

made. I have never seen a case in a negro child. It is more common among the German and American children than among the Irish, so far as my statistics go, and the children of the poor are particularly liable.

Many authors agree as to the influence of heredity in cases which develop in adult life, and instances are on record in which the parents of the patient had been affected. Trousseau⁹ and Hanfield Jones trace out the development in phthisical families, and Day calls attention to the fact that, among the Jews, it is very common and is often associated with epilepsy, or appears in the children of epileptic patients. It is by no means difficult in gouty families to learn not only that several children of the same family have been affected with chorea but that also the father or the mother had been a sufferer from the disease.

As to sex, it is commonly a disease of females, and the ratio is as three to one.

This is especially true when the subjects are between the ages of twelve and fifteen, the time of puberty. Of Pye-Smith's 136 cases, 98 were females and 38 males. Of 62 patients affected between the ages of six and ten, 47 were females, and the remainder males, while between the ages of six and fifteen, of the 106 cases 74 were females and the others males. In the cases in which the disease appears later in life there is a much greater preponderance of female patients, and this is true even of the anatomical form of the disease.

It is scarcely proper in this place to consider the variety of chorea known as post-hemiplegic, for this, after all, is a distinct affection, and the spasmodic movements are by no means pathognomonic. A degeneration of the pyramidal column, from whatever cause, will be quite likely to give rise to choreiform movements.

The influence of fevers, especially those of a zymotic nature, in the development of chorea, is important. Scarlet fever, measles, whooping-cough, and diphtheria sometimes leave after them a most intractable chorea, which oftentimes becomes a chronic affection.

Barclay, Bernheim, and others speak of typhoid as a cause or complication.

Onanism is mentioned as a cause, but I do not attach much importance to this statement, although it appears to find favor with the Germans.

Overstudy has undoubtedly much to do with its development. Some years ago I found by a careful system of inquiries, instituted by means of printed tables, that nearly twenty per cent. of the public school children of New York suffered from some choreiform trouble, which varied from simple limited twitchings to well-marked chorea. Dr. J. Crichton Browne, in the report of an investigation which he had made (see "Report upon Overpressure of Work in Public Elementary Schools," London, 1884), says that while he found much nervous motor trouble, he is of the opinion that chorea is not as common as here, but he admits that his paucity of findings may have been due to the fact that children were taken away from school as soon as affected.

Saturnine chorea may manifest itself in suddenly developed convulsive movements of the limbs. Tanquerel speaks of it ("Lead Diseases, a Treatise," etc., by L. Tanquerel des Planches, American translation, 1850, p. 288), the "first form of the convulsive variety," as follows: "The face, or one side of it only, one or several limbs, are agitated by rapid convulsions analogous to those produced by electric shocks. Instead of this effect all the parts may be struck with permanent contraction, remaining a longer or shorter time without interruption." It is usually a form of trouble connected with cerebral diseases of a grave type, and is the precursor of the rupture of a blood-vessel.

The association of chorea with epilepsy is occasional, and, when found, is an affection of long standing. I have met with it frequently in children, and almost without exception the attacks of epilepsy involved the limbs of one side of the body; in fact, there were a hemiepilepsy and hemichorea in association. In two cases there were general convulsions, beginning unilaterally in association with hemichorea.

Chorea is occasionally of traumatic origin, and is then, as a rule, dependent upon some grave cerebral lesion or meningeal irritation. Chauveau has reported a case that was dependent upon a cicatrix.

Kinnicutt and Heinemann have pointed out the relations of chorea to certain states of malarial poisoning.

A form of toxic chorea that is observed in adults is the direct result of tobacco. It is usually general, but may be confined to the muscles of the face. I have seen many cases of this disorder in subjects who used tobacco to excess. The movements were found in association with vague hyperæsthesia, or rather dysæsthesia, consisting of a "tightness" or a "feeling of tension" of the skin of the face and head, with palpitation and gastric disturbances—manifestations which subsided under the use of hypophosphites and upon the discontinuance of the habit.

In one boy, who was addicted to the practice of cigarette smoking, the disease was entirely due to this bad habit. In all of these cases the faces were often redolent of decomposed nicotine.

