

A T H E S I S

on

SOME PROBLEMS IN OBSTETRICS.

V O L U M E I.

The estimation of the length
of the Transverse, and True Conjugate
diameters of the pelvic brim .

by

Alfred C. Sandstein
M.B., Ch. B., 1898.
(1st Class honours)

James Scott Scholar, 1898

Freeland Barbour Fellow, 1898.

Charles Murchison Memorial Scholar, 1899.

Gunning Victoria ^{Tubal}Prizeman in Obstetrics,
1900.

Syme Surgical Fellow 1901

Thesis Gold Medallist 1901

Presented for

the degree of M.D. 1901.

*and the Syme Surgical and Good Sir
Memorial Fellowships.*



PREFACE.

The measurements on which this volume is founded, were made by the kind permission of Professor Simpson, Dr Alexander H. Freeland Barbour, and the Museum Committee of the Royal College of Surgeons through Mr . Cathcart, in the University Museum, in Dr. Barbour's museum and in the Museum of the Royal College of Surgeons, Edinburgh. I have to thank these gentlemen for the many kindnesses I have received at their hands, and for the many facilities that have been offered me.

Alfred C. Sandstein.

April, 1901.

CONTENTS.

- - - - -

PREFACE.		
CHAPTER I.	Statement of the problem -	p. 1
	Difficulties of its solution -	p. 2
	Conjugata vera	p. 3
	Transverse diameter of brim	p. 4
CHAPTER II.	The Transverse diameter of the Pelvic Brim	p. 8
	Importance of knowing its length	p. 8
	Rule for Calculation of its length	p. 9
	Original investigations	p.10
	Further investigations. Technique	p.12
	Acknowledgment of source of help and Explanation of Tables, &c.	p.13
	Arrangement of Pelves into groups.	p.21
CHAPTER III	The Transverse diameter of the brim in pelves taken according to their agreement with the Normal (or natural) pelvis.	p.25
	Normal (or natural) pelves.	p.25
	Large pelves.	p.26
	Justominor pelves	p. 26
	Funnel-shaped pelves.	p.26
	Obliquely contracted pelves	p.27
	Transversely contracted pelves	p.27
	Rickety pelves	p. 28
	Unclassified pelves	p.28
CHAPTER IV	The reason of the relation between the Trans- verse diameter of the brim, and the intercris- tal diameter	p.33
CHAPTER V	The true Conjugate	p.51
	The Conjugimeter	p.59

CHAPTER I.

Statement
of the
problem.

In every obstetric case to which the physician is called the examination of the patient, no matter what it is, no matter whether it is by sight or touch, by abdominal or by vaginal examination, has for its ultimate object, the solution of the problem - "HOW SOON WILL THIS LABOUR END IF LEFT TO NATURE." In every case, as her mental state has such a powerful influence over the muscular efforts made, and as the estimation of the probable duration is so difficult to make accurately, his politic answer to the patient's anxious inquiry, will be that "that depends upon yourself" while at the same time assuring her that "all is well."

But during the examination, his active mind, and his deft fingers have been busy in the pursuit of details that will answer this question. For, be it the condition of the Powers of Labour, be it the condition of the Passages concerned in Parturition, or be it the condition of the Passenger, its only import can be that it will or will not affect the duration (and successful termination) of the labour. Even if the labour be complicated by Haemorrhage, by Eclampsia or Prolapsus Funis, still the problem remains the same, by whatever devious way or by-path it is arrived at.

It is very evident that all future conduct of the case in question, depends on the answer to this question, which includes in itself the placing of the labour under one of the various categories, Natural, Laborious, Preternatural or Complex. And according as it is mentally placed in one class or another, so is the treatment applied.

