Roentgen pelvimetry

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ROENTGEN PELVIMETRY
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A THESIS

PRESENTED TO THE FACULTY OF THE
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DOCTOR OF MEDICINE.

Francis L. Simonds 1934.
I. INTRODUCTION.

Roentgen pelvimetry, or the measurements of the dimensions of the female pelvis by x-ray, is a subject on which comparatively little has been written. Very little mention of it is found in any of our modern obstetrical textbooks. Published articles have been written largely by Roentgenologists, most of whom are presenting some new method, which they feel is superior to any of the previously existing methods.

In fact, the taking of pelvic measurements by any method is a relatively new procedure, in spite of the indisputable fact that babies have been born since the world began. This is best explained on a basis of a poor understanding of the true anatomy of the female pelvis. It was not properly described for many centuries, so that neither its normal anatomy nor its abnormalities could have been thoroughly understood. This was due chiefly to the fact that the practice of obstetrics was in the hands of midwives, and male physicians gave little or no attention to the subject and did not study the mechanism of labor.

It was a theory, until comparatively recent times, that the pelvic bones separated at the time of labor to permit the passage of the child; hence the possibility of a contracted or deformed pelvis was not considered. It is apparent that if the pelvic bones separated at child birth
as was then supposed, the subject of pelvimetry would have relatively little importance.

Since the development of obstetrics on a sound basis, with a true understanding of the anatomy of the female pelvis, there has been a constant desire to actually measure the birth canal. As the science of obstetrics advanced it seems to have gained a feeling that, "to be forewarned is to be forearmed." To learn in advance the exact size of the superior strait and the relative size of the fetal head, as well as to foresee any possibility of a difficult or impossible delivery, has become a part of the ante-natal care of most obstetricians.

Many indications for the use of x-ray pelvimetry have been presented by various authors. As far back as 1900, Fabre, according to Dr. J. Warren Bell (1), stated that the process was painless; its application easy; its results accurate; and gave the following list of indications for its use:

1. Before marriage. In all cases where the skeleton presents congenital or acquired deformity, congenital dislocation of the hip, either unilateral or bilateral, infantile paralysis and hemiplegia; white tumors of the lower limbs; coxalgia; early and late rickets, etc.

2. During pregnancy. At a time anywhere in the pregnancy there is an indication for radiography of the patient whenever one has the presumptive signs of lesions of the pelvis, and more emphatically when one has absolute signs.
The therapeutic decisions should be based upon exact measurements of the inlet.

3. After confinement. Every time the mechanism of labor has presented anything particular, or that the abnormality cannot be explained by clinical examination. The conduct of the next confinement would then be established with certainty.

Moore (28), goes farther and states that, "Every primipara and every woman who gives a history of difficult labor, when reporting to the physician and a diagnosis of pregnancy has been made, should have a roentgenogram taken, to determine the dimensions and shape of the pelvic inlet--every case, whether primipara or multipara should have a roentgenogram taken at approximate term, to determine and diagnose the position of the child, the probability of a multiple pregnancy, the possibility of a malformed fetus, and the possibility of a disproportion between the pelvic inlet and the head of the child." He continues his arguments by stating that, "If on the first examination it is found that the patient has a small or deformed pelvis, the course of the pregnancy can be determined, regular routines of diet and general care can be followed out, and definite plans made for the final delivery method."

Collisi (7), advocates the use of x-ray in all cases because he feels it will show many contra-indications for the indiscriminate use of pituitrin and forceps, and to avoid disappointment to the mother and embarrassment to the
physician in the delivery of a still birth or monstrosity.

Matthews (29), enumerates the following conditions in which they have actually used x-ray to complete or make more positive the diagnosis:

1. Early pregnancy- fourteen to twenty weeks.
2. Multiple pregnancy.
3. Presentation and position.
5. Monsters, especially anencephalus.
6. Fetal death.
7. Spina bifida (cervical).
8. Pregnancy, presentation and position, and abnormalities in very large fat women (one over 260 lbs).
9. Previous cesarian section to determine if the child is normal.
10. Fibroids complicating possible pregnancy.
11. Ovarian cysts mistaken for pregnancy.

In every one of these cases there has been some doubt about the correctness of the diagnosis, as made by the usual methods in such cases, viz.: history, physical examination, laboratory methods, and clinical course.

Sichel (36), adds to the usual list of indications, the value that roentgenograms have in teaching medical students, interns, and residents, in medical schools and teaching hospitals.
Jarcho (19), believes that a roentgenogram should be obtained in every case of pregnancy in a primipara, and in all multipara with histories of previous difficult deliveries. "The information", he continues, "given by such roentgenographical films is invaluable in prenatal care and I believe that one can ill afford to omit such an important diagnostic aid."

Because of these many indications, because of the newness of the subject, and because of the future possibilities for its use, a review of the subject was considered worthy as a topic for a senior thesis.

It is impossible to report in detail all the methods thus far devised. To do so would add pages of statistics, and innumerable formulae, to say nothing of the many illustrations. Many methods closely resemble each other in general form, differing only in minor details. It has been found that Hirsch's classification (14), into five general groups will include all the different systems. A more detailed explanation of each general group, will be presented, and credit will be given to those who have contributed to its development. Some will be mentioned more fully, because of their historical interest, or because of the value of the subject matter presented.
II. HISTORY.

As a rule historical sketches are rather dry and uninteresting, but the following paragraphs taken from Jarcho's (20), new book entitled, "The Pelvis in Obstetrics", contributes many interesting details.

"The bible, Exodus 1:18-19, notes that the Hebrews, when in Egypt, had easier labors than the Egyptians. The bible does not of course, relate this fact in any way to possible pelvic abnormalities in the Egyptians. A modern writer, Currier, suggests a possible explanation as follows: "The Egyptians of 4000 thousand years ago were a cultured race and lived in cities. The change from a natural or nomadic life meant more or less change in the structure of the pelvis."


Hippocrates gave an inaccurate description of the anatomy of the pelvis, and asserted that the pelvic bones separate at the time of labor. Soranus, in the 2nd century, did indeed note that a narrow pelvis is a cause of difficult labor, but attributed all this to a failure of the pubic bones to separate. This statement by Soranus, inaugurated a false conception of pelvic pathology, that persisted for 1500 years, and was a definite hindrance to the development of the science of obstetrics.

Vesalius, the great anatomist of the sixteenth century, was the first to describe the anatomy of the pelvis...
accurately (1543) and to demonstrate that it was anatomically impossible for the pelvic bones to separate at the time of labor. A brief statement by Savanarola in his "Practica Maior" (1560), suggests the possibility of the pelvis not being wide enough to admit the passage of the child, but this was chiefly in relation to an unusually large child.

