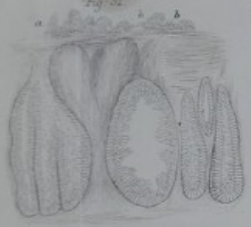

Fig. 34.

Fig. 32.

Fig. 35.

Fig. 36.

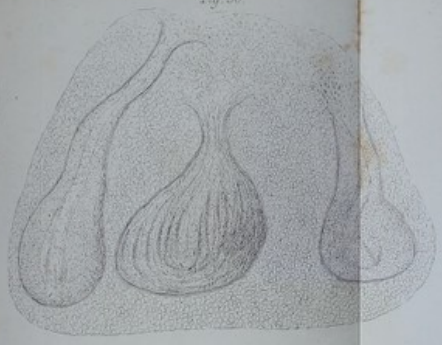

Fig. 37.

Fig. 38.

Fig. 38.

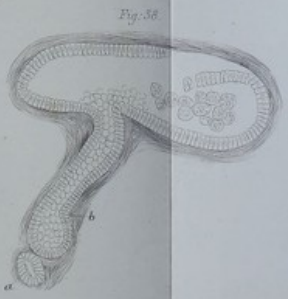

Fig. 40.

Fig. 41.

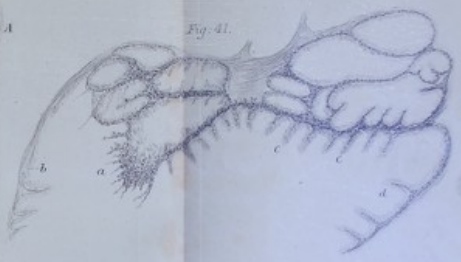

Fig. 42.

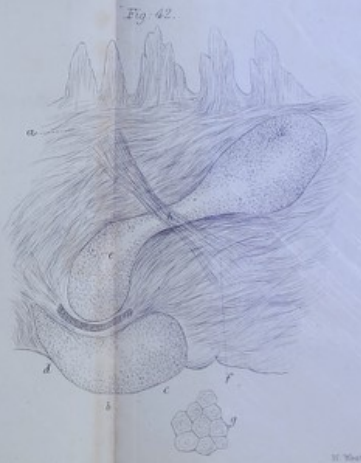

PLATE VIII—(*continued*).

Fig. 8. Represents a section through four growths (*f, f, f, f*), the adjacent walls of which have met superiorly, and enclosed the spaces *a, a', c.* From *a'* and *c* prolongations of these processes have been formed as described in the last, and continued into the stroma.

At *e* another, which had apparently been previously in connection with *c*, is almost completely separated as a cyst; and the same may be seen with respect to the connection between *d* and *a*. Chromic acid prep. × 250 diam.

Fig. 9. Represents a section through portions of three or four growths, slender and pedunculated, which have united above, and left inferiorly the spaces *d, e, e*, still covered by epithelium. Above, similar spaces are also left at *a, b, c*, in all stages of more or less complete conversion into closed cavities. Chromic acid prep. × 250 diam.

Fig. 10. Represents a section of a portion broken off, and free in the field of the microscope, from the end of one of these cauliflower growths. It is seen to be giving off two offshoots, and in its interior are seen two spaces (*a, a*), both lined by epithelium, and produced in the manner last described. Chromic acid prep. × 250 diam.

Fig. 11. Represents the stroma of one of these masses.

a. Showing at their free extremities a delicate hyaline, finely striated structure, enclosing a few nuclei; deeper in the tissue the stroma is more striated, and lines of nuclei mark the course of the vessels. The more fibrous tissue passes by insensible gradations into the comparatively structureless extremities of the growths.

b. Represents the stroma of a commencing growth. Both *a* and *b* have lost their epithelium. Recent prep., without reagents, × 460 diam.

Fig. 12. The end of one of these growths magnified 250 diam. Recent prep. In some cases, where the growth is very rapid, the epithelium attains a very large size, as seen in fig. 2, *d, d*.

