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VISUALIZATION OF THE UTERINE AND TUBAL CAVITIES

AN ESTIMATION OF THE VALUE, DANGERS, AND CONTRA-INDICATIONS—WITH A SECTION ON TECHNIC

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WE HAVE gathered a vast store of knowledge from the study of the shadows produced upon a sensitive recording medium by the varying grades of density of human tissues. Starting with bones, we have gone on to methods which visualize in shadow, the kidneys, the spleen, the gall-bladder, and the bronchi. Further, we have visualized cavities by the introduction of opaque media. The stomach and bowel, the ureters, the kidney pelves and the bladder have long been observed in silhouette. It is cause for wonder, then, why the genital tract, so often the seat of pathology, has not earlier been subjected to such studies.

Certainly the use of the X-ray in gynæcologic diagnosis has been tardy in its development. There is no doubt but that this lack of progress hinges on the fact that opaque fluids injected into the uterus may find their way into the abdominal cavity, provided the tubes are patent. In earlier studies gas was apparently thought safer, and from 1912 on the pelvic organs were studied by means of pneumoperitoneum by Goetze, Weber, Steward and Stein, Dryoff and Peterson and Cron, and many others. This method, however, entailed the dangers consequent upon the invasion of the abdominal cavity. There was always the possibility of puncture of the viscera and other dangers. These potentialities plus difficulty of interpretation without visualization of the cavities of the uterus and tubes, rather put the method into the discard. The dangers, which were real, were as follows: Puncture of the abdominal wall and the viscera, subcutaneous emphysema, peritoneal infection, and embolism. Rubin, who devised the means of placing gas within the abdominal cavity through the uterus and tubes, became distracted

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from the use of opaque fluids by his method of determining the patency of the tubes, and devoted his time to the study of insufflation.

From the experiments of Cary in 1914 down to the year 1925, various radiologically opaque substances have been used in the effort to visualize the cavities of the uterus and tubes, among them collargol, argyrol, sodium bromide and bismuth pastes. Some observers reported without presenting convincing evidence in the form of skiagrams. Some had disastrous accidents, and others abandoned the work because of poor results. In 1923, Sicard and Forestier published results of their use of iodized oil in the bronchial cavities and in the spinal canal, and soon thereafter this opaque medium was being used in the uterine and tubal cavities. Carlos Heuser, Carelli, Forsdike and Sicard were among the very first to use it in gynæcologic diagnosis and since then the names of Rubin, Jarcho, Randall, and Newell in America, and Cotte, Beclere and others abroad, stand out prominently. Upwards of two hundred medical papers from all corners of the world have been published on the subject.

My experience with the method covers a period of over three years, beginning in 1926 and comprising over two hundred cases observed in private practice and in a teaching service at the Multnomah Hospital. My first impression of the method was that it had limitless possibilities for the elucidation of gynæcologic diagnosis, but that it might present serious dangers. With increasing experience I have arrived at the conviction that it is simple, easily performed, a minor procedure from the patient's standpoint, and of the utmost value in a certain number of difficult gynæcologic studies. While further experience has merely strengthened this conviction, and my older fears have diminished, nevertheless there are a sufficient number of reports of accidents, apparently due to the method, to call for the exercise of caution and for the proper selection of cases. Hence, if any fair warning to be issued or any criticism made, it should be directed at the over-enthusiastic attitude which prompts the use of the injection in any and every gynæcological patient, in the quest for new and striking skiagrams.

There must be always a problem which gives fair promise of clarification by this procedure. As yet, purely for academic purposes it is not justified. If further conduct of the case is not apt

to be affected by the findings the examination should not be made. As in the case of the Rubin test the greatest caution should characterize these efforts, the feeling being that since the medium is more tangible there is perhaps more danger of forcing infective material into the peritoneal cavity. Experience has proven, however, again as in the case of the Rubin test, that thousands of injections may be done without apparent harmful results. The work of Curtis and others furnishes a rational background for our belief that the pelvic peritoneum is relatively immune to so-called infectious substances from this source, and that in point of fact, such substances are very much less frequently present than was supposed. Working with this hypothesis, many investigators have shown that the method is certainly no more dangerous in this or other respects than the introduction of air or gas. However, in the effort to be brief and clear, we will only consider these points individually in relation to illustrative cases.

This, in fact, will be the method of this paper which will constitute an effort to present besides its dangers and contra-indications, a careful description of the technic and, finally, clearly and briefly, certain factors of positive value in the use of the method. It must be granted without discussion that our data are anything but complete. Yet, it must also be granted that a detailed exposition of the advantages to be gained in difficult diagnoses of pelvic disorders is worthy of our very careful scrutiny.