Intestinal irritation is a most important cause of chorea, whether such irritation be from intestinal worms or from undigested food. Cases in which the expulsion of lumbricoides was followed by cure are numerous. Tardieu reports a case in which a sudden cure followed the expulsion of eight lumbricoides. I have frequently met with examples of the disease in which immediate relief was afforded after the rectum had been freed from a ball of pin-worms by a free injection of quassia or a saline enema. It rarely happens that the source of intestinal irritation is a Tænia solium, but, strange to say, children are sometimes the subjects of chorea from such a cause. Hanfield Jones speaks of a boy, nine years old, who was sleepless for four days and nights, who was in a state of constant motion, whose lips and teeth were covered with sordes, and who presented every appearance of collapse. A dose of oil of male fern brought away a tapeworm seven yards long, and in a few days the patient rapidly convalesced. I have reported elsewhere a case of this kind, and in this as well as in some other cases of chorea the distinguishing features are the sudden development and very violent and general character of the disease.

The influence of *imitation* and *fright* as exciting causes is supposed to play a very great part in the genesis of the malady.

In the epidemic form of the disorder there are many historical examples. The danger of association of healthy with choreic children has been, I am convinced, very much exaggerated. When the disease develops under these circumstances, the victims are usually hysterical subjects. In a child of weak nervous system a sudden fright may undoubtedly cause much mischief.

Strange considers the influence of two forms of fright (*British Med. Journal*, July 16th, 1881, p. 69), and he believes that in two-thirds of the cases it is the exciting cause. "Fright may operate in various ways, some simple, some more continuous and complicated. It need not be sudden, though that is generally the case. There is a kind of fear or fright to which children are exposed for long periods of time. Ill-tempered parents, especially the mother, may keep a child in perpetual trepidation and dread of punishment for unavoidable disasters. Again, the coming home of a drunken father must often be a source of continual terror to a delicate and sensitive girl. Ghost stories and foolish threats of 'Old Bogies,' and the like, so constantly used by ignorant mothers and nurses, need only to be mentioned to be severely reprobated."

The appearance of chorea in children who have been improperly fed is not always regarded with the importance it should be. An excessive meat diet is often responsible for this as well as other neuroses, notably epilepsy and hysteria. In these cases there is very often a history of broken sleep, night terrors, incontinence of urine, and not infrequently somnambulism.

The pathology of chorea has been considered by a number of English and continental observers, the former adhering to the theory of a cerebral origin of the affec-

tion. Todd, Stenhouse and Kirkes, Broadbent, Ogle, Tuckwell, Hughlings Jackson, and Bastian all favor the theory that it is an embolic disease, and that the corpus striatum is its seat. Though Todd was the first to point out this probable origin of the disease, starting from the standpoint of the unilateral spasm and hemiparesis, it was not until 1870, or thereabouts, that Kirkes stated that chorea is the result of irritation produced in the nerve centres by fine molecular particles of fibrin which are set free from an inflamed endocardium and washed by the blood into the cavities of these centres. Appreciating the important relationship of the middle cerebral artery to cerebral nutrition, the other investigators named look upon the corpora striata as the region most often affected. Ogle, Tuckwell, and others have found embolic plugging. Aitken believed the optic thalamus to be affected as well, but it would appear that in the cases under consideration there were sensory alterations.

A variety of experiments have been made by Raymond and other French investigators.

Raymond experimentally caused chorea in dogs by wounding the internal capsule and optic thalamus, producing chorea of the opposite side.

Rosenthal¹⁰ experimented, for the purpose of producing embolic occlusion, by injecting pollen into the left internal carotid of a choreic dog in whom the movements were most active in the right foreleg. The result of the injection was that the dog became powerless to change his position. Despite the abolition of voluntary movements, however, violent choreic convulsions occurred in the anterior limbs, in the eyes and tail, and continued for two days, until the death of the animal took place. Autopsy: Encephalitis of the left anterior lobe, softening of the left corpus striatum, embolism of the left middle cerebral artery, etc. The conclusion arrived at was that the abolition of function of the motor ganglia was followed by increase of choreic movement and irritation of the coordination centre.

Other investigators—among them Chauveau,¹¹ Carville, and Bert—operated upon choreic dogs; they cut the cervical cord and determined that the choreic movements were not dependent upon any influences emanating from the cerebrum or cerebellum. A section made lower down in the dorsal region in two other dogs resulted in diminution of the movements in the tail and legs. They concluded, therefore, that chorea minor was a spinal affection.

Le Gros and Onimus¹² made further experiments, and were also of the opinion that chorea was a disease of the cord. Excitation of the posterior column exaggerated the movements, and freezing this part of the cord produced a diminution in their intensity. The movements were not diminished by section of the posterior root zone, but only by the partial section of the posterior columns and horns.

