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PELVIC MEASUREMENTS AND THEIR IMPORTANCE IN  
OBSTETRIC PRACTICE.

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THE recent revival of the Cæsarean section will doubtless prove to be a great benefit to American obstetrics, even outside of the domain of the operation itself.

The one thing that the advocates of the improved operation most earnestly insist upon is, that it be deliberately chosen beforehand, and that no attempt be made to deliver in any other way. But the choice of so dangerous an operation implies the knowledge of an obstacle to delivery so formidable as to preclude a reasonable hope that any less radical procedure will be successful.

Now it is well known that in an overwhelming majority of all such cases the obstacle to delivery is some deformity of the pelvis, and that in every case of labor complicated by pelvic deformity it is necessary to consider with due care the nature and amount of the contraction before deciding upon any method of delivery, whether it be by induction of premature labor, the unaided powers of the patient at term, forceps, turning, embryotomy, gastro-elytrotomy, or Cæsarean section. So, when the advocates of the last-named operation insist upon its deliberate and exclusive choice in all suitable cases, they practically demand a careful examination of the pelvis of every pregnant woman before labor begins or as soon afterward as possible. For in no other way can the conditions which may make the operation necessary be excluded. As a matter of fact, skilful obstetricians have attended women in confinement, with no apprehension of the case being an unusual one, have tried the forceps, turning, and craniotomy in succession, and after the death of the

patient have regretted that Cæsarean section was not resorted to in the beginning.

Without any special search for such cases I have recently found accounts of three<sup>1</sup> on the pages of a single journal.

No doubt, many similar ones could be found. But for every one of these desperate cases of contracted pelvis there are many in which more conservative measures, such as the use of the forceps or turning, would suffice. That they are often overlooked is apparent from the number of reported cases of difficult labor in which the phenomena are such as would most likely be caused by a deformity of the pelvis, but in which no such examination has been made as would lead to its recognition. If interest in Cæsarean section causes these less dangerous, but far more frequent, cases of dystocia to be more thoroughly studied, that, in itself, will be a great gain. It cannot be doubted that in them a correct or even approximately correct knowledge of the pelvis would often lead to the adoption of better methods of treatment. The only question is, How is such knowledge to be obtained?

In order to form an independent opinion as to the value of such measurements as can be taken during life, I have recently made careful measurements of ninety dried female pelvises, found in the various museums of Philadelphia. In this number are included twenty plaster casts in the collection of the College of Physicians. They were made by Tramond, of Paris, and careful study of them has satisfied me that they are faithful reproductions of the real pelvises.

The ninety cases may be classified as follows:<sup>2</sup>

Normal . . . . .	12
Justo-major . . . . .	3
Generally contracted . . . . .	13
Flat . . . . .	10
Flat, generally contracted . . . . .	16
Flat and oblique . . . . .	2
Pseudo-osteomalacic . . . . .	7
Oblique . . . . .	6
Kyphotic <sup>3</sup> . . . . .	3
Transverse contraction, brim and outlet . . . . .	10
Transverse contraction of outlet . . . . .	6
Infantile . . . . .	1
Pelvis obtecta . . . . .	1

<sup>1</sup> I. E. Taylor: Equally Faulty or Contracted Pelvis, *American Journal of Obstetrics*, August, 1883.  
 J. L. Dawson, Jr.: Labor in a Justo-minor Pelvis, *American Journal of Obstetrics*, November, 1883.  
 H. C. Coe: Paper before Obstetrical Society of New York, *American Journal of Obstetrics*, April, 1888.

<sup>2</sup> It is not pretended that this classification is the best that might be made. The difficulty of properly placing transitional forms, especially in the slighter degrees of contraction, has been very perplexing.

<sup>3</sup> These cases are called kyphotic because in all of them the conjugate is elongated, the transverse shortened at inlet and outlet, the brim made more nearly horizontal, and the sacrum more nearly vertical, all of these changes being apparently due to a marked kyphosis of the lumbar or dorso-lumbar column. The distance of the anterior superior iliac spines, however, is not increased as it is in the most typical kyphotic pelvises.

In the discussion of these cases, by *conjugata vera* or true conjugate is meant the shortest distance from the promontory to the symphysis pubis. In cases of double promontory it is measured from the one nearer the symphysis. This diameter is regarded as shortened unless it exceeds 10 cm. (3.94 inches).<sup>1</sup> My measurements have all been taken in the metric system on account of its greater convenience. The most important ones are also given in inches.

Pelvic measurements as made during life are external and internal. The only instrument needed is a pelvimeter, or pair of calipers with a scale to indicate the distance of the points from each other. In selecting one from the many that have been devised, accuracy of graduation, rigidity, lightness, compactness, and absence of a set screw are qualities to be sought. In default of a regular pelvimeter, a pair of machinist's calipers with a scale or tape measure can be made to serve, but it will be more troublesome.

#### THE EXTERNAL CONJUGATE.

The length of this diameter is ascertained by placing one point of the pelvimeter in the depression just below the spinous process of the last lumbar vertebra and the other upon the upper border of the symphysis pubis at whatever point gives the greatest distance. Moderately firm pressure is employed, and the distance read on the scale.