The first description of a contracted pelvis was given by Arantius (1572), who was a pupil of Vesalius. He stated that if the os pubis is wider than it should be and curved inwards, so that it appears to be convex rather than concave, the birth passage is narrowed and the head of the child is caught on the os pubis, so that it cannot be delivered. The worst condition, he stated, is when the hand cannot be introduced for any operative procedure, because the passage is so narrow. Then in such instances, it is quite natural that both the mother and the child perish. This, then suggested a method for determining a narrow pelvis, by the introduction of the hand.

Mercurio in his "La Comare" (1596), noted the narrowing of the pelvis by curving inward of the os pubis, as an indication for cesarean section.

Most obstetricians of the sixteenth and seventeenth centuries, however, maintained the theory of the separation of the pelvic bones. So long as the theory of pelvic bone separation during delivery, was maintained, the scientific development of pelvimetry was hopelessly retarded.
Van Deventer, in a book for midwives, published in Latin in 1701, was the first to describe the bones of the pelvis as a part of a work on practical obstetrics, and included two plates to show the shape and position of the sacrum more correctly. These drawings and their descriptions are of great historical interest in relation to pelvimetry. Amongst the hindrances to labor he included a chapter on the "ill forms of the pelvis that may hinder the birth! The pelvis, he noted, may be too big or too little, or lastly too smooth. A narrow pelvis he defined as one too narrow in respect to its roundness, but too narrow a distance between the os pubis and the prominent part of the os sacrum. Too large a pelvis he regarded as a cause of precipitate labor, fraught with danger that the womb itself as well as the child might fall out of the body. He gave no definite pelvic measurements, but stated that the first thing a midwife was to do was to try the woman by the touch. He described the method of trying by the touch as nothing else than to pass the fore-fingers through the private parts into the vagina, in order to feel the os internum and neck of the uterus; and sometimes into the rectum, to discover the stretching of the fundus."

Smellie (37), in 1752 was the first to give definite pelvic measurements for normal and abnormal pelves. He also described the axis and inclination of the pelvis. He gives pelvis measurements for the width and the depth and described the form of the cavity inside. His measurements
apply to the dry pelvis denuded of soft parts. He was also the first to describe the diagonal conjugate and a method of measuring it by introducing the finger into the vagina and was the first to see that there was a determinate relation between the position of the child's head and the pelvis throughout the whole process of parturition.

In 1769, Johnson (21) described a method of measuring the pelvis in cases of difficult labor by introducing the whole hand, for which the physician must first determine certain measurements for his own hand.

These methods of determining certain pelvic measurements by the use of the finger or the whole hand, were the only ones known up to the middle of the eighteenth century.

Jarcho (20) gives credit for the use of the first pelvimeter for internal pelvimetry to Stein the elder, whose instrument designed in 1772, consisted of a wooden rod with a knob at one end and a measuring scale. This was introduced into the vagina with the patient lying on her back; it was pushed up to the hollow of the sacrum and in front was pressed against the pubic arch, and the point at which it touched the lower border of the symphysis marked, at first by the index finger of the hand not holding the instrument, and later by a movable marker.

Three years later Baudelocque first published his method of measuring the external diameters with a description
of a pair of calipers with a measuring scale. He was the first to describe the measurement of the external conjugate, for which he used these calipers. The conjugate vera was calculated from this measurement by the subtraction of 7.5 cm, which Baudelooque claimed represented the constant difference between the two measurements in both normal and contracted pelvies.

As the study of pelvimetry as a diagnostic procedure advanced, it was found and generally conceded that the external pelvic measurements were not indicative of the size of the inner pelvis and it was therefore concluded that the only measurements of any value were obtained by taking internal measurements. For this latter method many procedures and instruments have been devised. In some hands they seem to have gained considerable value in obtaining the desired information regarding the size and shape of the inner pelvis. The chief objections, however, have been mainly the distress it causes most patients and the lack of ability in the hands of many to obtain what could be called accurate results.

While it must be admitted that many things enter into the successful conduct of labor, such as the strength of the uterine muscles, the relaxation of the ilio-psoas muscles and other soft tissues, the condition of the kidneys, her heart and general mental and physical make-up; nevertheless, the size and shape of the pelvic inlet remain as a diagnostic element of extreme importance.

It is therefore not surprising that in less than two
years after the discovery of x-rays in 1895, by Roentgen, that two separate articles were published describing the use of these rays in studying the female pelvis.

According to Jarcho's account (20), Budin in 1897, published an article in which he brought out the fact that it was more important to know the shape and circumference of the superior pelvic strait, than that of the anteroposterior diameter. This article was based on the findings of a roentgenogram of a deformed pelvis.

During this same year Varnier wrote his first article entitled, "Pelvigraphie et Pelvimetrie par les Rayons X", (Pelvic photographs and pelvic measurements by the use of x-rays). In this article he states that in the year 1896, in conjunction with other collaborators, work was begun on roentgen pelvimetry. The first roentgenograms were taken on the body of a woman who had died of intestinal obstruction nine days following confinement. He found that due to the limited capacity of their equipment it was very difficult to get pictures that were very distinct, especially in large women or in women in the latter half of their pregnancy. In conclusion he remarks that it is possible by the use of x-rays to diagnose pelvic conditions that could not be diagnosed by other means.

Albert (20) in 1899, published a very classical article entitled, "Ueber die Verwertung der Roentgenstrahlen in der Geburtschilfe." (The use of x-ray in gynecology). The author advocated the use of the semi-recumbent position
in order to get the superior strait in a parallel line with the film. He also used the upper margin of the fifth lumbar vertebra and the superior part of the symphysis as his location for placing the superior strait in this parallel position. His calculations were made by the mathematical procedure in which the known quantities, distance of the superior strait from the film and focal distance of the tube were used. This then, is the first instance of the triangulation group of methods, to be described later.

Fabre and Fouchert in this same year wrote their first work and described what is commonly known as the Fabre method. This was a different method from that proposed by Albert and is given credit for being the first of the group known as the frame method.

The work of Budin, Varnier, Albert, Fabre, and Fouchert, at this early stage seemed to establish roentgen pelvimetry as a definite procedure and was the foundation from which the later work received its incentive.

The limitations in x-ray equipment, their inability to make good clear plates, and the long exposure time required, were all a detriment to very rapid progress. Between the time of these early reports and the close of the world war very little work was done and only a few reports were published.

The first American to report the use of x-rays in measuring the superior strait was Dr. G.E. Pfahler (30) of Philadelphia. Because of its historical interest the following is quoted from his original article:

"Probably the most critical period in the life of a
woman is that of the birth of her first child. Two lives are at stake at this time. Much of the uncertainty could be eliminated if the attending physician could determine accurately the diameters of the pelvis of the mother; and if with this he could know the exact size of the child's head, the case could be dealt with in the most skillful manner.