These observers concluded that the seat of the chorea was in the cells of the posterior horns, or in fibres connecting them with the great motor cells.

Numerous post-mortem examinations have been reported, the most important of which are those of Meynert and Ellischer,¹³ who found changes in the peripheral nerves as well as cerebral lesions.

The English authorities have made many autopsies, and their researches have revealed obstruction of the middle cerebral and smaller cerebral arteries, usually on the left side of the brain.

Bastian found, in one case of bilateral chorea, embolic plugging by an aggregation of white corpuscles, obliteration of small vessels in the corpora striata, serous effusion in the ventricles, etc. Hughes collected fourteen fatal cases in which the meninges were either congested or pale. There were effusions and subarachnoid and ventricular adhesions of the dura to the skull; in fact there was nothing distinctive about the findings. In eight of these cases the spinal canal was opened, and in these cases the cord was found to be perfectly healthy, as were also the membranes. In one there was slight congestion. In the other four there were adhesions of the arachnoid of ancient date, and softening of the posterior columns and

gray matter generally. In one case softening was found at the level of the third or fourth dorsal vertebra.

At best these particular results simply show that fatal chorea may be found with cerebro-spinal textural alterations of inconstant character.

The observations of a few English writers, among them Bastian, are of great value in pointing to the corpora striata as the chief seat of trouble.

The continental investigators have done much more accurate work and have shed great light upon the pathological anatomy of the disease.

Meynert,¹⁴ especially, and Schultze¹⁵ have both ably investigated fatal cases. The former found degeneration of a large number of cells of the cortical substance of the brain, some being swollen and the others shrivelled. Those of the third frontal convolution were involved quite extensively, and so also were those of the ganglia. There were general connective-tissue thickening, and proliferation in the motor tracts of the brain and cord.

The morbid appearances found by Ellischer included very extensive degeneration of the nerve elements of the corpus striatum, hyperplasia of the connective tissue, and proliferation of the nuclei, especially of the lenticular nucleus; the walls of the blood-vessels were also found to have undergone a thickening. At the same time the cord was involved, the posterior columns being the seat of some sclerosis in the gray matter, which was hyperæmic; and there was a decided nuclear proliferation in the gray substance adjacent to the cells, which were more or less diseased, they being pigmented and destitute of nuclei. Besides these changes there was a sclerosis of the peripheral nerve fibres, together with a certain amount of destruction of the ultimate nerve filaments. Dana¹⁶ (1898) practically agrees with certain observers and has found degeneration of nerve cells, perivascular dilatation, and infiltration of the cells of the intima of the small arteries; also fibrinous deposits on the walls of the heart.

As to Prognosis, we have to consider the question of duration of the immediate attack, its probable recurrence, and the possibility of a fatal termination. I have already called attention to the two first, and I shall simply add that chorea minor is usually a simple and curable affection. In adults this is not the case, for when no other cause can be ascertained, it is unhappily true that the affection is too often indicative of some such gross cerebral disease as tumor or sclerosis, or is a sequence of arterial rupture. I have seen many cases of the simple affection in chlorotic young women, in fact in women of thirty to forty, which was readily curable; so even this rule has its exceptions.

The danger in fatal cases arises from exhaustion, from the debility caused by the constant excessive motion, and by attendant insomnia. In febrile cases the prognosis is decidedly bad if anything like a typhoidal state supervenes.

Numerous fatal examples have been reported. Griswold¹⁶ relates a case which proved fatal in sixteen days, and Ogle¹⁷ brought forward sixteen other cases.

Haven, of Boston, has made some very interesting investigations, and has analyzed 200 cases of chorea. From his table it would appear that the average duration of the disease, in 25 such cases as he could follow up, was 94.5 days. In others it was 77 days, when arsenic was used.

Gray and Tuckwell have also gathered statistics in a number of cases when no treatment was given, and the average duration was from 72 to 76 days in different sets of cases. It is not uncommon to find cases which recover in six weeks, and sometimes, under the use of ferruginous tonics, the period may be much shorter.

The tendency to relapses is quite common; in fact, Haven found that there was 1 relapse in 23 cases, 2 in 4, 3 in 2, 4 in 1, 5 in 1, and 7 in 1, and 14 of these recurred in the first six months of the year. Von Ziemssen refers to the fact that recurrences are most common at puberty. Of 33 cases of chorea the notes of which I have kept—and the number would have been much larger were it

not for the fact that many were observed at dispensaries, where the attendance is so irregular and floating—I found that in 40 per cent. of the cases there were 2 relapses.