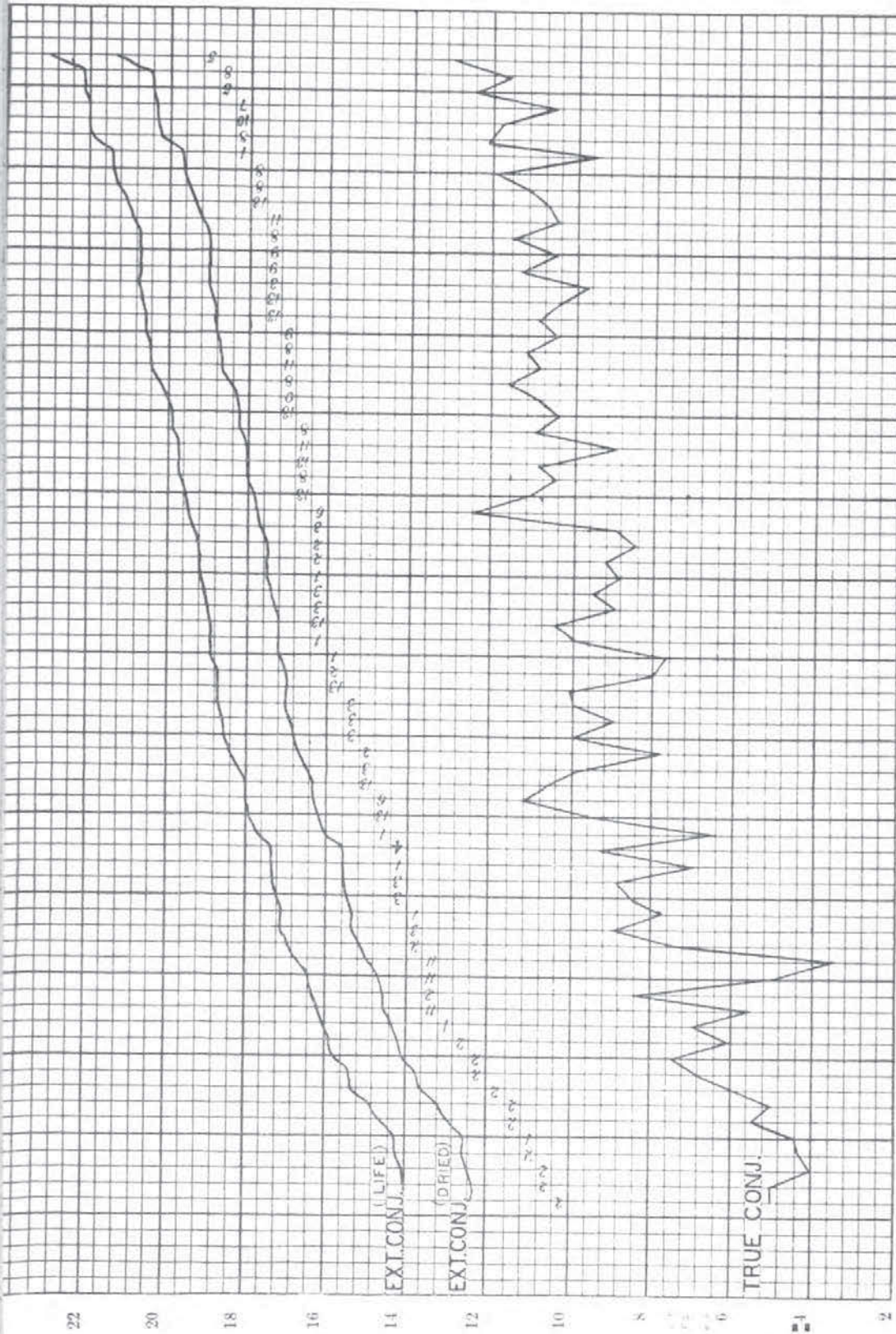
In thirty autopsies Litzmann<sup>2</sup> found the average excess of the external conjugate over the true conjugate to be 9.5 cm. (3.75 inches). Measured on the dried pelvis, the external conjugate is the distance from the extremity of the last lumbar spinous process to the tubercle of the os pubis close to the symphysis, and I have found it in seventy-four cases to average 7.8 cm. more than the true conjugate. Hence, in a typical normal pelvis, having a true conjugate of 11 cm., the external conjugate averages 20.5 cm. (8.07 inches) if taken during life, or 18.8 cm. if taken in the dried state. This makes the average thickness of the soft parts included during life 1.7 cm., which agrees precisely with the conclusion of Michaelis<sup>3</sup> that 8 lines (1.69 cm.) comes nearest the true average.

Baudelocque claimed that by subtracting 3 inches or 3½ inches from the external conjugate the true conjugate could be ascertained to a line. He was soon shown to be wrong both in taking too small an average amount to be subtracted, and especially in greatly under-estimating the range of the variation from this amount. Thus Litzmann, in the thirty autopsies already referred to, found the difference between the external and true conjugate to vary between 7 cm. and 12.5 cm. On this account,

<sup>1</sup> Spiegelberg: *Lehrbuch d. Geburtshilfe*, 2te Aufl., p. 394. Lusk: *Science and Art of Midwifery* 2d ed., p. 462.

<sup>2</sup> *Die Geburt bei engem Becken*, Leipzig, 1884, p. 26.

<sup>3</sup> *Das enge Becken*, Leipzig, 1865, p. 89.



Relation of true conjugate to external conjugate.

- |                              |                             |                                      |
|------------------------------|-----------------------------|--------------------------------------|
| 1. Flat.                     | 5. Justo-major.             | 9. Oblique.                          |
| 2. Flat generally contracted | 6. Kyphotic.                | 10. Pelvis obtecta.                  |
| 3. Generally contracted.     | 7. Nagle's oblique.         | 11. Pseudo-ostomalacic.              |
| 4. Infantile.                | 8. Normal.                  | 12. Robert's transverse contraction. |
|                              | 13. Transverse contraction. |                                      |

Baudelocque's diameter is sometimes spoken of as though it were useless. It still remains true, however, that by subtracting the correct average difference, an amount will be obtained which is more probably correct for the true conjugate than any other. Moreover, there is a certain proportion of cases in which this diameter will indicate with certainty that the pelvis is, or is not, contracted in the same direction.

Fig. 1 shows the relation between the conjugata externa and the conjugata vera in seventy-two dried pelvises, arranged in the order of the former diameter, each vertical line corresponding to a single specimen. In order to show the length of the external conjugate, as measured in life, it is assumed that the thickness of the included soft parts does not vary from the average. As a matter of fact, it does vary<sup>1</sup> from  $\frac{1}{4}$ " to  $1\frac{1}{4}$ " (0.6 cm. to 3.2 cm.), but any considerable variation could be detected on external examination, and allowed for with sufficient accuracy.

The following table shows the varying degree of probability that the true conjugate is not more than 10 cm. in a case whose external conjugate is given :

TABLE I.