Figs. 13 and 14. Show the commencement of one of these growths from the cells of the connective tissue. It is probable that there is a great increase at a later stage of the intercellular substance, in which the cell-walls become merged, while the nuclei of the cells represent the nuclei seen in the delicate stroma of the growth. At first the cells are closely packed, and lie thick together. Recent prep., without reagents, × 460 diam.

Plate VIII—(*continued*).

Fig. 15. Represents the trabecular appearance seen on a vertical section with a Valentin's knife through one of the larger masses of cauliflower growth. The irregular growth, enlargement, and coalescence of the papillæ form a series of spaces lined by epithelium, and often communicating with one another. The meshes contain large vessels. These do not appear to have dilated as cysts, nor do they in most cases form completely closed cavities.

Plate IX.

Figs. 16 to 35. Represent the growths of villi, tubular glands, and cystic formations from the glands.

Fig. 16. Represents three scattered villous growths covered with columnar epithelium. Some are slightly club-shaped, others are pointed. At *a* one is seen denuded of its epithelium; they are then seen to contain a loop of vessels, supported by a very delicate connective tissue, in which are some scattered nuclei. Recent prep. × 250 diam., without reagents.

Fig. 17. Represents the commencement of the formation of glands. Into the stratified mass of cells covering the surface spring up short papillæ, carrying vessels and a small amount of connective tissue; the spaces between these are gradually surrounded by a further growth inwards of the stroma of the walls of the cyst (*vide* text, pp. 254-5). Chromic acid prep. × 250 diam.

Fig. 18. Represents a gland-mass of epithelium stripped from its containing follicle; part of the follicle has probably been torn away with the epithelial mass (*a*), and tends to holds the cells together. The papillæ between which it lies are then seen at *b*, *b*. At *c* is the fossa left by the epithelium, up the sides of which the connective tissue was extending. Chromic acid prep. × 250 diam.

Fig. 19. Two very long villous growths, which reached almost entirely across a small cyst. They show numerous sinuses or diverticula, formed by inflections of the villi. (I do not think it possible that these could have been artificially made. The cyst was not compressed, and the section was made with a Valentin's knife.) Chromic acid prep. × 250 diam.

PLATE IX—(*continued*).

Fig. 20. Vertical section of a glandular growth imbedded in the stroma. They are not diverticula from a uniform surface, but their ends project as villi. Loops of vessels are seen crossing them at various heights, showing that they are completely imbedded. Chromic acid prep. × 250 diam.

Fig. 21. A glandular growth proceeding with great rapidity in the interior of a secondary cyst. Two glands are seen in process of multiplication by division, owing to the growth upwards of septa from their expanded bases (*a*, *a*).

At *b* the occlusion of the orifice of one of these glands by the pressure from adjacent growths. (Some of these, for distinctness' sake, have not been drawn.) The two sides have grown together, and a further growth is proceeding at the end.

At *c* a cyst, formed probably in a similar way, and the origin of which could be traced in a long fibrous cord proceeding from the side turned to the inner surface of the cyst (not figured), is already separated from the glands by the growth of the stroma and the distension of the cyst-wall. Chromic acid prep. × 150 diam.

Fig. 22. A large tubular process, with thickened walls, probably resulting from a dilated gland, has a septum forming across it, dividing it into two cavities. Chromic acid prep. × 250 diam.

Fig. 23. A secondary cyst, partially filled with a gland-growth, and representing all the processes of gland formation.

At *d* the cyst-wall is seen to be lined with only a single layer of epithelium. At *e* this has become stratified. At *f* papillæ are seen in course of growth; and at *g*, *g*, *g*, the further growth of the glands is seen. At *a*, *a*, are seen the division of the base of the glands by septa projecting from the base; at *b* the commencing closure of the orifice of one of the glands by the pressure of those adjoining; at *b'* a gland, multiple at its base, has been converted into a cyst in the same manner; *h*, *h*, are cysts which have had a similar origin. The ends of the tubes from which they were formed have continued to grow and branch as septa (*c*, *c*, *c*) within the cyst. Chromic acid prep. × 150, somewhat reduced.

