5-1-1933

Sterility in the human male and female

C. J. Toohey
University of Nebraska Medical Center

STERILITY

in the

Human Male and Female

****

Considering

the

Incidence

Etiology, Diagnosis

and

Treatment.

C. J. TOOHEY

A

Senior Thesis

***

Presented

to the

Faculty of the University of Nebraska

College of Medicine

in

Partial Fulfillment

of the

Requirements

for the

Degree

of

Doctor of Medicine

PREFACE

***

Preface

The following paper presents an attempt to survey the current literature and to condense, in a more or less comprehensive form, the voluminous material that has been written upon Sterility.

The literature upon the subject is exhaustive and deals with both the clinical and the laboratory aspects of the problem, and an attempt to intelligently classify and analyze the material most, necessarily, fail to reach that perfection that is to be desired.

The importance of the problem, both to the gynecologist and to the general practitioner can not be too strongly stressed. Its incidence is astounding, its etiology rests in a multitude of factors, its diagnosis is most obscure, and its management, in a high percentage of cases, is unsatisfactory as regards results from therapy.

The writer lays claim to no originality whatever. The literature has been perused and collected in an attempt to present all the various aspects of the problem as interpreted by the various investigators with special emphasis upon the opinions of the more recognized authorities.

The handling of the problem of both female and male sterility in all its aspects presents a more formidable task than was expected. It would seem more desirable to confine the attempt to one or another of the less comprehensive aspects of the subject. However, it is felt that sterility is so definitly a subject concerning both partners in a union and the various factors are so closely interwoven that handling of the matter, in any less comprehensive fashion would fail in its intended purpose.

****

The INCIDENCE of Sterility

THE INCIDENCE of STERILITY

Not only is it impossible to make an accurate statement on the incidence of sterility but it is also impossible to estimate its prevalance with any degree of certainty. Its incidence is subject to so many influences and varies so with locality, age, race, heredity, living conditions, diet, sex habits and factors innumerable that an intelligent attitude forbads a didactic statement.

Various writers are at wide variance on the subject; a fact that can, perhaps, be attributed to difference in locality, and the types of patients seen. Few authors make a definit observation on the matter. Levy of New Orleans, forms the exception when he states that it is a very "definit fact, as is fully proven by competent observers, that in our country, sterility, especially among the so-called middle and upper classes is on the increase". (41)

Coughlan of Sydney Australia has gathered all available figures in his country and finds that the incidence of sterility is as high as 7.9 percent in women who have been married for a period of ten years. (12).

In view of these figures one may feel safe in assuming that the incidence must be a great deal higher in women married for a lesse r age period. This writer is also of the opinion that this figure is lower than that of other countries, and feels that figures are incorrect because more women seem interested in consulting their physician to learn how to prevent conception rather than to correct a condition of infertility.

Marcus of Cleveland feels that ten percent of modern marriages are sterile, (47), while Mozer and Hoffman, who have analyzed five hundred cases of female sterility state that one out of seven unions in this country are barren. (62). They do not, however, state as to whether or not these unions are barren due to contraceptive measures or to an actual inability to procreate.

Bell of England also notices this point of difference as to whether a couple is childless due to actual inability to conceive or to preventitive measures instituted by them. He states that " according to the latest official statistics it appears that the birth rate per 1,000 of the population has fallen from 32.3 in the eighties, and 29.4 in the nineties of last century, to 16.3

in 1929, for England and Wales generally, and to 15.9 for London. The gap between the birth rate and the death rate is, it seems, being rapidly closed. In the last forty years, which is the period of birth control, the birth rate has dropped to one-half the previous level. Moreover, in the Registrar's General Decennial Supplement (1921), under the section on 'Occupational Fertility' it is stated that in Class I--the highest grade-- the fertility rate per 1,000 married males under fifty-five years of age is nearly half that of Class V (unskilled workers). Since the wives are included and births alone are taken into account, the term 'fecundity rate' would be better than 'fertility rate'. No account has been, or could be, taken as to the exact influence of contraception, but it must be clear that this factor has been concerned in the upper classes, otherwise their low fecundity rate is inexplicable. Such a state of class sterility could not occur naturally. (4)."

It is well to remember in forming ideas as to the incidence of sterility that we most differentiate between fecundity and sterility, that we have no way of determining the incidence of contraception, and that the accidents of abortion and miscarrage must in the large influence ourfigures.

Vignes, writing in Progres Médecine, states that

absolute infertility is present in 10 to 15 percent of marriages in France. (86).

The number of children in families vary. Certain families are very fertile, others less fertile and a great many childless. Some couples have a very great fertility and the female is always in the state of gestation or lactation. Laurentie has published the case of a woman who married at the age of 13 years, became pregnant 3 months later and had 36 gestations before she was 50 years of age. Of these 36 pregnancies, there were 12 abortions at various dates while the other 24 infants were strong and vigorous. This woman was very well preserved at the age of 85 and she had never been sick. Her mother had had 23 children.

Pearl and Surface lay stress on the fact that a distinction must be made between fertility and fecundity. Fecundity is the capability of an individual to prepare ripe germinal cells while fertility is the capability of a couple to give birth to individuals. (86).

Infertility is common and may be due to many causes such as a failure to form gametes, impediments to fecundation, impossibility of nidation, diorders of organogenesis, and diseases of the fetus or membranes.(8).

****

The ETIOLOGY of Sterility

THE ETIOLOGY of STERILITY

The question of etiological factors in the consideration of sterility, if completely discussed might well fill volumes. It is a condition of such multiform etiology, with factors both obvious and obscure, that even the compilation of a classification, without discussion of the various aspects, is a formidable problem.

Realizeing that any interference with the formation of either the male or female germ cells, or any failure in the normal sexual cycles may be the cause of sterility it seems worth while, at this point, to review the phenomenon of germ cell formatiom and sexual reproduction:

Sexual reproduction consists of the union of two specialized cells or gametes, resulting in a single cell which is know as the zygote. This constitutes the first or unicellular stage of an ovum which by successive multiplications and anatomical and functional differentiations results in an adult. The spermatozoa pass through the genitals and, after encountering the ovum, one sperm succeeds in penetrating the cell and enters, fertilizing it. The two half nuclei soon form a complete nucleus and the cell thus constituted divides into two

daughter cells which in turn divide. This cellular multiplication follows a certain pla n for the development of tissues and organs. The fertilized ovum passes to the uterus where nidation takes place upon the previously prepared endometrium. The fertilized ovum penetrates the highly vascular uterine tissue until a blood vessel is reached. The latter is eroded by a lytic property of the ovum and the maternal blood lake is formed. Cells produced by the ovum penetrate the uterine mucosa, firmly uniting the two and forming a passage way for nutritive material and oxygen. The ovum continues its development in the uterus, by the formation of membranes and continued cellular division.

***

The route of the sperm to its union with the ovum is a long and devious path, and any inflamation, abnormality or barrier that will check the union will lead to an infertile condition. There are certain basic requirements that must be met in any two individuals before conception may occur. The requirements are:

a. The testes must produce normal spermatozoa.

b. The sperm must be able to pass through the male seminal tract undamaged.

c. The vaginal and endocervical secretions must be favorable to the sperm deposited by ejaculation.

d. The cervix, uterus, and tubes must allow upward migration of the sperm and descent of the ovum.

e. The ovaries must produce normal ova.

f. The endometrium must be healthy to allow embedding and development.

If any of the above mentioned conditions are not fulfilled sterility will result. (1).

Watson (90) has suggested a comprehensive outline of the causes of sterility.

I. Defective Production of Spermatozoa:

A. Apparent Causes:

Undescent of the testes.

Underdevelopment of the testes.

Testicular atrophy.

B. Obscure Causes:

Hypofunction.

Sexual excesses.

Endocrine failure.

Constitutional states.

II. Obstruction or Hostility in the Male Passages:

A. Apparent Causes:

Urethral stricture.

B. Obscure causes:

Obstruction in the epididymis.

Hostility of prostatic secretions

Acidity.

Viscosity.

Infections.

III. Faults in Delivery and conception:

A. Apparent Causes:

Male malformations
Impotence
Female malformations
Dysparunia
Vaginismus
} Preventing Coitus

B. Obscure Causes:

Male

Premature ejaculation

Hypospadias

Female

Malformations

Abnormal pelvic mechanics

Cervical affections.

IV. Hostility to Sperms in Female Passages:

A. Vaginal Fluid:

Reaction ($_pH$)

Infections

B. Cervical Secretions:

Quantity

Viscosity

Infection

Serological

V. Tubal Occlusion:

A. Apparent:

Bilateral disease of the tubes.

B. Obscure:

Developmental defect.

Inflamatory damage

Muscle spasm

Adhesions over os

Endometriosis

VI. Defective Ovulation:

A. Ovarian underdevelopment or atrophy.

B. Ovarian dysfunction:

Peri-ovarian adhesions

Thickened tunica albuginea

Cysts

Persistent corpus lutea

C. Constitutional states.

VII. Endocrine Dyscrasia:

A. Individual Glands:

Thyroid

Pituitary

Ovaries

Testes

B. Combined Group:

Infantalism

Neuter type

Pseudo male

VIII. Relative Infertility

Another type of classification is given us by Troupin of Boston, who classifies the etiology of sterility according to types of the condition:

I. Absolute:

Conjenital malformations, nutrition, obesity, vaginismus, dysparunea, chronic cervicitis, retrodisplacements, anteflexion, fibroids, tubal occlusions, and gonnorrhea.

II. Relative:

" Apersistant low fertility in one or the other of

thepartners of the marriage".

"Conjugation by an individually imperfect gamete"

Lues, retrodisplacements, anteflexion, infantile organ, fibroids of the uterus or retroperitoneally.

III. Conditional:

Obesity, chronic cervicitis, retroflexion (post-partum), lacerated cervix, postpartum curret-tage, gonorrhea.

IV. Functional:

Azoospermia from gonorrheain the male.

Exposure to radiation. (85).

In the discussion of the so-called obscure cases of sterility Moench of New York City (57), divides them into four classes:

Selective fertility:

In this condition the above mentioned writer feels that there may be one of two conditions, or both present, as the etiological factor. Both partners in the union may have lowered fertility or the case may be one in which in-compatability exists between the sperm and the female gen-ital tract.

Vaginal Acidity:

Moench is of the opinion that this condition affects only weak sperms, and bases his opinion upon the fact that healthy sperms normally split glycogen to lactic acid. As the vaginal secretion has never been found to be more than 0.5 percent of lactic acid or an Hydrogen ion concentration greater than 4.7 he is convinced that the vagina is not spermatocidal to other than weak spermatozoa. Moench states that he has determined by repeated tests that healthy spermatozoa can live for hours in a 0.5 percent lactic acid solution. From these findings he deductes that if the sperm is killed by the acidity of the vaginal secretions, the sperm was previously unhealthy.

Sperm Immunity:

Moench advocates a theory which was previously presented to the writer by McGoogan of Omaha: As there are millions of spermatozoa deposited in the vaginal vault by each ejaculation the number of them absorbed must be enormous. It seems reasonable to suppose, that with this massive absoption, there is a possibility of an aquired

immunity being developed, to that particular sperm, by the formation of spermatoxic bodies. By the practice of contraceptive measures over aperiod of years the female in the union can possibly form immune bodies peculiar to her mates sperm with the result, that when children are desired a condition of sterility is found to be present. However, in this connection, it is wise to considerthe possibility of sterility since marriage which was not recognized beeause of the contraceptive practices.

Psychic Factors:

Moench refuses to recognize the psychic factor in sterility and bases his stand upon the number of pregnancies resulting from rape and intercourse under conditions that were abhorrent to the female. He feels that merely incompatible marital relations can not be considered as a factor in sterility in the face of such evidence. However, in the writers opinion, Moench does not consider the unknown number of women who submit to abhorrent coitus and do not become fertilized, the relative fecundity of the individual in the case, nor the more pronounced mental affect that unhappy and prolonged sex relations would have; in contradistinction to a case of sudden and violent coitus, without the element of prolonged psychic affect.

In a very large percentage of cases of sterility the etiology is most obscure. Seeking an answer to the problem workers are looking to constitutional and endocrine factors, and find their incidence, in causation, to be higher than was previously felt.

Dwinell (19) feels that lack of correct excercise and rest plays an important role in etiology. He states that in cases of infertility in which little apparent cause is found, the factors sought may be found in a study of the habits, diet, and vitamin intake of the patient.

The sex cells are the most highly differentiated cells in the animal body and are the first to suffer from sub-normal constitutional conditions. Deficient, immature, or toofew sperms, as well as poor ova or the cessation of ovulation, are important factors in sterility and may be due to purely constitutional factors. The cause may be found in protein deficiency, calcium deficiency, or a lack of vitamins A and E. Poor hygeine, over fatigue, sexual excesses, errors in diet, lack of exercise, anemia, and chronic intoxications must also be considered. (1).

Meaker (54) finds that, in cases of sterility, multiple causes are the rule rather than the exception, and constitutional factors depressing the fertility of one or both parties, are operative in a large proportion of cases.

Observers find that bodily types in women may be used as a key to their fertility. Hippocrates said "Women may be judged of whether or not they are in a fit state for conception by attending the following circumstance: in the first place to their shapes. Women of smaller stature more readily conceive than taller persons: the thin than the fat".