External conjugate in life <sup>2</sup>	External conjugate dried pelvis.	No. of cases.	No. with conjugate 10 cm. or less.
22 cm. or more.	20.3 cm. or more.	5	0
21 " to 21.9 cm.	19.3 " to 20.2 cm.	5	1
20 " to 20.9 "	18.3 " to 19.2 "	12	1
19 " to 19.9 "	17.3 " to 18.2 "	13	7
18 " to 18.9 "	16.3 " to 17.2 "	12	6
Less than 18 "	Less than 16.3 "	25	25

The greatest external conjugate, in which shortening of the true conjugate occurs, is 21.5 cm. By looking at Fig. 1 the contraction in this case is seen to be very slight; and going backward no marked case of contraction is found until the conjugata externa is reduced to 19.7 cm., where a true conjugate of 9 cm. is found. Below this point contraction becomes much more frequent and more marked.

The shortest external conjugate in which the true conjugate is not diminished is 18 cm. This is in a case of the kyphotic type, having a conjugate of 11.2 cm., and in another pelvis whose conjugate is 10.6 cm., apparently, but not certainly of the same type.<sup>3</sup>

The results obtained from this group of seventy-four cases accord very well with the conclusions of Litzmann,<sup>4</sup> which are as follows: When the external conjugate measures less than 16 cm. the pelvis is always nar-

<sup>1</sup> Michaelis, op. cit., p. 88.

<sup>2</sup> Estimated by adding 1.7 cm. to external conjugate of dried pelvis.

<sup>3</sup> This pelvis was disconnected from the rest of the skeleton, so I could not be certain.

<sup>4</sup> Die Geburt bei engem Becken, p. 26.

rowed in the same direction; when it is less than 19 cm. there is narrowing in more than half the cases; if it is from 19 cm. to 21.5 cm., narrowing scarcely occurs in one case out of ten; if it is more than 21.5 cm., contraction in this direction is not to be expected at all.

If I might be permitted to extend this statement by combining with it the results of my own cases, it would be as follows: If the external conjugate is less than 16 cm. ( $6\frac{1}{2}$ " ), shortening of the true conjugate is certain, and is likely to be very considerable; from 16 cm. to 18 cm. ( $6\frac{1}{2}$ " to  $7\frac{1}{8}$ " ) shortening is extremely probable; from 18 cm. to 20 cm. ( $7\frac{1}{8}$ " to  $7\frac{3}{8}$ " ) the chances are even; from 20 cm. to 21.5 cm. ( $7\frac{3}{8}$ " to  $8\frac{1}{2}$ " ) shortening of the true conjugate is highly improbable, and, if it does occur, slight; above 21.5 cm. ( $8\frac{1}{2}$ " ) contraction in this direction may be safely excluded.

#### THE DISTANCE OF THE ILIAC SPINES AND ILIAC CRESTS.

We owe the use of these transverse diameters of the large pelvis in obstetric diagnosis to the genius of Michaelis. The distance of the anterior superior spines of the ilium is measured by adjusting the points of the pelvimeter to the spine of each side just outside of the tendon of the sartorius. Michaelis<sup>1</sup> recommends that they be moved downward a short distance, so as to grasp the tendons again, and that the reading be then taken.

The distance of the crests is obtained by applying the instrument to the two opposite points that are most widely separated, or, in case the crests approach each other, as they recede from the spines, points about two inches back of the latter should be taken. For these two measurements it is convenient to use the abbreviations sp. il. and cr. il.

Litzmann<sup>2</sup> found that in two hundred normal pelves measured during life sp. il. averaged 27.2 cm. and cr. il. 29.5 cm. The amounts to be subtracted in order to give the corresponding measures for the dried pelvis, he concluded to be 1.2 cm. and 0.9 cm., respectively. Michaelis,<sup>3</sup> however, by measuring twelve pelves, both in the living and dried state, found the average difference to be 8" for sp. il., and 6" for cr. il. From this we are justified in concluding that the true differences are nearly 1.5 cm. and 1 cm. Here, as in the case of the external conjugate, any unusual thickness or thinness of the integument can be noticed, and an allowance made.

The text-books of obstetrics sometimes give these two diameters as much smaller, probably because inside measurements are meant. Such measurements serve no good purpose, and as they confuse the subject, it seems as though they might well be discarded.

<sup>1</sup> Das enge Becken, p. 70.

<sup>2</sup> Die Geburt bei engem Becken, p. 27.

<sup>3</sup> Das enge Becken, p. 92.

Fig. 2 gives the conjugate and transverse diameters of the brim, together with sp. il. and cr. il. of ninety dried pelvis arranged in the order of sp. il., each vertical line corresponding to a single specimen. That there is a relation between the transverse diameter and sp. il. is shown by the general rise of the line of the former, although it is very irregular, and is less rapid than that of the latter. In such a case we naturally expect the relation to be expressed approximately by a common ratio rather than by a common difference.

It is instructive to consider the cases in groups arranged in the same order.

TABLE II.

Sp. il. (dried pelvis).	Number of cases.	Average transverse.	Maximum transverse.	Minimum transverse.	Ratio of average transverse to sp. il. <sup>1</sup>
17 cm. to 19.5 cm.	8	10.4	11.5	8.8	0.517
20 " " 20.6 "	11	11.4	13.4	10.0	0.524
21 " " 21.5 "	12	11.7	12.5	11.0	0.516
22 " " 22.5 "	10	11.9	12.7	11.0	0.505
23 " " 23.8 "	13	12.6	13.2	12.0	0.504
24 " " 24.5 "	13	13.0	14.4	10.5	0.508
25 " " 25.7 "	10	13.0	13.8	11.4	0.487
26 " " 26.6 "	10	13.4	14.7	11.0	0.486
27	2	13.7	14.5	13.0	0.482

Here the average transverse diameter of the brim is seen to increase with tolerable regularity, but the striking irregularities in the columns containing the maximum and minimum seem to defy all attempts at computation. Still the attempt is not altogether fruitless. In the last column of the table it appears that the average ratio of the transverse diameter to sp. il., as measured during life, varies but little in the different groups, and that  $\frac{1}{2}$  is a close approximation to it.

