STERILITY

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The term sterility is somewhat difficult of precise scientific definition. It is not enough to say that sterility implies an inability to conceive, for it may be that by the removal of certain obstacles the individual may become perfectly capable of impregnation. It is necessary to understand, therefore, that the word sterility may be used in a variety of senses, for which a number of modifying terms have been suggested. Absolute sterility is a condition where impregnation is obviously impossible as in cases of absent uterus, or ovaries, or in congenital absence of vagina. The expressions primary and secondary sterility are frequently used. Primary sterility denotes that the individual does not conceive under normal conditions during the first few years of married life, arbitrary times being set by different observers, as three years (Kisch) and five years (Torkel and E. Fränkel). Secondary sterility is used to describe the individual who though fruitful in the first period of married life later becomes incapable of fertilization.

Primary sterility may or may not be absolute. A patient who by medical or surgical interference has become fertile may be said to have been primarily sterile. Even without medical interference a woman may be primarily sterile for a long period of time and then unexpectedly conceive, as in a case of my own, where primary sterility lasted for nineteen years before impregnation took place, though there was no

change in domestic conditions and no artificial interference. An example of secondary sterility is the so-called one-child sterility which results from infection of the genital tract after the first impregnation. The secondary form includes also various other conditions of acquired sterility such as may result from local or general infections, constitutional diseases, tumors, etc., which may affect the patient after a period of fertility.

There are other expressions used, such as temporary sterility, relative sterility, congenital sterility, etc. The term, acquired sterility, is one of much value and one which will frequently be used in this paper. It includes secondary sterility but can be used more broadly in that it may relate to individuals before marriage. It implies that in an individual, fully developed and entirely capable of conception, some cause intervenes which renders her incapable of conception. The causes are the same as those of secondary sterility, namely, infections, constitutional diseases, tumors, castration, etc.

The causes of sterility have been variously classified by different writers. These classifications are instructive and worthy of review.

Marion Sims in his early monograph referred sterility chiefly to mechanical obstruction, ignoring practically all other causes.

Mayerhofer divided the causes into (1) Disturbances in the ripening and escape of the ovum. (2) Mechanical hindrances to conception. (3) Pathological conditions in the uterine tissues.

F. Winckel distinguished the following groups: (1) Cases in which the meeting of the spermatozoön and the ovum is prevented. (2) Those where the spermatozoön or the ovary are chemically disturbed. (3) Those where the ovum is prevented from being discharged, or is killed by nutrition disturbances of the ovaries.

Kisch divides the subject into (1) Sterility produced by incapability of full development of the germ cell. (2) Sterility due to hindrance of contact between the normal sperm and ovum. (3) Sterility due to inability to nourish the impregnated egg.

A. Barone classifies the subject into 5 divisions: (1) Anatomical causes, especially those due to deficient development. (2) Psychonervous sterility. (3) Sterility from constitutional diseases. (4) Sterility from local pathological processes of the genitalia. (5) That due to mechanical obstruction.

Ferdinand Schenk adopts the following division: (1) Sterility—conditioned by pathological changes of a local nature. (2) Sterility—conditioned by pathological changes of a general nature. (3) Sterility—without obvious anatomic cause. (Cited from Neumann *Wien. med. Woch.*, 1911, p. 1094.)

I have found it convenient to divide the causes of sterility very broadly into those that are idiopathic and those that are acquired. The chief idiopathic causes of sterility are fetalism and infantilism of the genital organs. Fetalism, a term introduced by Alfred Hegar, relates to a faulty or arrested development that takes place in intra-uterine life, and is represented by the various forms of uterus didelphys or the failure of the union of the Müllerian ducts, and by conditions of aplasia, such as absence of the vagina, uterus, ovaries or tubes. In most cases of fetalism impregnation is obviously impossible, and therapeutic or surgical measures for producing fertility are entirely out of the question. Infantilism, on the other hand, as the term will be used in this paper, presupposes that the individual has been born with a full equipment of genital organs, without mechanical obstruction to fetation, but that during childhood an arrest in development takes place so that in the child-bearing age the organs retain certain characteristics of the prepubescent

period. Infantilism of the genitals may occur as the only stigma of defective development and the individual may be otherwise perfectly and even exceptionally developed; or the genital infantilism may constitute only an incident in a general hypoplasia manifested in other parts of the body. We see, therefore, two characteristic types of sterile women, one the large, full-blooded, often powerful-looking individual, with tendency to fat accumulation, and the other the meagre, unripe, old-maid type. In the woman of the first class there is usually nothing in the external appearances to suggest a genital hypoplasia, while the individual of the latter class exhibits numerous easily recognizable characteristics. Among the familiar marks of the old-maid type of woman are the long, thin, unbeautiful neck; the long small thorax; the weak flat back with its spinal curvature, winged scapulæ and lack of muscular development; the flat pelvis; the poor development of the glutei muscles; the narrow hips and slender thighs, and the underdeveloped or thin pendulous breasts. In both these classes of women the nervous system is extremely sensitive and the nervous equilibrium unstable. In both, there is usually some menstrual disturbances most commonly in the form of severe dysmenorrhea which is an important factor in the nervous symptomatology.

The genitals of the hypoplastic woman have characteristic forms. The uterus is smaller than normal and usually in some form of malposition. The cervix is narrow, elongated, and conical at the end. The external os is usually contracted but not necessarily so and may even be dilated. The uterus usually has an abnormal relationship to the cervix in that it is either anteflexed or retroflexed. The vagina is often narrow, or short, or with a short posterior wall that obliterates the pouch that normally lies behind the cervix and which is designated the receptaculum seminis. The ovaries are often entirely normal in appearance, but they may have one of two forms, which have been described by

Hermann as characteristic of sterile women. One is the long, thin, infantile type, and the other is the large, cystic variety. In the latter the outer sheath or albuginea is thicker than normal and there is less scarring of the surface, which is smooth and white, while small cystic degeneration is usually marked. The tubes not infrequently show marked torsion and the fimbriæ may be scanty. The external genitals may or may not be fully developed, but in the old-maid type of woman they are often meagre, the labia minora being pale and thin, and the labia majora being flat and ill-formed. In such cases the musculature of the perineum is often defective and occasionally vaginal prolapse or procidentia of the uterus occurs.

Causes of Infantilism. The causes of infantilism are somewhat problematical. It would seem as if hereditary and early environmental influences might be important factors. There is no doubt that syphilis, alcoholism, epilepsy, and insanity of ancestors, as well as race degeneration from incest or consanguinity are responsible for a certain amount of infantilism in the offspring. Premature birth, poor nourishment during infancy, early diseases, such as rickets, tuberculosis, chlorosis, etc., are often found in the histories of hypoplastic individuals. Many cases show congenital defects in the circulatory and respiratory organs, such as small hearts, narrow and thin-walled vessels, and long, narrow chest walls, with insufficient lung capacity, though these defects are often regarded not so much a cause of the genital infantilism as a manifestation of a general constitutional hypoplasia in which the genital defects incidentally take place.

It is necessary to take into consideration the possible relationship of the other glands of internal secretion, such as the adrenals, the thyroid, the hypophysis, and the thymus. It is well known that these organs all have an intimate relationship with the organs of generation, and it is not unreasonable to suppose that mild disturbances of the

harmony between these related organs of internal secretion may interfere with the most important function of the ovary and its germ cells. Diseases of the various organs of internal secretion are usually attended with genital atrophy or infantilism and sterility. Patients suffering from hypophyseal diseases such as acromegaly and giantism, or hypopituitarism, are amenorrheic and sterile. Patients with myxedema are usually sterile and have deficient genitalia, while Graves's disease is often attended with sterility and functional disturbances of menstruation. The same is true of Addison's disease. This branch of the subject of sterility is comparatively new, but the knowledge which is rapidly being acquired of the physiology and chemistry of the organs of internal secretion gives great promise of shedding light on a class of cases which has hitherto been completely baffling.

The question of the possible influence of the ovarian secretion on the development of the genitalia is a puzzling one, and one which at present is in a very theoretic stage. Early castration has been shown to limit the development of the uterus and the external genitals but most observations in human beings have been taken from males, and conclusions are drawn from the assumption that the testicles and ovaries are entirely analogous glands. It is doubtful if early castration of human females produces as profound an effect as it does in males. Certainly the cases of rudimentary or absent primary sexual organs in young women who are fully developed in their secondary characteristics would lead one to this conclusion. If one adopts the theory that the internal secretion of the ovaries is chiefly from the corpus luteum it is difficult to see how the ovary can be of great importance to development before the age of puberty. It is probable, however, that the follicle apparatus produces a secretion which presides over the functions of early development, though this has not yet been incontestably proved.

It is an interesting query why infantilism is more common in women than it is in men. It may be said that the sexual apparatus of woman is so much more complicated than that of man that the chances of local hypoplasia are very much increased. Hans Bab naively says: "In general habit, in bodily constitution, and in general mentality woman is halfway between man and child, and hence, a certain amount of infantilism may be regarded as physiological." There is possibly some biological basis for this theory.

In considering the causes of sterility from infantilism, it is necessary to realize that there is a wide field of possibilities, any one of which may conceivably be sufficient to prevent impregnation. These various abnormalities may occur in any part of the internal or external genitalia, and it is important to discuss them in detail.