Figs. 24 and 25. "Cysto-sarcoma," or "alveolar degeneration" of the ovary, produced by the gradual thickening of the walls of such a series of glands as partially fill the cysts figured in the last. The figure represents a section across a series of dilated tubular

PLATE IX—(*continued*).

follicles, many of which are divided by imperfect septa, and also lined with epithelium. The stroma and septa were highly injected. The spaces measured from $\frac{1}{40}$ to $\frac{1}{120}$ inch in diameter. Fig. 24 × 100 diam. Fig. 25 is a portion of fig. 24 × 250 diam. Recent prep.

Fig. 26. Represents the first stage in which the glands formed on the interior of the parent cyst become encapsuled within its wall. The stroma has already partially grown over their orifices, and a fresh growth of epithelium and papillæ is appearing on the surface.

At *a*, *a*, are seen two diverticula from one of the glands.

At *b* is seen a gland almost closed superiorly by the pressure of adjacent growths; it is partially divided at its base, where a cavity is already in course of formation. Chromic acid prep. × 150 diam.

Fig. 27. Represents a process by which successive strata of glands may be encapsuled in the wall. The growth of the stroma is in such cases irregular, shutting off masses at different times. The septa between the glands widen, so that masses are shut off, separated by wider interspaces of stroma than intervened between them in the first instance. Sometimes a large compound growth of glands and stroma will overlap and enclose one which has proceeded less rapidly, and these again become, in their turn, overgrown by the stroma. Many of the glands in this preparation are seen to be divided at their base. Chromic acid prep. × 150 diam.

Figs. 28, 29 (Plate IX), 30, 31 (Plate X), are representations of varieties in the result of this process. In fig. 28 composite masses of glands are seen imbedded below the surface, and are slightly elevated above it as small, hard nodules, of the size of millet or poppy seeds.

Such masses as *a*, *b*, *c*, when expanded into cysts, give rise to compound alveolar forms, wholly or partially separated by septa.

Others, again, as *e* (which fig. 29 represents more highly magnified, to show a repetition of the same process commencing in a secondary cyst), are portions of simple glands, shut off, and which expand side by side with the others, as we find the secondary cysts, when growing, are sometimes unilocular, sometimes multilocular, and that these varieties occur mingled together at fig. 28. One of these has already begun to form a cystic cavity. Chromic acid prep. × 150 diam.

Plate X.

Fig. 30. Is drawn to represent a cyst formed in the manner last described, which still gave evidence of its origin by a long tubular process proceeding from its upper side, and losing itself among the new growths of glands and stroma which had covered over the original growth.

a. The cyst, with a secondary formation of stratified epithelium commencing in its interior.

b. The tubular process leading from it. Chromic acid prep. × 150 diam.

Fig. 31. Gives an illustration of the same mode of proof of the origin of these cysts, except that it is shown in a less distinct manner at *b*, where a fibrous cord, extending from the upper part of the single cyst to the superficial layers of the stroma, marks its mode of origin.

At *a* the tubular origin is more distinctly marked. The upper surface, in both this preparation and the last, is covered with a new growth of epithelium and villi. Chromic acid prep. × 150 diam.

Fig. 32. Represents a condition in which these glands, deeply imbedded in the wall, are often found (in a quiescent state?—*vide* text, p. 260). They show no disposition to dilate into cavities, but appear to possess at any time the power of doing so. (Qy. Is this the condition described by Professor Förster?)

Fig. 33. Represents a condition which I believe to result from the fatty degeneration of the cells of the glands, as represented in fig. 32. They correspond precisely to these masses in form and arrangement, are found in the same parts, and often in juxtaposition in the same tumour. They appear to give rise to the next two conditions depicted.