Obstetricians have done much toward accomplishing this result by taking the external measurements of the pelvis, and by measuring approximately the internal diameters. Accuracy has, however, not been obtained though very much desired. It is this long felt want that prompted one of our obstetricians, Dr. W. Frank Haehnlen, to suggest to me the use of Roentgen rays for this purpose. Even the method that I shall describe, though it seems very simple, may not be found practical.

The principles upon which this technique is based are as follows:

1. The plate must be placed parallel with the brim of the true pelvis.

2. The distance of this pelvic brim from the anode must be measured as accurately as possible and recorded.

3. The anode of the tube must be placed in the axis of the plane of the brim of the pelvis.

4. The exact distance of the anode from the plate must be measured and recorded.

Having recorded these factors and obtained a good
radiograph, the determination of the diameters of the pelvis is a mere matter of calculation.

The diameters as measured in a radiograph represent the degree of divergence of the rays at the distance of the plate from the anode (20 inches). The question then is, "What is the degree of divergence of the rays at the distance of the pelvic brim from the anode? (We obtain the distance of the anode from the symphysis by direct measurement, or subtract the distance of the symphysis from the total distance of the anode from the plate).

Reducing this to a formula, let "A" represent the total distance of the anode from the plate; "B" the diameter as measured in the radiograph; "C" the distance of the symphysis or pelvic brim from the anode, and "X" the diameter of the true pelvis. Then the formula would stand:

\[ A : B :: C : X. \]

From this formula any diameter may be determined."

End of quote.

Dr. Pfahler devised a rather complicated set up for duplicating his results, utilizing a radiographic table and tube stand combination that suited his needs perfectly. This sort of an elaborate method of taking the pictures may have discouraged others from attempting it for it was not until 1912 when Dr. Manges (27), also of Philadelphia reported a different method, that any reports were made on the subject.

Following the world war and the introduction of the Potter-Bucky diaphragm, this work went forward with fairly rapid strides and considerable progress has been made.
III. CLASSIFICATION OF METHODS.

Hirsch in a discussion of a paper by Thoms in 1922, divided the various methods of roentgen pelvimetry into five general groups as follows:

1. Comparative.
2. Teleoroentgenographic.
3. Frame.
4. Triangulation.
5. Stereoroentgenographic.

He claimed at that time, that every known method could be included in this classification and in reviewing the literature since that date, there are still no methods that cannot be included under this list.

Moore (28) feels that this is too extensive a grouping and prefers to classify the procedures according to the recognized methods in vogue today. He divides them into two general groups as follows:

1. Methods based on mathematical calculations alone.
2. Methods based on mathematical calculations associated with triangulation and stereoroentgenographic procedures.

Hodges and Ledoux (15) differ from both of the above men and prefer to designate the two main groups as:

1. Position methods.
2. Parallax methods.

These authors claim that Hirsch's groups 1, 2, and 3 have one common feature- they involve the arrangement of the
patient in relation to the film, as an essential step.

For purposes of accuracy, detail and completeness, the classification of Hirsch will be followed in this discussion.

As mentioned in the introduction, it would require too much space to report fully every method that has been devised. In order to avoid this situation, each of the five groups will be discussed as a whole and some one representative method of that group will be presented in greater detail.
IV. DISCUSSION.

Group 1. The Comparative Method.

This method requires the taking of radiograms of dried pelves of various sizes and shapes, or of plaster models of normal and deformed pelves. These are compared with the radiograms of pelves of living individuals. It assumes a matching of the radiograms and referring back to the original pelvis or plaster model for the correct measurements.

MacKenzie seems to be the originator of this method and his work was first reported (25) in 1918. The following is copied from one of his articles:

"In a normal pelvis which is designated the "Standard Pelvis" the various diameters, both external and internal are accurately measured. When this pelvis is radiographed definite points can be marked on the inlet; the distance between these points will bear a definite ratio to that between the corresponding points measured on the pelvis. This radiograph is taken as the "Standard Plate". By radiographing the patient in the same position as the standard pelvis, an accurate comparison of the patients plate with the standard plate will be obtained and therefore of the patients pelvis with the standard or normal pelvis; from it the internal measurements can be mathematically worked out."

MacKenzie has the patient lying flat, face downwards on the table, with her symphysis pubis touching the carrier. He then tilts the tube toward the patients head and focuses
so that the primary rays pass through the center of the pelvic inlet.

The two drawings presented here are copied from his article.

![Diagram](image1)

![Diagram](image2)

Figure 1 shows a vertical section illustrating the axis of the inlet.

Figure 2 shows the relation of the pelvis to the X-rays and the plate.

J. Warren Bell (1) in 1921 conceived the idea of making plaster casts of deformed pelves and using them for the study of pelvimetry. However, he combined with them the use of the frame method for measuring, as devised by Fabre.

The disadvantages of this method are obvious. Only those who have access to a large number of pelves could even make a start on the many patterns required. No matter how
many patterns were available, there would always be the problem of getting an exact match for the film of the patient and a question as to whether that particular film had been taken under precisely the same conditions as the standard.
Group 2. Teleoroentgenographic.

This group listed by Hirsch in his classification apparently did not meet with success in roentgen pelvimetry. Reference is made to its use by various authors but not a single article could be found in which the author was advocating its use.

This method is based on the theory that by establishing a very long target film distance, distortion is thereby reduced to a minimum. Theoretically this is correct but practically cannot be made to apply to pelvic mensuration where absolutely accurate results are desirable.

Just what the target film distance would need to be in order to eliminate penumbra and distortion is not known. It has been worked out for the heart shadow as seventy two inches and undoubtedly would be greater for pelvic work. The inability of most equipments to operate at so great a distance and the great loss in detail on the film immediately rule it out as a practical system, for roentgen pelvimetry.
Group 3. The Frame Method.

By this method a frame or perforated lead plate is superimposed at the same level at which the measurements are desired. When the exposure is made this scale is shown on the film, but distorted in the same proportion as the region to be measured. Measurements are then read directly on the film from the distorted scale.

As mentioned in the history, this is the method that Fabre and Fouchert first devised in 1897 and is known today as the Fabre method. This system has many advocates at the present time, most of whom have made more or less extensive changes from the original method of Fabre.

Fabre and Fouchert devised a metal frame with points on the inner border exactly 1 cm. apart. This frame was placed over the film at the same level of the superior strait and when the exposure was made, a shadow of these points was cast upon the film, but distorted in exactly the same amount as the part to be measured. All that was necessary then was to count the number of spaces between points of the various landmarks to be measured and these represented the actual number of cm. of that part.