Frank (5) has distinguished four types among infertile women to which the vast majority conform:

A. The typical normal feminine

B. The infantile

C. The neuter

D. The pseudo-masculine

Berkow has shown by elaborate measurements and mathematical formulae that the above quotation from Hippocrates is essentially true. Women with glandular dysfunction and

constitutional signs, as shown by obesity and bodily contour, present a higher incidence of sterility than normally proportioned, small women. (5).

Malcolm has drawn attention to a custom in certain primitive races in Old Calabar where all young women of any social standing are subjected to two or three years of fattening, with the result that most of them prove to be completely sterile. (25)

Obesity per se is not a cause of sterility but only if found in conjunction with glandular dysfunction. When the two conditions appear together, sterility is usually the result of amenorrhea or hypothyroidism. (15).

The percentage of sterile marriages is highest in those showing ovarian disease, next highest in thyroid, and lowest in pituitary disorders. In non-endocrine groups infertility is definitly less frequent than in those having endocrine disease. Even in the non-endocrine group the incidence of sterility is double that usually recorded as the normal. (69).

The normal menstrual cycle depends upon the balanced activity of the two ovarian hormones; the female sex hormone generated by the Graafian follicle, produces growth

and vascularization of the uterus; and the lutean hormone, generated by the corpus luteum, produces pre-menstrual endometrial changes preparatory to the reception of the fertilized ovum. Sixteen of a group of thirty-seven regularly menstruating women, who were sterile, were probably subject to anovular menstruation as shown by the simultaneous abscence of pre-menstrual endometrium and a demonstrable quantity of female sex hormone a day or two before the onset of the expected flow. "The recovery of a demonstrable quantity of anterior pituitary sex hormone from the blood of women suffering from functional sterility is pathonomonic of primary ovarian failure. Normal fertile women and those suffering from pituitary hypofunction rarely, if ever, show a demonstrable quantity of the hormone except during pregnancy." (63).

According to Frank and Goldberger (23) the sex hormone has been extracted from various portions of the organism, especially the ovarian follicle, corpus luteum, and the placenta. The hormone occurs also in blood, bile, and urine and is essential for reproduction because it produces the changes noted in the infertile as well as the fertile sex cycle. Aschner in 1912 proved that the hormone produces

the effect, in castrated animals, of conjestion , hyperplasia etc., corresponding to menstruation. Frank finds that "in amenorrhea and functional sterility there is a lowering of the renal threshold for the excretion of the female sex hormone". It would seem, therefore, that the loss of the hormone through excessive excretion would result in amenorrhea and functional sterility.

Litzenberg of Minneapolis, writing in conjuction with Carey, (42) on the affect of the thyroid on sterility, analyzes a series of cases and draws a set of conclusions. He asserts that lowered metabolism, even moderate, interferes with the reproductive function in a large number of cases as shown by disturbed menses, sterility, and interruption of pregnancy. One third of all women studied, who had low basal metabolic rates, and nearly two thirds of the sterile women with a low B.M.R. had abnormal menses. Nearly one half of all women with a decreased rate were sterile, and more than one half of the sterile women had a low basal metabolic rate. A little less than one third of the women with a low rate, who conceived, aborted, some of them repeatedly. The restoration of the rate to normal by thyroid therapy and hygienic

measures, in many cases improved menstruation, premitted conception, and prevented interruption of pregnancy. "Therefore, in all cases where no other cause is found for abnormal menses, sterility, and abortions, the basal metabolic rate should be determined and, if found subnormal, be restored to normal by proper therapy".

The question of diet must necessarily be considered as a factor in the constitutional etiology of sterility. While clinicians find some success in the regulation of diet the question is one that is best understood when viewed in the light of laboratory research. Sure (84), by means of rat experimentation, has proven that vitamin B, in adequate quantities may be of aid in increasing fertility but is in no way as important as Vitamin A. Wilkinson and Nelson, also working with rats, have proved that Vitamin B and G (or B_2) is necessary in the diet for fertility, and that soy bean is especially potent in these Vitamins. Concerning the male factor in sterility Evans (22) has proved that Vitamin A is much more important than is Vitamin E, as marked testicular degeneration will take place if no Vitamin A is supplied and large quantities of Vitamin E is present. The reverse, however, is not true. Waddel

(88) has found that total sterility can be produced in rats fed on cows whole milk with small amounts of iron and copper salts. The condition is characterised by complete disappearance of germinal epithelium, great loss in amounts of testicular tissue, and pronounced edema. This condition is greatly intensified by the action of ferric chloride. What this action is, however, is unknown. The investigators feel that "this sterility is not apparently due to lack of Vitamin E".

At the present the question of vitamins is, at best, in a developmental stage. It would seem that, clinically, a variety of diet is most to be desired. If the diet is sufficienty varied the question of vitamins will, likely, be taken care of.

Macomber (46) is of the opinion that there is a large body of evidence, both experimental and clinical, which shows alterations of diet actually produces sterility. An analysis of the diets of 206 sterile women shows them to deviate from the normal in many important ways. A large number of these show evidence of nutritional disturbances. Of the 206, forty have become pregnant, as a result of changes in the diet and such other measures as the increasing of exercise, the taking of endocrine medication,

and the treatment of anemia. "We have in diet a means of treating sterility which we can not afford to neglect."

Quoting Elsner (20) on the constitutional aspect of sterility we find that "certain constitutional anomolies and diseases may cause sterility in a limited number of women in spite of normal findings in genital organs. Nephritis, diabetes, chlorosis, anemia, tuberculosis, scrophulosis, and a chronic abuse of alcohol, tobacco or morphine may causes sterility. On the other hand , it must be remembered that tuberculous women become prgnant more frequently than is desired. Among constitutional anomalies, obesity is a frequent cause of sterility. The activity of the ovaries diminishes during rapid or sudden increase of fat, the menstruation becomes scanty and less frequent or it may disappear entirely. It is impossible to determine whether the obesity or the diminished activity of ovaries is the primary factor or whether both conditions are due to the same cause."

In the consideration of ovarian etiology one must consider the questions of (a) hypoplasia from faulty development (b) depression of function from endocrine failure, and (c) thickened tunica albuginea preventing rupture

and expelling the ovum. These conditions, acting either functionally or locally can exert their influence on fertility. (28). Hypoplasia, by incomplete or deficient ovagenesis; endocrine failure, by deficient hormonal effect; and thickened tunica albuginea, by direct mechanics, are able, individually, to inhibit fertility.

By ovarian deficiency is meant a failure of reproduction due to failure of ovulation. This condition can be caused by any condition that seriously impairs ovarian circulation and leads to chronic passive conjestion , by the formation, often due to the same cause, of cystic ovaries; and by certain constitutional and emotional factors which act on ovarian function either directly or indirectly. In some of these latter conditions, as in toxic goiter or diabetes, the resulting sterility may be incidental to the primary cause; in others the sterility may be the only indication of disturbed function. (43).

Moench (57) believes that abnormal ova are nor uncommon in women who are normal clinically i.e. those who have a normal menstrual history, normal cervical and vaginal secretions, and normal physical condition.

In ovarian hypofunction the oppertunity for fer-

tilization is diminished in proportion to the reduced ovulation. Other contributing factors such as tubal occlution, male impotence etc., must, however, be excluded before entering into a study of the ovarian causation of sterility. The natural incidence of fertility is smaller in women with habitually delayed periods than in women who menstruate normally. In a series of 1044 consecutive gynecological cases from Mt. Sinai Hospital in New York City, and 4642 private gynecological cases, Rubin has collected some interesting figures. He has added to the above cases 2200 private cases of sterility and 660 private obstetrical cases. The object of the investigation was to study the occurence and incidence of habitually delayed menstruation, and the fertility attending it as compared with normally menstruating women of these three groups and the general population. The results collected by Rubin (74) are, briefly: The menses are habitually delayed or scanty in 3.5-8.0 percent of all gynecological patients and in about 10 percent of those patients whose marriage is sterile. These patients are more apt to be sterile than normally menstruating women, the primary sterility varying between 30-70 percent and

the total, including secondary sterility, amounts in some groups to as high as 93 percent. "Sterility varies directly with the period of delay".

In the discussion of the more local causes of sterility there is a multitude of factors to be considered. A mere list of the local causes according to Elsner (20) may include an exceptionally thick or deformed hymen, vaginismus, acquired atresia of the vagina, changes of the pelvis, vesico-vaginal fistulae, pathological vaginal secretions, abnormally small uterus, sharp anteflextion, stenosis of the external or internal cervical orfice, deficient development of the vaginal vault, or any stigmata of infantilism. However women with similiar findings may become pregnant and have children, as these conditions do not always causes sterility. Another component must be added to these findings in order to assure sterility, and possibly the internal secretions play the most deciding role in these cases. If the hypoplasia of the genital organs is only a part of genital inferiority and is combined with dysmenorrhea, dysparunia, vaginismus or rapid effluvium of the semen, then not the hypoplasia but the

deficient constitution of the woman must be regarded as the real causes of the sterility. It is doubtful if dyspareunia, unless so marked as to prohibit coitus, has as great a role in the production of sterility as is commonly supposed.

Elsner feels that inflamatory changes in the uterine mucosa play a more important role in sterility than stenoses of the cervical orfices. He takes the much doubted stand that there is such a clinical entity as chronic, patchy, purulent endometritis, and feels that purulent secretions may be present in the uterus causing a chronic condition. There can be no doubt that an acute infection, as that following artificial abortion, would damage spermatozoa and afford no fit area for nidation if fertilization did occur.

Unilateral ovarian tumors such as follicular and dermoid cysts may cause sterility but conception will usually take place, if they are the only factor, following their removal. Pregnancy occurs less frequently in the presence of parametric or perimetritic affections, and in conditions of retroversion and retroflexion. However, in most instances retroposition of the uterus causes

sterility only if it is combined with inflamatory processes. In women with secondary sterility, injuries due to puerperal or gonorrheal infection are usually responsible for the condition as adhesions quite commonly cause obliteration of the lumen of the Fallopian tubes. In fact Campell (7) says "it appears that 40-50 percent of all sterility is due to obstruction in the Fallopian tubes" due to one or another cause. Seguy of France (77) says that obliverations are found in about 45 percent of the cases of sterility in females in France.

Thick tenacious mucopurulent discharge from sever endocervicitis has a decidedly destructive action on the sperm and the milder degrees of endocevicitis which often escape casual examination, may also prevent conception.(30).

The element of trauma must also be considered in a discussion of the etiology of sterility. According to Bell, of London, (4): "Trauma, for the most part operative, may result in the disappearance of essential parts of the generative organs, or in their mutilation to so great an extent as to prevent conception. Conservation of function, when possible, should always be attempted in operations on the female genitalia. Further, the

danger of rendering a young woman sterile by an imperfect operation must be mentioned. In the performance of posterior colporrhaphy, for example, a 'sump' should always be left in the natural position of the posterior fornix in which the semen can collect. A circular amputation of the cervix obliverating the fornices may cause sterility.

There is a high incidence of sterility resulting from curretage of the uterus, either in criminal abortion or for the various other reasons. The subsequent sterile condition may be the result of infection and the occlusion of the tubes, loss of normal endometrium, or peritonitis with adhesions. (59).

There is also a form of sterility due to a disorder or absence of the chemotaxis which permits the spermatozoa deposited in the genital passages of the woman to pass upward to the ovum. "This very important biological problem has hardly been studied and there is no complete work on the question of chenotaxis in the French literature." (77). Many cases of unexplained sterility where a clinical examination does not show any evident cause, and in which certain authors have considered an incompatability between the sperm and the ovum, are probably due to disorders of the dynamic factors concerned in the ascention of the sperm.

Among the local causes of sterility should be included uterine fibroids. Fibroids may be of several types, and their effect upon fertility tends to depend upon both their type and size. The sub-mucous type of fibroid have the most pronounced effect upon fertility with the sub-peritoneal type exerting the least influence, and the intramural tumors falling between the other two in effect. There is, at this time, two colored patients in the University hospital who have multiple uterine fibroids of a duration of eighteen months, and both of these patients have been delivered of normal, full term babies.

Functional sterility is frequently produced in young women when x-rays or radium are applied for the treatment of menorrhagia. The use of radiation therapy should always be confined to the hands of an experienced operator, especially when used for pelvic work on sexually active individuals, due to the danger of glandular distruction. "Valuable as radium is in certain cases, the greatest care is required in its use; so it is better to give small, and if necessary repeated, doses rather than large doses. (4).

The affect of artificial abortion on the incience of sterility is marked. According to Rubin (71) tubal sterility following artificial abortion is of such great frequency that it appears to be second in importance only to gonorrhea. He states that sterility which is anteceded by an artificial abortion is due to tubal occlusion 3½ times as often as in cases of primary sterility, 6.1 times as often as in one child sterility, and 7.7 times as often as in cases preceded by spontaneous miscarriages. Eighteen out of 219 patients who had one or more induced abortions became pregnant after utero-tubal insufflation as against 31 out of 239 patients who had had spontaneous miscarriages. The fallopian tube appears particulary prone to damage by the operation of artificial abortion; the uterine end and the isthmus are frequently sealed. "Apart from the well known dangers of induced abortion patients may well be warned against this operation because of the danger of permanant sterility".