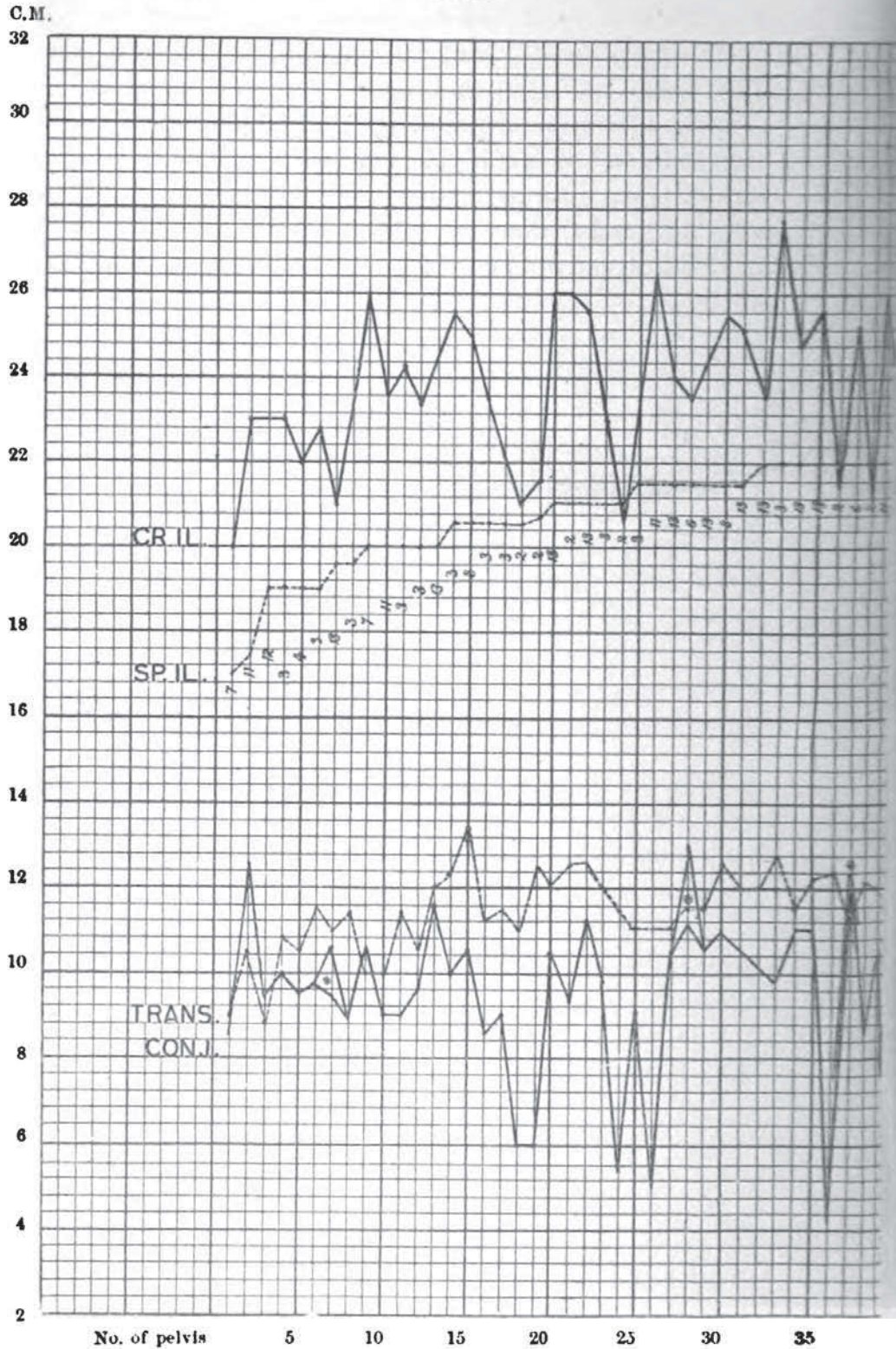
Now, taking each of these eighty-nine cases separately, adding 1.5 cm. to sp. il. to get the corresponding measurement during life, and assuming one-half of this to be the transverse diameter of the brim, I find the error to be less than 1 cm. ( $\frac{2}{3}$ "") in seventy. In the remaining nineteen it is 1 cm. or more, and in two cases it exceeds 2 cm.

It must not be forgotten, in judging of this result, that these cases do not fairly represent the general run of deformed pelvis; because the slighter and less irregular forms of contraction do not commonly find their way into museums; so that, in actual practice, we may reasonably expect the proportion of gross errors to be smaller. But when they do occur, can they be detected and reduced in amount?

The factors capable of disturbing the usual ratio between the diameters in question are changes in the inclination, breadth, and thickness

<sup>1</sup> Sp. il. is here supposed to be taken during life, and to average 1.5 cm. more than in the dried pelvis.

FIG. 2.