According to Jarcho (20), Marie and Cluzet in 1900, improved this frame by making it of wood and using only small metal points along the inner border, each exactly 1 cm. apart. In this way nothing would show on the film but the shadows of these points, each representing a distance of 1 centimeter.
Thoms, working in the Yale department of obstetrics and gynecology, has pioneered this method in America and has been one of the most ardent supporters of its use. His first report was published in 1922 (40), since which time he has contributed five more articles describing minor changes in technique. These publications appeared in 1925 (41), two in 1927 (42) (43), and one each in 1929 (44) and 1934 (45).

His earlier methods were similar and depended upon two factors: first, the position of the patient, it being necessary for the superior strait to be exactly parallel with the sensitive film below; and second, the interposition of a lead scale in the plane of the superior strait following the removal of the patient, and a secondary flash exposure made on the same film. Certain points in this technique appeared difficult, particularly the position of the patient in order to have the superior strait of the patient parallel to the film.

In the present method, this procedure has been simplified, so that the position of the patient is now semi-recumbent and only slightly different from that assumed when an ordinary anteroposterior pelvic roentgenogram is taken. In this position the superior strait is not parallel with the sensitive film. Instead of a simple enlargement of the true image of the superior strait there is, therefore, some distortion, which, however is corrected in the method of mensuration. In the conclusion
of his most recent article (45), Dr. Thoms mentions the adoption of a sensitized paper instead of the usual celluloid film, which has reduced the cost of the procedure.

The following diagrams serve best to illustrate the Thoms method:

- **T.** Target of tube.
- **PSS.** Plane of superior strait.
- **SP.** Sensitive plate.
- **PB.** Plumb bob.
- **Ca.** Calipers.
- **Sp.** Sensitive plate.

Lead plate on a thin wooden board with adjustable support.
The perforations in the lead are exactly 1 cm. apart. By double exposure, first of the pelvic inlet and then of the lead plate made to occupy exactly the same plane, the latter becomes a measuring scale on the exposed film.

This figure shows how the true conjugate and the transverse diameter may be measured by simply counting the spaces between the perforations and expressing in centimeters. Although these spaces are actually more than 1 cm. apart on the film, they have been distorted to exactly the same extent as the pelvic inlet.

The method described by Heublein, Roberts and Ogden (13) is a modification of Thoms. A light frame, with an adjustable back rest, is used instead of a box with a
bucky diaphragm. This frame is placed at one end of the bucky table and held in place by a cleat which extends over the edge of the table.

The patient is seated upon the end of the table in a semi-recumbent position, with her feet resting on a chair and her back arched against the back rest. In order to make the superior strait parallel to the film, the anterior point is taken just below the upper margin of the symphysis pubis, and a posterior point near the upper apex of Michaelis' rhomboid. The patient is placed in such a position that these two points are an equal distance from the table and a measurement is then taken with calipers. Unequal distortion is avoided by centering the tube accurately over the pelvic inlet, and a central point 5 cm. behind the symphysis pubis is taken. Then without changing position or distance of the tube, the lead sheet is placed in the same plane and a flash exposure made, as before.

Jarcho (19) has described a method similar but has also introduced some modifications. While Thoms places the patient in a semi-recumbent position, Jarcho prefers a sitting position with a back rest supporting the head and back, and the lower portion of the back arched so as to bring the imaginary line between the anterior superior border of the symphysis pubis and an identifying adhesive tab on the back, on a horizontal plane. This makes the superior strait parallel to the film, which is incorporated within a bucky diaphragm. By bracing her feet against a foot rest and her hands against the table, the patient is
enabled to maintain the required position with considerable comfort. The thighs are parallel to the film while the feet and legs are allowed to hang over the edge.

Moore (28) uses the lead plate method of Thoms but in addition has devised a very ingenious ruler for measuring distances on the film. This ruler is made of elastic material with a scale reading exactly true when at rest. This may be set according to the distance between the dots on the film so that the measurements are then distorted in the same proportion as the pelvic shadow. Any diameter may then be measured directly without counting or calculations.

In this system a study of triangles, with known quantities, is made and from these factors the unknowns are determined. It involves the same principles of mathematics and radiology as used for the localization of foreign bodies.

Albert of Dresden (20) was the first to utilize this method. His method is mentioned in the historical sketch since he was one of the earliest writers on the subject. In fact, he is given credit by some authors as the original user of x-rays for pelvimetry.

Pfahler's work, mentioned earlier, was the first of this system in America. Others who have contributed to this group of methods are; Riddell (32), Hooton (16), Guthmann (20), Fierstein (20), Martius (20), Van Allen (46), and Stewart (39).

Albert radiographed the pelvis with the patient in a semi-recumbent position with the spinous process of the last lumbar vertebra and the upper border of the symphysis pubis at the same level, so that the plane of the pelvic inlet was parallel with the surface of the plate. The measurements on the plate were then corrected in relation to the target plate distance and the distance of the upper border of the symphysis.

Guthmann in 1928 described a method for determining the conjugate vera by x-ray examination with the patient in the lateral position. The measurement is based upon
the mathematical calculation of the enlargement factor. The ray is centered through the middle of the plane of the pelvic inlet with the patient lying on her side, so that the symphysis pubis and the promontory are clearly shown on the film. The calculations used depend upon the following factors: The focus film distance equals 60 cm.; the transverse diameter of the patient measured with a pelvimeter in the plane of the inlet, divided by 2; to which is added the distance between the under surface of the body and the film (equal to 2 cm. with the Potter-Bucky diaphragm.) From this the enlargement factor is determined for the measurement of the conjugata vera on the film (i.e., from the symphysis pubis to the promontory), and so the true measurement of the conjugata vera is obtained. In order to facilitate calculations, Guthmann presents tables showing the film measurements and actual measurements of the conjugata vera for various half transverse diameter measurements.

The equation used for determining the true internal conjugate or $X$ is based on the geometrical principle that parallel lines cut by lines radiating from a point are divided into proportionate segments (the point being the x-ray tube, the parallel lines the conjugates of the pelvis and conjugates on the x-ray film.) The equation is:

$$\frac{\text{Ext. Conj. \, x-ray}}{\text{Ext. Conj.}} :: \frac{\text{Int. Conj. \, x-ray}}{X \text{ or (Int. Conj.)}}$$

One film is taken in the anteroposterior plane, as
this shows the fetal position. The lateral view is then taken with the patient lying on the side in which the fetal back is located. A caliper pelvimeter is applied in position to measure the external conjugate, with both ends in the same horizontal plane, and fixed with adhesive tape in this position. The measurements made on the film are: The apparent internal conjugate from the foremost point of the sacral promontory to the internal superior margin of the pubic bone, and the apparent external conjugate between the shadows of the caliper ends of the pelvimeter. The known factor is the measurement of the external conjugate with the pelvimeter.