Dangers.—The dangers which we have pointed out are as follows:

1. Infection: Cervical, uterine, tubal, peritoneal.

2. Trauma: Incident to manipulation, cervical tears, trauma to intra-uterine growths as pregnancy, carcinoma of the fundus, degenerated subserous fibroid, endometrial polyp, etc., possible rupture of ectopic pregnancy and, more remotely, rupture of broad ligament or ovarian cysts, etc.

3. Shock due to peritoneal irritation from injected substance or impurities carried from the lower genital tract.

4. The introduction of the injection fluid with or without impurities from the genital tract into the lymphatics or into the circulation of the uterus and parametrium.

5. Iodism: As long as the iodized oil can be readily evacuated,

which is the usual condition of affairs, there is no fear of absorption. But in cases with large sacculated dilatation of the closed distal ends of the tubes (hydrosalpinx) the iodized oil might remain for a very long period of time and absorption of iodine take place. In this condition of extreme dilatation of the distal end of the tube the musculature is so drawn out and stretched as to lose all its tone and power to contract, and hence the tube cannot empty itself. In spite of this possibility, in repeated examinations I have never been able to detect iodine in the urine.

The gravest danger mentioned is that of infection to the uterus, tubes or peritoneum. This danger, I feel is not real and happens so rarely as to be negligible, at least in the hands of the men who seem to be doing the bulk of the work. Many writers have reported numerous cases in which the injection was made in the face of actual acute infection, not only of the vaginal tract, but of the tubes as well. In fact, certain French observers have advised injections into the uterus and tubes with the idea of maintaining patency during acute and subacute attacks of salpingitis. They report no ill effects from the injection in acute infections of the tubes, not even a rise of temperature. This, on the face of it, seems fantastic, and the French have been inclined to attribute this freedom from infection in such cases to the fact that their iodized oil (lipiodol) was antiseptic in its action. This, however, is not a fact. In experiments at the University of Oregon, Buckley and I have shown that lipiodol has no antiseptic action. Whether it prevents transmission of infectious material by some mechanical means I cannot say. I have injected one case of acute gonorrhœal infection of the vaginal tract and both tubes. The tubes were found to be acutely inflamed, the distal ends were patent, and thick creamy pus could be expressed from the fimbriated ends. A Bell-Beuttner operation was done, the abdomen was closed without drainage, and the patient made an uneventful recovery and showed morbidity at no time. (Fig. 2 B.) I believe that, in the proper hands and with the usual antiseptic and aseptic precautions, the danger from infection or peritonitis is negligible.

The danger from trauma must be considered. Trauma may be from excessive force used in the injection or by the instrumentation. The use of excessive force of injection can be prevented by the use

FIG. 1

In this case the method was used to differentiate between acute appendicitis and acute right salpingitis. The skiagram showed the tubes to be normal and at operation there was found an acute appendicitis. The sphincter of Kennedy is easily seen at the cornual ends of both tubes. Pregnancy followed the injection three months later and at term there was a normal delivery of a healthy baby. This I consider normal for uterus and tubes. The apparent L-shaped defect in uterus is no doubt due to the cannula.