The residual paralysis is sometimes, though rarely, quite lasting. If a hemichorea exist for a year, it is quite likely to be associated with some loss of muscular substance. In one of West's cases—a girl—it was found, three months after the movements had ceased, that the left arm was half an inch smaller than the right. In another patient—who had kept her hands clenched for a long time—there was wasting and contraction.

The DIAGNOSIS of chorea should be simple enough, if we throw out of consideration those cases of organic origin, the so-called "post-hemiplegic chorea." The movements themselves can hardly be confounded with any others. They are coarse, jerky, and irregular, and in no sense rhythmical. The same cannot be said of the movements observed in post-hemiplegic chorea, in which, besides eccentric jactitations, there is usually more or less tremor. The movements of chorea may in simple cases (I may say always in chorea minor) be controlled, in part or wholly, by the exercise of the will. Embarrassment and diversion of attention seem to aggravate the intensity.

The age of the subject is also a determining factor. Those forms of degeneration of the brain or spinal cord in which hyperkinesia is a symptom are very rare in children, the exception, perhaps, being cerebral hypertrophy and hemiatrophy; and here we find errors in development and other concomitant symptoms which render diagnosis quite simple.

In paralysis agitans we have an affection which resembles to some extent certain varieties of adult chorea. We find festination, associated movements, no aggravation by attempt at control, and a "fineness" of the spasms which can hardly be called choreic.

In the diagnosis of the particular cases much depends upon our ability to determine the probable nature of the chorea itself; whether it be due to eccentric irritation, to anemia; whether it be a sequence of one of the zymotic diseases; or whether it be a symptomatic affection, the result of some form of tissue change. These things are important when we come to predict the course of the malady. It will readily be seen how much credit may be gained by recognizing the true nature of a chorea dependent upon intestinal worms or other irritative causes, and promptly curing the same by expulsion of the irritating agents. The connection of the disease with some affection of the heart is also most important to recognize.

The TREATMENT of chorea has probably received more attention than that of any other nervous disorder, and the list of remedies, good, bad, and indifferent, is very long. As I have said, there is very little difference between the duration of the malady in those patients for whom the expectant treatment is ordered, and the duration in the case of those who are subjected to a rigorous course of medication of the orthodox kind. In the practice of medicine, masterly inactivity is not always the most prudent method of procedure, but in chorea minor I would counsel the simplest treatment possible. Of the vast horde of remedies, I think we can discard all but three or four, and I will name them in their order of usefulness: (1) Arsenic; (2) strychnine; (3) iron; (4) the fats.

There is a second list of remedies which are employed for the purpose of reaching special conditions, and among these I may mention heat and cold, anthelmintics, sedatives, the coal-tar products, etc.

If we do use any of the remedies of the first order, it must be freely and with the idea of getting their full physiological effects; especially is this true of arsenic and strychnine. In children the dose of the former should be rapidly increased until slight œdema becomes visible below the eyes, while the good effects of strychnine are obtained only when there is complaint of tension of the back-leg muscles. For reasons of safety as well as on account of greater efficacy, a bulky solution of strychnine is recommended in preference to drops or granules. In combination with the syrup of the iodide of iron, the latter drug is of especial service in the anemia of chorea.

To this mixture may be added digitalis, especially in many cases in which cardiac asthenia is a feature. The French writers favor the division of chorea into many forms with relation to the etiological factors. When such forms are clearly made out, of course it becomes our aim to direct special treatment to the individual cases. In those forms with *rheumatismal* history, the salicylate of soda, the tincture of cimicifuga racemosa, sulphur and vapor baths and alkalies, are of great service; hysterical cases are most helped by the valerianate of zinc, cyripedin, or cannabis indica. In many cases the removal of an ulcerated wisdom tooth is sufficient to effect the disappearance of a violent chorea, and when intestinal worms exist, we are to turn to turpentine, kousso, or santonin.

Should the movements be sufficiently violent, as they often are, to necessitate the use of restraint, I know of no better remedies than hyoscyamine or chloral hydrate. Of the benefit of calabar bean in such cases, I have little to say. It has never been of the slightest service in several cases in which I have tried it, and I may say the same thing of belladonna. Axenfeld recommends opium in large doses, but he wisely cautions those who administer it to children. Gery and Fuster recommend the repeated use of chloroform—in inhalation—several times a day.