Ovaries. As has been said, the ovaries of women, who are sterile on account of infantilism, may be entirely normal or they may present certain characteristics typical of the hypoplastic condition. In somewhat rare instances there is an incomplete descent of the ovary, which may be retained in a position at or even above the brim of the pelvis. It is usually associated with a short appendiculo-ovarian ligament which may have the effect of retroverting the uterus. In one of my own cases the right ovary and end of the tube lay above the brim of the pelvis, the tube being attached to the right side of a double uterus. In this instance the defect must have been fetal in origin. Busse[1] describes a case in which the left adnexa lay in the kidney region, as a result of adhesions following a fetal peritonitis. Non-descent of the ovary, however, is not to be regarded as a common cause of sterility, and whenever it occurs there are usually other stigmas of developmental defect sufficient to prevent fetation.

[1] Ref. Beiträge zur Geb. u. Gyn., 1909, p. 21.

The ovaries in infantilism often present certain characteristics that may be of special significance. They may be very small, often not larger than a hazel-nut. The contour instead of being oval is often elongated or spindle-shaped, while in other instances the ovary while retaining its normal contour is markedly flattened.

Another characteristic frequently seen in infantile ovaries is the dense whiteness and smoothness of the surface. This is due to a marked thickening of the albuginea, or connective-tissue cortex of the organ. Many times the ovaries of infantilism are larger than normal, due to the tendency to atretic follicle formation.

If these hypoplastic ovaries be examined microscopically it will often be found that most of the follicles have not developed beyond the primordial state, and that there is a marked increase in connective tissue as manifested by the thickened albuginea. According to Kehrer[1] this development of the follicle apparatus accounts for the defective function of the ovaries on the ground of a deficient ovarian secretion; and explains the frequency of the late onset of menstruation, the frequency of amenorrhea, and dysmenorrhea, of sterility and failure of sexual impulse, vicarious menstruation, etc. It should be remembered, however, in this connection, that such explanations are only theoretical and that there has as yet been no incontestable proof of any such influence of the ovarian inner secretion.

Just as theoretical is the explanation of ovarian deficiency on what might be called mechanical grounds by which an attempt is made to show that the proper ripening and bursting of the follicle is prevented either by too great external resistance or by insufficient internal pressure.

Ovaries vary very greatly in size and in the number of follicles in different individuals and even in the same indi-

[1] Monatsschr. f. Geb. u. Gyn., 1909.

vidual. According to Waldeyer and Heyse, the average total number of follicles amounts to about 3500. Only about 400 of these follicles ripen during the thirty years of menstrual life, hence most of them become atretic with the consequent death of the ovum and the granulosa epithelium. According to Strassman (v. Winckel I) this follicle-atresia represents a rudimentary state of development and takes place not only in young childhood but even in fetal life. Certain it is that it is very characteristic of the ovaries of hypoplastic genitalia in which the follicle atresia seems to take the place partially or completely of the normal ripening and bursting. The cause of this is uncertain, but may be explained theoretically with a certain amount of reason. The complicated process of ripening and bursting of a normal mature follicle presupposes rather a delicate balance between the internal pressure of the follicle and the resisting power of the surrounding envelope of the ovary. As has been pointed out, the ovaries of sterile women often show an albuginea (or connective-tissue cortex) which is thicker and denser than normal. It is also seen that the cells of the germinal epithelium in infantile ovaries are higher and larger than those of the normal ovary. Hence it is conceivable that the follicle meets with too great a resistance to reach full maturity and discharge of the ovum. It is possible, too, as Hans Bab suggests, that the internal pressure of the follicle may be deficient on account of incomplete congestion, as is manifested by the scanty or infrequent menstruation which often characterizes these cases. It is not uncommon to find no traces whatever of corpus luteum formation in these ovaries.

It must be admitted that our knowledge of an ovarian insufficiency is vague and based almost entirely on theory; nevertheless, it seems altogether probable that such a condition does actually exist, howsoever it may be caused. There is certainly reasonable hope that the studies that are

now being carried on in the physiology and pathology of the ovarian functions will in time lead to a clearer understanding of abnormal menstruation and ovarian sterility, subjects which at present are veiled in mystery.

TUBES. Although we know that the tubes play a most important role in the acquired sterility, such as results from gonorrhea and tuberculosis, we do not always realize that they, too, may take part in the genital hypoplasia, and be the means of preventing conception. Some of the theories regarding infantilism of the tubes are worthy of note. W. A. Freund, to whom we are indebted for the foundation of our present knowledge of the subject of infantilism, called attention to the fact that at birth the tubes are markedly twisted in a spiral form, especially at the uterine ends. We are familiar with this appearance in cases of chronic salpingitis, and it was at first objected that what Freund had interpreted as a congenital twisting was in fact the result of a fetal pelvic inflammation. This abnormality has been found so commonly, however, in cases of genital hypoplasia, that it is now regarded as a stigma of infantilism, and it is thought that it may in some way prevent conception. It is supposed also that this congenital twisting of the tube may account for those unexplained cases of extra-uterine pregnancy which occasionally occur in women who have long been sterile.

Bumm has called attention to the fact that the development of the fimbriated end of the tube may be of great importance in receiving the egg on its passage from the ovary, and shows how in normal cases the fimbriæ exhibit a beautifully delicate and profuse structure, while in others it is scanty and meagre. When one considers the frequency with which impregnation takes place after resection of the tubes, it must be admitted that the presence of the fimbriæ is not necessarily essential to impregnation, though it is probable that defective development of them acts as a partial preventive of conception.

Other structures of the tube which may be affected by infantilism are the musculature, the labyrinth, and the cilia. The arrangement of the muscular structure of the tubes makes it probable that a peristaltic action takes place, which is important in passing on the germ cells and that incomplete action due to congenital weakness may result in sterility or extra-uterine pregnancy. The labyrinth and the cilia are of very great importance in a sterility which is due to inflammatory processes, and there is no reason to doubt that an incomplete development of these delicate structures of the tube may also have a considerable influence in preventing fertility.

One author (Bab) seriously recommends hydrostatic dilatation of the tubes by injection of normal salt-solution into the uterine cavity. Such a procedure is, however, unsurgical, dangerous, and entirely impracticable.

Uterus. In making a diagnosis of genital infantilism one is very largely guided by the examination of the uterus, and it is to this organ that surgical or manipulative treatment is usually directed. There is no doubt that developmental abnormalities in the position of the uterus often cause sterility as is proved by the frequency with which the condition is cured by surgical interference.

The infantile uterus is the keynote to genital hypoplasia and is easily recognizable. It may appear in two forms: in the first, the entire uterus, normal in its proportions of the body and neck, is simply a miniature of the fully developed organ, and is termed a pubescent or dwarf uterus. In the second and far more common form, there is a disproportion between the body and neck. Whereas normally the body of the uterus is about 7 cm. long and the cervix 3 cm., in the infantile uterus the conditions are reversed, the cervix being longer than the body. There is usually also an abnormal relationship in position between the body and the neck, in the form of a sharp anteflexion or retroflexion.

The long cervix is slender and conical and *points in the axis* of the vagina whether the body be ante- or retroflexed. If there is no abnormal flexion and the body is in position, the cervix points in the proper direction, but is so long that it impinges on the posterior wall of the vagina and gives one the impression of being far back in the sacrum.

Of the conditions of retroflexion and anteflexion that of anteflexion is much more common and occurs so frequently that a diagnosis of its presence can usually be made from the history of dysmenorrhea and sterility with which it is usually associated. The cause of anterflexion, or, as Karl Hegar better terms it, "hyperanteflexion" has been variously explained. Mathes thinks it is due to a congenital shortening of the utero-sacral ligaments which, being attached high on the back of the uterus, draw it sharply back toward the sacral fossa. Others have ascribed the condition to a muscular contraction. A long study of these cases has convinced me that so-called congenital anteflexion is largely gravitational, due to defective development of the supporting structures of the uterus, and my reasons for this belief are as follows:

In the average case of anteflexion the cervix is always found pointing in the direction of the long axis of the vagina, exactly as it does in backward displacements. The whole organ is found to lie backward toward the sacrum in the position properly called retrocession. Under full anesthesia the organ is invariably found to be soft and flaccid and abnormally mobile. If the abdomen be opened, the anteflexion is at once reduced by lifting the fundus toward the abdominal wall, whereupon the cervix assumes its proper direction, pointing at right angles to the axis of the vagina. On releasing the hold of the fundus the uterus immediately drops weakly back into its former position. It seems evident that the organ, lacking the helping support of fully developed ligaments and deficient in its own musculature is squatting helplessly in the sacral hollow, the only thing to prevent the

fundus falling back in retroflexion being the round ligaments. Abnormally short uterosacral ligaments would, of course, encourage the condition, but, on the other hand, it is not unreasonable to suppose that the shortness of the ligaments is secondary to the long retrocession of the uterus. As a matter of fact, the uterosacral ligaments are by no means always short. As will be seen later, this conception of the cause of hyperanteflexion has an important bearing on the method of treatment.

The retroflexions of infantilism can, in my opinion, be explained in the same way; namely, that in most cases the retrodisplacement is gravitational and the result of defective support. According to this theory the only difference between the anteflexion and retroflexion of infantilism would be that in anteflexion the round ligaments are sufficiently short to hold the fundus forward. In both cases the anatomical condition is essentially the same, namely, a *retrodisplacement*, due to imperfect support.

Undoubtedly other defects which are usually assigned as the cause of retroflexion favor its occurrence, such for example, as the incomplete descent of the ovary or an abnormally short anterior vaginal wall, which tends to draw the cervix forward and the fundus back (Saenger). It may be said that incomplete descent of the ovary is rare, while short vaginal wall occurs with equal frequency in anteflexion.