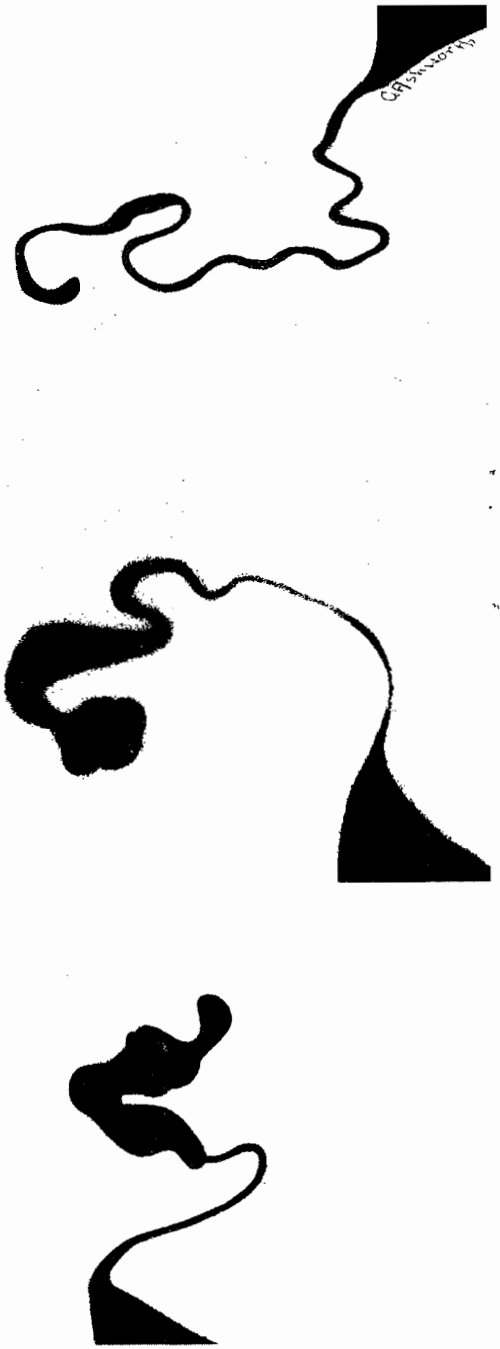


FIG. 2

C—Chronic salpingitis: Note sharp, well-defined outline of tubal cavity with absence of distal dilatation.

B—Acute salpingitis: Note hazy outline tubal cavity.

A—Normal.

of the Beclere syringe with manometer attached, or, better still, by the excellent apparatus devised by Jarcho. With the use of either of these instruments the pressure can be gauged to a nicety and definite precision can be added to the manœuvre. The incidence of ordinary instrumental trauma can be easily avoided by careful manipulation. Approximately 50 per cent. of my patients were operated on at some time following the injection and in none can I say that there was any sign of peritoneal infection, irritation, or adhesion. These cases gave proof of the harmlessness of the method, and also helped to correlate the pre-operative diagnosis with the post-operative.

Certain contra-indications should be observed. These are: 1. Pregnancy (uterine): Notwithstanding the fact that certain South American writers apparently advise the injection of iodized oil and visualization with the X-ray as a test for early pregnancy, and quote a series of cases to prove its innocuousness, I cannot agree that the examination should be made where there is the probability of a normal pregnancy. Experience has taught us that one cannot be too careful in the handling and manipulation of the pregnant uterus, particularly in so far as any intra-uterine manipulation is concerned. Plass, in a recent critical study of many cases, even advises that the manœuvre of replacing a retroflexed pregnant uterus is as apt to cause an abortion as is the possible impaction. Nevertheless, in the proper hands and with the academic viewpoint, the method may be used in cases that are to have a therapeutic abortion. I feel that the dangers which are to prove themselves ultimately real will be in those where too much pressure has been used and in those who are pregnant.

2. Acute infections involving the lower or the entire genital tract and adnexa: It is obvious that the method might offer real danger where it is used in the presence of acute infection of the genital tract, and I can see no reason for its use in such cases except that of a differential diagnosis between an acute right salpingitis and an acute appendicitis. Here it is apparent that were the condition acute appendicitis one would wish to operate at once, but if the condition were an acute infection of the tubes it would be far better to treat the patient conservatively. Fig. 1 is an example of such a condition.

3. Bleeding: In bleeding from the uterine cavity it is also obvious that since there are either open vessels or sinuses or both there would be some danger of oil embolism. Furthermore, if Sampson's theory as to the cause of endometriosis is correct, we have another real danger.

4. Where the examination cannot change the procedure to be adopted: In other words, the examination should not be done purely experimentally.

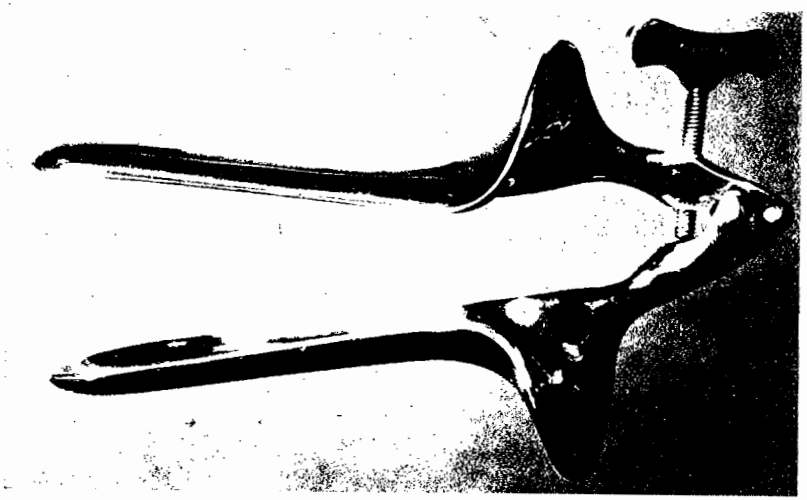
We cannot here consider in detail the validity of the more or less routine contra-indications mentioned above. It would certainly seem unwise to inject a pregnant uterus, yet it has been done apparently without harm many times, and Heuser uses the method for the diagnosis of early pregnancy. No doubt the safety which Heuser reports in injecting the pregnant uterus must be due largely to a certain personal delicacy of technic. It is also interesting to note that some observers have used this method in a large series in whom therapeutic abortion was to be performed with little or no harm to the pregnancy. It has been the practice of others to inject pregnant uteri for research purposes. They report only occasional disturbance to the pregnancy. Nevertheless, I feel that there should seldom be an indication sufficiently strong to overcome the possible harm it might cause. One abortion in one hundred would appear to me sufficient to prohibit its use in uterine pregnancy for any purpose.