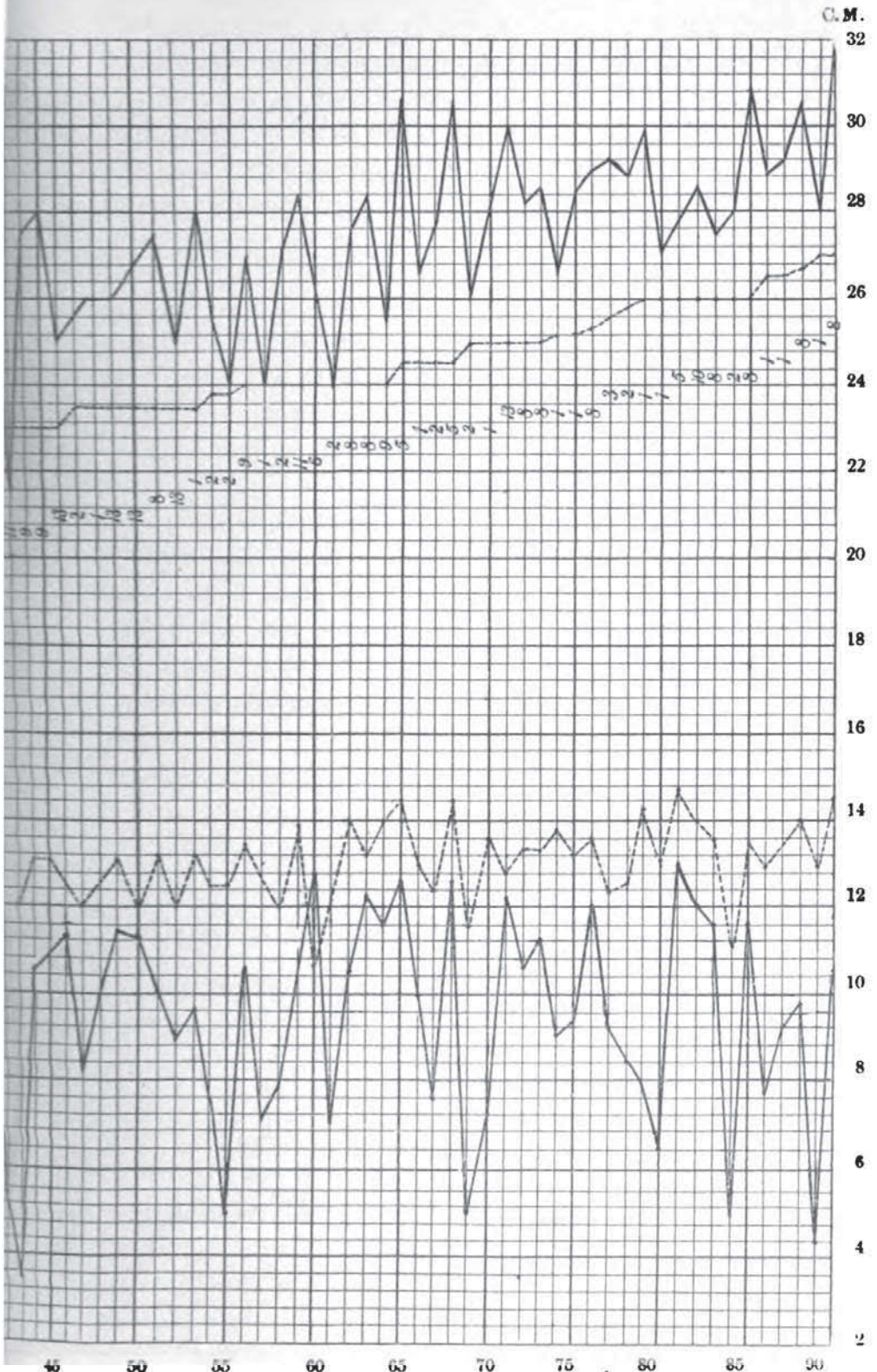


Relation of conjugate and transverse to iliac diameters.

1. Flat.
2. Flat generally contracted.
3. Generally contracted.
4. Infantile.
5. Justo-major.
6. Kyphotic.

\* Two conjugates, owing to double promontory.





- 7. Nägele's oblique.
- 8. Normal.
- 9. Oblique.
- 10. Pelvis obtecta.
- 11. Pseudo-osteomalacic.
- 12. Roberts's transverse contraction.
- 13. Transverse contraction.

of the spreading portions of the ilia, especially in the anterior part. The thickness of the bones at the edges can be estimated without special difficulty. Some idea as to whether the breadth and inclination are greater or less than normal may be obtained by external palpation, paying particular attention to the length and direction of the line joining the superior and inferior spines of each side. Combined external and internal palpation will be of more value. If the ilia are thicker, broader, and more nearly horizontal than usual, one-half of sp. il. will be greater than the transverse diameter, and 1 cm., 2 cm., or even 2.5 cm. should be subtracted. If the opposite conditions prevail, an addition should be made; but it will seldom need to be more than 1.5 cm. It may fairly be claimed that the distance of the iliac spines is of great value in estimating the transverse diameter if used with all due care.

There is also a relation between the two iliac diameters and the true conjugate, which, considering their difference in direction, is truly remarkable. Examining Fig. 2, it will be seen that there are fifteen cases in which the line of cr. il. is within 1.3 cm. ( $\frac{1}{2}$ "') of that of sp. il. or actually falls below it. In every one of these cases the true conjugate is less than 10 cm. Hence it is plain that a very small or reversed difference between these two diameters is a strong indication of flattening.

The extent to which this is true is best shown in tabular form. Here, again, due allowance must be made for the fact that museum specimens are so largely pathological.

TABLE III.

Difference between sp. il. and cr. il.	Number of cases.	Number with conjugate of 10 cm. or less.
-1.5 cm. to 0 cm.	7	7 = 100 per cent.
0 " " 0.9 "	2	2 = 100 "
1 " " 1.9 "	12	9 = 75 "
2 " " 2.9 "	16	8 = 50 "
3 " " 3.9 "	24	12 = 50 "
4 " " 4.9 "	15	5 = 33 "
5 " " 6 "	14	5 = 35 "

Here, it appears that with increase of the difference in question the liability to flattening decreases, but it is also plain that no amount of this difference excludes flattening. Litzmann<sup>1</sup> thinks the explanation to consist in the fact that in rachitic children, the bones being soft, the pressure of inflated intestines pushes the expansions of the ilia apart in front and makes them more nearly horizontal, while the downward thrust on the sacrum brings the posterior ends of the ilia nearer together, and spreads their anterior ends further apart, at the same time that the promontory is brought nearer the symphysis pubis.

<sup>1</sup> Die Geburt bei engem Becken, p. 28

Kehrer also attributes the diminished difference between cr. il. and sp. il., in flattened pelves, to rickets, but thinks that the pull of the muscles attached to the pelvis is the principal factor in producing the distortion.

In non-rachitic flattening the two diameters usually have the normal relation to each other. On the other hand, the difference between them is very small in a considerable proportion of normal pelves.

Litzmann, as the result of extended researches, makes the following statement:

"The mean difference of the two transverse diameters is, in normal pelves, as in the dried skeleton, something more than 2 cm. Yet this relation is subject to great variation (nearly 5 cm.) corresponding to the varying degree of curvature of the iliac bones. In more than two-thirds of the cases the difference varies between 1.3 cm. and 2.7 cm. In nearly one-fifth it exceeds this amount; the large pelvis appears more closed in front; the distance of the anterior superior iliac spines is as much as 5.4 cm. less than the greatest distance of the iliac crests from each other. More rarely, in a little more than one-tenth of the cases, the curvature of the iliac bones is less; they open forward; the difference between the two transverse diameters falls as low as 0.45 cm."