Hooton's method (16) used at the Manchester, England, City hospital, is as follows:

Antero-posterior and lateral films are made with the centering 1½ in. above the os pubis and just before the great trochanter; 20 ma., 80 to 100 kv., and doubly screened films are used with exposures of from four to seven seconds, on the bucky diaphragm.

The measurements are made as follows: the thickness of the patient from the pubis to the table equals a; the maximum width across the trochanters equals b. The focus film distance is c. On the anteroposterior film the transverse diameter is measured and designated d; on the lateral film the distance from the sacral promontory to the back of the pubis as e. The calculation is as follows:
\[
\frac{d \times (a - \frac{2}{3} a)}{c} = \text{true transverse diameter.}
\]

\[
\frac{e \times (a - \frac{1}{3} b)}{c} = \text{true conjugate diameter.}
\]

Tests on the skeleton, by the author show that this measurement is accurate within 1/12 inch (0.2 cm.).

In a personal communication to Dr. Jarcho (20), Fierstein, of New York states that he used a method of roentgen pelvimetry based upon geometrical proportion. He employs a constant target film distance and calculates the true diameters of the projection, depending on the object-film distances. He presents a chart of these calculations as follows:

Chart for Roentgen Pelvimetry (Fierstein)

(Based on a constant target film distance of 90 cm.)

Formula-

Size of object = \( \frac{(\text{Target film dist.}) - (\text{Object film dist.}) \times \text{Proj.}}{90} \)

Percentages by which size of projection is to be multiplied to obtain size of object, with varying object-film distances.

<table>
<thead>
<tr>
<th>Obj-film in cm.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>94</td>
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<tr>
<td>6</td>
<td>93</td>
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<tr>
<td>7</td>
<td>92</td>
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<tr>
<td>8</td>
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<td>84</td>
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Martius (20) method provides for the use of either mathematical calculation, based on the distance from the target to the film; or a specially prepared cross bar scale, adjusted to the focal distance of 70 cm. The exposure is made with the patient in the Albert sitting position with the legs elevated, so that the pelvic inlet is parallel to the film.

Van Allen (46) in 1916, by exposing five successive plates with the patient in the semi-recumbent position used the law of similar triangles and worked out mathematically the relationship of the various points of the pelvis to each other.

Jarcho (20) also suggests the following method of figuring the size of the inlet without the use of the perforated lead plate. He states that, "if the factors are known, the pelvic diameters can be calculated from such a roentgenogram by geometrical methods."

A simple calculation of the true pelvic diameters without the use of the perforated lead plate may be made as follows: Multiply the actual measurements on the

<table>
<thead>
<tr>
<th>Obj. film in cm</th>
<th>Percentage</th>
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<tr>
<td>15</td>
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<td>25</td>
<td>72</td>
</tr>
</tbody>
</table>
film by the following fraction:

\[
\frac{(\text{Tube dist. from film})-(\text{Adhesive tab. dist. from film})}{(\text{Tube distance from film})}
\]

Hypher's modification of Robert's method (18) follows this same general plan. He has the patient sit on the bucky diaphragm with her legs inclined at such an angle that the plane of the true pelvic brim is parallel to the film. For the posterior marker he uses the spine of the fifth lumbar vertebra. The required internal diameters are measured on the film and multiplied by the following fraction:

\[
\frac{(\text{Tube-film dist.)})-(\text{Fifth lumb. spinefilm dist.)}}{(\text{Tube dist. from film.})}
\]

He states that the result gives the actual diameter with a possible error not exceeding 3 mm.

Perhaps the most recent contribution to the field of roentgen pelvimetry and one of the most noteworthy, is that of Dr. John N. Stewart, a recent Nebraska graduate and now located in the Stratton Clinic, at Stratton, Nebraska. Dr. Stewart's work (39) was done while an intern at Immanuel Hospital in Omaha, at the suggestion of Dr. A.F. Tyler. Because of the importance of the work it is being presented here in considerable detail.

The following is quoted directly from Dr. Stewart's original article:
"If the multiplicity of methods that have been devised during the past ten or fifteen years are a criterion, our present day methods may be regarded as not completely satisfactory. In general, the present roentgenographical methods have these disadvantages: Technical difficulty in both making and reading films leading to inaccuracy due to slight and almost unavoidable errors in technic; necessity for a complicated mathematical solution of formulae in interpreting the films; expensive apparatus for placing the patient, making and reading the films.

The author believes that most of these disadvantages have been eliminated in the method to be described, which has the following advantages:

1. The size and shape of the pelvic inlet may be obtained.

2. The size and shape of impalpable objects, such as fetal heads, may be obtained and the size and shape of such objects as hearts, kidneys, calculi, foreign bodies or various bones of the skeleton may be measured. The method may also be employed to measure the depth of foreign bodies in the tissues.

3. The placing of the patient and the making of the films is not an exacting procedure.

4. The reading of the films requires no mathematical calculations, but is merely measured with a rule which gives the actual dimensions of the object in centimeters.
5. The method, depending upon the size of the object and the sharpness of the shadows cast, is accurate in from 96 to 98 percent of the cases.

6. The method may be used wherever an ordinary x-ray apparatus is available. The use of the Potter-Bucky diaphragm is advisable, but satisfactory results may be obtained with the use of less expensive fine line stationary grids.

The Basis of the Method.

Since parallel roentgen rays are not obtainable for ordinary roentgenographic use and divergent rays are used instead, roentgenograms are necessarily enlarged, distorted images of objects. For this reason, unless some method is devised to correct this distortion, measurements taken on the film cannot be used to indicate the actual size of the object, but only to ascertain the shape or relative dimensions of the object.

The author's method deals with the correction of the distortion of the image. With the distortion corrected by the author's distortion correcting rule, the measurements of the image directly become the actual dimensions of the object. The amount of distortion of any roentgenogram is dependent upon two factors, namely: (1) the tube film distance, and (2) the object film distance. The tube film distance can always be measured and is therefore, a known value at all times. The object to film distance, on the other hand, can only be measured in certain
instances in which the object has accurately palpable landmarks, such as the female pelvis. In this case the plane of the superior strait is the object and, providing this plane is parallel to the film, can be measured with an ordinary ruler using the superior border of the symphysis pubis as the landmark, because it is approximately in the same plane as the superior strait of the pelvis.

However, in the case of the fetal head, there is only a relatively indefinite landmark. The object to film distance cannot be measured accurately, but can only be estimated. Herein lies the chief difficulty with the present methods of cephalometry in which the object to film distance is determined by palpation. Since the distortion depends upon this distance, it is imperative that it be ascertained with a fair degree of accuracy. No method to be accurate should depend upon the palpation of indefinite landmarks, but should be free from data obtained by palpation unless the landmarks are definite and constant ones, such as the anterior superior border of the symphysis, the anterior superior spines of the ischii, the posterior process of the vertebra, and the like.