The difficulties in the way of solving the Problem. When treating a parturient woman, the physician can satisfy himself as to the condition of the Powers, of the soft Parts of the Passages and of the Passenger. He can also gain a certain amount of information as to the Bony Passages. But it is more especially with regard to these bony passages which surround the soft passages, that he experiences difficulty. For the pelvis, and more especially the true pelvis, consisting as it does of a Superior Strait or Brim or Inlet, a Cavity or basin, and an Inferior Strait or Outlet offers itself for investigation in the living subject, almost entirely at its Outlet and to a less extent in its Cavity. That part through which the foetal head has first to pass, and which, therefore, offers resistance in the early and most dangerous part (if the process of labour is interfered with) of parturition, namely the inlet, is the furthest removed from the touch of the Obstetrician. It is not entirely inaccessible,

for one can touch the upper end of the Symphysis Pubis externally above the Pubes, and one can touch the Sacral Promontory per Vaginam, through the posterior fornix. But, with these reservations, it is practically so. For the inlet (or brim, as it will be called hereafter in this thesis) is an ellipse. And in order to estimate its condition, that is to say its measurements, it is necessary, at least, to know its conjugate or anteroposterior diameter, and its transverse diameter.

(1). The conjugata vera.

The Conjugate (the name signifying the shortest diameter of an ellipse) is dignified by the name of conjugata vera, and extends between the centre of the upper edge of the Sacral promontory and the upper end of the posterior margin of the symphysis pubis. Although both the points can be got at separately; nevertheless, it is impossible in the living subject, to measure the distance between them by a direct measurement from one point to the other. Therefore the Obstetrician is compelled to rely upon the relation between the diagonal conjugate and the true conjugate as ascertained on the dry bony pelvis, and to apply this to the living subject by ascertaining, as he can do, in her, the diagonal conjugate.

This is somewhat unsatisfactory, For the law of averages does not hold well even in normal subjects, as

4.

will be shown hereafter; and this relation is not so exact as is thought, nor so fixed. Still less does it hold for abnormal subjects; as is confessed by the recommendation to subtract $\frac{3}{4}$ inch instead of $\frac{1}{2}$ inch from the diagonal conjugate of a ricketly flat pelvis, to get its true conjugate. Nor is it reasonable to expect a fixed amount such as $\frac{1}{2}$ inch or $\frac{3}{4}$ inch to apply to pelves which may vary in their measurement from true conjugates of 2 inches to those of 5 inches, in their angles of inclination of the pelvic brim by 20° , and in the depth of their symphyses pubes by indefinite amounts from 4.5 C.M. to 6 C.M.

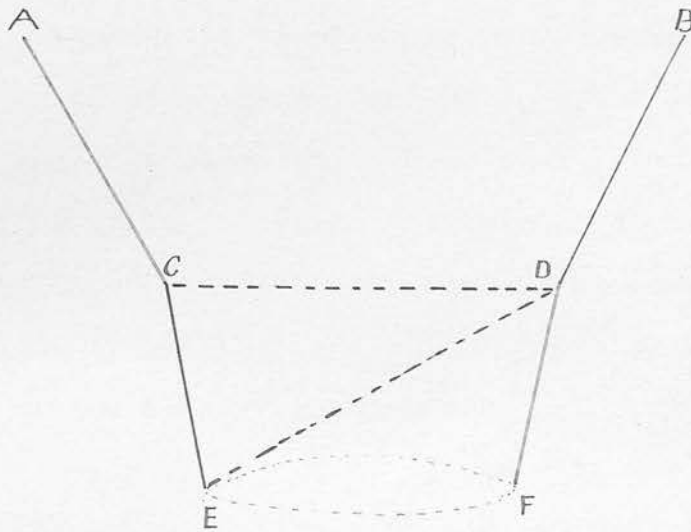
(2). The Transverse diameter of the Brim.

The Transverse diameter of the elliptical brim is quite incapable of direct measurement in the living subject. For neither of the extremities of its diameters are accessible to the obstetrician.

The position shortly then with regard to the Conjugata vera is this. The pelvic brim being practically beyond reach, reliance has to be placed upon the relation between it and the rest of the true pelvis, as ascertained by experiment on the dead subject. The information gained thus, is applied to the living subject.