Another highly frequent cause of sterility by occlusion of the tubes is due to the role played by appendicitis. Repeated attacks of appendicitis produce, in many cases, a localized pelvic peritonitis, so that the

open ends of the tubes can be easily healed by adhesions; or there can be a constriction somewhere in the course of the tube, producing a permanent disturbance of its function. Rubin (75) finds that in 3143 cases of sterility (one continuous series) the appendix was removed in 465 cases (14.7 percent). This can be compared with a series of 3,963 gynecological patients whose complaint was not sterility and among which there were 112 cases of sterility in a group of 304 whose appendices had been removed. The frequency of sterility in this group amounted to 37 percent. It can easily be understood that other pathology besides appendicitis contributed to this high percentage of sterility. The majority of the patients were between the ages of 25 and 35; the average age at the time of operation was between 15 and 25. All patients had been married more than three years when they presented themselves for treatment of their sterility. Contraceptive measures were used only by about 10 percent of the cases, but had been given up by the majority of these for more than a year.

Following these figures farther we find that 335, or 72.04 percent of the 465 cases had primary sterility, and 130, or 27.96 percent, were relatively sterile. In 55.9 percent of the cases, the appendix was removed before mar-

riage, so the husband could be excluded as an etiological factor in this group. Forty patients were operated upon after appendectomy; of these, 20 had an operation on the tubes, ovaries, or both. When tubal pahtology was present the right tube was found to be more frequently involved than the left. In the 92 cases in which appendectomy was performed in connection with other operative measures, a tubal pregnancy was found 10 times, 33 had an öophorectomy or a partial resection of the ovary, nine had a salpingectomy, and nine a salpingo-öophorectomy. These laparotomies confirmed the frequency with which pathological conditions of the tube and ovary accompany appendicitis.

Examination of the seminal fluid in 300 cases by Hühner's method and of condom specimens showed a normal semen in 62 percent and an abnormal semen in 38 percent. This must be included in the proper evaluation of appendicitis and any other etiologic factors in the sterility statistics.

"Abnormalities of the pelvic organs were extremely frequent and often several were present simultaneously. Displacements of the uterus and diseases of the adnexia formed a high percentage. In the absence of signs of gonorrhea, no small number of these changes ought to be

ascribed to appendicitis. Appendicitis exerted a harmful influence on the ovaries, as can be demonstrated by a study of menstruation. Disturbed ovarian function, as judged by menstrual irregularities occured in 32.3 percent of the interval cases and in 16.67 percent of the acute cases. Most of the disturbances were in the form of hypomenorrhea and oligomenorrhea. The highest percentage of menstrual disorders occured in the interval cases, probably because these had suffered several attacks before operation was performed. On the other hand, the cases which were operated upon during the first attack were freer from these disturbances because the tubes and ovaries were subjected to less damage". The condition of the tubes was investigated in 306 of the 465 cases, by means of insufflation. Normal function of the tubes was found in only 112, or 39.5 percent. The percentage of normal tubes is lower after the interval operation than after operation during the acute attack or after other operations in which the appendix is removed secondarily. Nonpatency and narrowing of the tubes occured in 178, or 58.1 percent, spasm in 7, or 2.3 percent of cases. These figures show a frequency of nonpatent tubes twice as great as that which occurs in general

sterility statistics.

In conclusion, Rubin agrees with Giles that even the mildest attack of appendicitis, in a young female patient or in a woman of the childbearing age, should not be looked on lightly, but that appendectomy should be carried out as soon as possible in the course of an attack of appendicitis.

Knopf of New York, writing on "Myths About Sterility From Contraception" presents the following conclusions:

a. Injuricus methods of contraception or criminal abortion may cause later sterility, because of infectious and inflamatory processes.

b. Rational, scientific "conception control" does not produce later sterility.

c. In this country there are a large number of nervous women and broken down bodies from excessive childbearing, thousands of homes which contain more children than can be properly fed and clothed, and many unhappy marital unions because of the ever present fear of pregnacy. (39).

The Male Factor in Etiology

Various investigators do not entirely agree on the part the male plays in sterility. However, in the main, their findings are fairly constant. Cox (5) says that one third of all sterility is due to the male. Aldridge (1) puts the figure at 30 percent, and Fosdike of the Soho Hospital for Women in London, places the percentage at 25. (92). Gross found the male deficient in 18 percent of a series of 192 cases, and Hagner states that 45 percent of the soldiers in the German army, who had had bilateral gonorrheal epididymitis, were found to be sterile. (29). Hunner and Wharton in an analysis of 526 cases of sterility, examined the husband in 279 instances and found 56, or 20 percent, to be sterile. (85). Dickinson and Cary, after an analysis of 1,763 cases of sterility, report that "the average proportion due to poor semen stands at 31.25 percent". Rubin examined the seminal fluid in 300 cases, by Hühner's method and from condom specimens and found a normal semen in 62 percent and pathologic semen in 38 percent. (75).

The causes of male sterility, while not as numerous as those of the female, are however many, and sometimes most obscure. Hagner (29) lists the following causes of

male sterility.

1. Aspermia: The condition in which there are no sperm developed, and for which, at the present, there is no remedy.
2. Azoospermia: The condition in which there are no sperms present in the semen.
3. Oligospermia: In which sperms are present in the semen but are few in number, motionless, or having only transient motion.
4. Anatomic abnormalities: Which prevent the passage of semen through the urethra.
5. Stricture: Which prevents passage of the semen through the meatus.
6. Sexual incompatability.
7. Sexual excesses with weak sperm formation.
8. Disease of any portion of the genital tract, of which gonorrheal epididymitis has the worst prognosis.
9. Psychic factors: Causing inability to correctly perform coitus.

Sage (76) considers the commonest causes of aspermia to be:

1. The after results of gonorrhea, infection plus unavoidable or meddlesome treatment.

2. Acute infections other than gonorrhea; carelessly handled mumps being the most active.

3. A large group of cases, the vitality of whose sperm cells has been lowered by causes other than local infection; i.e. systemic derangements.

Azoonspermia is uncommon due to lues and the writer has been able to find only 19 cases reported in the literature. In the larger portion of these cases the condition has been remedied, or helped, by anti-luetic treatment, if instituted at an early enough date. Ronchese (67) reports one case in which, by Sulpharsphenamine therapy, the patient recovered sufficient sperms to impregnate his wife.

The normal physiology of the testicle has not been studied to such an extent as has the ovary although it is known that certain testicles elaborate spermatozoa which are partly or totally deprived of any fecundating power. We also know that normally every ejaculation contains a certain percentage of abnormal and dead spermatozoa. (77). No exhaustive study has been made of the action of the spermatic fluid, from the prostate, and the secretion of

the other glands on the vitality of the spermatozoa. Nor has an intensive study been made on the subject of the harmful effect of infections of the male genital passages on the fecundating power of spermatozoa. However, we do know that sterility may be caused by mechanical or infectious lesions of the male genital passages.

Meaker(54) states that the male carries a share of the responsibility in the great majority of cases. The incidence of constitutional faults is greater in the male than in the female; on the male side constitutional faults are commoner than local faults. "The intelligent management of sterility demands, as a routine, in addition to gynecological and urological examination, a comprehensive survey of the constitutional states of both the husband and wife".

According to Bell (4): "It is unscientific, and often inhumane, to subject a woman whose only complaint is sterility to what may be tiresome, if not painful, investigations, and perhaps to operations, until the condition of the husband has been estabilished. It should be definitly understood that before anything is done to a woman the husband must be examined. In a con-

siderable percentage of cases the male partner is found to be either impotent or temprarily, or permanently, sterile from absence or abnormality of the spermatozoa".

****

An attempt to briefly summarize the etiology of sterility presents many obstacles. The subject is too massive to yeild itself to casual summary. Consulting Meaker (52) we derive the following:

a. The older idea, that sterility of mating is probably due to some single abnormal condition has led in the past to incomplete investigation , inadequate treatment and generally unsatisfactory results.

b. Modern research shows that sterility is commonly due to the combined influence of multipe causative factors. Any one of these, excepting the comparatively few absolute factors, may not be sufficient to cause sterility; all of them together depress fertility below the threshold of conception.

c. About one-third of all demonstrable causative factors are extra-genital conditions of constitutional depression which lowers the inherent fertility of the

gametes. Such conditions are operative, in one or both partners, in nearly 90 percent of all sterile matings. In the male they are, in the aggregate, more important than abnormal local conditions.

d. About one-third of all demonstrable causative factors are on the male side, and two-thirds are on the female side. In more than 90 percent of clinical cases, however, there is some division of responsibility between the two partners.

e. A radical revision of older ideas of causation requires the establishment of new standards for the complete diagnostic study of the sterile mating. Complete investigation points the way to adequate treatment, which in Meaker's cases has thus far yielded a percentage of successful results more than twice as great as the average obtained by former methods.

"Sterility is relative and not absolute in 75 percent of clinical cases. In practically every case the cause is a sum total of multiple factors rather than a single abnormality. The responsibility is divided between the male and the female in 90 percent of the cases". (53).

Consulting Meaker further (56) we find that he stresses

four points in etiology.

a. The true significance of local genital abnormalities.

b. The influence of constitutional depressions.

c. The multiple incidence of etiological factors.

d. The division of the responsibility between the male and the female.

Stein and Leventhal (83) have summarized the findings in 300 sterile matings. They found female causes to be 89.4 percent, male 28.8 percent, and both male and female 18.1 percent. The outstanding female causes were obstruction in the tubes, chronic endocervicitis, and uterine under development. The chief male causes were found to be pathological conditions leading to aspermia or necrospermia. Pregnancy occured in 58 women after investigation and removal of causes, or 19.3 percent for the entire series of 300 cases.

The DIAGNOSIS of Sterility

THE DIAGNOSIS OF STERILITY

Before discussing the methods used in the diagnosis of sterility it is well to consider a classification of the different types of the condition:

a. Absolute Sterility-- In which conception has never occured.

b. Relative Sterility-- In which conception has taken place but death of the fetus occured early in gestation or the delivery of a non-viable child has been the result.

c. Conditional Sterility-- In which the woman has given birth to one or more children at normal intervals but these pregnancies have been followed by protracted periods of unfruitfulness. This is, of course, an aquired condition.

d. Functional Sterility-- In which, through some prohibitive external factor a woman has never had proper oppertunity to become pregnant. (85).

The methods of diagnosis of sterility has been greatly improved by the development of new steps in procedure. These new steps in procedure may be briefly listed as;

a. Improved methods of estimating fertility in the male.

b. Post coital examination.

c. The determination of tubal patency by the Rubin method of insufflation and the injection of the tubes by lipiodol.

The estimation of fertility in the male will be considered later. The post coital examination, or Hühner test, should be done within one hour following intercourse. The patient is put in the extreme lithotomy position and a warm bivalve vaginal speculum inserted. Aspecimen is taken from the seminal pool and from various levels of the cervical canal. These specimens should be examined microscopically and an estimation of pH made. (1) By a comparison of the sperm activity at the various levels the degree of hostility of the cervical secretions can be ascertained. The Hühner examination should be one of the first steps taken in the diagnosis of sterility. If no living sperms are found the husband should be sent ot a competent urologist and an attempt made to remedy the condition. If the condition cannot be remedied the wife should not be subjected to any further treatment or to an operation. (2)

Following the Hühner test the patency of the tubes should be examined by means of the Rubin test. Campbell

(7) says: "With modern methods of diagnosis it is possible to determine definity the patency of the fallopian tubes and, in cases of tubal obstruction, the point of occlusion can be accurately located by radiography".

According to Rubin (70), who perfected the test, the cardinal indication for utero-tubal insufflation is to determine the patency of the fallopian tubes, and he says that the method has been found useful:

a. In deciding upon the advisability of an operation to relieve sterility.

b. As a post-operative measure to test and maintain the patency of newly formed stroma.

c. To check the results of a tubal sterilization opertaion.

d. To determine the secondary effect upon the tubes of induced abortions, uterine retrodisplacements and appendicitis.

e. To determine the condition of the residual tube after tubal pregnancy.

f. To determine the tubal status before prescribing contraceptive measures in suitable cases.

g. For the treatment of dysmenorrhea.

Rubin considers, as contraindications for the pro-

cedure:

a. Inflamations of the genital tract.

b. Menstruation.

c. Abnormal bleeding from the genital tract.

d. Pregnancy.

e. Sever constitutional diseases-- T.B., heart lesions nephritis etc.

f. Neuroses.

In Rubin's series insufflation was used as a diagnostic and therapeutic measure in 2273 cases of sterility and he has reached the following set of conclutions:

a. There was no serious sequalae in any of the insufflations.

b. The post-menstrual phase of 4 to 7 days is the optimum time to institute the procedure.

c. A uniform pressure rate of flow of the gas is essential for safety and CO_2 is best to use because of its rapid absorption.

d. The use of the kymograph aids greatly in diagnosing tubal patency, non-patency, stenosis and spasms.

e. The site of lesions can be determined by auscultation.

f. Forty three percent of sterility patients had non-

patent tubes. The remainder had various degrees of tubal obstuction.

g. Tubal obstructions following induced abortions occured in 60 percent of cases, appendicitis 60 percent, fibroids 58 percent, retroflexions 65 percent, and residual tube following extra-uterine pregnancy 82 percent.

Aldridge (1) gives as his contra-indications to the Rubin test bleeding, active infections, nervousness, and organic heart disease. He feels that the best time to institute the procedure is one week post-menstrual, that CO_2 gas is best, and that the operation should be done with an apparatus which shows the rate of flow, the volume used, and that constantly registers intra-uterine pressure. The intra-uterine pressure should never rise over 200 mm of Mercury. Aldridge says that lipiodol is the best medium for locating the point of obstruction, by radiography, if the CO_2 shows an obstruction to be present.