Mathematical correction of the distortion is the basis of the following method. The correction depends upon the geometric relationships shown in figure 1.
For explanatory purposes, let $X$ represent the size of the object, $A'$ the size of the image cast on the film, with the tube distance $A$, and the object at distance $D$ from the film. Observe that this figure represents two similar isosceles triangles with their apices at the target of the tube, sides coinciding, and their bases $X$ and $A'$ parallel to each other. Since the bases of similar triangles are proportional as their altitudes:

then: $X : A' :: (A-D) : A$

or $\frac{X}{A'} = \frac{(A-D)}{A}$

therefore: $X = A' \frac{(A-D)}{A}$ \hspace{1cm} (1).

The above equation may be solved for $X$ by Arithmetic.
or by the use of a slide rule in a few minutes time because A, the tube to film distance, may be measured and is a known value; A', the size of the image on the film, can be measured and becomes a known value; and D, the object to film distance, in certain instances previously mentioned where palpable landmarks are present, may be measured and becomes a known value. In all other cases D (by present day methods) can be only estimated, and then the calculated figure for X becomes an inaccurate figure. The problem is now a matter of accurately determining the value of D in cases where it cannot be measured, because when D is known, the calculation of X is easy and accurate, but without an accurate value for D, the calculation of X is either inaccurate or impossible.

To accomplish this, the following method is employed. Two films are made at two different tube to film distances while all other factors remain the same, i.e., the patient remains in the same position while the two films are being made. The two images cast are on two separate films, thesecond in the same position relative to the patient as the first. See figure 2.
Let \( X \) represent the size of the object, \( D \) the object to film distance, \( A' \) the size of the image cast on the film with the tube at distance \( A \), and \( B' \) the size of the image with the tube at distance \( B \). Then as shown above:

\[
X = \frac{A' (A-D)}{A} \quad (1)
\]

Similarly:

\[
X = \frac{B' (B-D)}{B}
\]

Hence:

\[
\frac{A'}{A} = \frac{B'}{B} (B-D)
\]

Since \( A' \) and \( B' \) represent the sizes of the images on the film, their values are known. By substitution of known values for \( A' \), \( B' \), \( A \) and \( B \), in the
above equation (2), the value of D can be calculated with accuracy. Once the value of D is known, X can be solved in the first equation (1).

As I mentioned previously, one of the principal drawbacks of some of the methods is the rather complicated mathematics involved in order to read the films. For this reason I have devised a slide rule to eliminate all mathematics from the method as far as the user is concerned. See figure 3.

![Figure 3](image)

The author's distortion correcting rule, showing the rubber rule attached to the sliding member, which when set for the conditions under which the film was made, distorts the rubber rule the same amount that the film's image was distorted, hence, the rubber rule reads directly the size of the image.

The rule is constructed of a strip of uniform semi-transparent rubber supported fixedly at one end and at the other end by a sliding member to which is attached a cross hair, similar to those found on regular slide rules. The cross-hair is used as the indicator for setting the sliding member at the intersection of the proper lines on the printed scale. When the cross-hair is set at zero, at which time the object would be theoretically against the film and the size of the object equal to the size of the image, the rubber rule is "at rest" and the graduations are exactly one centimeter apart. It may be seen that as the object to film
distance $D$, is increased, the amount of distortion of the roentgenogram is increased. Likewise, as the slide is set for a greater value for $D$, the amount of the distortion of the rubber rule is increased, each graduation of the scale distorting an equal amount. In short, when the slide is set for the conditions under which a particular film was made, i.e., the same tube to film distance and the same object to film distance as any particular film, the rubber rule will be distorted as the image on the particular film. Hence, the slide rule set for the proper values of $A$ and $D$, the rule is used to measure the size of the image, which readings are directly (without any calculations) the actual dimensions of the object in centimeters. The only data necessary for correction of the distortion of any film is the correct value of $A$ and $D$.

I have shown that by the use of the second formula, $D$ can be calculated in cases when it cannot be measured, but to further eliminate mathematics from the method, I have devised a second slide rule and attached it to the back of the rule. See figure 4.

**FIGURE 4.**

The reverse side of the rule with the attached sliding scale. This scale calculates the object-to-film distance by the method described in the text.
The slide rule shown in figure 4 is merely a device to subtract the logarithm A' from the logarithm B', or in other words, divide the ratio A'/B'. The resulting quotient is not expressed as such, but is expressed directly in terms of D. Hence, if the sliding scale is set so that the value for A' coincides with the value of B', the small arrow points to the correct value of D without any calculations. Now that the value of D is known, the data are complete for the setting of the rubber scale on the reverse side, and one may go about the simple procedure of measuring the film and getting the readings that are directly the actual dimensions of the object in centimeters. " end of quote.

Stewart's work has not yet been recognized for its full value, for a recent article makes no mention of his method. Not only does his method offer a quick and accurate means of measuring the pelvis, a foreign body or the fetal head, but also eliminates the need of any special apparatus or the use of complicated formulas. All that is required is an x-ray film and his slide rule.

Walton (47) (48) working at the University of Maryland, has devised a "false centimeter chart" to correct the roentgenographic distortion of the parts to be measured. It was drawn from a series of exposures of a perforated metal centimeter rule at heights from 1 to 30 cm, which is also used for the roentgenographic study of the pelvis. The diameters of the pelvic inlet are measured and checked against the chart corresponding to the height of the symphysis above the film.
Group 5. Stereoroentgenographic Methods.

In this system the patient is first placed in a position that the obstetrical landmarks to be used will best be seen on the film. Stereoscopic roentgenograms are taken with a known tube shift and a known focal distance. The film center must be known in relation to the focal point and the shift of the tube must be parallel to the film. Computations are made by the use of precalculated tables and formulas or by mechanical devices used to reconstruct the problem involved.

Dr. Willis F. Manges (27) of Philadelphia, was the first to apply the stereoscopic method to the measuring of the female pelvis. His system was first reported to the New York Obstetrical Society at a meeting on January 9, 1912. At this time he mentioned the work being done by Pfahler which we have already described. Briefly stated, Manges technique was a combination of stereoroentgenography and the MacKenzie Davidson cross thread localization, both of which were well established procedures in other types of x-ray work.

According to Jarcho (20) Runge and Gruenhagen were the first Germans to utilize this method and they described their technique in a German magazine of Obstetrics and Gynecology in 1915. They used a stereoscope to identify the points to be measured on the plate. An ordinary plumb-bob was fastened under the target to the
center of the plate holder. The tube was set at a
known distance above the plate, 80 cm., then the plate
was shifted for a second picture exactly 10 cm. This
gave two known measurements, 80 cm. in a perpendicular
line and 10 cm. in a horizontal line. From this a
formula was figured for finding any measurement wanted.