A rough comparison will serve to show how matters stand. The whole pelvis may be compared to a funnel.

Fig. i.



The upper part of the funnel (Fig. i. A.B.C.D.) represents the false pelvis; the internal aperture (C.D.) the brim, and the neck (C.D.E.F.) the cavity and outlet of the true pelvis. The anteroposterior diameter of C.D. (or the brim) is estimated by its relation to D.E. (or the diagonal conjugate) as found by measurement in other funnels, notwithstanding the fact that funnels are made as large or as small and their necks as long or as short relatively to the upper part, as the

fancy of man demands.

Even then, this gives no information as to the Transverse diameter of the brim. It is quite evident that ellipses may be any width in the longest diameter with the same length in the conjugate or shortest diameter. And so it is with the pelvic brim which with a conjugate of 3 inches, may be 3, 4, or 5 inches in the transverse diameter, and so on.

Thus while investigators have given the physician a fixed amount to subtract from the diagonal conjugate to get the true conjugate, they have stopped short at the transverse diameter, and left him to guess approximately at the shape of the elliptical brim by calculating the relation between two diameters, neither of which has even the slight merit of having one of its extremities on the pelvic brim. That is to say he is told that the normal relation between the intercrystal and interspinous diameters of the false pelvis is one inch, and that according as the interspinous diameter is less than one inch less, or more than one inch less, than the intercrystal so is the pelvis flattened or otherwise altered. By this he guesses at the shape of the brim but cannot tell the length of the Transverse diameter.

It is proposed, in this thesis to take up these two

7.

subjects, the Transverse and the Anteroposterior or conjugate diameters of the brim; and it is hoped to throw some light on the calculation of the length of the Transverse diameter, and to suggest also something in connection with the Conjugata vera.

CHAPTER II.

"The Transverse diameter of the Pelvic Brim."

in pelves taken at random.

I am not aware that any attempt has been made to enable us to calculate the length of this diameter in the living female. It has, of course, been measured in the normal pelvis and given the length of five inches. It is certain that anything below this is abnormally small. Parvin places it at 13.5 C.M. about $5\frac{2}{5}$ inches. Playfair gives it as $5\frac{1}{3}$ inches, and in twenty-eight cases taken at random, in the postmortem room, I found that it averaged $5\frac{1}{10}$ inches.

This is in a normal pelvis. But when one comes to abnormal pelves, the length of the diameter may be anything above or below this. We can of course, guess whether the diameter is likely to be large or small from the size and general shape of the pelvis, but no accurate estimation has hitherto been possible.

importance of knowing the length of the Transverse diameter. It is a matter of no little importance, however, to know the length of the Transverse diameter. Suppose two pelves, each flat rickety and each with a conjugata vera of $3\frac{1}{4}$ inches. Here the treatment lies between forceps and version. But in the one case there may be a transverse diameter of $5\frac{1}{2}$ inches and in the other only $4\frac{1}{2}$ inches. Obviously as the head in version

enters the brim in the Transverse diameter, there would be much more room in the one case than in the other. So that not only would it help in the decision between forceps and version, but in cases where we could determine the length of the transverse diameter, it might decide us to perform embryulcia when the smallness of the Transverse offered little chance of the delivery of a living child, rather than by a forcible extraction to injure the maternal passages.

Calculation of the length of the transverse diameter in the living female.

The calculation of the length of the Transverse diameter of the brim in the living subject is perfectly easy, by a very simple mathematical calculation. All that has to be done is to measure the length of the Intercristal diameter. This extends between the two widest apart points in the same transverse plain, on the summits of the iliac crests. Divide the number, thus got, by two and that represents the length of the Transverse diameter of the Brim in that particular pelvis. This very simple and easy measurement and the simple process of dividing it into two, gives the transverse diameter, and that very closely.