Our next inquiry is: "Why do developmental flexions of the uterus cause sterility?" Up to the present time no very satisfactory answer to this question has been evolved. It is inconceivable that the bend in the uterus should act as an actual mechanical obstruction to the passage of the spermatozoön by narrowing the canal. In most cases the canal is dilated with great ease, the only difficulty being in those instances where a cicatricial band forms near the point of flexion. The old-time theory of obstruction is explained away by the observations of uteri in swine, sheep, and dogs,

in which the sharpest physiological flexions cause no hindrance to the spermatozoa.

There is little doubt that the abnormal relationship that exists between the cervix and vagina in all cases of forward or backward flexion has an important influence in preventing sterility. We have seen that the cervix points in the direction of the long axis of the vagina, instead of at right angles to it. It would at first seem as if the former were a more favorable position for the reception of the spermatozoön after ejaculation, and in fact, anatomists not so very long ago believed it to be the normal position of the cervix. Even *Gray's Anatomy* in its latest edition depicts the normal uterus in the second degree of retroversion with the cervix pointing in the long axis of the vagina. It has been pointed out, however, that the pouch which lies behind the vaginal portion of the cervix plays an important role in the retention of the semen, and has aptly been termed by Beigel the receptaculum seminis. Under normal anatomical conditions the cervix points directly into this receptacle and after coition dips into the pool of semen there retained. In this way the passage of the spermatozoa into the cervical canal is greatly favored. In nearly all cases of hypoplasia this proper relationship between cervix and vagina is disturbed. If the uterus is flexed either forward or backward, the cervix points directly away from the receptaculum. When there is no flexion, the cervix is often so long that it impinges strongly against the posterior wall and the receptaculum is obliterated. Abnormal shortness of the vaginal wall may bring about like conditions, for if the anterior wall is too short the cervix is pulled forward, and if the posterior wall is too short the receptaculum is obliterated.

It has been mentioned above that in many cases of flexion due to hypoplasia there exists a cicatricial band in the cervical canal corresponding to the point of angulation, usually at the level of the internal os. This band offers a distinct

resistance to the passage of sound or dilator, and gives an impression similar to that given by a urethral stricture. Bumm has styled this condition "callous stenosis" of the cervix, and is of the opinion that it is an important factor in the prevention of conception. The origin of this cicatricial band is not known. Whether it is a result of the long-standing flexion or whether it existed primarily and was instrumental in causing the flexion is a matter of speculation. The existence of abnormal connective tissue in the infantile uterus is not surprising in view of the fact that in the uterus before puberty there is a large proportion of connective tissue to musculature (Theilhaber).

It is also a matter of speculation as to how this cicatricial band serves to prevent conception. It may alter the reaction of the cervical secretions by interference with its circulation or it may favor the formation of a cervical mucous plug which obstructs the entrance of spermatozoa. Moreover, it is observed that where this callous stenosis is present the cervix has a tendency to be stiff and unyielding. Sims, many years ago, called attention to the fact that the structure of the cervix, as well as its form and position, is of much significance for the reception of the spermatozoön, and there is no doubt that a cervix lacking in normal mobility is unfavorable to fertility. This is especially important in view of the fact that the normal cervix has to a certain extent the function of aspirating the semen from the vagina (Rohleder, p. 131). E. Fränkel has pointed out that the prognosis for the cure of sterility where callous stenosis is present is especially bad.

The term "effluvium seminis" is used to describe the escape of semen from the vagina following coitus, and is thought by some to be an important cause of sterility. This condition may be brought about by lacerations and prolapse of the vaginal walls from childbirth, but it may also be the result of hypoplastic defects in the vaginal wall. Bumm has

repeatedly shown, in cases of short anterior vaginal wall, the absence of spermatozoa in the vaginal or cervical secretion shortly after coitus. It is said that some women have the power of voluntarily pressing out the semen and thus preventing conception for long periods of time. Bumm says: "Although only one spermatozoön is necessary for fertilization, nevertheless there is little chance of a meeting of the egg and this one, if out of the millions of spermatazoa deposited at each coition, at least thousands do not reach the internal genitalia."

Natanson and Konigstein[1] have investigated the significance of the escape of semen from the vagina as a cause of sterility in 26 sterile women who complained of this complication. They examined the uterine and vaginal secretions for spermatozoa from three to sixty hours post coitum. Of the 26 cases, 13 had uterine misplacements, 11 were hypoplastic, and 2 had cervical catarrh without anatomical changes of the uterus. 22 of the women had primary, and 4 had secondary sterility. In 38.5 per cent. spermatozoa were not found in the uterus, and in some of these they were not found in the vagina. Hence it is likely that the man was at fault in some of these cases. Spermatozoa were found in the uterine and vaginal secretions in 6 out of the 13 misplacement cases, in 9 out of the 11 hypoplastic cases, and in 1 of the cervical catarrh cases. Inasmuch as spermatozoa were found in large numbers in the uterine secretions of 61.5 per cent. of these cases, the writers conclude that the symptom of effluvium seminis cannot be regarded as an adequate cause for sterility.

Although effluvium seminis may prevent conception to a certain extent, its effect must be only relative, as is proved by the frequency with which impregnation takes place without introition. The following is a case in point:

[1] Wien. klin. Woch., 1910, No. 22.

A woman, aged twenty-eight years, married about a year and a half to a man considerably older than herself, consulted doctors for a rapidly growing abdominal tumor. There had been a cessation of menses. Both husband and wife denied having had coitus, and each doctor after examination of the patient made a diagnosis of fibroid tumor. She consulted me for operation. Examination showed a pregnancy that was within a few days of full term. The hymen was unruptured and was so small that the little finger could not be introduced. The husband then admitted coitus without introition.

ACQUIRED STERILITY

GONORRHEA. Of the acquired causes of sterility gonorrhea is by far the most important, especially when one considers the blighting effect the disease has on the procreative powers of man as well as of woman.

In woman gonorrhea most commonly prevents fertility by sealing the ends of the Fallopian tubes, or by so injuring the mucous membrane of the tubes as to destroy their function as oviducts. This injury consists in a gluing together of the tips of the delicate rugæ of the tubal mucous membrane so that the germ cell, instead of finding a free passage through the tube, encounters a labyrinth of blind pockets. It is probable, too, that in this process there is a more or less permanent destruction of the cilia which clothe the tubal epithelium and which are thought to aid in the transference of the germ cell.

Gonorrheal infection of the adnexa has been differently estimated as the cause of sterility in women in proportions varying from 8 per cent. to 59 per cent. Sänger's figures, showing 33 per cent., are probably near the truth.

Gonorrhea limits fertility also by infection of the cervical mucous membrane, chronic endocervicitis being a frequent

cause for primary sterility. This condition is, however, less serious than when the adnexa are involved. Endocervicitis may also be the cause of secondary sterility for it not infrequently happens that a gonorrhea of the cervix acquired after impregnation ascends to the tubes postpartum and thus causes a permanent secondary sterility. This process is the chief factor in one-child sterility. The part played by man in sterile marriages has of late received much attention, and he has been found at fault in a far greater number of cases than was formerly supposed. The cause of sterility in man, outside of impotency, is most commonly due to gonorrheal disease of the epididymes, vasa deferentia, or the seminal vesicles. The conditions found are azoöspermia, due to occlusion of the vasa deferentia from a double epididymitis; necrospermia, in which the spermatozoa are killed on account of pathological changes in the seminal vesicles and prostate; aspermatism, due to stricture.[1] Lier and Asher found that 70 per cent. of sterility in man is due to gonorrheal changes, and in comparing the relative responsibility of man and woman in sterile marriages they estimated that of man at about 40 per cent. and that of woman at about 60 per cent. The actual moral responsibility of man, however, is considerably greater than appears in these figures, because a very large percentage of the gonorrhea in married women has been transmitted from husband to wife.

Puerperal Sepsis. It is very difficult to compare the effects of gonorrheal infections with those of puerperal sepsis. Puerperal sepsis is itself frequently the result of gonorrheal infection, so that in such cases the cause and effect are essentially gonorrheal. Where the infection is entirely puerperal it is probable that permanent damage is less than that wrought by gonorrhea. Puerperal infections are more apt to invade the pelvis through the lymph channels

[1] Finger. Die Pathologie und Therapie der Sterilität beim Manne.

of the uterus and parametrium. Thus it is that the tubes are attacked from the outside. Even when puerperal sepsis passes into the tubes through the uterine ostia there is far less damage to the tubal mucosa than in gonorrheal salpingitis. Microscopically the pus is seen to be lying on the surface instead of invading the submucosa. There is not the plastic exudation and gluing of the rugæ that is seen in gonorrheal salpingitis and it is possible thus sometimes to make a microscopic diagnosis between the two forms of infection.

ENDOCERVICITIS. Endocervicitis, not gonorrheal in origin, is a condition to be reckoned with in treating sterility and one which is more readily susceptible of cure than are most of the other causes. It is manifested by a hypersecretion of the glands of the cervical mucous membrane, so that the cervix is filled continually with a thick plug of mucus, which acts as a complete mechanical obstruction to the passage of the spermatozoön. In some cases the reaction of the cervical secretion which is normally alkaline becomes acid, and hence becomes a medium in which it is impossible for the sperm cell to live.

This form of endocervitis may be due to ectropion and irritation of the cervical mucous membrane following laceration of the cervix, under which circumstances, according to Schauta, it may be a sufficient cause for sterility. On the other hand, it is often seen in nulliparous uteri even in virgins. It is often associated with hypoplastic uteri, in which case it may be induced by a callous stenosis of the internal os.