Chamberlain and Newell (5) in 1921 simplified
this method and changed the form of the plumb-bob so
that it registered on the film. Their plumb-bob con­sists of a small brass rod with a wire cross at right
angles through one end. It hangs from a small lead
ring in the aluminum filter placed under the target.
A small piece of lead wire is placed under each flank of
the patient, who lies supine on the Potter-Bucky dia­
phragm.

The tube is set 80 cm. above the film. The two
exposures are made, shifting the tube 10 cm. (as with
the Runge and Gruenhagen method), thus giving two films
in slightly different projections. The shadows are or­i­
ented by the two lead wires and the plumb-bob. With the
stereoscope, the ends of the diameters to be measured are
marked on both films, and a tracing made containing all
the points on both films. The separation of the pairs of
dots for each point on this tracing depends upon the
height of the object above the film, which is measured
in centimeters by a special scale. A geometrical figure
gives the length of the diameter ( = Y) directly.
Other diameters are calculated by means of mathematical formulae for the inlet and outlet.

Johnson (22) in 1925 presented what he calls the radiogrameter. It consists of a series of lines parallel to the base of the truncated right angle triangle, and a series of meridian lines crossing through them. The parallel lines are numbered 0.5 to 50, and are drawn at intervals from the base line, such intervals having been determined mathematically. When the radiographs are taken each line on the scale represents the actual height, above the base of the scale, of a plane passing through a point having a shift in its shadow when measured in millimeters, corresponding to the numbers along the altitude of the scale.

Dr. Johnson experimented by taking radiographs of a wooden box about a foot square, in which several nails were driven at random. This was radiographed and various distances were then calculated and compared with the actual measurements. In repeated experiments there was at no time a variation of more than 1 mm. between the measured distances of the various points.

Another method which he used for checking the accuracy of his method was by the use of a 10 cm. bar which he places somewhere on the patient, so that it will cast a shadow on the film and then the length of the bar is calculated from its shadow and if this agrees with the actual length, the technique must have been correct.
The following is quoted from Dr. Johnson's (23) article:

"Practical Application of the Method"

"In the practical application of the method the first problem presenting itself was that of pelvimetry, which, I believe, is the most difficult of all. In order to get well oriented as to anatomical points shown on the radiograph from which various measurements were to be made, a dry pelvis was placed in position on the table similar to that of an imaginary patient. Stereoscopic radiographs were made according to the technique outlined. The various diameters of the pelvis were calculated and compared with the diameters as measured directly on the pelvis by another observer. In no instance was there a variation of more than 1 mm. between the calculated and the actual diameters. These results were so encouraging that the method was put into actual practice with results noted in the following illustrative case.

Case 1. Female, age 25, at term with a history of previous difficult delivery. A Cesarian section had already been decided upon, regardless of the radiographic findings. Diameters of the pelvis were calculated and found to compare favorably with those of the normal, with the exception of perhaps a half a centimeter shortening of the conjugata vera. The diameters of the sagittal plane of the fetal head were also calculated, which also seemed quite normal. Two
days after the examination, the baby was delivered by Cesarian section and the unmoulded head measured by the interne in charge, at the hospital. As compared with the calculated diameters, there was a variation of 2 mm. in the sub-occipito-bregmatic diameter and a variation of 1 mm. in the fronto-occipito diameter."

In 1927 Johnson (23) again presents his system, with changes which he states, make it much less complicated. The change was in the method of measuring the unknown distances, after the films were made. In 1929 (24) he presented the system to the Section on Obstetrics, Gynecology, and Abdominal Surgery, at the eighteenth annual session of the A.M.A., in Portland, with more details and further improvements and a list of fifty selected cases. He also proposed a new name for the procedure and one for his instrument, as follows:

"Stereo-roentgen-ometry"—a process for determining the solid dimensions of a radio-opaque object from its stereoscopic roentgenograms.

"Stereo-roentgen-ometer"—an instrument used in stereoroentgenometry."

The basic principle of his system is best explained by the duplication of his figure and its explanation:

In the figure, XY represents the radio-opaque object in space, somewhere between the target of the x-ray tube and the film. When the target is at position A, the shadow Ax and Ay will be cast on the film. When the target is at B, the shadow Bx By will be cast.

The stereoroentgenometer is an instrument for reproducing these conditions. A view box establishes the plane of the roentgenogram and provides illumination. An adjustable bar on the right fixes the roentgenogram in proper position and corresponds to the shadows of the special marker. Flexible wires, arise from points similar to the two positions of the target and represent the x-rays. Adjustable pointers fix in space the relative positions of various unknown points. The distance between these points is measured directly and represents the actual measurements of that particular part.
A rather recent method of stereoscopic roentgen-ray pelvimetry has been described by Hodges and Ledoux (15) 1932. This method employs certain features of the methods of Manges, Chamberlain and Newell, and Johnson. A modification of the semi-recumbent position of Thoms is used, and in some cases lateral films are made. While the accuracy of stereoscopic methods does not depend on the relative position of the subject and the film, it is important that the points between which measurements are to be made can be seen clearly. An obstetrical roentgen table is used, with the apparatus so adjusted that the target film distance is exactly 89 cm., the tube shift 9.7 cm., the plane of the tube shift is parallel to that of the plane of the film, and the relationship between the film center and target positions is known. A marker of lead, reinforced with brass and pierced by two small holes, exactly 9.7 cm. apart, is attached to the potter-bucky grid tray. Stereoscopic films are taken and Johnson's stereoroentgenometer is usually employed for making computations. Hodges and Ledoux, however, present tables and a monogram of their own that can be used when the stereoroentgenometer is not available.
This ends the presentation of the various methods used for Roentgen pelvimetry. It has been interesting to note, that without any exceptions the author of each method has been positive that his results were accurate within a very few millimeters and that anyone doing x-ray work could easily master the technique.

One more article has been reviewed, in which the author feels that this work is not beyond criticism and that many errors occur. Goethals (11) of Boston, has the following report and criticisms to offer:

"Accuracy not Obtained by X-ray Pelvimetry"

"In the pelvimeter phase of our work we have been faced with the well nigh insuperable difficulty of securing control measurements of the conjugata vera for purposes of comparison. It is impossible to measure this diameter with mathematical accuracy by any means other than a rule, caliper, or other metric device, at autopsy. In one case, which, because it was not a breech delivery, is not included in our series, in which post-mortem examination was done on a patient whose pelvis had been previously measured by x-ray, the radiologic conjugate vera tallied identically at 12.0 cm.