TECHNIC OF INJECTIONS

Needless to say, in the injection of iodized oil into the uterus and tubes, one should exercise the principles of strict asepsis. The patient should receive an enema and empty the bladder prior to the injection, although failure to do this does not preclude good results. The patient is placed in the lithotomy position over a Bucky diaphragm with the film in place. A bivalve speculum is then inserted into the vagina and the cervix is exposed. (Fig. 3.) It is advisable to use a special speculum of the type made by Mathieu of Paris, which is open at one side allowing its removal with the volsellum and cannula still in place.

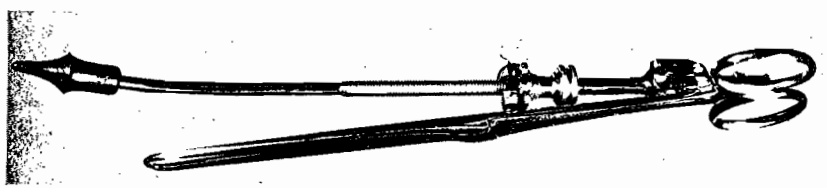
The vagina and cervix are carefully wiped free of mucus, and the cervix and the external os are painted with tincture of iodine. The right lateral lip of the cervix is then grasped with a volsellum

FIG. 3



Form of bivalve speculum used. *(Beclere.)*

FIG. 4



Urethral cannula, with rubber tip attached. *(Beclere.)*

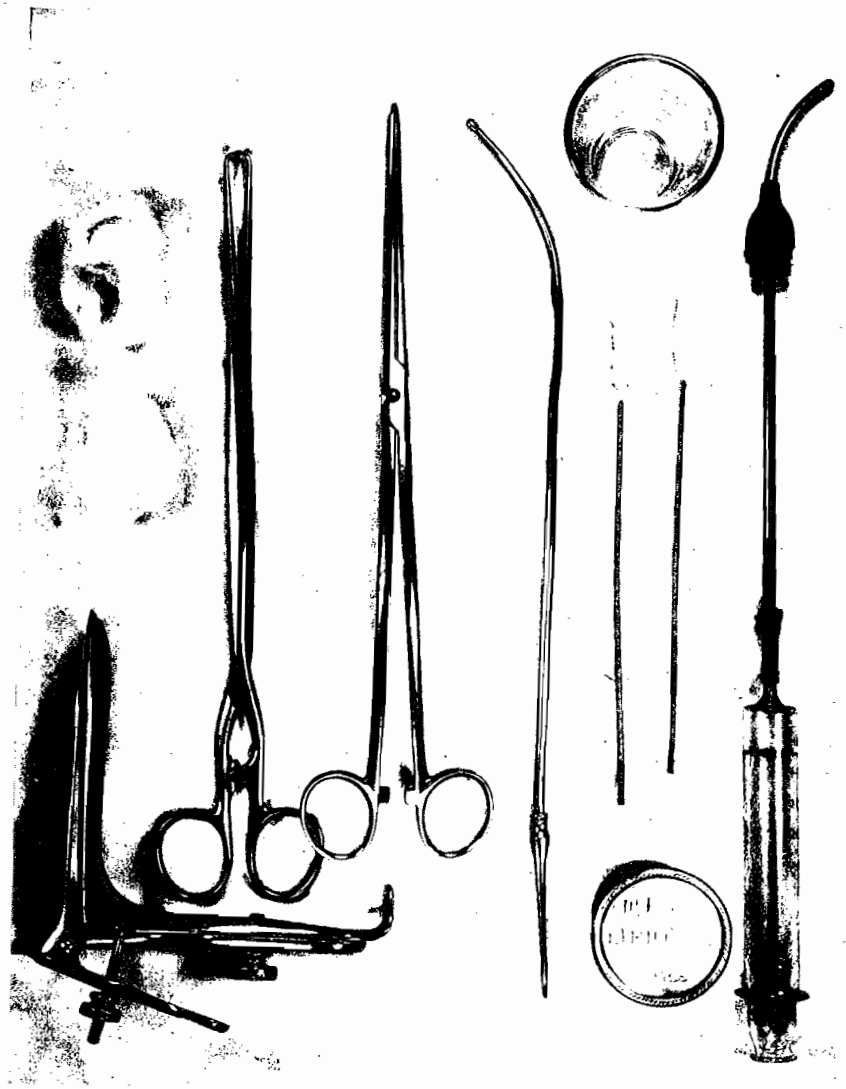


Fig. 5

Early instruments used by the writer for the injection of iodized oil.

and a sound is introduced into the uterus to determine the direction of the uterine cavity and its depth. (The larger the uterine cavity, the more oil is required.)