That this mucous hypersecretion is a definite etiological factor in sterility is entirely proved by the frequency with which a simple removal of the plug by a curetting or local treatment of the cervix is followed by fertility.

ENDOMETRITIS. When we come to infections of the endometrium with reference to sterility it must be admitted that our knowledge is very vague. We read much in the text-

books of the symptoms and treatment of acute gonorrheal endometritis and the baleful results of chronic endometritis as a result of the same disease. Nevertheless we find infrequent microscopic evidence of true endometritis, acute or chronic, even in cases of active gonorrhea of the adnexa. I am of the opinion, held by Dr. H. A. Kelly, that true endometritis is rare. It is evident that the gonococcus has little liking for the endometrium and passes to the more congenial tubal mucous membrane as rapidly as possible. In my experience infectious endometritis both acute and chronic is much more commonly the result of puerperal sepsis. It is doubtful if endometritis from any cause (excepting possibly tuberculosis) plays an important part in preventing conception, though it is probable that the chronic interstitial endometritis that occasionally follows puerperal or gonorrheal sepsis may encourage spontaneous abortion by offering a poor soil for the nourishment of the ovum.

GENITAL TUBERCULOSIS. Genital tuberculosis is nearly always attended with sterility. The tubes become involved in adhesions and become closed in the same way as in a gonorrheal infection. If the endosalpinx is involved the disease entirely obliterates the tubal canal, and frequently invades the endometrium and myometrium from above. Early genital tuberculosis often causes complete amenorrhea. The following cases is an excellent example:

A woman, aged twenty-eight years, had been married four years without children, and she sought treatment for sterility. The patient was a stout, rather fat person in apparently good health. She had had pneumonia fifteen years before and grip eight years before. *She had never menstruated in her life,* but for years she had had a constant foul, yellow discharge. She frequently had pelvic pains which she felt shooting into the rectum and vagina, and there was continual backache. She had had some bleeding from the rectum, which suggested occasional vicarious menstruation,

but it was not distinctive. Otherwise the patient was in good health, and the physical examination was negative. She stated that at the age of thirteen years she had suddenly begun to grow fat, and that she had been increasing so ever since.

Pelvic examination of this patient revealed a small, undeveloped uterus, with an infantile cervix in very sharp anteflexion. Nothing definite could be made out in the pelvis. The case was supposed to be one of infantilism, and it was decided to dilate and curette the uterus, and to straighten out the anteflexion by an anterior fixation, with very little hope of success. The uterus was dilated with great difficulty, and the anteflexion of the cervix was so rigid as to prevent completely the curetting of the uterine canal. The abdomen was then opened, and it was found that both tubes and ovaries were involved in dense, old adhesions to the intestines and parietal peritoneum. There was no sign of tubercles, and the case was supposed to be one of old gonorrheal inflammation. As there was no possibility of curing the patient's sterility, and as she was having definite symptoms from the inflammatory condition, uterus, tubes, and ovaries were removed by a supravaginal hysterectomy. A piece of ovarian tissue was implanted into the leaves of the left broad ligament. It was not until sections from the specimen were examined that the true diagnosis was discovered.

The pathological diagnosis was as follows: Bilateral, tubercular salpingitis; chronic interstitial oöphoritis; tubercular metritis; acute tubercular endometritis; corpus luteum cyst.

This pathological finding was most interesting. Both ovaries showed corpus luteum cysts. This was of moment because it showed that, although the uterus had not been menstruating, the ovaries had been ovulating. The conclusion to be drawn from this is that the cause of amenorrhea must have been in the atrophy of the myometrium and the

endometrium rather than in the ovaries. This was borne out by the fact that the tubercular process was absent in the ovaries, but present in the myometrium and endometrium. The acute endometritis which was doubtless a mixed infection of other organisms besides the tubercle bacillus accounted for the constant foul discharge which the patient had had ever since she could remember.

The fact that the patient had never menstruated, and that she had suddenly begun to grow fat at the age of thirteen years, makes it probable that the tubercular process began slowly and insidiously before the age of thirteen years and had an opportunity to invade a non-menstruating organ and thus inhibit its development.

CYSTIC DEGENERATION. Kossman thinks that small cystic degeneration of the ovaries causes sterility. It is not likely that cystic degeneration is itself a cause of sterility but rather merely an associated condition. We have already seen how it may be the result either of too great resistance on the part of the albuginea or of a deficient internal pressure in cases of hypoplasia. Cystic degeneration is also common in pelvic inflammatory cases but it is undoubtedly of entirely secondary importance as regards sterility. As a result of the investigations of Schiekele and others cystic degeneration of the ovaries is no longer regarded as an essential disease.

ACQUIRED MISPLACEMENTS OF THE UTERUS. It has already been pointed out that congenital or developmental misplacement may be an important factor in sterility. Acquired malposition may also prevent or limit fertility. There is no doubt that women with acquired retroversion-flexion are in a large percentage of cases sterile. That the malposition of the uterus is the cause of the sterility is shown sufficiently well by the frequency with which these patients become preganant after restoring the uterus to its normal position. In acquired retroversion conception is probably

prevented in the same way as in hypoplastic malpositions, not by mechanical obstruction, but by the dislocation of the cervix, by which it no longer properly dips into the receptaculum seminis.

Relaxation of the vaginal walls is sometimes regarded as a cause of sterility. It is doubtful, however, if this cause is a frequent one, for it is surprising occasionally to find women pregnant who have very marked prolapse sometimes amounting to a complete procidentia. If relaxation of the vagina does prevent conception it is probable that it is due to the inability of the semen to remain in the vagina, with consequent effluvium.

Tumors. The relation of tumors to conception may be important. Tumors of the external genitals, like cysts of Bartholin's glands, vaginal cysts, fibromas of the vulva or vagina, advanced carcinoma or sarcoma of the cervix or vagina may prevent proper coition. Carcinoma in the early stages does not necessarily cause sterility, for instances of cancer associated with pregnancy are occasionally observed, and would be seen oftener if cancer did not usually occur later than the child-bearing period.

Women with double ovarian tumors are usualy sterile but unilateral cysts are no prevention to conception. Women with dermoid cysts of the ovary are frequently sterile but they are very apt to have stigmata of hypoplasia in other parts of the genital apparatus.

The relationship of uterine myomas to sterility is a subject that has created a great amount of speculation and argument. That fibroids should act as a hindrance to fertility is not surprising when one considers the frequent complication of diseased adnexa, the deformities of the uterine canal, the atrophic and hypertrophic changes in the endometrium, the profuse menstruation, and other abnormal conditions which the presence of myomas may bring about. These are obvious mechanical hindrances to im-

pregnation, and might readily act to cause a secondary sterility.

This explanation, however, does not account for the primary sterility which it is claimed characterizes many myomatous women before the fibroids grow to a size sufficient to act as a mechanical hindrance to conception. Some authors believe that there is an inherent constitutional cause for the limited fertility of the fibroid uterus. Abraham Froell[1] says in his recent work on the subject: "There exists an unknown connection between the physiological functions of the uterus and myoma formation. Myomatous women have menstruated at an earlier age than the average, and conversely girls who begin to menstruate early are more likely than others to develop myomas in later life. A late menopause is the rule in women who have myomas." The author is of the opinion that the myomatous constitution limits, and in some instances, prohibits fertility.

In opposition to this view, Hofmeier believes that the tumors under question have no influence on primary sterility, and goes so far as to say that in later years they even conduce to fertility by prolonging the period of menstruation and ovulation. This latter view does not have many adherents, although Hofmeier presents numerous interesting cases to prove his point. Bamart[2] in a review of 500 cases, concludes that there is no proof of any influence of myomas on primary or secondary sterility, nor on fertility. The causes of sterility in myomatous women he assigns to other lesions of the genital tract or to disease of the husband.

The position of the myoma in the uterus has been shown to be of considerable importance, the interstitial type being more unfavorable to impregnation than the subserous.

[1] Studien über das Uterusmyom in seinen Beziehungen zu Konzeption Schwangerschaft, Geburt. und Woch., Stockholm.

[2] Münchener Dissertationen, 1909.

Taking into account the various evidence on the question, and the observations from personal experience, it is a safe conclusion that the myomatous habit, or diathesis, has little, if anything, to do with sterility but that myomas of certain sizes, or in certain positions, or under certain pathological conditions, of which the myomatous growth is itself the cause (adenexa disease, endometrial changes, distortion of uterine canal, etc.) may be the cause of primary or secondary sterility.

Scipiades[1] has recently published a study of 985 myoma cases from the Budapest clinic, where he had exceptional opportunities to get exact statistics. His figures relating to sterility in myomatous women are very much higher than those usually given. Some of his observations are interesting. He considers that conception is probable only when the tumor is less than an apple in size, and is growing in a centrifugal direction from the interstitium, and does not in any way influence the uterine canal or the endometrium. At the period of symptoms, if these conditions are not present, conception is extremely rare, so that the fertility of such women is only 0.01 per cent. He observes that sterility exerts the following influence on the myomatous condition. In women who, on account of virginity, or otherwise, have been sterile before the appearance of symptoms from myoma, one sees the large interstitial threatening fibroids more often than in women who before the onset of symptoms were fruitful. He finds that the greater the fertility, the greater is the tendency of the myoma to migrate either centrifugally, or centripetally, from the interstitium, while the actual growth of the fibroid and development of the myomatous seeds in the body of the uterus are correspondingly less. The writer concludes from his observations that a causative relationship exists between myoma

[1] Mitteilungen aus der Zweiten Frauer-Klinik der Konigl. ung. Universität Budapest, Band ii, Heft 1.

formation and primary sterility, because in sterile women, who are sexually sound before and after myomectomies, 30 per cent. remain sterile.