In some cases the remedies cited above may be used hypodermically, but, as a rule, this is an unnecessarily painful mode of treatment. Arsenic has been used in this way.

Four or five drops of Fowler's solution may be injected daily in the affected member; and by Radcliffe, Eulen- burg, and others, it is said to act more quickly than when administered by the stomach.

The use of cold is occasionally of great benefit to the choreic patient. The application of the ether spray to the entire spine every day, for ten or fifteen minutes, or the application of cold by means of the ice-bag, is excellent, especially in violent cases. I have of late applied the needle douche, using several gallons of water.

It is of the utmost importance that the patient should be kept quiet, and that muscular exercise should be forbidden. A few hours' seclusion daily, in a dark room, works wonders, and at other times the patient should be made to assume a recumbent position, if possible.

There is no other nervous disease which is helped so much by proper diet as this. Fats are essential, and a liberal administration of milk and cream as well as fresh butter is highly recommended. Good substantial soups, raw meat, and condensed nitrogenous nourishment should be provided to the exclusion of everything else which simply satisfies hunger or gratifies the capricious appetite of the patient. Sea air is of immense service, and sea baths, if not too wearisome, are to be advised. Still-water bathing, of course, is to be preferred to surf bathing.

Moral treatment is of great value in many cases. West, whose sensible ideas of treatment I have always adopted, when possible, calls attention to the emotional perversion in choreic children, and speaks as well of the hebetude and weariness of mind, which seem to disappear with the movements. He considers moral therapeutics inapplicable to those cases of partial chorea which sometimes, though not often, last through life. The treatment should consist in removing mental strain, abridging study, and instituting a regular life and proper habits, and in building up the child's will power. The consciousness of the child, in regard to his infirmities, should not always be awakened, except when it is clearly a bad habit and not the result of disease.

Alan McLane Hamilton.

¹ Hecker's Epidemics of the Middle Ages.
² A Clinical Treatise on the Diseases of the Nervous System, by M. Rosenthal, p. 390.
³ Boston Med. and Surg. Journal, vol. cxii., No. 14.
⁴ Annales Medico-Psych., 1865.
⁵ On Idioey and Imbecility, p. 242.
⁶ British Medical Journal, vol. II., 1873, p. 9.
⁷ Boston Med. and Surg. Journal, 1881, p. 297.
⁸ Ein Fall von angeborener Chorea. Wiener med. Wochenschrift, 1876, xxvi., 456.
⁹ On Functional Nervous Disorders, p. 350.
¹⁰ Op. cit., p. 388.

¹¹ Archives Générales de Méd., March, 1865.
¹² Comptes rendus, tome lxx., 1870.
¹³ Archiv für path. Anat., lxi., pp. 485-493, Berlin, 1874.
¹⁴ Wien. med. Wochenschrift, 1868, xviii., 227, 244; Wien. med. Presse, 1868, ix., 194-196.
¹⁵ Deutsches Archiv für klinische Med., 1877, xx., 383, 396.
¹⁶ Cincinnati Journal of Medicine, 1867, II., 338.
¹⁷ British and Foreign Medico-Chir. Rev., 1868, xii., 208, 465.
¹⁸ Text-Book of Nervous Diseases, 4th edition, 1898.

CHORION.—The chorion is the outermost of the membranes which surround the embryo, and plays a most important part in its development, as it soon comes in contact with the decidua and takes an active part in the formation of the fetal portion of the placenta.

According to Minot, "the chorion is the whole of that portion of the extra-embryonic somatopleure which is not concerned in the formation of the amnion." This definition is undoubtedly correct for a large number of animals, but recent investigations render it doubtful whether it applies to man; as all of the earliest human ova which have yet been described (from the latter part of the first and the beginning of the second week) possess a distinctly formed chorion before there is any apparent differentiation into somato- and splancho-pleure.

According to Kollmann, it is more than probable that a distinct chorion is formed by the time the ovum reaches the uterine cavity, but unfortunately so young a specimen has not as yet been observed.

Theoretically, the chorion represents the outer layer of the blastodermic vesicle, and accordingly its epithelial layer must be derived from the primary ectoderm of the ovum. The earliest human ova which have yet been described are those of Peters and Graf Spee, in both of which the chorion is perfectly developed, while the embryo is in a very rudimentary condition.