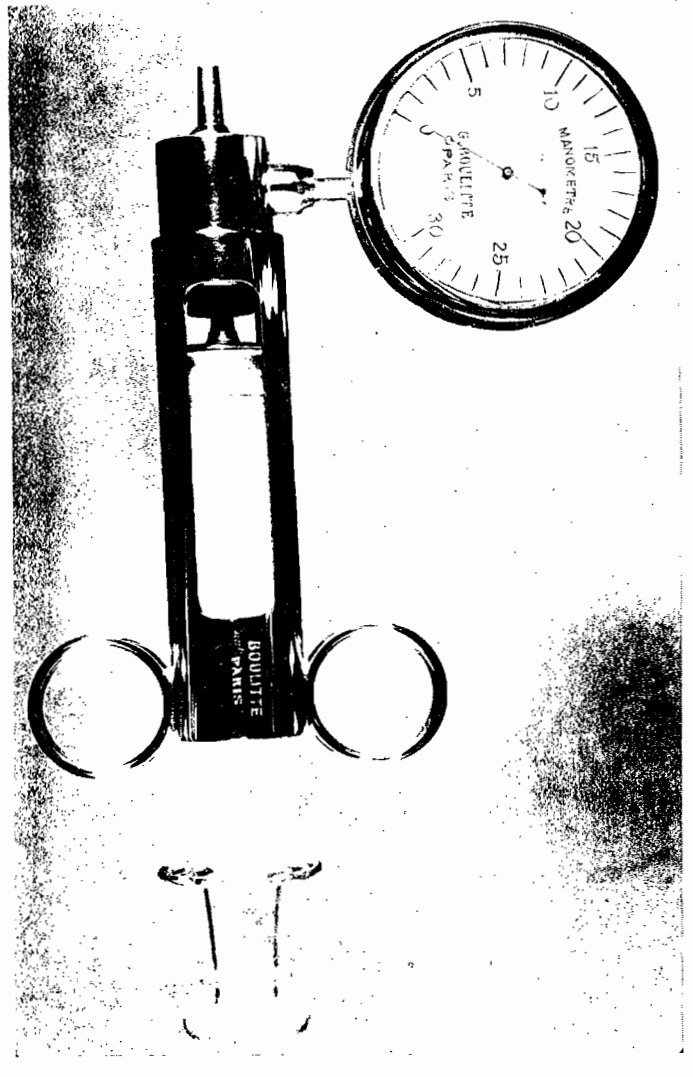
For injecting the oil, I used a modified Keyes-Ultzman urethral cannula with a rubber tip attached, until recently when I obtained the instrument of Claude Beclere made by Collin of Paris. (Fig. 4.) This instrument consists of a tenaculum forceps and a cannula which can be fastened together by a small firm clamp. The cannula has at its end a soft pliable rubber acorn which is so arranged that, when the acorn fits into the external os and the tenaculum is *in situ,* by a screw ratchet the acorn can be tightened into the external os. At the distal end of the cannula is a small petcock which can be closed after the injection is completed. By the use of this instrument the iodized oil can be prevented from flowing out of the uterus and a series of pictures can be taken if necessary, or the patient can be examined fluoroscopically. With this apparatus the injection can be made in one room and the patient can be transferred to the X-ray room without any interference in the manœuvre. Fig. 5 shows the early instruments used by me in the injection of iodized oil. Note the Keyes-Ultzman cannula, with rubber tip attached and locked to syringe. These simple instruments are easily procurable and are adequate. The newer instruments shown make for a more exact technic, but are not indispensable.