In contradistinction to this statement of Scipiades are the views of A. Martin,[1] whose experience accords fully with the hypothesis of Hofmeier mentioned above. Martin can see no causal relationship between myomas and sterility. He says "We see cases of conception with cervical myomas as well as with those of the body. We see pregnancy with submucous, intramural, and subserous fibroids, with solitary and multiple, large and small. Conception occurs both in cases where the uterine canal is normal, and where it is greatly distorted." Martin concludes therefore that neither the position, size nor multiplicity of myomas have any influence on fertility, other conditions being favorable. He also inclines to favor the second part of Hofmeier's hypothesis that uterine myomas tend to increase fertility in some cases.

The following cases are good examples of the influence of myomas on fertility: In the first case the tumor was of the subserous variety, and yet it obviously acted as a hindrance to conception. In the second case a cervical myoma seems to have prevented conception at one period in the woman's life, while at a later period she became pregnant even after a similar growth had recurred. After a study of these two cases it is not surprising that there exists a wide divergence of opinion on the subject.

A woman, aged thirty-two years, of the small, undeveloped type, had been married about nine months. She had always suffered from severe dysmenorrhea, and had twice been dilated and curetted for this condition. Six months before, having had an attack of pain in her right side, she had consulted a doctor, who at first thought that she was pregnant

[1] Address at the Medical Congress at Budapest, 1909.

and then told her she had a fibroid, and advised against an operation. Examination showed a small fibroid on the right of the uterus, and its removal was advised. It appeared that the presence of this fibroid, which was apparently growing toward the broad ligament, was a factor in the dysmenorrhea, and as the patient was desirous of having children, it was feared that it might either prevent conception or be a source of danger in case she should become pregnant. The tumor was of such a size at that time that it could evidently be enucleated without trouble. The operation for some reason was deferred for five weeks. Examination at the end of this time showed that the tumor during the five weeks had increased to three or four times its former size, and was now nearly as large as a grapefruit. The abdomen was opened, and although the tumor had greatly increased, it was still found possible to enucleate it. At the same time the uterus, which had been pressed back by the tumor, and had a tendency to retroversion, was restored to its proper position by abdominal shortening of the round ligaments by a modified Gilliam's operation. The patient made a good recovery. Three months after leaving the hospital she became pregnant, and in due time gave birth naturally to a normal child.

A woman, aged thirty-one years, who had had one child, had been suffering from menorrhagia for fourteen months. Examination showed the os to be dilated and a fibroid just presenting. The uterus corresponded to the size of about three months' pregnancy. The operation which consisted of a vaginal myomectomy was performed on October 9, 1906. The patient made a good recovery from this operation and left the hospital with a uterus still somewhat larger and softer than normal. About a year later she wrote that she had become pregnant very soon after her return home from the hospital and had had a normal delivery of a healthy child.

Nothing more was heard from this patient until March 27,

1911, when she was brought to the hospital in a moribund condition. She had been preganant since the previous October. About a week before her appearance, she had had a profuse hemorrhage, followed by a foul, watery discharge. She had been vomiting, and had headache and pain in the back, with chills and fever. During this time she had been treated by her local physician for the grippe.

Examination showed the uterus to be very large and soft, evidently pregnant. A soft, sloughing mass blocked the cervical canal which was dilated. An eminent obstetrician was called in consultation, and an immediate operation was advised. The patient came to the table in an extremely bad condition. The mass blocking the cervical canal was first delivered and proved to be a foul, sloughing fibroid, which was scooped out with the hand. A macerated fetus between four and five months was then delivered together with the placenta. More sloughing necrotic portions of myomas could then be scooped from the uterine canal. The patient's condition, however, was so extreme that further procedures were inadvisable. The patient died about two hours after the operation without reacting to stimulation.

This case shows well the possibility of a uterus developing new fibroids after a myomectomy. It also illustrates the influence which pregnancy frequently has on the growth of uterine myomas. It is probable that the pregnancy which immediately followed the myomectomy accelerated the development of myomas, the seeds of which undoubtedly existed at the time of the first operation. The early development of these myomas, however, was not sufficient to interfere with a normal pregnancy and delivery. During the next four years these myomas had an opportunity to grow in the usual way, and when the last pregnancy took place they evidently developed rapidly. Necrosis of the fibroids and maceration of the fetus then took place, the process which makes the association of pregnancy and myomatous uteri

dangerous. In this case the danger was especially great because one of the fibroids blocked the cervical canal and prevented the discharge of the dead fetus. An early diagnosis and hysterectomy would have saved the life of this patient.

The case further illustrates the fact that the existence of uterine fibroids is no specific bar to impregnation. In the early part of this woman's career the submucous myoma presenting at the os had acted as a mechanical obstruction to impregnation, which took place immediately after the removal of the tumor. The numerous fibroids must have existed at the time of the last conception.

X-RAY. The influence of the *x*-ray on fertility is a matter of considerable importance at the present day, especially in view of its employment in the treatment of uterine myomas, which in some quarters is being so urgently recommended. There is now no doubt that the *x*-ray permanently destroys the follicles of the ovary. M. Fränkel[1] has shown that the ovaries of women who have been treated by the *x*-ray show marked atrophy of the Graafian and ripening follicles, as well as a scarcity of primordial follicles.

Reifferscheid[2] has shown by animal experimentation that there is no possible regeneration of a follicle that has once been injured by the influence of the *x*-ray. He also found that the epithelium of the oviducts undergoes severe injury when exposed to the rays. From these observations and from those of many others it is established that the *x*-ray may render an individual completely and irreparably sterile.

It has been noticed by some observers that in certain cases following pelvic treatment by the rays there is a temporary period of amenorrhea followed in several months by a reëstablishment of the normal menses. This is explained

[1] Die Röntgen-Strahlen in der Gyn., 1912.

[2] Experimentelle Untersuchungen über die Regeneration der Strahlen Geschadigter Ovarien.

by the fact that *x*-ray treatment is given only long enough to destroy the riper follicles and that it is not continued a sufficient length of time to injure the primordial follicles which are somewhat more resistant to the ray. In the course of time these follicles develop and ripen with consequent resumption of the menses. It is, however, possible with suficient dosage to injure all the follicles and thus completely to destroy the function of the ovaries.

I have had an opportunity to study the ovaries of a patient who had received *x*-ray treatment at the hands of a general practitioner. In this case a multiple fibroid tumor of the uterus had been subjected to treatment over a period of six months. During this time symptoms of pelvic pain and uterine bleeding had somewhat increased so that operation became necessary. On opening the abdomen an extensive pelvic inflammatory condition was found with comparatively fresh adhesions. Several of the myomas had undergone cystic degeneration. One ovary was cystic and showed the remains of a corpus luteum while the other ovary was small and shrunken. Miscroscopic examination of the ovarian tissue of the smaller ovary disclosed only a rare primordial follicle. In this case the *x*-ray treatment had not resulted in a complete destruction of the ovarian function for the patient had continued to menstruate even more profusely than before. The *x*-ray had, however, undoubtedly been a factor in causing a degeneration of the myomas and in bringing about or aggravating a pelvic inflammatory process. The scarcity of follicles is not conclusive evidence in this case of a destruction by the *x*-ray of the other follicles, as the patient's age was forty-three years, nevertheless they were relatively fewer than one would expect to find in an actively menstruating woman of that age.

Miscellaneous Causes. Under the wasting influence of some diseases the uterus may undergo certain atrophic changes and thus become sterile. The constitutional dis-

eases which may induce sterility are chlorosis, tuberculosis, diabetes, leukemia, Graves's disease, Addison's disease, nephritis, etc. Of these, tuberculosis of the lungs and Graves's disease most commonly cause trophic changes in the genitalia.

Diseases of the hypophysis exert a very distinct influence on the genitalia with atrophy of the ovaries, amenorrhea, sterility, and lack of secondary sexual characters. Mention is made elsewhere of the relationship between hypophyseal disease and the pelvic organs.

Changes in the germ cells of the ovaries with consequent sterility are said to take place in the chronic poisoning of morphine, arsenic, alcohol, phosphorus, and lead. Leppich in the study of 100 alcoholics found 28.3 per cent. of them unfruitful.

There is a certain relationship between adiposity and hypoplasia of the sexual organs. It may be said in general that adiposity tends to follow badly functionating sexual glands, as in amenorrheic girls, castrated individuals, and women at the climacteric. Conditions described as infantilism, hypopituitarism, eunuchoidism, hypothyroidism, disgenitalism, dystrophia adiposogenitalis, etc., are all frequently attended by fat deposit and sexual underdevelopment.[1] Conversely, it is stated by Kirsch, Müller, and Horrocks that overnourished women show diminished fertility. This, however, is not a constant rule, for occasionally fat women are extremely fertile. One writer observes that whereas in thin women one out of every 10 is sterile, in fat women an average of 4 out of 10 do not conceive. In my hospital clinics I see a disproportionately large number of Hebrew women whose chief complaint is sterility. These women are invariably fat but they almost invariably are found to have some form of local hypoplasia. It seems very doubtful if the ordinary acquisition of fat in

[1] Neurath. Wien. Woch., 1912, Nr. 2.

a woman whose genitalia are sound would limit her fertility. It is probable that where fat deposit and sterility are found associated the fat is a manifestation of an ovarian deficiency.