Spiegelberg<sup>1</sup> formulates with great definiteness the use that may be made of these two diameters in ascertaining the type of any pelvis under examination. I quote his statement in full:

- "The results obtained may be as follows:
- "*a.* The distances are of average length, and their relation to each other the usual one, cr. il. 2.5 to 3 cm. larger than sp. il.
  - "*b.* The distances are more or less below the average, but have the normal relation to each other.
  - "*c.* The distance of the cr. il. is average, that of the sp. il. is greater than average; the difference between them is small, has disappeared, or is even reversed.
  - "*d.* Both distances are below average, and, at the same time, show the relation to each other given under *c.*
- "In the Case *a* we almost certainly have a pelvis of normal size to deal with.
- "In the Case *b*, with one of congenitally small build, but not otherwise changed in form (generally and evenly too small).
- "In the Case *c* transverse straightening and, therefore, flattening exists, with otherwise roomy dimensions.
- "In the Case *d* the pelvis is small and, at the same time, flat (generally contracted, flat pelvis)."

Although he does not say so, Spiegelberg must have meant these statements to be taken as only approximately true, for the exceptions are numerous, and so experienced and learned an obstetrician certainly knew of them.

Of twenty-three specimens coming fairly under his "Case *a*," ten were contracted at the inlet. Of thirty-one in "Case *b*," fourteen could not be called generally contracted. Two out of four in "Case *c*" were normal. Seventeen cases corresponding with the definition "*d*" in-

<sup>1</sup> Lehrbuch der Geburtshilfe, p. 397.

cluded flat, pseudo-osteomalacic, kyphotic, and oblique specimens that could not fairly be called flat generally contracted.

Undoubtedly cases as they occur in practice would make a better showing than this, but the necessity for caution is evident. Fortunately, the evidence given by the external conjugate can always be added to that of the iliac diameters, and this will prevent the acceptance of many errors that would result from too great reliance on the latter.

#### DISTANCE OF THE POSTERIOR SUPERIOR ILIAC SPINES.

To determine this distance the lowest point accessible to touch on the posterior part of the inner margin of each iliac crest is to be found, and their distance from each other measured either with the pelvimeter or a tape. In the normal dried pelvis I have found it to average 8.6 cm. It is often easy to measure during life, but in stout patients it may be difficult. In a single case Litzmann found the difference between its length during life and the corresponding measure in the dried state to be 0.6 cm. He found it to be diminished in generally contracted specimens, but to preserve the normal ratio to sp. il., while in flat, non-rachitic cases it was both absolutely and relatively smaller; still more so in flat, generally contracted ones, and most of all in the flat rachitic type.

My own results are in full accord with this statement. The distance is also diminished in the rarer cases of kyphotic pelvis<sup>1</sup> and Naegele's obliquity. In the latter the sacral spinous processes are nearer one spine than the other, which constitutes a valuable diagnostic sign. Except in the generally contracted pelvis, the diminution of this diameter is entirely independent of the width of the sacrum. It is, therefore, hard to understand why Litzmann should have spoken of it as capable of indicating the breadth of the sacrum and through it the length of the transverse diameter partly depending upon it.

#### ADDITIONAL EXTERNAL MEASUREMENTS.

Kiwisch has proposed that the external circumference be measured in a plane passing through the upper border of the symphysis and the spinous process of the last lumbar vertebra. This circumference averages about 90 cm., and is said to vary but little in normal pelvis. If it is as low as 75 cm. or 65 cm., as it may sometimes be, the pelvis is certainly much contracted.<sup>2</sup> It seems evident that this measurement cannot be relied upon except to confirm conclusions arrived at by other means; but, as it is easily and quickly made, there can be no objection to taking it into account.

A number of oblique external diameters have been proposed as a

<sup>1</sup> Spiegelberg: *Lehrbuch d. Geb.*, pp. 445, 446.

<sup>2</sup> Carl Braun: *Lehrbuch d. Ges. Gynäkologie*, 2te Aufl., p. 671.

means of ascertaining the presence or absence of obliquity at the brim. The most important of these diameters are measured from the anterior superior spinous process of the ilium, on each side, to the posterior superior spinous process, the tuberosity of the ischium and the trochanter, of the opposite side. It is difficult to fix upon the points, whose distance is to be found, with the necessary precision. Moreover, when the measurements are properly made they are not thoroughly reliable. They may be of value when taken in connection with other evidences of asymmetry, but taken alone they may even indicate an obliquity opposite to the one actually existing.

In the general run of cases the external conjugate with the distances of the anterior superior iliac spines, iliac crests, and posterior superior iliac spines will tell all that external diameters are capable of telling. All taken together, they will furnish a strong indication of the type of the pelvis, and, if contraction exists, they will give a rough notion as to its extent. This, however, is not sufficient in a case of deformity, and the investigation must be pursued further by means of internal examination.

#### THE DIAGONAL CONJUGATE.

This is at once the oldest and the most valuable of all pelvic measurements. It was used by Smellie and enabled him to give the first estimates of the varying degrees of contraction that had any precision. When accurately made and carefully interpreted it gives the length of the true conjugate with a degree of precision that leaves little to be desired. Difficulties occur, however, both in making and in interpreting the measurement, and these require minute attention.

The measurement consists in the introduction of two fingers into the vagina, pressing the end of the middle finger against the promontory, bringing the radial edge of the hand against the sub-pubic ligament, marking the point of contact, and finally, after withdrawal of the hand, measurement of the distance from the mark to the end of the middle finger. It is not always possible to do this. In 611 cases in which Litzmann<sup>1</sup> attempted to determine the diagonal conjugate he succeeded in 301 and failed in 310. The promontory could not be reached in 61. The promontory was reached with difficulty, but its distance from the sub-pubic ligament not accurately measured, in 15. The measurement was hindered by resistance of the external genitals—rigid perineum, œdema of the vulva, etc.—in 17. It was hindered by low position of the uterus, head, or bag of waters in 175. Cause of failure not given in 42. The fact that in the majority of all these failures the cause was interference of the uterus, head, or bag of waters cannot fail to arrest attention. It clearly shows the wisdom of undertaking the examination early. And

<sup>1</sup> *Die Formen des Beckens*, p. 4.

since, in cases of contraction, premature labor is one of the most valuable methods of obviating the difficulties that would otherwise occur, the examination ought to be made when the patient is received. On the other hand, if the *head* prevents measurement, and is not impacted, that is so much evidence against the existence of contraction at the brim. In about one-fourth of the failures the cause was difficulty in reaching the promontory. These are only partial failures however, for a minimum value for the diagonal conjugate, and through it for the true conjugate, will be given, and this may be all that is needed.