I was first led to make this observation, during my experiments on Symphysiotomy. It occurred to me that it would be interesting to see if, in the 28 pelvises

which I experimented on, which were fresh cadavera, and were taken at random, there existed any fixed relation between those diameters which lay in the same plane as the transverse diameter of the brim, and the transverse diameter of the brim. These measurements were not made to test this relation; but after the measurements had been made for other purposes, the idea simply came that it would be well to see, if any such fixed relation did exist. On tabulating the Intercristal, the Intertrochanteric the Interspincous and the Transverse of brim, to my surprise the Intercristal diameter averaged exactly double the Transverse.

Original
Cases 1 to
28.

I have tabulated these 28 cases at the beginning of my list of measurements at the end of this book and they are Nos. 1 to 28, inclusive. The following table is the average length of these diameters in these 28 cases and shows the relation.

Diameter	Average length	
	inches	centimetres
Intertrochanteric	11.3	28.7
Intercristal	10.1	25.7
Interspincous	8.8	22.5
Transverse (Brim)	5.1	13.05

This table was got by taking the average length of the 28 diameters. I may mention that all the measurements

were made with Prowchownik's Callipers, which I shall describe later. (See Vol. II.)

If cases 1 to 28 are looked at, it will be seen that

in 22 cases the Transverse diameter of Brim exceeded half the Intercristal by $\frac{1}{10}$ in. (or .5 M.M.) to $\frac{9}{10}$ in. (2.25 C.M.)

in 6 cases it was less than half the Intercristal diameter by $\frac{2}{25}$ in. (.2 C.M.) to $\frac{3}{10}$ in. (.75 C.M.)

Relation between Transverse and $\frac{1}{2}$ intercristal

	Mean.
* In 22 cases Tr., <u>exceeded</u> half I.C. by $\frac{1}{10}$ in., or .75 C.M.	
In 6 cases Tr., <u>was less than</u> half I.C. by $\frac{2}{25}$ in. or .25 C.M.	
In all the 28 cases the difference between Tr., and half I.C. was $\frac{3}{10}$ in. or .75 C.M.	

The above table gives the mean of the difference between the Transverse diameter of the brim and half the intercristal in these 28 cases and it was $\frac{3}{10}$ of an inch or .75 C.M. (The average difference was $\frac{8}{25}$ inches or .8 C.M.)

In those 22 cases where the Transverse exceeded half of the intercristal the mean excess was again

$\frac{3}{10}$ in (.75 C.M.) The average excess nearly $\frac{7}{15}$ in. (.7 C.M.)

* Tr. = Transverse diameter of Brim.
* I.C. = intercristal diameter.

In those 6 cases where the Transverse was less than half of the intercrystal, the mean deficiency was $\frac{3}{10}$ in (.75 C.M.) The average deficiency was $\frac{8}{25}$ in (.75 C.M.)

So that in these 28 cases the relation between the Transverse diameter of the brim and half the intercrystal diameter was correct to $\frac{3}{10}$ inches.

In 18 of them the calculation would have been out only from about $\frac{1}{3}$ inch to $\frac{1}{50}$ inch.

This discovery was sufficiently exact and important to make me wish to carry the investigation further. And this I have done.

But first of all, I must acknowledge my indebtedness to Professor Simpson, not only for the use of instruments but also for his great kindness in allowing me free access to all his museum specimens; and to Dr. Barbour and to Mr C. W. Cathcart, for similar kindnesses at their hands.

The instrument used by me was Prowchownik's Callipers, lent me by Professor Simpson, and figured in Vol. II. drawings I and II. The advantages of these callipers lay in the exactness of the measurement to millimetres, and in the fact that by simply closing the handles to zero, swinging round the bar on the pivot thus formed at the end of the handles, and then crossing

the arms; the internal diameters could be measured, reading now the scale from right to left.

Acknowledg- As I have stated, the first 28 pelves were measured
ment of source of in the postmortem room and taken at random. Pelves
Pelves measured. 28-79 were measured by Professor Simpson's kind per-
Explanation mission in his obstetrical museum; while Nos. 80-94
of Tables and their columns. and 95-112 were made by the kind permission of Dr.