The protective sterility which women normally undergo during lactation occasionally becomes permanent. During lactation the uterus and ovaries become actually atrophied and cease to functionate. Cases have been reported where on account of overlactation the uterus has become permanently atrophied. This doubtless accounts for the premature senile atrophy of the external genitalia that one occasionally sees in women of the poorer classes who have been fertile earlier in life.

Cases have been reported of permanent atrophy of the uterus, and amenorrhea after an overzealous curetting operation.

After all has been said concerning the pathology of sterility there remains a very large percentage of marital fruitlessness which is referable to the Malthusian doctrine and is the result of preventive measures. Engelman in a study of social conditions in the United States estimated that only 12 per cent. of apparent sterility is due to disease. He found that in the beginning of the nineteenth century in this country the average birth rate for each marriage was 5 children, while at the end of the century it was between 1 and 2. Absence of orgasm and libido-sexualis plays a certain part in sterility. Although some women who experience neither of these sensations are fertile, nevertheless, frigidity is especially common in sterile individuals. Matthews Duncan in an examination of 191 sterile women found that 39 were without libido, and 62 did not experience orgasm. Kisch in an examination of 69 sterile women found that 26 derived no pleasure from coitus. Neumann finds that in most women who lack sexual sensibility some hypodevelopment, or pathological disturbance of the genital organs can be found.

Vaginismus is an occasional cause of sterility. Two cases that I call to mind both show evidences of hypoplasia, one of them being sterile, and the other having had only one child.

There are some cases where sterility cannot be accounted for by any physical defect on the part of either husband or wife. In cases of this kind Mayerhofer has advanced the interesting theory that the penetration power of the spermatozoa of a given individual may be greater with some women than it is with others. The most famous example of this theory is that of Napoleon and the Empress Josephine. Josephine had two children by her first marriage. The marriage with Napoleon was fruitless, but Napoleon in his second marriage with Marie Louise had a son, the Herzog von Reichstadt.

Consanguinity limits fertility. According to the figures of Göhlerts from 32 to 33 per cent. of consanguineous marriages are sterile, as against the average sterility of 8 to 15 per cent.

The mingling of individuals of certain widely different races leads in several generations to sterility. Examples of this are the octoroons who represent the repeated mingling in three generations of whites and negroes, and the Lipplapps of Java who represent in the same way the union of the Dutch and the Malays. This is an illustration of race degeneration. It has been supposed that octoroons are absolutely sterile but this is not entirely true.

TREATMENT

ACQUIRED MALPOSITION. Much of the reconstructive surgery for sterility is directed to cases of malposition of the uterus.

It may be said in this connection that where sterility is due to a uterine displacement which is the result of child-

birth or miscarriage a correction of the malposition may be expected to cure the sterility with a reasonable amount of certainty, if all other causes can be excluded. The question always arises as to the proper method of replacing the uterus to its normal forward position without causing possible future trouble at childbirth. This is not the place to discuss the merits of the great number of operations for retroversion, and mention can only be made of them. There is probably no operation for retroversion of which it can postitively be said that it will cause no possible trouble to the obstetrician in future parturition. Nevertheless there are several operations that are comparatively safe and after which serious dystocia is exceedingly rare. The safest form of operation is probably that by which the uterus is supported by reduplication or attachment of the round ligaments. Examples of this principle are Baldy's operation in which the round ligaments are drawn through the broad ligaments and attached to the back of the uterus; and Coffey's operation by which the ligaments are attached to the anterior surface of the uterus. Of these two Baldy's operation is much the more effective.

Abdominal shortening of the round ligaments is usually regarded as a safe method for supporting the uterus, nevertheless I have had one case done by Mayo's modification of Gilliam's operation which came to Cesarean section.

Fixation of the round ligaments to the anterior abdominal wall by Olshausen's method is an excellent operation and has proved very satisfactory, notably in the hands of Vineburg, of New York. Occasionally the simple use of a pessary is all that is required.

Hypoplastic Malpositions. Operative treatment for hypoplastic malpositions is successful in only a limited number of cases. We have pointed out that in these cases there may be numerous possible factors causing the sterility of which the misplacement is only one. Inasmuch as the

malposition of the uterus is the only tangible element in the condition which we can materially correct, operative treatment is usually indicated, for success follows sufficiently often to make surgical interference justifiable, though with our present knowledge it must be admitted that it is always to a certain extent experimental.

Surgical treatment is in most cases directed to a correction of the anteflexion and stenosis of the cervix, and ranges from simple dilatation to elaborate abdominal or vaginal operations. Simple dilatation without other surgical measures is successful in a small number of cases. It happens sufficiently often, however, to make it advisable in any hypoplastic case, either as an operation itself or in connection with some other more elaborate procedure. Dilatation, however, has no permanent effect on the position of the womb and the flexion practically always reasserts itself almost immediately. The use of a uterine stem pessary after dilatation according to the method recommended by Davenport many years ago is not infrequently successful according to those who employ the method. It should be remembered, however, that the placing of a stem pessary in the uterus is unsurgical in principle. I have seen 2 cases of salpingitis following its use.

Numerous vaginal operations have been devised to obviate the effect of the anteflexion of the cervix and of these the most important is Dudley's posterior discission of the cervix. By this operation the angle in the uterine canal is obliterated by doing away with the cervical leg of the angle. Numerous cures for sterility have been reported for this operation, notably by Dudley and Reynolds. My own observations of the operation have been rather unfavorable. The operation creates an artificial laceration of the cervix and as such causes symptoms so that it is sometimes necessary to restore the organ to its former condition. In one case where the operation had been done before marriage for dysmenorrhea

and the patient had remained sterile for four years after marriage, I repaired the cervix. The patient became pregnant soon after the operation. In this case the posterior discission had acted as a bar to conception, probably on account of the ectropion and cervicitis which resulted from the artificial laceration.

Another vaginal operation for anteflexion is that recently exploited by Pozzi. It consists in deep bilateral incisions of the cervix. This operation also creates an artificial laceration which may result in symptoms. In one case under my observation pregnancy took place in a few months after operation but eventuated in miscarriage. In several cases ectropion, cervicitis, and leucorrhea succeeded the operation.

In my own practice, I have frequently treated anteflexion cases by a round ligament suspension operation. I have been led to this procedure by observation of the anatomical position of anteflexed uteri. In the examination of a large number of these cases I have found, as mentioned above, that the uterus though anteflexed lies well back in the hollow of the sacrum in a position best described by the term retrocession. Under ether these uteri are abnormally flaccid, and if the abdomen be opened it may be seen that the anteflexion is completely reduced by lifting up the fundus of the uterus. By this manœuvre the cervix turns directly back toward the sacrum into its proper position at right angles to the vagina.

Keeping this in mind the logical method of placing the uterus in a more normal position is by some form of anterior suspension, and this can best be done by a round ligament operation.

The Alexander operation will accomplish this result, but it is uncertain, as the round ligaments are often rudimentary, hard to find, and uncertain in their supporting power. Abdominal shortening of the ligaments by the method of Kelly, Mayo, or Simpson or Gilliam will also accomplish the reduc-

tion of the flexion. In these operations, however, the uterus often is too much faced toward the abdominal wall, the result of a low attachment of the round ligaments somewhat characteristic of the hypoplastic type of uterus. Baldy's operation is not applicable in these cases as it is apt to preserve the anteflexion. The best method is the fixation of the bases of the round ligaments to the abdominal wall, according to the method of Olshausen and Vineburg, as in this way the position of the uterus can be perfectly controlled.

By the method of anterior suspension of the anteflexed uterus the angle between fundus and cervix is completely and permanently reduced. This operation combined with a dilatation of the cervix has given me far better results for dysmenorrhea than I have been able to obtain by any vaginal operation and has resulted in a number of instances in a cure for sterility. The operation has also the advantage of not mutilating the uterus as is done in the Dudley and Pozzi operations.

After all has been said of operations for sterility in hypoplastic cases it must be admitted that only a comparatively small percentage result in success. It is a question therefore if such haphazard operating is justifiable. It may be answered that in the majority of these cases the sterility is associated with severe dysmenorrhea and that in general the same operation is indicated for both conditions and therefore justifiable for the relief of pain. None of the operations are dangerous and do not therefore entail an unjustifiable risk, even in the absence of dysmenorrhea.

Salpingitis. Although gonorrheal salpingitis is one of the most common causes of sterility, all women who have had salpingitis are not necessarily doomed to sterility. I have a sufficient number of cases to show conclusively that in some instances gonorrhea of the tubes heals spontaneously, the final proof of which is a later normal pregnancy. A case

of salpingitis which is afterward complicated by a tubal pregnancy cannot be said to be cured, as the permanent results of the pathological processes in the mucous membrane are enough to interfere with the complete passage of the ovum. If, however, a normal pregnancy takes place, we may regard the tube as having been restored to its normal functionating condition. These statements are made on the hypothesis that a tubal infection from gonorrhea is always bilateral. This idea is at present universally accepted, and is borne out invariably by all the histological examinations in my own series of cases, whenever an opportunity has been afforded to test the truth of the rule. When, therefore, we operate on a case of pelvic inflammation, and finding conclusive evidence of salpingitis in one tube, leave the whole, or a part of the other tube, we are justified in assuming that the tube left behind has not only been previously infected, but is entirely healed if pregnancy ensues later.