A syringe containing approximately twenty cubic centimetres of the oil is locked to the cannula by means of a bayonet attachment. The cannula is then inserted into the uterine cavity in the direction made out by the sound, so that the rubber tip actually plugs the external os and acts as a cork. If the oil should be too viscous, warming will make it flow more easily. While I have used three different types of oil, I am extremely partial to the French oil made by Lafay and called lipiodol. One must be certain that the oil is clear and that the container has been newly opened. The oil is then injected slowly and carefully until approximately three cubic centimetres have been injected. Formerly, I used the instruments shown in Fig. 5, but of late I have been using the syringe with the manometer attachment devised by Claude Beclere of Paris and made by G. Boulitte. (Fig. 6.) With this instrument one is always con-

scious of the amount of pressure being used. The needle, the zero mark, and the thirty cubic centimetres mark are topped with a radium substance so that the amount of pressure can be watched in the dark room when the patient is being fluoroscoped. There is no doubt that the use of the manometer is a marked refinement in the technic. In this country Jarcho has devised an instrument which seems to be even more practical than that of Beclere. I am absolutely convinced that a manometer of some type should be used to avoid the possibility of excessive pressure.

At the instant of injection the patient will experience slight cramps, due to uterine contraction. After a pause of a few seconds, more oil can be injected. The amount of oil injected is variable, depending, first, on the size of the uterine cavity, and, second, on the amount of resistance felt. (A large or deep uterine cavity will hold more than ten cubic centimetres of the oil and a small uterine cavity with the cornual ends of the tubes obstructed will offer marked resistance to over five cubic centimetres.) From five to eight cubic centimetres of the oil will fill the average uterus and tubes. When one estimates that the uterus and tubes are filled, the petcock is closed, the speculum and syringe are removed, and the oil cannot run out. Then the signal is given and, with the instruments in position as before stated, the flash is made.

During preparation for the injection of the lipiodol the patient is apt to become apprehensive. For this reason it is wise to explain in detail just what is to be done and in what manner the picture is to be taken. Warning should be given that slight uterine cramps will be felt and that any movement on her part after the procedure has started will necessitate an additional injection. Gentle admonition is wise before grasping the cervix with the tenaculum and again when the uterine sound is passed and the cannula is inserted. After three cubic centimetres of the oil have been injected it is well to ask concerning the uterine cramps and to give assurance that they will soon pass off. In my experience it has been only the neurotic subjects who have suffered any inconvenience during or following the use of this diagnostic manœuvre. With the aid of a good light and accessible instruments the entire injection can be made, together with the taking of the skiagram in less than two minutes from the



Syringe with attached manometer. (*Beclere.*)

Fig. 6

FIG. 8A

Invasion of an enlarged endometrial cavity by protusions of a large degenerative fibroid. (See in 8B and 8C.)

Huge pedunculated Fibromyoma of Uterus.