Peters obtained his ovum at an autopsy upon a woman who committed suicide three days after missing a menstrual period, and he believed that it was not more than three or four days old. From his description, however, it appears to be somewhat older, but certainly not older than ten days. The ovum measured 1.6 x 0.8 x 0.9 mm. in its various diameters, and is therefore the smallest which has thus far been reported. It was embedded in the decidua and lay beneath its surface, having apparently burrowed its way through the epithelium; and it gives most important information concerning the mode of implantation of the ovum and the development of the decidua reflexa. The ovum presented a well-developed chorion which consisted of two layers: an inner layer of mesoderm and an outer layer composed of many layers

of epithelial cells, which Peters designated as trophoblast.

Protruding from the surface of the chorion were a few elevations, whose interior was filled with connective tissue, representing the earliest stage of villous formation. The trophoblast was arranged in many layers and surrounded the connective tissue of the chorion as a distinct capsule. It was made up in great part of round or polyhedral cells, which stained deeply and presented distinct vesicular nuclei, between which were a few masses of protoplasm which showed no tendency to

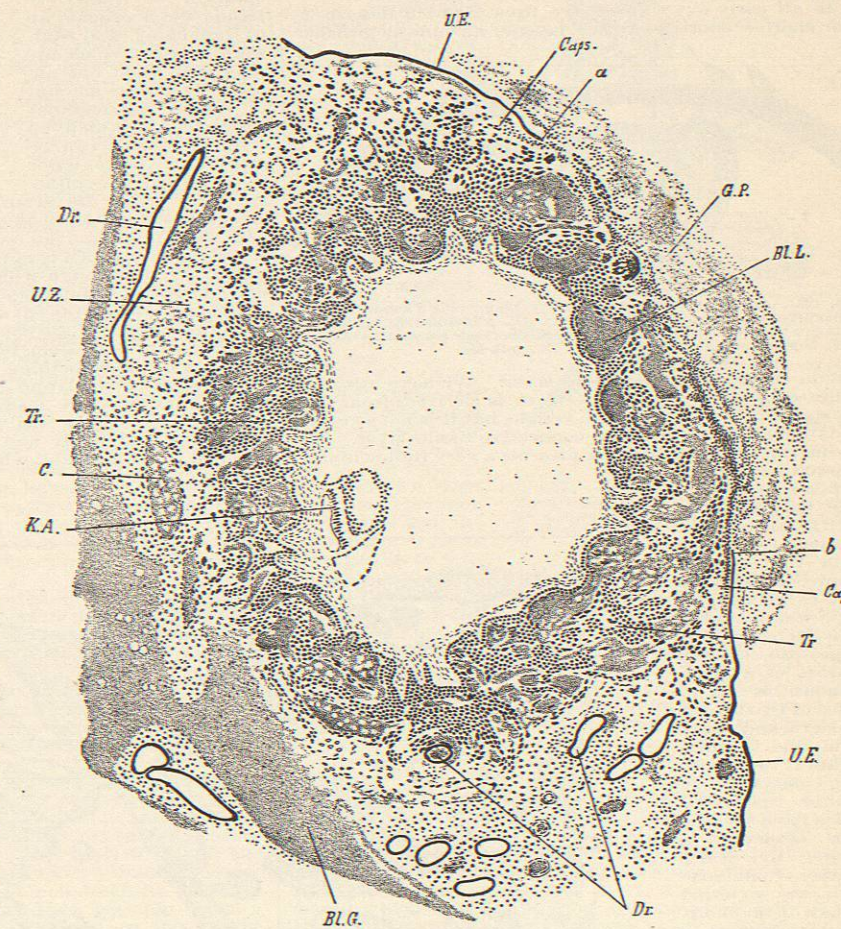


FIG. 1291.—Peters' Early Ovum. U.E., Uterine epithelium; B.L., lakes of blood; Caps., decidua reflexa; G.P., "Gewebspilz"; Dr., uterine glands; U.Z., decidua vera; Tr., trophoblasts; C., capillaries; K.A., beginning embryo; B.L.G., large blood-vessels; a-b, point of entrance of ovum.

divide into individual cells, through which were scattered irregularly shaped, darkly staining nuclei. The trophoblastic cells were apparently growing very rapidly, and had opened up dilated capillaries in the surrounding decidua, so that numerous small cavities were formed, which were lined by trophoblastic cells and filled with blood, and which probably represent the earliest stages in the formation of the intervillous circulation (Fig. 1291).

Spee's embryo was cast off from the uterus as an oval body, 9 x 6.5 mm., and consisted of a vesicle which en-