The next most accurate method of measuring the true conjugate directly is at the time of Cesarian section or other laparotomy, and we were fortunate enough to find one case in our assignment series in which these conditions were fulfilled, the x-ray conjugate vera tallying exactly
with the measured diameter at 10.0 cm.

Realizing at the outset of our investigations the impossibility of achieving accurate control measurements for our x-ray mensuration of the true conjugate, we decided upon recording the diagonal conjugate in the cases of our breech assignment series. This was easily done, because all cases were delivered under general anesthesia, and the readings of the diagonal conjugates obtained and tabulated.

In 29 cases or 33 percent of the breech deliveries, satisfactory x-ray measurements were obtained and checked against determinations of the diagonal conjugate. In one additional private case the controlled information is at hand. Eighteen or sixty percent of the cases showed the diagonal conjugate greater than the x-ray conjugate vera, of which ten or thirtythree percent of the total number, gave a reading from 1 to 2 cm. greater. Ten or thirty-three percent of the cases, showed a measured diagonal conjugate less than the x-ray measurement of the true conjugate.

We have no explanation to offer to account for these discrepancies, save that we are uncertain, in some cases, as to the exact location of the promontory in the film. The top of the symphysis is easy to locate, but the shadow of the promontory, when taken from directly above with the patient recumbent, is often ill defined
in outline and poorly contrasted against the shadow of the sacrum below. This bad differentiation may be lessened by taking exposures with the patient in the semi-reclining position as advocated by Thoms, since in this posture the pelvic inlet is brought closer to the horizontal plane and the promontory is more sharply defined.

This was carried out in a few of our patients post-partum, but we found it impracticable in the full term gravida, because of the higher dosage of x-rays required to penetrate the greater thickness of the intervening tissues and fluid, and because the protrusion of the abdomen, tended to interfere with the tube shift.

On the other hand the manual measurement of the diagonal conjugate is also, at best, an approximation. We feel strongly that there is room for much more work with accurately controlled x-ray pelvimetry, before we can place entire reliance on measurements obtained in this way."

Clifford (51) in an article just published reports some improvements on the stereoroentgenographic method of Johnson and says that, "through tests applied to the finished film and through added controls it is possible to recognize prior to the birth of the infant, those determinations which can be relied upon with a high degree of accuracy."
CASE HISTORIES.

Case 1. Below is a reduced print of the film taken on a woman at term.

The measurements of the pelvis made by Dr. Stewart are as follows:

- Transverse diameter: 13.5 cm.
- Antero-pésterior diameter: 10.25 cm.
- Left oblique: 11.75 cm.
- Right oblique: 11.75 cm.

The head is in the pelvic inlet.

The following day the patient was delivered after a few hours of labor without complications.
Case 2. Mrs G. Patient of Dr. L.S. McGoogan.

Age 28. Para II, Gravida III. History of previous difficult deliveries, so an x-ray was taken and measured by Stewart's method as follows:

Trans. diameter 13.5 cm.
A.P. " 10.0 cm.
R.O. 11.75 cm.
L.O. 11.75 cm.

Head in the pelvic inlet
Right Occiput Posterior.

The conjugate vera was measured digitally and estimated at 9.5 cm. as compared with a 10 cm. x-ray measurement. In view of the history and findings a Cesarian section was advised and refused. Labor was induced on 1/4/34 the estimated due date and remained a persistent R.O.P.; the cervix was fully dilated for two hours without progress in labor; The Scanzoni Maneuver was performed and the patient was delivered of a male child weighing 8# 9 Oz.
Case 3. Mrs J.N.T. Patient of Dr. Clarence Crook.

Age 21. Para I. Condition excellent. Ht. 5' 2", usual wt. 104, Bones very small; muscles well developed.

Breech presentation.

Pelvimetry

<table>
<thead>
<tr>
<th>Metric</th>
<th>Measurement</th>
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<tbody>
<tr>
<td>Int. Sp.</td>
<td>21 Cm.</td>
</tr>
<tr>
<td>Int. Cr.</td>
<td>24 &quot;</td>
</tr>
<tr>
<td>Int. Tro.</td>
<td>29 &quot;</td>
</tr>
<tr>
<td>Ext. Conj</td>
<td>17 1/2 &quot;</td>
</tr>
<tr>
<td>R. Ob.</td>
<td>19 &quot;</td>
</tr>
<tr>
<td>L. Ob.</td>
<td>20 &quot;</td>
</tr>
<tr>
<td>Circum.</td>
<td>81 &quot;</td>
</tr>
<tr>
<td>Dia. Conj.</td>
<td>10 &quot;</td>
</tr>
</tbody>
</table>

X-ray pelvimetry.

Dia. Conj. | 10 1/2 Cm. |
Trans. | 11 " |

Tendency to acorn type.


Impression: Normal size child with normal presentation could be born alive through this pelvis.
Case 4.  Patient of Dr. Clarence Crook.
This case is presented to illustrate the value of a routine radiograph at or near term. The positive print fails to give the detail found in the original film but on close observation one can easily see that it is a case of face presentation with rather marked hyper-extension of the head.
Case 5. Mrs H.M. Patient of Dr. Clarence Crook.

Age 20. Para I. General examination showed her condition fine except for a slight dark brown discharge at times. B.P. 120/80

Pelvimetry:

- Int. Sp. 24 Cm.
- Int. Cr. 28 "
- Int. Tr. 32 W
- Ext. Conj. 19 "
- R. Obl. 21 "
- L. Obl. 22 "
- Circum. 92 "
- Pub to Coc 10½"
- Isch. Sp. 11 "

X-Ray Pelvimetry

- Conj. Vera 11 Cm.
- Trans. dia. 13

Course of Pregnancy: Sinus draining from old mastoidectomy scar. Last two weeks 4 Plus Albumin and B.P. 160/90.

Labor: Weak irregular pains 6 hrs. Membranes ruptured. normal breech extraction after 3½ hours; total 9; hrs.

Results: Normal breech. Recovery slow due to a low grade pyelitis.

Doctor Crook's work illustrates the method of Thoms.
SUMMARY.

1. Pelvimetry is a relatively new procedure, but has been a topic of interest since the establishment of obstetrics on a sound basis.

2. Roentgen pelvimetry has occupied the minds of radiologists and obstetricians alike, almost since the discovery of x-rays.

3. Many methods have been introduced for measuring the superior strait of the female pelvis. Almost without exception the author claims that his method gives accurate results.

4. Dr. John N. Stewart, University of Nebraska graduate, perfected a slide rule that gives easy and accurate results.

5. Dr. T.R. Goethals of Boston, claims that the present methods do not give accurate results and that there is need for more work in this field.
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