Tables p. I-XV Barbour, in his museum, and of the Museum Committee of
the Royal College of Surgeons, Edinburgh, respectively.

Tables p. XVI-XVIII. All the other pelves were measured in the museum
of the Royal College.

The pelves are in the first tables p. I to XVIII, simply arranged in the chronological order of measurement, and are numbered in that order. This has a double advantage, in that first of all the number placed in the 1st column serves a permanent index and by it each pelvis is, as it were, named, and secondly by running the eye up and down the columns one can see how slight in pelves taken at random the divergence is from pelvis to pelvis.

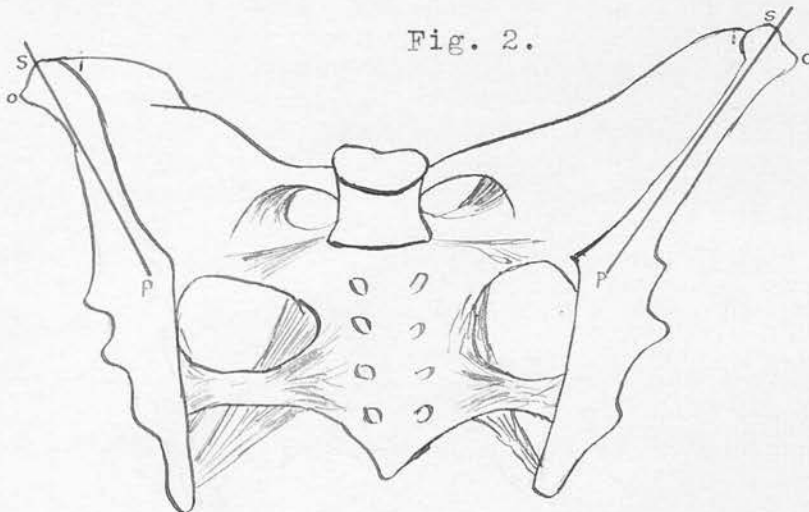
The first column, then, gives the chronological order of ^{the} measurement and serves as an index.

The second column is in red ink in order to lessen its prominence; or rather so as to allow other figures to stand out by contrast and so not to confuse the eye. It gives the measurement of the intercrystal diameter

if it is measured between the outer edges of the crests. It is not the least important column for various reasons. For it brings out what has never been given distinction in lectures or text-books; namely, that the intercrystal diameter should be measured between the summits of the crests and not between its outer edges.

The reason of this is that the outer edge of the crest overhangs and projects, and that therefore the intercrystal diameter as measured between the summits of the crests is less than the intercrystal as measured between the outer edges of the crests. It must not be forgotten that this overhanging edge is on each ilium and that it is therefore double the distance from the outer edge to the summit of the crest that is added to the diameter measured between the summits of the crest to make it correspond with the same diameter measured between the outer edges of the crests. Thus the difference becomes quite appreciable. This is easily seen on glancing down the column marked "between the outer edges of the crests". In No. 29 the difference is 1.7 C.M., in No. 30, 1 C.M., in 31, .7 C.M., in 32, .6 C.M., in 33, 1.7 C.M., in 34, 1.2 C.M., in 35, 1 C.M., in 36, .9 C.M., in 37, 1.3 C.M., in 38, .8 C.M., and so on. So that there is a distinct difference between the diameter as measured in these two ways.

The measurement should be made between the summits of the crests because (1). the amount of projection and overhanging of the outer lip varies greatly in each pelvis, as easily may be seen from the few mentioned above, and by casting the eye down this column in Nos. 29 to 112: while on the other hand the summit of the crest is a fixed point, as it always corresponds with the centre of the thickness of the ilium. That is to say it continues the plane of the bone and is its boundary line; while the outer and inner edges of the crests are merely linear thickenings on the boundary of the outer and inner surfaces of the iliac bone for the purpose of giving attachment to muscles and fascia. So that the more muscular the person, the more the outer lip projects. What is meant may be easily seen from Fig. 2. below.