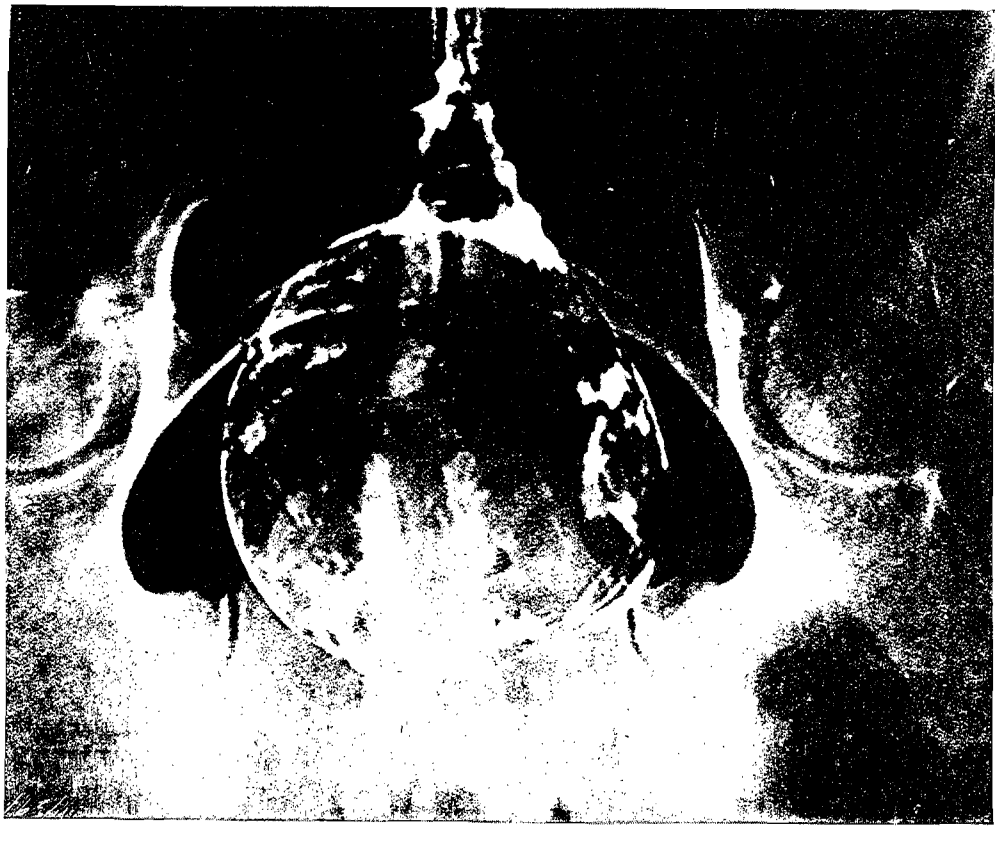
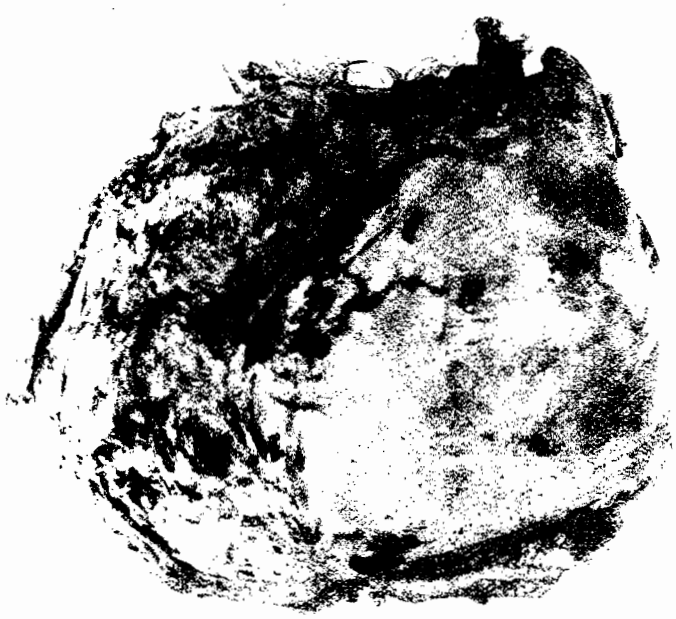


FIG. 7

FIG. 8B

Incised uterus showing a degenerative fibroid. (See also A and C.)

FIG. 8C



Uterus containing degenerating fibroid seen in 8A and 8B.

Fig. 9

Skiagram of case of intraligamentary cyst described on page 198.

introduction to the removal of the speculum. The patient is then turned on her side and a lateral view taken. This makes for additional precision. A part of my routine consists in the taking of twenty-four-hour plates to determine the possible presence of leakage into the peritoneal cavity where the tubes have been thought to be closed at the first examination. This procedure may be of further value in demonstrating the retention of the opaque substance in an hydrosalpinx which is permeable from the mesial end.

It is to be hoped that the foregoing description of the technic of injection will be found practical and available. It remains now to describe and depict certain definite tangible factors which I have encountered in the attempt to elucidate gynæcologic diagnosis by this method. My procedure will be simply to mention the various conditions encountered with no particular attempt at completeness. Innumerable theoretical advantages can be pictured, but it is my intention at this time to enumerate only some of those which actually have occurred in my experience.

Fibromata of the Uterus.—A fibroma the size of a baby's head was outlined in the vaginal cavity by the use of lipiodol as shown in Fig. 7. This fibroid was subserous, pedunculated, and pendant into the vagina with a partial inversion of the fundus. It was later delivered by forceps and its peduncle amputated and the uterus replaced. I have substantiated the diagnosis of fibromata of the uterus in twenty cases by this method. Fig. 8 A illustrates invasion of an enlarged endometrial cavity by protrusions of a large degenerating fibroid. The growth was later removed at operation and is shown in an accompanying cut. (Figs. 8 B and 8 C.) The special findings indicating this condition are discussed in an earlier paper.

In visualizing the uterus in cases of myomata, Beclere has suggested the use of a small lead wire fitted on the abdominal wall around the contour of the tumor, so that when the skiagram is made the lead wire will outline a considerable part of the contour of the tumor, and the shadow of the lipiodol in the uterine cavity will show the relationship between the tumor mass and the cavity of the uterus.