Proctor (64) agrees with Aldridge that the best time for the test is seven days post-menstrual and adds that the patient should refrain from intercourse during that interval.

Schmitz (78) gives as his indication for the Rubin test, merely sterility in the female (the male having been proven fertile), to determine the patency of the tubes, and suggests pneumoperitoneum in cases with obscure pathology. Schmitz considers more contraindications than do either Rubin or Aldridge and lists: In the presence of amenorrhea unless pregnancy can be absolutely excluded, the pre-menstrual phase of the endometrial cycle, uterine hemorrhages, acute or sub-acute infections of the genital tract, profuse leucorrhea in the presence of a cervicitis, advanced organic disease of the heart, lung or kidney, disturbance of metabolism as diabetes mellitus, and dysfunction of ductless glands.

Rubin (72), writing on tubal insufflation for strictures says: "The method of utero-tubal insufflation can determine the fact of tubal patency and non-patency. It can, in the vast majority of cases of non-patent tubes, render information as to the site of the obstruction at the uterine end or the fimbriated end and thus aid in a decision for or against operative intervention to open the tubes. With the help of abdominal auscultation and careful notation of the pelvic pain reaction during the

examination it is often possible to locate the tube which may be the seat of a permeable stricture. The diagnosis of bilateral permeable strictures is more difficult whether gas or iodized oil is used. With the aid of the kymograph certain alterations of tubal function, such as utero-tubal spasm and those due to peri-tubal adhesions, are also readily diagnosed."

Since Rubin introduced the procedure it has been widely accepted, modified and improved upon. Each clinician has his own tecnique and style of apparatus. Of these many modifications some have been incorporated in the literature and are open to our inspection.

Hansen (31) feels that there are disadvantages to the usual Rubin apparatus in that it requires a portable tank which is not always available, that the control of pressure and rate of flow is inconvenient and even dangerous, and that the high pressure tank should be eliminated. He states that the volume needed is small and can be contained in a bottle to be forced out by pressure from a sphygmomanometer, the pressure can be controlled, and the apparatus made more easily portable. (Fig. 1).

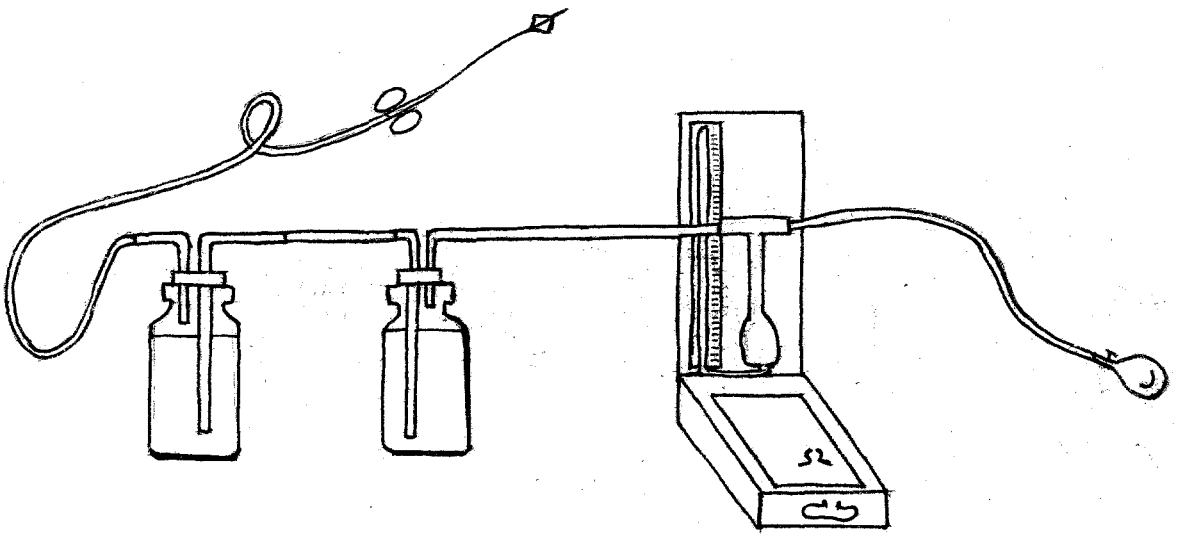

Figure. 1.

Jones has perfected a device with a kymograph attached which records the instant gas passes through the tube. The CO_2 is instantly shut off if any part of the apparatus is neglected, thus affording certain safety to the patient. The instrument has 250 mm of Mercury as its maximum pressure, 100 mm of Hg. per second maximum rate of pressure increase, and 160 cc. maximum volume. (For details of apparatus and hook-up see reference #35).

Baldwins modification is quite simple and consists of a flow volumeter, a manometer, and a cylinder for containing the medium. Its virtue rests in its ability to give definit knowledge of pressure exerted at all times. (See reference #3 for details).

Momback of Cincinnati has developed a new cannula (60) that he claims is greatly superior to the old style. He feels that there are some disadvantages to the Keyes-Ultzman type with the Valentine tip. Namely: the rubber tip tends to split and loosen on the shaft of the cannula, and the rubber in contact with the tip exerts a corrosive affect because of its sulpher content. His new cannula is 24cm long, and curved to fit the uterine curve. The obturator is an olive shaped metal piece (A), it is hollow inside to reduce weight, and drilled with four holes (B). There are two ring grips (C) on the distal end to hold the instrument while operating. The end contains a knob-like projection (D) to fit a Luer syringe for lipiodol, or a rubber tube for the Rubin test. No stop-cock is included because of the danger of leaks. (See Figure 2.)

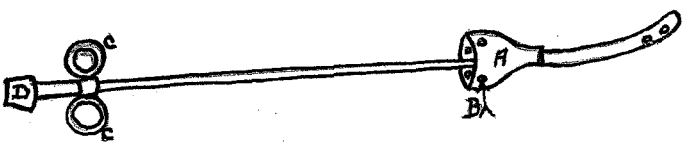

Figure 2.

Hyams (34) has developed a rubber tipped cannula to replace the older ones of metal construction. He holds that the cervix is not uniform in size, shape, or consistency, nor is the uterus always in a normal AV position; hence the passage of a metal cannula often means a great deal of trauma to the cervix, and opens avenues for infection. He feels that his cannula has the following advantages:

a. The terminal portion is semi-rigid but flexible.

b. The instrument may be used on any insufflation apparatus.

c. With the removal of the rubber obstructing tip the instrument becomes an ideal uterine sound.

d. It offers a minimum amount of trauma to the cervix.

e. Any abnormal condition of the cervical canal, internal os , or uterus, can not interfere with the passage of the rubber tip.

f. The flexible tip, being independent of the shaft, can be replaced when necessary.

Sovak (81) has developed an intrapelvic syringe for determining the patency of a tube at operation. The end of the syringe can be introduced into the tube, and by

squeezing, force air into the uterus. By the presence or absence of a gurgling in the uterus the operator can determine the tubes patency or non-patency. Its advantages lie in that it is simple, inexpensive, easily sterilized, not readily breakable, shows patency or non-patency readily, and the site of occlusion, and does not traumatize as a probe does. (See Figure 3).

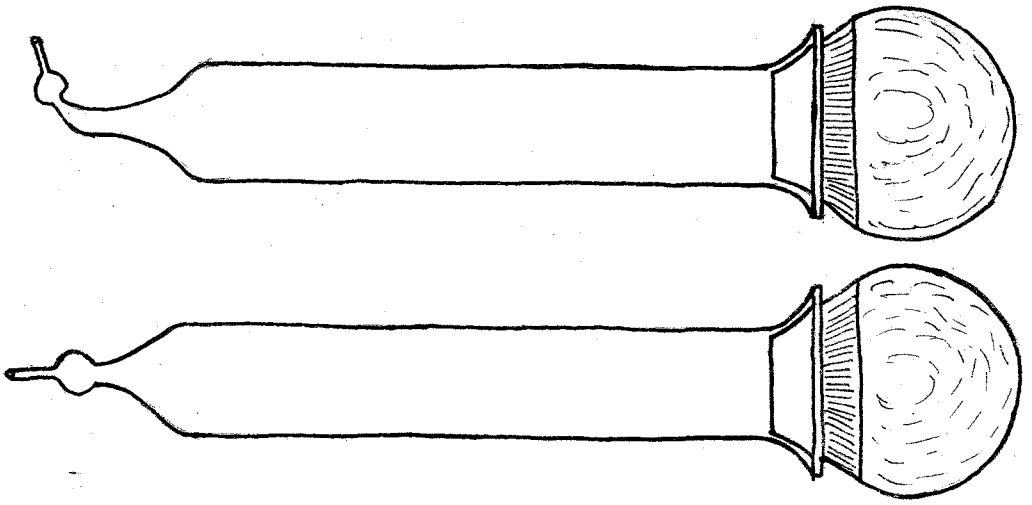

Figure 3.

Regarding the technique of the Rubin test we find it very well discussed by Bell (4) and can do no better than quote: "Experience enables on accurately to guage the amount of air injected. If an unnecessarily large quantity

of gas is pumped into the uterus and on through the tubes, for twenty-four hours there may be a certain amount of discomfort, with pain in the neighborhood of the right scapula, due to the downward displacement of the liver by the air which collects under the diaphram and gives the diagnostic feature of patency of the tubes on x-ray examination of the abdomen. Radiographic observation, however, is often an unnecessary refinement, for anyone experienced in the method is usually able to tell by the way the manometric needle falls after reaching about 80 mm. Hg. of pressure, that the air is passing into the peritoneal cavity. Moreover, it can be heard whistling through the abdominal ostia of the tubes if a stethoscope is placed on either side of the hypogastrium. The uterine catheter, which is fitted with a rubber or metal obturator, is held firmly in the cervix gripped on either side by volsella forceps, otherwise the air will escape. If there is any doubt the cervix can be submerged in saline solution and any escape of gas noted. I have never found this necessary. The free perforated end of the catheter should not extend more than one and one-half inches into the uterus. If the first test is not positive, a second test should be made shortly afterwards, for occasionally thereis spasm of the isthmial

portion of the tube which produces temporary occlusion.

"In cases of doubt, and in those in which it is important to define the site of the obstruction, it is advisable to test also with lipiodol, 6 to 8 cc. of which are injected with a syringe connected to the uterine catheter. A subsequent x-ray treatment gives a clear picture of the result. It may here be added that one of these methods of testing the patency of the tubes should always be practiced about three weeks subsequently to conservative operations, such as salpingostomy, performed to relieve occluded tubes. We have, in them, a method of testing the perfection or otherwise of our operative procedures."

Soter (80) prefers to use air instead of gas and uses the apparatus designed by Zarcho, which consists of a pressure bulb of a manometer to measure the pressure and a long cannula with a rubber stopper to fit into the cervix. There is also a container that can be used for lipiodol injections if so desired. The apparatus is very simple and compact.

This writers states that if the tube is non-patent the test should be repeated at monthly intervals. Three insufflations with failure to obtain a subphrenic pneumo-peritoneum

may be taken to mean tubal closure.

"The patient is put in the lithotomy position. No anesthetic is necessary except for very nervous patients when nitrous oxide or ethylene can be used. It is preferable to have the patient stay in the hospital for twelve hours but the work can also be done in the office.

"The cervix is now exposed by the introduction of Sims' speculum and the anterior lip of the cervix is grasped with a double tenaculum, after the cervix has been cleared of any mucous and sterilized with iodine or mercurochrome. A probe is now inserted and the direction of the cervical canal is determined. The intra-uterine cannula can be shaped to go in any direction of the cervical canal. The rubber fits tightly against the cervical canal, so as not to allow any regurgitation. A slight traction on the tenaculum makes the rubber fit snugly in the external os. After the cannula is fitted the assistant pumps air slowly until the mercury column indicated in the manometer is raised to 200 mm. of mercury.

"In many clinics CO_2 is used instead of air. The advantage is that it is absorbed quickly, whereas it takes from 24 to 48 hours for air to be absorbed. However, inasmuch as so small a quantity as approximately 30 cc. of air

is sufficient with this pressometer, very slight distress is occasioned and the patient may go about her business next day.

"The symptoms of pertubation are as follows:

"1. The manometer play. If the mercury in the manometer receds rapidly with a constant pressure the tube is patent. If the tube is patent the manometer plays between 20 and 70 mm. of mercury, or it may go up to 100 or even 200 and drop. If the mercury stays up after repeated attempts that is a good sign that there is an obstruction present. In the presence of a permeable stricture the gas rises to high pressure and drops gradually, steadily with no fluctuations. In cases of spasm the mercury rises high, usually between 100 and 200 mm. of mercury, but when spasm is relieved it drops as in normal cases. A spastic condition can be overcome by preliminary injections of atropine.

"2. Auscultation. On auscultation over the abdomen, the noise of passage of the air through the tubes is distinctly heard and cannot easily be confused with peristalsis, or any other noise, and the experienced examiner is not easily misled. The passage of air is almost always felt by the patient herself.

"3. Subjective symptoms. Pain in the shoulder is the most characteristic symptom of the entrance of air under the diaphragm, and it can be visualized fluoroscopically. This symptom is always pathognomonic.

"4. X-ray. The demonstration of a cycle-shaped mass of air between the liver and the diaphragm is the most certain and the simplest evidence of patency of the tubes.