It is this possibility of restoring a woman to fertility that forms the most important foundation stone of conservative surgery in cases of gonorrheal salpingitis, and is more to be considered than the matter of retaining functionating organs, because, as we constantly see, the general results as to future general health are apt to be better after hysterectomy than after partial conservation.

The cases where an attempt should be made to secure fertility are young, unmarried women, or married women who are particularly anxious to have children. The subject should always be considered before operating on such cases, and should be discussed with the patient beforehand. The possibility of leaving the tubes in a condition where impregnation may later take place cannot always be foretold, as it is not uncommon to find them much more diseased than was supposed, so that the patient must be made thoroughly acquainted with the chances in order to avoid later disappointment. On the other hand, many patients are over-

anxious to have all thier pelvic organs removed after the discomforts and suffering of pelvic inflammatory disease, and it is sometimes necessary for the surgeon to urge such patients to take the chances of a conservative operation in order to provide against possible later social unhappiness.

The various operations for securing or preserving fertility in women suffering from chronic pelvic inflammation are sufficiently familiar. It not infrequently happens, that although one tube is obliterated, adherent and seriously damaged, the opposite tube remains patent and with few adhesions. In such a case the diseased tube should be completely exsected from the cornu of the uterus. The removal or conservation of the ovary depends on the amount of destruction which it has suffered, and also on the condition of the other ovary. In some cases I have flushed out the remaining tube with 70 per cent. alcohol and sterile water. Whether this manœuvre is of any value is doubtful.

In another class of cases both tubes are sealed at the fimbriated end, yet have escaped serious injury otherwise. In such a case it may be possible to preserve a portion of both tubes by resecting the outer third, or it may be necessary to extirpate one and preserve a part of the other. Resection of a portion of a tube should never be employed, excepting as a means to preserve the patient's fertility, for there is always the possibility of a later acute infection of the proximal stump. If the tube is resected for the purpose of fertility, it is left as long as possible, and a plastic operation is performed on the distal end of the tube in order to preserve an open ostium. The usual method of performing a so-called stomatoplastic operation on the stump of the tube is simply to approximate the tubal mucous membrane to the peritoneal covering of the tube by means of fine interrupted catgut sutures. A more effective method is to slit the tube longitudinally for ½ to ¾ inch and to apply only enough sutures to control the bleeding, as it is thought that the

sutures favor an adhesive closure of the lumen. Still another method of doing a stomatoplastic on the tube is to engage the end of the tubal stump in a slit in the ovary.

A third class of cases where fertility is desired comprises those conditions where both tubes are beyond repair, but where one or both ovaries are in fairly good condition. The only possibility in these cases is after extirpating the tubes to implant a piece of ovary in each cornu of the uterus. The chances of success in this operation are of course extremely small. Successful results by this method have been secured in animals, and a few cases of impregnation have been reported in human beings.

In cases where pregnancy has ensued after leaving an entire tube it may be asked if the operation has been instrumental in securing this result. I am inclined to think that it is, though indirectly. The removal of the more actively diseased tube by a careful technical operation, and the usual suspension of the uterus by some appropriate method leave the organs in a position much more favorable for impregnation, and in many cases prevent the further formation of immobilizing and obstructive adhesions. The general health of the patient is usually greatly improved, while the sexual functions, which are sometimes disturbed by the chronic pelvic disease, may be restored to the normal condition.

In order to determine the percentage of possible impregnation after chronic pelvic inflammation I wrote letters to many patients who had had conservative operations for this disease, and have a series of 90 cases of whom I have exact data. All of these 90 cases were in the child-bearing period. All had pelvic inflammatory disease, a very high percentage of which was doubtless of gonorrheal origin. Microscopic examination of the portions of the tubes or ovaries confirmed in every case the diagnosis of salpingitis. In all of the cases operations were done which would conceivably leave the patient fertile, and comprised such pro-

cedures as exsection of one tube, resection of both tubes, exsection of one tube and resection of the other, resection of the tube and insertion of the ostium of the tubal stump in the ovary, etc. In some cases both tubes were exsected and ovarian tissue implanted in the uterine cornua. No case was included where both tubes were exsected without implantation.

Of the 90 cases, 16 or 17.7 per cent. conceived at varying times after the operation. Of these 16 conceptions 11 were normal pregnancies, while 5 ended in abortion.

In 55 cases an entire tube was left in, and of these 10 conceived, or 18 per cent. In 35 cases both tubes were operated on, one or both of them being resected, and having a stomatoplastic done on the ostium of the stump of at least one. In other words, these cases had only a part of one, or parts of both tubes, left. One was a case of implantation of ovaries in the uterine cornua. Of the 35 cases 6 conceived, or 16.8 per cent.

In the 90 cases no calculation was made of the absence of exposure to conception from non-marriage, divorce, widowhood, continence, use of preventives, etc., which if such data were included would reduce the total number somewhat and increase the percentage of fertility.

The high percentage of abortions is noticeable, and is not easily explained, excepting on the theory that some chronic change has occurred in the endometrium which has left it unsuitable soil for the nourishment of the fetus. The condition commonly found in the endometrium is a chronic interstitial endometritis.

Endocervicitis. Some of the most brilliant results in the treatment of sterility are those gained when the condition is due to endocervicitis. As we have seen, conception may be prevented in these cases by the mucous secretion which either blocks the passage of the spermatozoön mechanically or by becoming acid destroys its vitality. Success in these

cases depends of course on the integrity of the other pelvic organs.

In mild cases of endocervicitis a simple curetting and thorough removal of the plug of mucus is often followed by early conception. If it is suspected that the endocervicitis is due to gonorrhea great care should be exercised in curetting the cervix, for it is not difficult to extend the disease to the tubes. The operation should therefore be kept below the level of the internal os.

Endocervicitis sometimes yields to local treatment, the method of application of which is shown in the description of the following case:

A woman, aged thirty-two years, had been married four years. A short time after marriage she had had an abortion at two months, and since that time had been sterile. She had always been perfectly well before marriage. Since the abortion she had had a continuous leucorrhea, which, however, was not severe. The catamenia had always been regular and accompanied by moderate pain. Two years before consultation she had undergone an operation for appendicitis. She was most anxious to have children.

Examination showed pelvic organs normal in size and position. From the cervix was exuding a thick, clear, mucous fluid. This was a case of chronic endocervicitis, and was given the following treatment:

Twice each week the cervical canal was curetted without ether with a small sharp nasal curette, after which Churchill's tincture of iodine was applied to the curetted area. The cervix and vagina were painted with iodine, and tampons soaked in glycerine and ichthyol were placed in the vagina. The discharge ceased after two or three weeks' treatment, and a short time later the patient became pregnant, being eventually delivered of a healthy child.

The exact nature of the infection of the cervical canal in this case is not known, as no bacterial examination was

made. The infection started at the time of the abortion. The chances are that it was not gonorrhea.

When endocervicitis resists all ordinary treatment it is to treatment more readily than gonorrheal endocervicitis necessary to resort to surgical measures, the best operation being that of Schroeder by which the most of the mucous membrane of the cervix is exsected. I have performed this operation several times for sterility but though it has been successful in removing the discharge, conception has not taken place in any of the cases. This may be due to undetected adnexal disease. It is possible, too, that the removal of the cervical mucus is a factor in the continued sterility, for it is thought that this mucus is of great importance to the spermatozoön. On the other hand, I have observed several cases of impregnation after high amputation of the cervix.

Mild Disturbance of Endocervix. The physician is frequently called upon to treat cases of sterility in which no definite anatomical or constitutional cause for the condition either in husband or wife can be discovered. It is probable that in a certain number of these cases there is some disturbance in the chemical reaction of the cervical or vaginal secretions. This point has recently been well emphasized by Reynolds.[1] The alkalinity of the cervical secretion is absolutely essential for the passage of the spermatozoön into the uterine cavity and it is likely that mild catarrhal conditions of the endocervix may modify the secretion so that it becomes hostile to the life of the germ cell. It is possible, too, that mild catarrhal or other disturbances of the endocervix may interfere with the proper functioning of the cervical glands during cohabitation. It has been shown that normally these glands secrete and press out during sexual excitement fine mucus threads, from their ducts. These threads (so-called "Kristeller") are alkaline

[1] Jour. Amer. Med. Assoc., January 11, 1913.

in reaction and are the paths by which the spermatozoa mount into the cervical canal. There is no doubt that mild inflammatory processes or the retention of inspissated mucus in the cervix may interfere with this important function. Certain it is that cases like the following must be explained in some such way.

A woman, aged thirty-eight years, who had been married seven years without conceiving, consulted me for sterility. Examination showed a perfectly healthy individual with normal pelvic organs. The husband was healthy and marital relations were normal. Dilatation and curettement of the cervix was advised. Under ether a small, dry film of mucus was found in the cervical canal. There was a moderate amount of "callous stenosis" in the posterior wall of the cervix near the internal os. The cervical canal was curetted. Three months after operation the patient became pregnant and was delivered normally.

Position in Coitus. Under rare conditions a change in position in coitus will cure sterility. The following case illustrates the occasional possibility of overcoming sterility by a change of position in coitus.

A healthy, vigorous woman, aged twenty-eight years, sought advice for sterility. She had been married for four years without becoming pregnant. Both she and her husband were extremely anxious to have children. The husband was a young man in good health, who denied having had any venereal disease. The patient had never had any serious sickness. Her periods were regular, but somewhat scanty, and there had been some dysmenorrhea before marriage. For the last six months there had been some smarting discomfort of the vagina after coitus.