The attempt to reach the promontory will be much favored by attention to the following points first laid down by Michaelis.

1. Bladder and rectum must be empty.
2. The patient should lie on her back with knees drawn up, the coccyx and perineum entirely free, but the sacrum elevated on a cushion so as to diminish the inclination of the pelvis as much as possible.
3. The hand must be well oiled and the labia or hairs must not be pushed in.
4. The examining arm must be supported in overcoming the resistance of the perineum, otherwise it will soon be exhausted and begin to tremble. Michaelis used the left arm, in order to have his right hand free, and placed the left foot upon a stool so as to bring the knee to press against the elbow, thus taking part of the strain off the arm.
5. The elbow must be dropped until the forearm is horizontal, perhaps even further.
6. The ring and little fingers must be bent at right angles at the first joint but not supported in the hand; only the surfaces of the first phalanges are to exert pressure.
7. Continued steady pressure is to be kept up so as gradually to overcome the resistance, but it must not be exerted upon the pubic bones.

The posterior wall of the pelvis is to be followed upward, and the promontory is recognized by the breadth of the cartilage between it and the last lumbar vertebra. After fixing the end of the middle finger on the middle of the promontory *the index finger of the right hand should carefully examine the posterior surface of the symphysis pubis, in order to compare its direction with that of the examining fingers*, in view of the possible necessity for a correction on account of the angle between the true conjugate and the symphysis being greater or less than usual. Then, after carefully making sure of the ligamentum arcuatum, the radial edge of the examining hand is to be brought in contact with it and the point marked by the nail of the right forefinger. Michaelis recommends that in doing this the elbow be raised, and the forearm brought into extreme pronation, so that the sensitive volar surface be directed toward the ligament. He thinks that most errors come from not accurately marking the anterior point. The left hand having been withdrawn,

as nearly as possible in the same position, the distance between the ulnar side of the end of the middle finger and the mark left by the nail can best be taken by the pelvimeter.

The diagonal conjugate having been measured, it remains to deduce from it the true conjugate. This is usually a very simple matter, consisting merely in the subtraction of the average difference between the two. Playfair,<sup>1</sup> in agreement with Baudelocque and the older obstetric writers generally, gives it as  $\frac{1}{2}$ " (1.27 cm.), but this is certainly too small. Lusk<sup>2</sup> subtracts from  $\frac{3}{4}$ " to  $\frac{1}{2}$ ", according to the height of the symphysis. Spiegelberg<sup>3</sup> and Carl Braun<sup>4</sup> mention 1.8 cm. (0.72") as a general average.

My own measurements of ten normal pelvises show an average difference between the two conjugates of 1.73 cm., while in forty-one flattened or generally contracted specimens it is 1.85 cm. (0.73"). If 1.8 cm. or  $\frac{3}{4}$ " be taken, it will be near enough to the true average for all practical purposes. But the average difference may not be correct for an individual case. I have found the actual difference to vary from 0.8 cm. to 3.6 cm. It is, therefore, necessary to inquire into the number and extent of the errors that would result from assuming the average difference as fixed.

In forty-one flattened or generally contracted pelvises I found that subtracting 1.8 cm. from the diagonal conjugate gave an error in the length of the true conjugate not exceeding 0.5 cm. ( $\frac{1}{2}$ ") in twenty-nine, or 71 per cent.; exceeding 0.5 cm., but not exceeding 1 cm. in eleven, or 27 per cent.; exceeding 1 cm., in one case, or 2 per cent. Here, of course, the proportionate number of serious errors is excessively large, owing to the fact, already twice mentioned, that museum specimens include an undue proportion of greatly distorted pelvises. It was the rule of Michaelis to subtract a fixed average, except where there was manifest reason for its being too great or too small.

In trying to account for the comparatively few serious discrepancies that do occur, the variation in the height of the symphysis naturally suggests itself. Taking 4 cm. as the average height of the symphysis, and constructing on paper the triangle formed by it and the two conjugates, it will be found that each variation of 0.5 cm. in the height of the symphysis makes a corresponding variation of 0.3 cm. in the difference between the conjugates.

It might naturally be expected, then, that where the symphysis is not of the usual height a correction amounting to three-fifths of the variation would eliminate many of the errors in the estimation of the true

<sup>1</sup> System of Midwifery, 3d Am. ed., p. 386.

<sup>2</sup> Lehrbuch d. Geburtshülfe, p. 400.

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<sup>3</sup> Sci. and Art of Midwifery, p. 467.

<sup>4</sup> Lehrbuch d. Gesamten Gynäkologie, p. 673.

conjugate. Such an expectation is not justified when put to a practical test.

In my cases the greatest difference of all between the two conjugates was found along with an average symphysis; the least of all, along with one greater than the average.

Taking thirty-nine<sup>1</sup> of these cases the sum of all errors resulting from the subtraction of a fixed difference, 1.8 cm., was 15.7 cm., an average of 0.4 cm. Making the correction for variation in the height of the symphysis, many errors were diminished, but others were increased, so that the sum total was a trifle greater, 16 cm. instead of 15.7.

This remarkable result shows at once that there must be another and more variable factor in the difference between the conjugates; and the only one possible is the conjugato-symphysial angle, which has for its sides the true conjugate and the line joining its anterior extremity and the middle of the subpubic ligament. I found this angle in each case by plotting on paper, three sides of the triangle being known. It averaged in the thirty-nine cases  $106^{\circ} 30'$ , which corresponds closely with what Litzmann<sup>2</sup> appears to take as the average, viz.,  $105^{\circ}$ .

In the case having the greatest difference between the conjugates, this angle was also greatest, reaching  $145^{\circ}$ . On the other hand, the smallest difference was associated with the smallest angle, viz.,  $86^{\circ}$ . By taking half as many millimetres as the difference in degrees between the angle and its average,  $105^{\circ}$ , as the proper correction for the amount to be subtracted from the diagonal conjugate in each case, all the great errors are much reduced, and the sum total is brought down to 11.4 cm., although no attention is paid to the height of the symphysis. But by combining a correction for the symphysis with one for the conjugato-symphysial angle the best result is attained, the sum of all errors in the thirty-nine cases being 6.8 cm.