"The matter of localization of the obstruction is sometimes of importance. It has been found by repeated observation and controlled by laparotomies, as well as lipiodol injection, that when the tubes are closed at the uterine end, the pressure rises to 200 and as a rule the patient feels discomfort over the symphysis, in the mid-line referable to the uterus. When the tubes are closed on the isthmi the same median supra-symphysial pain is noted by the patient with discomfort just lateral to the uterus. When the tubes are closed at the fimbria a more intense pain is noted by the patient and radiates well out to the sides. In cases where plastic operation is considered advisable lipiodol injection is indicated.....where no surgery is indicated Rubin's test is a much easier and safer procedure. Lipiodol is more difficult to inject, if it stays within the

tubes for a long time, paralyzes the musculature for some time and causes a greater discomfort. Also the danger of infection is greater. Because of its density it carries germs upward much more easily than air.

"There is practically no serious danger following the test. Workers have performed thousands of the tests without an accident.....rupture of a tube is possible if pressure is very high, and respiratory syncope seen when a large amount of gas is injected". However the latter "disappears when the patient is put in the knee-chest position. Gas emboli is a very rare accident".

Most monographs on sterility state or imply that there are many cases in which the etiology is obscure or indeterminable. The percentage of cases, in which the cause is not found, is not given, however for any complete series. Unusual or atypical cases are not tabulated and data referring to the more common errors or omissions in diagnosis are not assembled. According to Cary (10) in a series of 190 completely studied cases of sterile union, there were six cases, or 3 percent, in which repeated detailed study failed to reveal any condition preventing conception. Frig-

idity, probable low fertility, inheritance, and minor lesions occurring simultaneously in husband and wife are regarded as unfavorable influences in four of the obscure cases.

Abnormal sexual relations were discovered as a cause of sterility in four cases which were considered as obscure problems.

"Failure to recognize the lesser semen defects as a cause of sterility constitues one of the most common errors in diagnosis.

"As differentiated from endocervicitis, the less obvious changes in the secretions of the chronically conjested or poorly drained cervix should be studied in obscure cases as a possible barrier to sperm cell migration.

"Statistics seem to indicate that stenosis of the cervix is the major lesion preventing pregnancy in about one-third of the underdeveloped cases. Retroversion is not listed as a cause in any case.

"X-ray studies of the tubes indicates that in patients with a previous history of acute pelvic inflamation the presumptive diagnosis of adnexial disease as a cause of sterility is not necessarily disproved by positive patency tests.

"From an analysis of this series it appears that, in 9 out of 10 cases, the etiology of sterility will be ultimately determined by a critical review of four potential causes; namely, male responsibility, occluded tubes, underdevelopment with ovarian hypoplasia, and endocervicitis."

****

Diagnosis in the Male

"Any tubal testing or operative procedure for sterility that is done on a wife, before the present condition of the husband is determined, should, in these days, carry the stigma of mal-practice". (41).

In examining the husband of a sterile couple the first procedure to carry out is to obtain a history and determine if there is anything in his history that could cause a closure of the tubes leading from the testicle to the urethra, or if there has been some pathology that could have destroyed the sperm producing structures of the testicle. If there is nothing of this sort in the history, the clinical examination will show either a normal testicle, epididymis and vas, or it may show an absence of either the epididymis or the vas. It may also show the rare condition of congenital absence of sperm formation. This condition is manifested

clinically by the testicles being a little smaller than normal, slightly more globular and considerably harder than a normal sperm producing testicle. If we do not find this type of testicle or any nodules in the vas or epididymis, the next step in our clinical diagnosis is the examination of a specimen of semen. (40).

This examination should consist of actual count, morphology, the number of immature cells, and the vitality. (1).

In addition to the above tests there should be physical and chemical tests and a microscopic test of formed elements other than sperms, together with a study of the viscocity, and the Hydrogen ion concentration as determined by the colorimeter. The $_{p}H$ in a normal specimen varies between 7.6 and 9.2 with most of the figures falling between 8.0 and 8.4. ; and in no instances has an acid semen been found. (87).

Walker (89) classifies sperm as:

a. Hemospermia: Due to chronic inflamation or conjestion in the seminal tract, scurvy etc. If the blood is well mixed with the semen the inflamation is in the vesicles, if not well mixed the trouble is in the posterior urethra.

b. Pyospermia: The position of infection can be told by the degree of pus mixture with the sperms as in the case of hemospermia above.

c. Necrozoöspermia: The presence of dead or malformed sperms indicate hostile prostatic or vesicular fluid and demands a careful examination of the seminal tract.

d. Oligozoöspermia: The normal count is 100,000,000 per cc. The count is lowered with age, sexual excesses, constitutional derangements, sever illness, or small testes.

e. Azoöspermia: Indicates the failure of sperm to develop or a blockage in the tract. A careful examination is indicated in this condition, with special emphasis on old gonorrhea infections.

The obtaining of a specimen of semen may be done by the use of the condom with intercourse, friction and glass container, withdrawal, or from the seminal pool in the vagina. However, according to Lespinasse (40) "to obtain a specimen of semen, actual intercourse must be indulged in. Semen obtained in any other way is not reliable". "The normal ejaculation is from 3 to 8 cc. in

volume and should contain around five hundred million spermatozoa. Any diminution in this number lessens the mechanical chance of a sperm meeting the ovum and hence is conducive to sterility.

The technique of the sperm count is essentially that of a leucocyte count, according to the method advanced by Macomber (44). A blood counting chamber and a white blood cell pipette is required. A solution of 5% sodium bicarbonate with 1% of formalin is used. The semen is drawn up to the 0.5 mark and diluted to the 11 mark as for a white count. The pipette is then shaken, a drop put on the counting chamber and counted as a white count would be. The number of sperms in a mm square x 10 (depth) x 20 (dilution) = the number per cm. x 1000 = the number per cc. The sodium bicarbonate dissolves mucous and the formalin kills the sperms. The study of 294 patients shows the normal to be approximately 100,000,000 per cc.

After the number of sperms have been computed the next step in procedure should be a study of their morphology. "The next point to observe is an examination of the sperm. Are the tails long and straight, their axis in line with the axis of the head, or are they short and per-

haps at right angles to the axis of the head, and is the head normal and elliptical or is it larger than normal and globular, or even angular? The neck piece is often thickened and considerably enlarged". (40).

According to Moench (56), in a normal semen the abnormal heads do not exceed 19-20 percent. When the sperm head abnormalities reach 20-23 percent impaired fertility may be assumed. When the sperm head abnormalities are above 25 percent clinical sterility is usually present.

If the non-motile sperm are found to have their tails turned up they were dead at the time of ejaculation. If the tails are straight they have died subsequently. Few abnormal cells are motile. (24).

The motility of the spermatozoa should next be determined by following the sperm across the high power field. A really extraordinary specimen will have a progressive, vibratile motion and go across the field in from 3 to 5 seconds. The speeds vary to as high as 30, 40, or 50 seconds and then absolute immotility or rather motility in situ. Just the exact amount of motility that is necessary for the sperm to impregnate has not, as yet, been determined. (40).

The Huhner test, or the examination of the sperms within the female, following coitus, is very valuable in an evaluation of the sperm. The technique is relatively simple. The patient is insructed to have intercourse, lying with the knees flexed and the hips elevated. She should wear a sanitary pad and present herself for examination within one hour following coitus. She should not be kept waiting, but should be seen immediately upon arrival. The pad should first be examined and an estimation made of the amount of semen lost. A vaginal speculum should next be inserted and the amount of semen in the seminal pool estimated. Normally it will contain 30-40 minums. Semen should then be drawn up in a warm pipette and placed on a warm cover slip where it is examined for number and morphology of the sperms. Following this there should be a bit of mucous removed from the external os, by means of a special cannula, and from the internal os. These specimens should be examined and motility determined as a key to the hostility of the cervical secretions. The remains of the original specimen can then be stained and examined for number and morphology. (61)

Cary (11) agrees with the above and states that the

specimen should be examined by means of a cannula attached to a Luer syringe. The sperms in the cervical mucous should be examined and their condition contrasted with that of the sperms in the seminal pool, as an index to the hostility of the cervical secretions.

Gottschalk (27), states that sperms die quickly in the vulva, and in the vagina within a few hours, but live much longer in the cervix. They have been found alive and active in the uterus 5 and 6 days post-coitus, and in the distal portion of the tube nearly a month after recorded intercourse. (Wenkle).

The value of the Huhner test lies in that:

a. It allows a woman, without her husbands knowledge, to ascertain the condition of the sperm.

b. It rules out physical defect as the cause and proves whether or not the secretions are inimical to the sperm.

c. It definitely places the blame with the husband in conditions in which he is to blame.

d.. It saves the wife needless treatment in cases in which the husband is at fault or the secretions too acid.

e. It is extremely simple. (27).

Mason (48), has done a great deal of work on the sperm factor in sterility. He states that "the first specimens of semen and spermatozoa were from husbands of women who were sterile, through marriages ranging from one and one-half to twelve years. Later specimens were examined which were obtained from men know to be fertile, having from three to five children. Some of these specimens were obtained by condom, and some were obtained by means of a pipette from the vaginal vault. For purposes of morphology study it made no difference.

"In each specimen, from stained smears, with the high dry objective, and 10x eyepiece, 500 consecutive specimens were examined, and the number of grossly abnormal forms, without regard to type were counted. The average of these forms in the specimens from sterile marriages was somewhat higher than those counted from specimens from husbands of fertile marriage, being 9 percent and 5 percent respectively.

"The next step consisted of measurements of the lengths and diameters of the head, and the lengths of the tails, of 250 consecutive sperms.....When these microscopic data were correlated with the clinical data in the particular sterility problem being studied, it was found

that the greatest variation occured in the specimens from husbands whose wives showed the least cause for failure to concieve.

"In all specimens, regardless of what percentage of grossly abnormal forms were present, or how much variation was shown in measurements of the remining forms, the definite maiority was always 5 x 3 microns in size and of regular contour.....with tails approximately 55 microns long, the heads being almost filled with dense unclear material, except for an area of cytoplasm from 1.5 to 2 microns at the proximal end." This the author believes, may be taken as the gross morphology of the normal human spermatozoan, and he would apply the terms meglosperm and microsperm to forms larger or smaller than this, respectively.

"As a result of observations upon the lengths of time that various sperm specimens lived, it was concluded that, roughly, normal sperms will survive in appreciable numbers for at least 24 hours, under ordinary conditions of temperature, and that to obtain an estimate of sperm vitality, sufficient for clinical purposes, it is not necessary to keep the specimen at a temperature corresponding to that of the body."

From time measurements of motility, it seemed that a minimum of 3 to 4 hours was more than ample time for an appreciable number of sperms to reach their destination in the tubes. Another observation was, that by the addition of vaginal secretion to the semen, an immediate though transient stimulation of sperm movement was noted.

"Kurzrok and Miller seem to have conclusively demonstrated a ferment or lysin in semen which is specific for cervical mucous. It is apparently absent in some cases. This.....could well explain some hitherto baffling cases of sterility. " (48)

"The frequent direction to patients.....who complain of sterility, and whose vaginal secretions are found to be acid, to take an alkaline douche just before intercourse, may serve only to place another obstacle in nature's pathway. I have not yet found a vaginal secretion so acid that, when mixed with semen in proportions far greater than those obtaining after intercourse, when dilution by the alkaline semen and increased alkaline cervical secretion has taken place, had any immediate effect upon spermatozoa except to stimulate their motility".

In a series of experiments with semen and thick cer-

vical mucous, obtained in each case from patients whose complaint was sterility, it was observed that the spermatozoa never progressed further than a few microns into the mucous.

"As a result of these observations, it was concluded that, in those cases where husband and wife are apparently normal, but where conception does not occur and especially after careful examination of the semen shows it to be up to a normal standard for fertility, the chief bar to conception lies in the inability, for one cause or another, of the sperms to pass the barrier of the cervical canal and internal os". (48).

Keen and Payne of Philadelphia (37) suggest, in the diagnosis of sterility, the following method of procedure:

1. History: A careful history of both the husband and wife, at seperate sittings. Past history of pregnancies, infections, menstrual history, venereal, mumps in the male, hernia, habits and occupation of the male, excesses, general health.
2. Physical Examination: Endocrines, foci of infection, complete examination of both the male and female.
3. Gynecological Examination: Huhner test, complete semen

examination. Less than 100,000,000 per cc. can be taken to mean clinical sterility.

4. Patency tests: Rubin test with the kymograph, and lipiodol injections.

5. Laboratory Investigation: Blood, urine, Wasserman reaction, thyroid tests (B.M.R.), pituitary, glucose tolerance, Frank test on mice.

The diagnosis of sterility, and the examination of the male, is relatively so easy, that it is not justifiable to do any sterility operation on a woman until it has been determined that the husband is normal.

****

The TREATMENT of Sterility

THE TREATMENT of STERILITY

The treatment of sterility is a subject upon which there is a very great difference of opinion. On practically every phase of the question there can be found arguments for and against the particular therapy under discussion. The decision does not fall under this writers authority and our task is merely to present the various theories as advanced by their exponents.

The intelligent management of sterility requires, in every case, a complete study of both partners, and dealing with constitutional as well as local factors. (53).

About one third of all sterility is due to the male and about one fourth of these defects offer hope of responding to therapy. In the female relief in 20 to 25 percent of cases can be expected if the treatment is carried out persistently. (13).

Marcus (47), emphasizes the importance of prophylactic measures at puberty. He urges that the clinician:

a. Stress hygiene at puberty, proper sex education, and better control of venereal disease.

b. Be aware of threatened hypoplasia and treat

seriously the menstrual disorders of puberty.

c. Early and through investigation, complete and exhaustive treatment, with better coöperation on the part of the husband and of the doctor to whom he is referred for study.