The pelvic examination was entirely negative. The uterus was normal in size and position, and there were no signs of any inflammatory disease in the adnexa or the cervix. There were no stigmata of hypoplasia. Coitus a tergo was advised.

The patient became pregnant almost immediately and was normally delivered of a healthy child in the due course of time.

Little can be said in this paper of the constitutional and medical treatment of sterility. Such treatment should be directed along logical lines to suit the individual case. The same may be said with regard to the regulation of sexual hygiene.

Ovarian Implantation and Transplantation. When one considers the extraordinary success that has been attained in modern times by the transplantation of various organs of the body, one cannot help feeling that this field of surgery may in time become of value in the treatment and cure of certain forms of sterility. Investigators are working continually in this line and a certain amount of success has been attained, especially in animals. It is evident that transplanted ovarian tissue is enabled for a while at least to retain its function, though eventual atrophy usually takes place in a comparatively short period of time. We are chiefly interested in those experiments which have resulted in impregnation. Numerous instances have been reported in animals, where successful pregnancy has resulted, both from auto- and hetero-transplantation. Among those who first reported successful results were Krauer,[1] Ribbert, Herlitzka Grigorieff[2] and Rubinstein.[3] In one case a rabbit became pregnant one and one-half years after the operation. Grigorieff saw 4 out of 12 rabbits become pregnant after transplantation. In more recent times interesting experiments have been carried on to test the influence of heredity in cases of hetero-transplantation by which it is found that the heritable qualities of the original germ cells are not changed by the new host.[4]

[1] Zentr. f. Gyn., 1896, No. 21, and Arch. f. Gyn., Band lx.
[2] Ibid., 1897, No. 22. [3] St. Petersburg Med. Woch., 1899, No. 31.
[4] This has been denied by Guthrie, Jour. Amer. Med. Assoc., 1908, No. 9.

A few cases of impregnation following transplantation in human beings have been reported. The most famous one is that of Morris.[1] Morris' case was one of pelvic peritonitis in which both adnexa were removed and a piece of ovary implanted in the end of one tube. This patient aborted four months after the operation and then menstruated for four years.

Frank in 1898[2] reported 3 cases of autotransplantation of the ovary in one of which pregnancy going to full term took place. In another, probable abortion occurred and in a third there was a suspected extra-uterine pregnancy. In 1905[3] Halliday-Crom reported the following case. A patient had amenorrhea following a miscarriage, with symptoms of change of life. An operation was performed and the ovaries which showed small cystic degeneration were removed and an ovary from another woman was implanted. Menstruation appeared four months later, and four years after, conception took place with normal birth.

I have had one case similar to that reported by Morris, in which abortion probably took place several months after operation. The case was reported as one of abortion by her family physician, but as the products of conception were not seen the case cannot be regarded as absolutely proved. Franklin H. Martin has recently reported a similar case.[4] The lack of success that most ovarian transplantations meet with is undoubtedly due to our lack of knowledge of a proper technique and the more or less accidental successes which occasionally take place convince one that sooner or later as the science of surgery advances a means will be found of transplanting the ovary so as to maintain its functions with constant result. If such a result can be attained, many cases

[1] New York Med. Jour., 1906.
[2] Zentr. für Gyn., 1898, No. 17.
[3] Trans. of the Edinburgh Obst. Society, Ref. Zentr. f. Gyn., 1906.
[4] Amer. Jour. Obst., August, 1912.

of sterility due to gonorrheal or tubercular disease, or to ovarian deficiency will be curable. In the case of transplantation from another woman the question of who is the mother, would become an important one. According to law the woman who bears the child would be regarded as the mother but from a biological standpoint the woman who originally produced the germ cells of the ovary should be considered the true mother for from her the child would derive its heritable characteristics.

ORGANOTHERAPY. In considering the medical treatment of sterility due to hypoplasia one naturally inquires as to the possibilities of ovarian organotheraphy.

In the great advance that has been given to the science of general physiology by the discoveries revealed in the study of the organs of internal secretion there has been some promise that the fog which has clouded our knowledge of the physiology of the female pelvic organs would be lifted. The results up to the present have been disappointing and even now we are not much beyond the realm of theory. It can only be said that the ovaries probably manufacture an internal secretion which is of importance both to the local organs of generation and to the general organism of the individual, though just how this influence is manifested or in what tissues of the ovaries the secretion is produced, or how important it is to the individual are questions that have not yet been definitely settled. There are some who regard the ovarian secretion as of the greatest possible value and see in its study a possible solution of the many gynecological problems, while some like J. M. Baldy regard the whole subject as the veriest "nonsense."

On the theory that there is an important ovarian secretion, our inquiry is whether ovarian extract is of value in the treatment of sterility, which may be ascribed to ovarian deficiency. Up to the present time the success of ovarian therapy has been very limited. There seems to be undoubted

evidence that in some cases it is of value for use in the vasomotor disturbances following castration. I have found it so beneficial in these cases that I am using it as a routine. Schickele reports a case of cure of kraurosis vulvæ which he claims as a result of the hyperemic effect of the extract on the external genitals. I have reported a similar case.[1] In general, however, reports of the use of ovarian extract have been largely negative, and I have noticed no case in the literature where this treatment unquestionably led to a cure of sterility. The fact, however, remains that the present methods of ovarian therapy are extremely crude and that the possibilities of finding in it a valuable remedy have not as yet been exhausted. It is quite conceivable that if the ovarian secretion could be properly extracted and so administered as to produce its proper physiological effects, it might be of value in those cases of sterility in which supposedly there is an incomplete ripening of follicles owing to a deficient circulation of blood in the ovaries. This idea is plausible, as it has been shown by animal experimentation that ovarian extract may produce a genital hyperemia.

Hans Bab has summed up the defects in the use of ovarian extract somewhat as follows: (1) A direct influence of ovarian therapy on improving the functions of the ovaries has not yet been proved. (2) It is very probable that in the change from the ovaries to the commercial extract important ingredients of the ovarian secretion are disturbed. (3) Inasmuch as it is apparent that ovarian therapy is successful in treating the disturbances of the menopause, while it has no effect on stopping uterine atrophy or in restoring menstruation, it is probable that only a part of the full effect of the ovarian secretion is reproduced. (4) The ovarian secretion is in the most intimate relationship with the other organs of internal secretion which exercise a regulating effect on each other.

[1] American Jour. Obst., 1913.

This effect is entirely lost in organotherapy. (6) While in the body the ovarian secretion passes directly into the circulation, ovarian therapy requires that the substance pass through the digestive apparatus, so that a chemical disturbance in the secretion is more than probable.

ARTIFICIAL IMPREGNATION. At the present day very little is heard of artificial impregnation in the human race, the practice having fallen into a certain amount of disrepute, as a result of religious, social, and even legal objections. There is no doubt, however, that the great success that has been attained in recent years in the artificial impregnation of domestic animals will lead eventually to a more extended trial of its possibilities in the treatment of sterility in woman. Artificial fertilization of fishes was done successfully as early as the year 1700 and has been developed scientifically since the middle of the last century, so that at present it is an extremely important factor in the industry of pisciculture. In the year 1780, Spallenzani succeeded in artificially fertilizing a bitch, and was the first to impregnate thus an animal of the mammalian type. This experiment of Spallanzani attracted much attention at the time, but very little was done in animal fertilization for more than a century. In recent times the procedure has again been taken up and has been put to very practical use in the breeding of domestic animals. Everest Millais[1] reported 15 successful results out of 19 trials in fertilizing bitches and showed that these results equalled those of natural methods. Elias Iwanoff, a Russian, worked on the artificial breeding of horses, and in 1907 reported that results were even more successful than by natural breeding. He succeeded in fertilizing mares that had previously been sterile. His experiments with cattle, sheep, and other domestic animals produced a like result. Since then the process has been widely adopted by breeders of animals.

[1] Biol. Zent., 1908.

To Marion Sims belongs the credit of being the first to fertilize a woman artificially, which he did in 1866. The operation, however, has been little practised and only a comparatively few cases have been reported. Rohleder, in his monograph, collects all the cases from the literature, including his own, and making allowances for several doubtful instances, reports 65 cases with 21 successful results. Döderlein has recently reported another case.[1] The subject has been exhaustively treated by Rohleder in an appendix to his book entitled *Die Zeugung beim Menschen,* to which the reader is referred for a detailed description of the operation. The technique is extremely simple and by the method suggested by Rohleder there seems little danger of sepsis if proper precautions are taken. By this method the semen is injected into the cervical canal after a slight dilatation.

By the technique used by Sims the few drops necessary for injection were collected from the posterior vault of the vagina post coitum. Rohleder criticises this method because the spermatozoa are deposited and left for a time in the acid secretion of the vagina which is inimical to their life. He therefore takes the semen from a condom and injects it immediately into the cervix. The operation is done during the first few days after menstruation and immediately post coitum. This last he considers important as at that time the alkaline secretion of the cervix is more profuse and hence more favorable to the life of the spermatozoön. It is of very great importance to exclude the possibility of a gonococcus infection by a careful examination of the genitalia of both husband and wife. More than one operation has resulted in gonorrhea.

It is evident that artificial impregnation is only indicated when the genitalia of the woman are practically normal excepting for slight deviations such as anteflexion of the cervix.

[1] Ref. Zentr. f. Gyn., 1912, p. 519.

I have had no personal experience with artificial impregnation but I can see no reason why it is not feasible and justifiable in certain selected cases.

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