The use of lipiodol in uterine fibromyomata has another advantage. The patency of the tubes may decide the surgeon between myomectomy and hysterectomy.

Normal Uterine and Tubal Cavities.—It is frequently of the greatest importance, in making a diagnosis by a process of elimination, to know that the upper genital tract is normal. We can arrive at a fair estimate by the use of X-ray visualization as shown in Fig. 1.

Ectopic Pregnancy.—Fig. 9 demonstrates the value of visualization when the question of the differentiation of a possible tubal pregnancy arises. In this case, in the face of a perfect clinical picture of right tubal pregnancy, the right tube was shown to fill normally but to be out of its normal course. Due to this deviation and the mass, a diagnosis of infected intra-ligamentary cyst was made and substantiated by operation. In another case, a provisional diagnosis of left tubal pregnancy was made, contingent upon the finding of a closed left tube with a patent contra-lateral tube. The diagnosis was substantiated at operation. Fig. 10 shows a patent right tube where a right tubal pregnancy was suspected. Operation showed an inflammatory mass in the right adnexa. (There was also a pedunculated subserous fibroid.) The method has been of value in relation to the differentiation of tubal pregnancy in six cases in my series.

Occluded Tubes.—This condition as a sequel to disease or operative procedure is all too frequent. Probably the outstanding value of this procedure lies in the definite diagnosis of such a condition together with the location of the occlusion. It is of inestimable value in the prognosis of the treatment of sterility. For example, as in the case visualized in Fig. 11, a definite statement may be made obviating further inconvenience and expense on the part of the patient. In this instance three dilatations and curettements were done by other doctors before the X-ray examination determined the condition of closure shown. Occasionally, as where a so-called club-ended tube is shown, the possibility of a successful plastic operation may be indicated.

Adnexal Anomalies.—Cysts, inflammatory masses, solid tumors of the ovaries, etc., have all been indicated by variations from the normal in my experience. While an exact diagnosis is not frequently possible, yet the available data is often such as to clinch directly, or by a process of exclusion, a diagnosis indicated by clinical findings.

Fig. 10.—In this case a right tubal pregnancy was suspected because of classic symptoms and a mass in the right side. The skiagram shows the entire length of the right tube, the left tube occluded at the cornual end. There is a filling defect in the upper portion of the uterine cavity and the lower portion instead of being sharply angular is widely dilated. The right tube is obviously chronically diseased. The condition as found at operation was as follows. Chronic bilateral salpingitis, ovarian cyst on the right and pedunculated fibroid as large as one's thumb hanging from the fundus of the uterus. (This accounted for the peculiar shape and filling defect of the uterine cavity.)

Fig. 11

Occluded tubes.

Salpingitis.—The method is extremely valuable in the study of tubal disease. The harsh lines of the chronic salpingitis (see Fig. 2 C) in contrast to the fuzzy delineation in the acute condition (see Fig. 2 B) is a striking differential point. The rosette-shaped shadow of the fimbriated end of the acutely infected tube is in sharp contrast to the thin wire like shadow which carries to the end of the chronically infected tube. (Figs. 2 C and 2 B.) It is understood, of course, that acutely infected tubes are seldom impermeable to lipiodol, whereas subacutely infected tubes are more often impermeable, and chronic tubes are frequently closed at the cornual ends. An outstanding point in the use of this method is its value in indicating conservation of a chronically or subacutely infected tube, which may later become permeable either spontaneously or by plastic operation. I have several times been surprised to note at operation in cases where the tubes have been shown patent to the extreme distal end that the gross appearance of the tube was one of massive infection of a type which formerly we would have considered closed and worthless.

Certain factors then which have proven of outstanding value in my experience of this method can be enumerated. They are as follows:

1. The determination and localization of occlusion of the tubes.
2. The visualization and orientation of the uterine cavity.
3. The diagnosis of intra-uterine tumors.
4. The demonstration of other abnormalities of the uterine and tubal cavities (uterine subinvolution, infantile uterus, etc.).
5. The differentiation of ectopic pregnancy.
6. The differentiation of right salpingitis from acute appendicitis.
7. The demonstration that a tube in the region of the pelvic mass is not an integral part of the pathology.
8. The differentiation of acute and chronic salpingitis.
9. As an indication for hysterectomy for fibroids in preference to myomectomy where the tubes can be shown occluded.
10. Finally, and by no means a minor consideration, is its definite and indisputable value for teaching purposes.