In a series of 92 sterile couples studied by Cron (16), there have occurred 31 pregnancies following various methods of treatment, and the majority of pregnancies progressed to term. Endocervicitis and cervicitis are very common causes. Treatment by radial cauterization of the infected cervix has resulted in 30 percent of the women becoming pregnant.

Quoteing Matheiu and Schauffler (49) on endocervicitis: "The importance of linear cauterization in the treatment of cervical erosion and endocervicitis, and thus in the treatment of sterility, has obtruded itself upon us. Out of 31 cases which had linear cauterization in the course of treatment for sterility, 7 can be excluded as obviously not suitable (unsatisfactory semen), negative Rubin test, insufficient time elapsed etc. Out of the remining 24, in which the outstanding factor seemed to be erosion with endocervicitis, the sterility was relieved in 11 cases, (18 percent of the series). Cautery alone was held responsible in 8 of these cases."

There is a great deal of controversy about the use of alkaline douches. Alarge number of writers insist that the acidity of the cervical secretions does not exert any harmful effect on the sperms. Other authors have found excellent clinical results accrue from the changing of the vaginal reaction by means of pre-coital douches. Bonney (6) considers them as more or less empirical and is not overly enthusiastic about the practice. Seguy (77) says that it has been found that sterility may be due to leucorrhea which is harmful to the spermatozoa on account of the acidity which it produces in the genital passages but such conditions are easily controlled since the lower genital passages are easily accessible in the female. The problem becomes more difficult in the uterus and tubes. The author is continuing his investigations and hopes that he may be able to formulate very interesting methods of treatment.

Cox (14), suggests palliative treatment with vaginal douches of tannic acid and glycerin or ichthyol-glycerin sponges.

Insufflation is of value as a therapeutic measure, especially in the treatment of narrowed or occluded tubes.

In these cases the result is obtained by separation of the agglutinated mucosal folds in the tubes, by liberation of the adhesions at the fimbriated end, and by the straightening of kinks and twists. Bell (4), reports that after insufflation pregnancy followed in 35 of 306 cases cases of sterility, or 11.4 percent. In a general group of 2, 113 insufflated cases , 16 percent became pregnant. Twenty of the 35 cases which became pregnant had narrowed or adherent tubes, as shown by insufflation. Nearly 50 percent of the pregnancies took place within 2 months after the insufflation.

Cron (16), holds that obstructed fallopian tubes are the cause of sterility in 25 percent of sterile women and that the patency test is not only of diagnostic but of therapeutic value as well. This clinician has seen 23 patients become pregnant following the forcing of CO_2 through the tubes. Rubin (70), states that "tubal insufflation has a definite therapeutic value in sterility". Pregnancy followed in 62 percent of 398 of his cases and no other treatment was used.

Daniel (17), contends that insufflation is of definite therapeutic value. In his technique he "always begins with

a low pressure, since an initial pressure of over 100 mm. causes spasms of the tubal sphincter at the uterine end or a hyperperistalsis of the whole oviduct; both of these conditions hinder the insufflation". This investigator uses a pressure between 100 and 150 mm though he has observed cases in which he had to use a pressure of 220 to250mm. to establish a clear passage. In such cases the value of insufflation is indeniable. The danger of tubal rupture does not seem to be very great as Daniel has forced air to a pressure of 300 to 400 mm. into 8 extirpated oviducts with a clamp tied on one end. A fissure of the tube between the ampulla and the isthmus resulted in only one case and histological examination revealed a chronic inflammatory change in this oviduct.

"According to the most frequent data in the literature pregnancy occurs in 11 percent of the cases after tubal insufflation. The writer saw 4 out of 35 women undergo pregnancy after a successful insufflation. According to the experience of the writer, primary sterility has a greater chance of being eliminated by insufflation than does the secondary. Moreover, successful results are quite possible even when sterility has lasted for more than five years. Eighty percent of the pregnancies

after insufflation carried to term; whereas the remaining 20 percent resulted in miscarriages, probably due to an inferior quality of the uterine mucosa". (17).

Forsdike, of London, according to Wilson, (92), advises waiting9 months after lipiodol injection, if the tubes are patent, before doing anything else. If the patient is not pregnant by that time he advises further procedure.

Contrasted with the many opinions in favor of tubal insufflation as a therapeutic measure we find Bonney (6), "believes that cure of sterility by tubal insufflation is impossible except perhaps in very rare instances".

Some authorities advocate artificial insemination, under certain conditions, in sterility. Huxley (33), contends that it is indicated only if the male has healthy sperms but is impotent and the wife is normal. The time of greatest fertility should be chosen, a condom specimen obtained and kept at the optimum temperature, to be injected as soon after emission as possible. A few drops should be injected, at low pressure, into the uterine cavity. Huxley feels that it is possible that repeated

injections will need to be made.

Bonney (6), states that the sperms are not naturally injected into the uterus but must find their way of their own accord, hence "there is only one condition.....in which direct deposition into the uterus would be helpful and that is when the vaginal discharge is toxic to the sperm but the uterine discharge is not. The great drawback to artificial insemination of the uterus is the infrequency with which it can be carried out..... A far better procedure is injection of the semen into the upper vagina by means of a syringe. The husband and wife should be instructed how to do this themselves, so that it can be carried out frequently".

Mason (48), advocates "the treatment, of the introduction of the sperms into the uterus by means of a pipette. Needless to say, there should be no pathogenic organisms in the cervix or vault. In doubtful cases condom specimens of semen may be used. Otherwise the patient is instructed to come to the office as soon after intercourse as possible, but not longer than one hour, when the injection is made directly from the vaginal vault. The injection of such material into the uterus is not without its theor-

etical dangers, but as yet we have had no accidents. Not more than a few drops of semen or material should be injected, and this gently; it is not the purpose to force it into the tubes but inject it in the uterus". This treatment would also be indicated in those cases found by Kurzrok and Miller, (see above), in which a cervical mucous lysin is absent in the semen. The author places the day at which ovulation occurs as the eleventh day after the last menstrual period and uses the twelfth day for artificial insemination. "Naturally, the number of cases which meet the requirements for selection such as outlined will be small. Usually some grosser lesion will be responsible for the sterility. So far, in my own cases falling in the former class, pregnancy has followed insemination in two cases, or two and six year sterility, and has failed in two others after three trials. In one of the latter, failure was predicted because of the failure of the sperms to meet requirements, and the second seemed to be a fair specimen when measured by standards as described above."

- In those cases which are shown to have tubal occlusion and which do not respond to insufflation therapy

the clinician must resort to surgery. The problem may then be handled by salpingotomy or periuterine insufflation.

Considering the procedure of salpingotomy Kerwin (38), advocates the proper selection of cases and an appropriate technique. In the proper selection of cases:

a. The husband must be proven perfectly fertile.

b. The patient must be at the right age for procreation. Patients over 35 years of age are not suitable.

c. The patient must show no signs of infantalism or endocrine dysfunction.

d. There must be no acute inflamatory processes present, whether post-abortal, puerperal, or gonorrheal.

e. There must be no chronic inflamatory processes present unless there has been careful pre-operative preparation.

Kerwins technique consists of lipiodol injection to ascertain the site of the obstruction. Then a laporotomy is done and the tube lifted out through the incision. The adhered fimbriated end may either be slipped out or an incision made into the tube as needed. (The technique in detail is not indicated in this paper).

The surgical methods used, according to Rubin (73), may be any one of the following which is best suited to the case at hand:

a. A simple opening of the fimbria when they are but lightly agglutinated.

b. The making of a stroma at the closed end of a hydrosalpinx.

c. A partial resection of an occluded portion of the tube.

d. When the isthmus is blocked, a resection should be made as far as the patent point and implant the latter into the fundus.

e. When the tubes are absent or irreparably obliverated, the ovary should be implanted on one or both sides, into the uterine cavity, by Tuffier's method.

Quoting Schmitz (78), we read: "The treatment of sterility due to atresia or aplasia caused chiefly by infections deserves our earnest attention. The desire of a barren wife mated to a potent husband to bear offspring and to submit to any measure to attain that end should be heeded. The newer diagnostic measures enable the gynecologist to visualize anatomic changes in the genital tract and es-

pecially in the uterine tubes. It is possible, there-by, to determine the indicated method of surgical procedure. Exploratory laparotomies are certainly not anymore justtifiable. The success of surgical treatment probably depends on the presence of a normal tubal mucosa. The efficacy of the operation should be tested by repeated air inflations and hystero-salpingographies. Thereby reocclusions, especially of the abdominal ostium, may be forestalled. The transplantation of an ovary into the uterine cavity in the absence of both tubes has shown the same percentage of full term pregnancies as salpingotomy".

Campbell (7), states that, since tubal obstruction forms an absolute barrier to conception and it is possible to diagnose and locate the point of obstruction, (see above), operative procedure, with the primary object of restoring tubal patency should be considered in every case. With recent advances in technique the results from reparative surgery are encouraging. "We wish to make a plea for thorough investigation of all cases of sterility, remembering that those of tubal origin are no longer entirely hopeless".

Bonney (6), has a method of surgical technique that is original and more than worth the time of anyone interested in the matter. (See reference 6 in bibliography). He states that blockage at the abdominal ostium only is the easiest variety of obstruction to treat surgically, and that blockage at the uterine ostium requires, for its satisfactory correction, reimplantation of the tubes into the uterus.

In contrast to the ideas of the exponents of surgery for the correction of sterility, by means of salpingotomy, we find Aldridge (1), and Seguy (77), very much opposed to the procedure. The former says that surgery is disappointing even under the most favorable conditions. If the obstruction is at the proximal end attempts to open the lumen almost invariably fail, in his opinion. He quotes Polak in saying that if the obstruction is at the fimbrial end and the tubal wall is not infiltrated we can only expect a satisfactory result in eight percent of cases. Seguy says: "Many plastic operations have been advised for obliverated tubes but these should be perfected, because the results obtained up to the present time are not very encouraging..... Unfortunately the reestablishment of permeability is not the only difficulty and it is

also necessary to obtain normal physiological conditions. Obliverated tubes are usually altered in their structure and the pavilion may not be capable of receiving the ovum after its discharge from the follicle. Some authors have considered that it is better to remove such a tube and to implant the ovary directly into the uterus".

Many writers agree with Seguy on the benifits of uterine implantation of the ovary. Rubin (73), quoted above, suggests implanting the ovaries, by Tuffiers method, but only when the tubes are absent or irreparably obliverated. Schmitz (78), also quoted above, also advocates the transplantation, in the absence of both tubes and when salpingotomy is impossible, and says that the procedure has shown the same percentage of full term pregnancies as salpingotomy. Elsner (20), says: "If both tubes are absent or partly damaged, a transplantation of the ovaries may be successful; the nerves and vessels of the ovary must be preserved".

Bell (4), also sanctions the operation if salpingotomy is not possible. "Sometimes, however, it is impossible to save either tube. It has, therefore, been sug-

gested by Estes and Tuffier that in some of these cases the ovary attached to its normal blood supply, or a graft of the ovary, should be implanted in the uterus in such a manner as to allow the surface of the ovary to project into the cavity. I have performed such operations about ten times without immediate or remote harm to the patient, indeed with considerable improvement in her general condition. Tuffier, on the other hand, has reported some accidentsafter these procedures. In some of my few cases it is too soon to give up hope, but, so far, in none has pregnancy ensued. This, I think, is about the limit to which we can go in surgical conservation of the function of conception".

Another method for the treatment of steriltiy has been used with good results. This procedure also demands a laparotomy, and consists of periuterine insufflation of the tubes. This procedure is accomplished by means of the intrapelvic syringe, of which, a satisfactory one has been developed by Hyams. (Figure 3). According to Rubin (73), this procedure has the following advantages:

a. Establishes patency of the duct system and opens the "pin-point" cervix.

b. Enables the cervix to expell a mucous plug from its deeper portion.

c. Seperates mild agglutinations and straightens out tortuous folds.

d. Overcomes utero-tubal spasm in some cases.

e. Stimulates the psychic and accomplishes results through suggestion.

In some instances, as if the adhesions are too firm, the hand syringe méntioned will not exert sufficient force to overcome the occlusion. In that case the gas pressure apparatus must be enlisted and some times as high as 150 to 200 mm. of mercury is required to break up the adhesions.

In the treatment of sterility, when due to fibroids, the procedure is relatively simple. Bonney (6), states that "fibroids causing sterility should be treated by myomectomy. It is possible to conserve the uterus in almost every case, leaving an organ capable of childbearing." McGoogan of Omaha contends that 60 percent of women with fibroids will conceive, some will abort, some will go to term normally, and some will rupture the uterus. The latter's method of procedure is to remove the neoplasm and

leave the uterus if the growth is not too extensive. If the tumor is too large and involves the entire organ an hysterectomy is indicated.

In the treatment of sterility due to cervical stenosis, dilatation is frequently performed. Bonney (6), says that this procedure does favor conception although not with anything like the frequency commonly claimed. As quite a number of the young married women suffer from "first day" dysmenorrhea, dilatation often has a double advantage. This operation should always be followed by insufflation. "Moreover, dilatation forms an essential part of tube insufflation which nowadays should always be performed in a case of sterility. To merely dilate the cervix and leave the tubes untested is inadequate practice".