Figs. 34 and 35. Are, I believe, conditions which are the result of the fatty degeneration of these glands last described. The oil-globules are absorbed, or the stroma undergoes the same change, and breaks down in part, and a series of irregular areolar spaces are left in the stroma, some still persisting as closed cavities, others communicating with one another and with the surfaces, but all destitute of an epithelial lining. This may take place to a much more marked extent than has been figured here. I believe that such structures may have given rise in part to the theory of the alveolar origin of these cystic formations.

PLATE X—(*continued*).

Fig. 36. Diverticula from wall of a thin-walled cyst, opening into its cavity by narrow orifices, and expanding on the outer side into large, hollow, flask-shaped processes, lined by a spheroidal epithelium. Their lining membrane was partially thrown into folds from the pressure of the covering-glass. Natural prep. with glycerine, × 100 diam.

Figs. 37 and 38. Instances of small cysts giving off diverticula, which only become hollow after they have gained considerably in length. They have no membrana limitans. In fig. 38 is seen a process of secondary cyst-formation from one of these diverticula by a process of constriction.

At *a* a cyst is already formed in this manner, and the process is seen commencing at *b*. A similar process appears to be commencing at fig. 37, *a*. Both are chromic acid preps. Fig. 38 × 150 diam., fig. 39 × 250 diam.

Fig. 39. Represents a long tubular process passing from a small dilated cyst (A). The narrower part (*a*) has complete constrictions at *b*, *b'*; *b*, *c'*; *c*, *c'*; *c'*, *d*; at *d* it passes into a long process, in which at first two and later only a single row of columnar cells are visible. There was seen, on altering the focus, another constriction between A and *b*, but this could not be drawn.

At *b*, on altering the focus, a partial continuity of the epithelium through the constriction could also be seen. There is another partial constriction between *b* and *c*. Chromic acid prep. × 230 diam., reduced.

Fig. 40. The end of a crypt similar to those last described, seen with a superficial focus. There is observed a crowd of nuclei where the epithelium ends, and where the stroma does not surround the end of the crypt so closely as in other parts. Further removed from the end of the tube the nuclei are seen more elongated. Chromic acid prep. × 460 diam.

Fig. 41. Portion of an alveolar arrangement of the cysts, forming a less-marked condition of fig. 24 (Plate IX), where the septa of the cysts were in a condition of fatty degeneration. The epithelium still preserved; but at *a* are seen ragged remains of cyst-walls which have ruptured. Part of the wall of the larger cavity is still smooth, but at other parts the growth of septa beginning as papillary processes may be seen extending into it, and these are seen repeated in some of the smaller cavities. Many of these were seen, under higher powers, to contain glandular

PLATE X—(*continued*).

structures, similar to those in figs. 20, 23 (Plate IX). Others contained large villous growths, as in fig. 19. This figure was taken from another portion of the same tumour as that from which fig. 24 was drawn. Chromic acid prep. × 74 diam.

Fig. 42. Gives a further illustration of the multiplication of cysts by division.

c. Was a small cyst of the size of a pin's point, to the naked eye, seen through the peritoneal covering of one of the cysts containing papillary growths before described. On making a vertical section through it and the wall below with a Valentin's knife, I found the structures as here figured.

a. Represents the inner wall of the parent cavity, covered with small papillary and commencing cauliflower excrescences.

b. Represents the peritoneal surface, which appeared almost to form the outer wall of the cyst *c*.

Between *c* and the inner wall lay a long, double, club-shaped cyst (*e*), which was separated from *c* by the blood-vessel *d*. It presented a constriction at its centre (*h*); and across this, and partly enclosing it, was a band of thick fibrous tissue (*f*) which was spread into and lost in the rest of the stroma. My impression is that the cyst *c* had been formed by the earlier constriction of a portion from *e*, and that *e* had been formed from one of the papillary growths in the manner before described. They were both lined with polygonal cells, precisely similar in both cases, of which *g* is a specimen, as seen in *c*, magnified 460 diam. Recent prep. × 100 diam.