Now, how are we to make any practical application of these facts? The difficulties are obvious, for, while the height of the symphysis can easily be taken, it alone is nearly, if not quite, useless, and the situation of the angle does not admit of its being measured. True, many instruments have been devised in order to measure it, but their objectionable features have so far proved fatal to their extended use. Spiegelberg thinks it easy, by taking the height of the symphysis, together with its inclination and the height of the promontory into consideration, to make any correction that may be necessary. Others object that, in reality, it is very difficult, and the point certainly seems to be well taken. It must be borne in mind that the height of the promontory above the brim, and the inclination of the symphysis to the horizon are of no con-

<sup>1</sup> In two, owing to an oversight, the symphysis was not measured.

<sup>2</sup> Geb. bei engem Becken, p. 32.



sequence, except in so far as they influence the conjugato-symphysial angle. Michaelis's method of estimating any variation in this angle, already mentioned in connection with the measurement of the diagonal conjugate, seems to be the simplest and best.

The average amount to be subtracted should be adhered to, except where the reasons for changing it are manifest, and then it will be safer to make the correction too small rather than too large. Lusk aptly remarks, in this connection: "It is just here that judgment and experience furnish the best safeguard against vital inaccuracies."

#### THE TRANSVERSE DIAMETER OF THE BRIM.

The true conjugate being the shortest and most frequently contracted diameter of the inlet, and at the same time the one admitting of most accurate determination, has accordingly been regarded as by far the most important as a guide to treatment. Nevertheless, the enormous clinical difference between a simple flat pelvis and a generally contracted one of the same conjugate, makes it extremely desirable that some accurate method of finding the transverse diameter be found.

It has long been recommended that the varying degree of ease or difficulty with which the lateral walls of the pelvis can be reached in internal examination be taken into consideration, in connection with the external transverse measurements already discussed, as the best means of attaining the desired knowledge. This kind of an examination should always be made, changing the hand so as to reach both sides of the pelvis under the same conditions. This will at the same time be a valuable means of detecting obliquity.

Löhlein<sup>1</sup> has made an extensive study of the transverse diameter and has devised a method of computing it from the distance between the middle of the ligamentum arcuatum and the upper anterior corner of the great sacro-sciatic foramen of each side. This distance he calls the oblique ascending diameter, and measures it in the same manner as the diagonal conjugate. In the normal pelvis it is 2 cm. less than the transverse diameter. In flat pelvises the relation between the two is inconstant, but in five generally contracted pelvises Löhlein found a tolerably constant difference averaging 1.57 cm. In flat generally contracted pelvises he found the individual variations to be greater, but still hoped that further experience would make his method useful in these cases.

As far as I have been able to test this method by measurement of fourteen specimens the result has not been encouraging. The number of cases, however, was too small and the types too varied to test thoroughly Löhlein's proposition, which refers only to generally contracted and flat generally contracted cases. We ought not to expect a constant

<sup>1</sup> Zur Beckenmessung. Ztschrift. f. Geb. und Gyn., vol. xi.

difference between the two diameters, but rather a constant ratio, and only in case the whole examination indicates a pelvis of normal form, though diminished size. In this country the most tragic results have been associated with just such cases. It is probable that in these pelvises six-sevenths of the oblique ascending diameter is a close approximation to the transverse. Of course, both sides should be measured, and the mean taken. A difference between them of more than a few millimetres is evidence of obliquity.

#### DIAMETERS OF THE OUTLET.

The outlet being but very rarely more contracted than the inlet, comparatively little attention has been paid to it. It is not difficult to ascertain the direct diameter with sufficient accuracy. Attention to the curvature of the sacrum, together with its inclination to the lumbar column, will often be sufficient to show whether or not there is any considerable contraction in this direction.

The distance from the subpubic ligament to the sacro-coccygeal junction may be measured directly in the same manner as the diagonal conjugate, or, more conveniently, it may be taken externally with the pelvimeter and 1 cm. to 1.5 cm.<sup>1</sup> be subtracted.

The transverse diameter of the outlet cannot be easily or accurately measured, partly because soft parts of variable thickness cover the ischial tuberosities and also because the points whose distance is to be taken are not easily recognized even in the dried pelvis. With the patient on her back, the thighs flexed on the abdomen, and the knees moderately separated, the distance can be approximately measured with the pelvimeter or a tape, 1 cm. to 2 cm. being added for the skin and fat.

In conclusion, it seems proper to offer some definite opinions as to the bearing of pelvic measurements on obstetric practice. I would suggest the following :

1. Measurements are not to be regarded as necessary only in rare cases and hence but rarely employed. On the contrary, the pelvis of every pregnant woman should be examined when she is received, as a patient or as soon afterward as possible.

On this point Spiegelberg says :

“ It cannot be too urgently impressed that the pelvis is to be included in the examination of every pregnant and parturient woman, even when there is not the least suspicion of contraction. In this way, not only will the overlooking of anomalies be avoided, but the obstetrician will be prevented from finding himself at some time during labor brought face to face with difficulties of which he had no presentiment, and which, with timely knowledge he might have avoided or at least made less formidable.”<sup>2</sup>

<sup>1</sup> Briesky, quoted by Carl Braun : *Lehrb. d. Ges. Gynäkologie*, p. 670.

<sup>2</sup> *Lehrb. d. Geburtshilfe*, p. 395.

The fortunate termination of previous labors by no means does away with the necessity for this examination. It is an undoubted fact, amply sustained by experience, that in cases of contraction the difficulties tend to increase with the number of labors, and while the first and second labors may end favorably, later ones may require the severest operative procedures.<sup>1</sup>

2. The examination should consist in measurement of the external conjugate, anterior and posterior iliac spines, and iliac crests. If these external measurements indicate a normal pelvis, the examination may end with them. But if contraction is suspected, the diagonal conjugate and the oblique ascending diameter of Löhlein should also be taken. These measurements should be considered in the light thrown upon them by the previous history and general condition of the patient, and especially by a careful internal and external palpation of the pelvic bones, which will reveal the necessity for further measurements if it exists.