Elsner (20), also recommeneds dilatation for cervical stenosis. Fehling's method consists of introduction into the cervix of a 5cm. long glass tube which is slightly curved and perforated; it contains a glass slide on one side in order to prevent its entering the uterine cavity. The tube is introduced into the cervical canal and left there for two or three days. After it has been removed

irrigations with a 1 percent solution of formalin are given. The method can be repeated three or four times.

Most gynecologists prefer the dilatation to plastic operations on the cervix. Unilateral or bilateral splitting of the internal cervical orfice has been given up because of the danger of hemorrhage or scar formation. In cases of extreme stenosis of the external cervical orfice a stomatoplasty may be indicated; bilateral incisions are made in the cervix that do not reach the internal os, and a wedge shaped portion is removed from both lips of the cervix. This operation should be preformed after all other causes of sterility have been eliminated and is contraindicated in the presence of any inflamatory processes of the uterus, tubes, ovaries, or parametria. (55).

Considering sterility from the viewpoint of local vaginal conditions: "In some cases the failure to conceive is due to imperfect penetration during intercourse. In nearly all of them the vaginal orfice is unduly narrow and rigid and the pain evoked produces a quite natural resistive spasm which increases the difficulty. Women of this type are frequently hypersensitive and over strung, but it is a

mistake to regard the dysparunia as of purely nervous origin." Merely stretching the parts under anesthetic does little or no good as a rule and the failure only increases the patients concern. The orfice should be deliberately enlarged by a plastic operation. (6).

The treatment with hot air gives excellent results and should be tried in every case. The use of diathermy may also be successful. Various baths including mud baths may be required. Old adhesions may be seperated by gentle massage. In the cases of vaginismus the cause must be found. In the presence of inflamations or injuries, such conditions must be treated. The vagina should be gently dilated. In grave cases an excision of the entire hymen may be indicated. There are few indications for the treatment of dysparunia, especially in cases where the libido and sensation of satisfaction during the cohabitation are absent. If the semen escapes from the vagina, the intercourse in another position may lead to conception. (14)

The use of radiation as a therapeutic measure in sterility is still a question that is open to discussion. Kaplan, (36), says: "The biologic action of the ovary and

its intimate connection with menstruation, and the control of associated endocrine glands, especially the pituitary, is not, as yet, clearly understood. For the correction of female functional disorders the x-rays have proved efficatious, either when applied to the ovary or pituitary body or other glandular areas.

"The reaction to radiation is not, as yet, clearly understood. Normal children have been born of irradiated mothers and, when properly given, x-rays are neither harmful to the mothers nor to their offspring".

****

The Treatment of Sterility in the Male

Sterility is commonly caused by a congenital inability to form sperms, on the part of the husband. This condition is due to an absence of spermatogenic tissue, of congenital origin, with normal development of the sexual side of the testicle. "These individuals have a normally developed testicle, as regards the sex side, but no development of the spermatogenic side. Sexually these individuals are normal, or stronger than normal, as regards

their sexual libido. "here is no treatment that will remedy this condition. It is due to a congenital absence of spermatogenic tissue, which classifies with the deformities." (4).

In the group whose semen shows no spermatozoa, we have two divisions: a. Those which have no production of sperms, and b. Those with obsructions that prevent the sperms from leaving the testicle, although normal sperms are developed.

In the first group, as stated above, there is no therapeutic measure of value.

In the second group we have the obstructed types. These individuals practically always give a history of mumps, gonorrhea, or trauma to the testicle. Clinically examination will show an infiltrate in the epididymis or in the vas and the semen examination shows the absence of sperms. The relief of this type of patient is purely surgical and the percentage of cures depends entirely upon the location of the obstruction (26).

The commonest point of obstruction, according to Bell, (4), is in the lower portion of the epididymis. "Here we relieve the condition by joining the vas to the epididymis

above the point of obstruction. This is best done by direct vaso-epididymostomy, an operation devised by the writer which joins the vas to one particular epididymis tubule loop. Results here depend upon the surgeon and not to chance". The authors results in this operation are 60 to 70 percent successful.

"The next most common siteof obstruction is in the vas and here we simply cut out the obstruction and do an end-to-end anastomosis of the vas. Results here are almost always obtained. Obstructions in the vas, deep down in the pelvis, are surgically inaccessible and therefore unrelievable directly." In this type of operation Bell has devised the sac technique, which converts the tunica vaginalis into a spermatocoele. By tapping this sac, sperms may be obtained for injection into the wife's uterus. "Obstructions in the head of the epididymis and in the mediastinum of the testicle are relievable by proper anastomosis of the mediastinum testis and the vas, or one of the tubules of the epididymis and vas, but results here are relatively few".

Hagner (29), does a suture of the vas to the globus major and reports excellent results.

Chronically inflamed vesicles also play a role in the

males sterility. This condition shows itself by the sausage casing shreds which may be expressed form the inflamed organ, and consist of pus, vesicular secretions, and desquamated vesicular epithelium. These shreds may become so thick and so hard as to plug the ejaculatory ducts. Where there is a history of gonorrhea and one suspects a vesiculitis, the patient should never be operated upon until the physician has tried to express this plug, by vesicular pressure and expression. Occational this obstruction may be relieved by catherization. "Naturally we wish to reieve the patient in the simplest and surest manner possible. Occassionally the obstructions are so located that the mechanics work out in such a way that we can do a vaso-vasotomy joining the right vas to the left vas, where the results are much better than in a vaso-epididymostomy. As an example, this operation would be indicated where the right vas is closed in the pelvis and the left tail of the epididymis is closed. Therefore, by joining the two vasi together, the sperm from the right testicle would go through the right epididymis, a portion of the right vas, through the anastomotic opening into the left vas, on through the abdomen and out in the urethra. Anothertype of case suitable for the so-called

cross operation is the following: The right testicle is atrophied and obviously is not producing spermatozoa. The epididymis and vas of the right side are perfectly normal. The left vas is closed in the pelvis and the left epididymis is closed in its tail. To relieve a situation of this sort, it is necessary to join the right vas to the left epididymis and then the sperm from the left testicle will enter the urethra through the right ejaculatory duct". (4).

****

The Management of Constitutional Therapy

A large and important part in the constitutional management of sterility lies in endocrine therapy. A dysfunction of the ductless glands, in any part, may be the deciding factor in theattempt to assist fertility. Rubin (74), suggest a carefully balanced diet, an improvement of the hygienic and psychic conditions, thyroid therapy if the B.M.R. is subnormal, and ovarian and pituitary extracts of proved potency. He is not, however, enthusiastic about the results obtained, but is more in favor of small doses of x-ray to the hypophysis and the ovaries. This, he says,

restores menstrual periodicity to nearly normal in 80 to 90 percent and increases fertility to at least 50 percent. He feels that there is only theoretical damage to the germ plasm, in the hands of a competent operator, but that results would be even better if the ideal combination of pituitary and ovarian hormones could be found.

Litzengerg, above, reports good results through the elevation of subnormal basal metabolic rates, by thyroid therapy.

Mazer and Hoffman (63), found that a low dosage irradiation of the affected endocrine glands was successful in reestablishing menstrual periodicity in more than 50 percent of 38 women thus treated; and feel that organotherapy is far less effective. The number of succeeding pregnancies is relatively equal in the two groups treated , respectively, by x-ray stimulation and organotherapy however.

Evans (2), suggests ovarian extract when the periods are delayed or scanty, pituitary extract if the patient is excessively obese, and thyroid therapy if the basal metabolic rate is low. These patients should be kept under constant supervision when taking endocrine extracts.

Bonney(6), says: "Of recent years it has become common practice to treat sterile women with various endocrine extracts in the hope that they will stimulate the ov-

aries to produce not only 'bigger and better' egg cells but more of them.....There is no evidence at all that these extracts produce any effects on women".

Those cases with amenorrhea are the most intractable to treatment, and those with hypothyroidism the most amenable to treatment. (25).

In the case of Vitamins we may have a new aid to fertility but the question is still very much in a developmental stage. Smith (79), has proved conclusively, through work on rats that the Vitamin E, as contained in cod liver oil, is of definite value in increasing fertility. Anspach (2), reports good results clinically by the use of a diet high in Vitamin A and Calcium lactate. Evans (21), in his work with rats, found that he could definitly control sterility by giving or refusing Vitamin E in the diet. This fat soluble, anti-sterility substance is best in its concentrated form in oil of germ wheat.

Cron (16), says: "one must keep in mind the fact that a lowered fertility of either sex cell without absolute sterility may exist and that the solution of this problem rests upon a relief of some such disturbances as an endocrine dys-

crasia, protein or Vitamin E starvation, sexual excesses, nervous exhaustion, or constitutional derangements.

In the cases of male responsibility Moench (58), advocates sexual rest, with coitus only once in 2 weeks, excercise, rest and diet, and psychic management. He feels that anterior pituitary and other glandular tonics are of no avail, and contends that there is no known spermatogenic treatments of value. Espinasse (40) says: "The treatment of deformed sperm is purely endocrine, vitamin and dietetic. The motility of the sperm varies with the contitutional vigor and the state of bodily health of the individual. When the individual is suffering from any infectious disease or low grade of sepsis, the motility of his sperm will be markedly impaired. The giving of a high protein diet, a diet rich in vitamin, is essential in the treatment of this type of patient".

Huxley (32), contends that conception is more easily accomplished if the cervix is directly inseminated. He suggests that the wife lie on the back with the knees flexed and seperated. This gives free access, no restriction of energy and the semen can be retained in the vagina.

After coitus the sphincter should be contracted and the patient lie in the semi-prone position, with a pillow under the hips, for four hours. Anspach (2), suggests coitus one week after the menstrual period. Temperance in indulgence is to be urged because one vigorous coitus is better than several forced ones. The wife is encouraged to join in the act, should void before retiring and be ready for the night, take a douche of sodium Bicarbonate pre-coitus, and lie with the hips elevated for 6 to 8 hours after the intercourse. This author insists that all pelvic pathology should be cleared up the first thing and all pelvic abnormalities corrected before the technique of intercourse is investigated.

In conclusion, "the diet should be regulated and arsenic and iron may be indicated. The surroundings should be changed and separation from the husband is benificial. In cases of obesity, proper diet should be prescribed and thyroid preparations given.....In cases of amenorrhea or dysmenorrhea instead of ovarian substitution therapy, the treatment with preparations of the estrus hormone should be tried." (20)

"We have assumed that a woman in good general health, whose menstrual history is normal, and whose genital organs show nothing grossly abnormal, secretes normal ova. That this assumption is correct in all cases is doubtful. At present we have no means of knowing this except when conception occurs. As in other fields, we know very little about the delicate physico-chemical reactions and balances concerned in the reproductive processes, and until more of the biologic fundementals are known, our efforts in many obscure cases of sterility will be gropings in the darkness." (48).

Good health, a natural mode of life, and a normal psychological outlook, in the absence of physical defects and lesions, are the concomitants of natural reproduction.

****

A Study of Six Cases of Sterility.

A STUDY of SIX CASES of STERILITY

CASE I :

Mrs. P.D., age 33, married 10 years with no pregnancies. Menses began at 14, regular every 28 days, normal with some dysmenorrhea but no leucorrhea. No history of gonorrhea in either the patient or her husband. No contraceptives had been used.

Physical Examination: Obese patient. Examination essentially negative.

Pelvic Examination: Cervix normal and not stenosed, uterus normal size and postition. Adnexia normal.

Procedure: Five cc. of lipiodol injected without much pain. Films showed uterus well filled but tubes not visualized. One month later two injections were made. Films showed the uterus to be distended, shadow was normal, with both tubes occluded at the cornu. Films 1 hour and 24 hours later showed no oil in the tubes or peritoneal cavity. (18)

Diagnosis: Bilateral occlution of the tubes at the cornu.

CASE II:

Mrs. R.S., age 35, married 12 years with no pregnancies. Past history negative. Menses began at 12, normal,

no leucorrhea. No history of gonorrhea in either the patient or her husband. No contraceptive measures used.

Physical Examination: Essentially negative

Pelvic Examination: Essentially negative

Procedure: The injection of 6 cc. of lipiodol caused cramps. Films showed uterine lumen well filled and normal. The left tube was visualized and oil was present in the peritoneal cavity on the left side. The right tube was occluded at the uterine end.

Diagnosis: Occlusion of the right tube at the cornu. (18).

CASE III:

Mrs. R.C., age 28, married 6 years with no pregnancies. Health good. Menses began at 14, every 28 days and normal. No history of gonorrhea in the patient or husband. No history of lecorrhea. No contraceptives had been used after the first year of marriage.

Physical Examination: Negative.

Pelvic Examination: Bimanual showed normal cervix and uterus . Adnexia could not be palpated and there was no tenderness.

Procedure: Five cc. of lipiodol injected July 27, 1927.

Films showed oil in the uterine lumen, the tubes, and escaping from fimbriated end of each tube.

Diagnosis: Patent tubes.

Outcome: The patient missed first period August 16, normal pregnancy, and on May 28, 1928 patient was delivered of a healthy 8 pound girl. (18).

CASE IV:

Mrs. V.C., age 28, 6 years married with no pregnancies. Menses irregular every 4 to 10 weeks, normal flow and no dysmenorrhea. No history of gonorrhea in the patient or husband. No contraceptives used other than mild douches.

Physical Examination: Negative and patient in good health.

Pelvic Examination: Normal cervix, no erosions. Uterus normal in size, anteflexed and with no adnexial masses or tenderness.

Procedure: Six cc. of lipiodol injected on Feb. 15, 1930. Films 10 minutes, one hour, and 24 hours later showed both tubes filled with oil but no oil escaping into the peritoneal cavity. Advised to wait a few months and have injection repeated. Menses normal in March, April, and May. In June missed period and in July and August had a slight show for one day. Feb 10, 1931 delivered of a normal 7 pound boy. (18).

CASE: V:

First seen Feb 13, 1924. Age 32, married 9 years with no pregnancies. Catamenia 2 to 3 weeks, late and scanty. Pelvic organs essentially normal. Tubes open. B.M.R. minus 23 Jan 20, 1927. and 16 pounds overweight. Sperm count 60, 000,000 per cc. with poor vitality. B.M.R. minus 22 on June 28, 1927. Both husband and wife lost on diet to normal weight. Then were put on normal diet with 2200 calories and 90 grams of protein and made to exercise. Both took some thyroid. Menses became normal. Baby born June18, 1928. (43).

CASE VI:

First seen in May of 1924. Age 25, married over two years with no pregnancies. Retroverted uterus and enlarged ovaries. Operation June 24. Large blood cyst left ovary, adhesions and adenomatous nodules in Douglas' fossa. Retention cysts in the right ovary. Cysts removed and the uterus suspended. Normal baby born in December of 1925. (43).

(This case illustrates how the development of a pathological condition, such as one of Sampson's endometrial cysts, can upset the ovarian function; and how in early stages surgical treatment can restore the function to normal.)

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Aldridge,J.H.: Important Factors in the Diagnosis and Treatment of Sterility., Canad.M.A.J.,24,660-664,May'31.
2. Anspach,B.M. : Results in Therapy of Sterility., Am.J.Ob &Gyn.,19,1-15,Jan'30.
3. Baldwin,J.C. : Baldwin Modification of the Jarcho Pressometer for Transuterine Insufflation.,Am.J.Ob&Gyn., 22,783-784,Nov'31.
4. Bell, W.B. : Sterility in Woman, Brit.Med.Jour.,1,629-632, April5, '30.
5. Berkow, S.G. : Body Types in Women of Infertile Constitution.,Arch.Int.Med.,48,234-248, Aug'31.
6. Bonney,Victor: The Treatment of Sterility.,Lancet,1,971-975,May7'32.
7. Campbell,A.M. : Important Features of Sterility,.Am.J.Surg. 7,620-628,Nov'29.
8. Campbell,E.: Fallopian Tube Sterility,.J.Med,11,573-576,Jan'31
9. Carey,W.H.: Essentials of theDiagnostic Survey of Sterility YaleJ.Biol.&Med.,4,691-710,May'32.
10. Car,W.H.:Diagnosis of Obscure CasesofSterility,M.J&Rec.,130, 1-7, July 3 '29.
11. Cary,W.H.: The Study of Sperm Cell Migration in the Female Secretions,NewY.State J.Med,30,131-136,Feb 1'30.
12. Coghlan,C.: Sterility in Women,M.J.Australia,1,209-211,Feb'30.

13. Cox,D.M.: Etiology of Sterility,Kentucky M.J.,29,301-302,Jun' 31.

14. Cox,H.C.: Treatment of the Infantile Uterus in Sterility, M.Rec & Ann.,25,717-720,April'31.

15. Crew,F.A.E.: Human Sterility,Eugenic Rev.,23,127-128,July'31

16. Cron,R.S.: Sterility,Wisconsin Med.J.,29,185-191,April'30.

17. Daniel,C.: Therapeutic Effect of Insufflation of the Fallopian Tubes in Sterile Women,Gynecologie,8,3-10,Mch 10'32.

18. Downing,W.L. & Larsen,W.W.: Lipiodol Injection in Diagnosis & Treatment of Sterility,J.Iowa M.Soc.,21,672-674,Dec'31.

19. Dwinnel,G.F.: Sterility,N.Eng J.Med.,201,677-687,Oct 3 '29.

20. Elsner,A.: Sterility in Woman and its Treatment,Med.Welt., 3,53-57,Oct'29.

21. Evans,H.M.; Testicular Degeneration Due to Diet,J.A.M.A., 99,469-475,Aug 6 '32.

22. Evans,H.M.: Testicular Degeneration Due to Inadequate Vitamine A,Am.J.Physiol,99,477-486,Jan'32.

23. Frank,R.T.&Goldberger,M.A.: The Female Hormone in Sterility, J.A.M.A.,94,1197-1199,April 18 '30.

24. Fullerton,W.D.: Etiology of Sterility,Ohio S.M.J.,28,110-114, Feb'32.

25. Gardiner-Hill,H. & Smith,J.F.: The Relation of Fatness to Sterility,J.Ob & Gyn of Brit.Emp.,37,256-271,March'30.

26. Garvin,C.H.: Sterility in the Male,J.Nat.M.A.,23,57-61,Apr'31.

27. Gottschalk,C.G.: The Hühner Test in Diagnosis of Sterility, M.Womens J.,36,64-66,March '29.

28. Gray,A.: Common Causes of Sterility,Post-Grad M.J.6,147-153 June'31.

29. Hagner,F.R.: Sterility in the Male,Surg Gyn & Ob.,52,330-335, Feb'31,#2A.

30. Haisfield,A.R.: Sterility in the Female,J.Florida M.A., 16, 444-447,Apr'30.

31. Hanson,S.: Simplified Method of Introducing CO_2 in Patency Tests ofthe Fallopian Tubes,Am.J.Ob&Gyn,21,749-750,May'31.

32. Huxley,F.M.: General Considerations in the Therapy of Sterility,Lancet, 2,138-139,July 20 '29.

33. Huxley,F.M.: Local Measures in Therapy of Sterility in the Female,Lancet, 2, 186-187, July 20, '29.

34. Hyams,M.N.: New Cannula for Transuterine Insufflation,Am.J. Ob & Gyn,21,746-747, May'31.

35. Jones,H.M.: A Device With Fixed Safety Limits For the Rubin Test,Am.J.Ob & Gyn,19,119123, Jan'30.

36. Kaplan,I.I.: Radiation Treatment of Sterility,Am.J.Ob & Gyn, 21,52-59, Jan'31.

37. Keen,F.E.&Kane,F.L.: The Investigation of Sterility, Am.J.Ob. & Gyn, 23,857-862,June'32.

38. Kerwin,M.: Surgical Treament of Steriltiy,Tr.Am.Gyn.Soc.,53, 162-168,'28

39. Knopf,S.A.: The Myths About Sterility Following Contr ceptive Measures,M.J. & Rec.,132,368-371,Oct 15 '30.

40. Lespinasse,V.D.: Sterility in the Male,Ill.M.J.,61,509-511,'32

41. Levy,W.E.: Clinical Study of Sterility,New Orleans M&S.J.,82, 214-218, Oct '29.

42. Litzenberg,J.C. & Carey,J.B.: Relation of Basal Metabolism to Gestation, Am.J.Ob & Gyn,17,550-552,April '29.

43. Macomber,D.: Ovarian Deficiency as a Cause of Sterility, Am.J.Ob & Gyn,19,739-747,June '30.

44. Macomber,D.: The Sperm Count,New Eng.J.M.,200,982-984,May'29.

45. Macomber,D.: A Satistical & Clinical Study of 1000 Cases of Sterility, Am.J.Ob & Gyn, 17, 621-636,May'29.

46. Macomber,D.: Diet in the Etiology and Treatment of Sterility, Tr.Sect.O. & Gyn. & Ab.S. A.M.A., 149-163,1929.

47. Marcus,S.: Treatment of Sterility,M.Womens J.,38,144-146,June '31.

48. Mason,Lyman W.: Sterility with Special Reference to Spermatozoon,Am.J.Ob & Gyn,17,376385,March '29.

49. Mahtieu,A. & Schaffler G.C.: The Management of Sterility, Northwest Med.,28,53-64,Febr.'29.

50. Meaker,S.R.: Causes of Human Sterility,J.Ob & Gym. of Brit. Emp.,38,807-813, '31.

51. Meaker,S.R.: The Need For Complete Investigation of Cases of Sterility,J.Med.,11,354-364, Sept.'30.

52. Meaker,S.R.: Survey of Causative Factors in Sterility,Am.J. Ob. & Gyn,20,749-759, Dec'30.

53. Meaker,S.R.: Fundemental Nature of Relative Sterility,New Eng.J.Med,201,160-162,July25 '29.

54. Meaker,S.R.: Constitutional Factors in the Causation of Sterility, J.A.M.A.,92,1493-1494,May4 '29.

55. Michele,S.: Treatmentof Female Sterility by Artificial Fecundation,Proc.Sec.Int.Cong.Sex Research,483-488,'31.

56. Moench,C.L. & Holt,H.: Sperm Morphology in Relation to Fertility,Am.J.Ob & Gyn,22,199-210, Aug'31.

57. Moench,G.L.: So Called Obscure Cases of Sterility, J.A.M.A. 94,1204-1207,April 19, '30.

58, Moench,G.L. & Holt,H.: Examination of the Male & of Semen in Cases of Distubbed Fertility,M.Hearld,49,1-7,Jan'30.

59. Mombach,G.: Sterility,J.Med.,10,474-480,Dec '29.

60. Mombach,G.: New Cannula for Performing the Rubin Test, Am.J.Ob & Gyn,19,841-842,June'30.

61. Morgan,H.S.: Investigation of Sterility,Neb.M.J.,17,386-388, Sept '32.

62. Mozer,C. & Hoffman,J.: Female Sterility, an Analysis of 500 Cases, M.J. & Rec.,129,90-94,Jan 16 '29.

63. Mazer,C. & Andrussier,I.: The Incidence, Diagnosis & Treatment of Functional Sterility,Am.J.Ob & Gyn,22,46-59,July'31.

64. Procter,I.: Diagnosis of Sterility,Virg,M.Mon,56,373-379,Sept '29.

65. Pugh,W.S.: Sterility in the Female from Gonorrhea,M.World, 49,235-236,June '31.

66. Richards, F.: The TreatmentofSterility in the Female,J.Florida M.A.,18,273-277,Dec '31.

67. Ronchese, F.: Sterility from Lues, Result of Treatment,Urol. & Cutan. Rev.,36,242-243,April'32.

68. Rowe,A.W.: Constitutional Factors in Human Sterility,Proc. Sec.Int.Cong.Sex Research,434-444,1931.

69. Rowe,A.W.: Endocrine Influence in Sterility,J.A.M.A.,95,1219-1221,Oct 25'30

70. Rubin,I.C.: Uterotubal Insufflation, Am.J.O&G,24, Oct '32.

71. Rubin,I.A.: Sterility Secondary to Induced Abortion,N.Y.State J.Med.,31,213-217,Feb15 '31.

72. Rubin,I.C.: Tubal Stricture and Their Localization,Am.J.Ob & Gym,20,28-50,July'30.

73. Rubin,I.C.: Sterility,N.Y.State J.Med,29,379-387,Apr.1,'29.

74. Rubin,I.C.: Ovarian Hypofunction in Relation to Sterility, Am.J.Ob & Gyn,18,603-622,Nov'29.

75. Rubin,I.C.: The Role of Appendicitis in the Etiology of Female Sterility,Monatsschrift für Geburtschulfe und Gynökologie,92,161-164,Sept'32.

76. Sage,D.Y.: Barreness Apperently Due to Azoonspermia,J.M.A. Georgia,19,200-201,May'30.

77. Seguy,J.: Regarding the Cause of Sterility,Medécine,12,269-273,Apr'31.

78. Schmitz,H.: Obstructions Causeing Sterility,Am.J.Ob & Gyn, 23,47-53,Jan'32.

79. Smith,H.O. & Nelson,V.E.: Cod Liver Oil for Reproduction and Lactation,Proc.Soc.Exper.Biol.& Med.,28.393,Jan'31.

80. Soter,S.D.: Tubal Insufflation in Sterility by use of the Air Pressometer,Illinois M.J., 61,146-148,Feb'32.

81. Sovac,F.W.: Intrapelvic Syringe in Insufflation of the Fallopian Tubes,Am.J.Ob & Gyn,23,596-597,April'32.

82. Spachman,W.C.: Uterine Cannula for the Rubin Test, Indian Med.Gaz.,67, 180-185, Mch'32.

83. Stein & Leventhal.: Infertility and Sterility, J.A.M.A., 98,621-628, Feb. 20 '32.

84. Sure,B.: Dietary Requirements for Fertility and Lactation, J.Nutrition,2,485-489,May '30.

85. Troupin,A.S.: Female Sterility, M.J. & Rec.,129,503-508,May 1 '29.

86. Vignes,H.: Fecundity & Sterility,Progres.med.,44,281-291, Feb. 16 '29.

87. Vose,S.N.: The Critical Examination of Semen,Urol. & Cutan. Rev.,34,826-830,Dec '30.

88. Waddell,J.: Male Sterility on Milk Diets,J.Nut,4,67-77,May31

89. Walker,K.: Interpretation of Tests of Sterility and Fertility in the Male,Lancet,2,995-996,Nov.9'29.

90. Watson,M.C.: Review of Methods of Diagnosis of Sterility in the Female,Canad.M.A.J.,23,1721,July '30.

91. Wilkinson,P.D. & Nelson,V.E.: Diet in Relation to Reproduction and Lactation, Am.J.Physiol.,96,139-145,Jan '31.

92. Wilson,K.: Modern Vews of Sterility,M.J.Australia,1,732-739, June 7 '30.

****