S = summit of iliac crest

i = inner edge of iliac crest.

O = outer edge " " "

P S = plane of centre of iliac crest.

P S is the plane of the centre of ilium and S is its boundary, while O is merely an excrescence on the surface of ilium.

But not only do I say this because of the varying amount of the projection of the outer lip and because the summit really bounds the bone but (2) because the amount of the projection of the outer lip is variable in different pelvis, and is not necessarily greater in a large pelvis even proportionately to a small pelvis. A large woman need not at all be so muscular as a small one. If the measurement were made between the outer edges a serious error would creep in. For a small pelvis with a projecting outer lip would have perhaps, nearly as large an intercrystal diameter, as a large pelvis with a small outer lip. Thus "justominor" pelvis No. 82 has an intercrystal measured between its outer lips as 26.7 C.M. (summits 25.6 C.M.) while "Normal" pelvis No. 44, has an intercrystal diameter measured between its outer edges of 27 C.M. (summits 26.5 C.M.), only 3 M.M. larger than the justominor pelvis.

(3) The anterior superior spine, which terminates the crest anteriorly, can scarcely be said to have any inner or outer edge. That is to say the outer and inner surfaces of the ilium approximate gradually to one another, until they meet anteriorly, and at the anterior superior spine, the plane of the centre of the table of bone forming the ilium coincides with the outer and inner surfaces as they all meet there. Therefore the anterior superior spine is again on the boundary of this plane and therefore it should be a comparison of the relation of the intercrystal diameter as measured between the summits of the crests with the interspinous diameter because they are both diameters measured between points which, on each side respectively, are on the boundaries of the same plane; and not a comparison of the relation of the intercrystal as measured between the outer lips of the crests with the interspinous diameter, because the former is measured between two points which are on the boundaries of surfaces whose plane lies outside the plane of the surface on whose boundary the anterior superior spines rest.

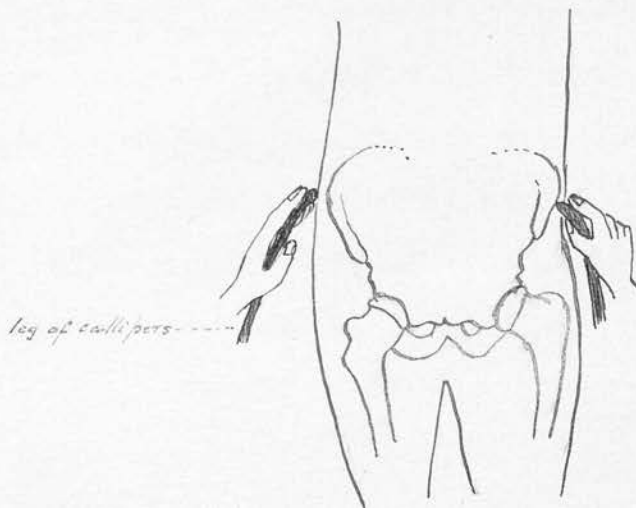
As I have shown, the outer lips are thick and projecting in proportion to the muscular development of the individual and not in any relation to the general and particular shaping and conformation of the bones; and

there-fore if the intercrystal diameter were measured between them, it also would increase with the muscular development of the individual; while the interspinous diameter measured between two points whose situation varied only with the conformation of the pelvis would remain unaltered.

We must be accurate in dealing with such subjects, and we must compare like with like and seek relations between like and like, and not between like and unlike. The intercrystal diameter measured between the summits of the crests, varies only with the conformation of the bones. The interspinous diameter also does so. Therefore we must compare the interspinous with its like, the intercrystal diameter measured between the summits of the crests. If we do not, and if we compare it with the intercrystal measured between the outer edges of the crests, then we increase the intercrystal proportionally to the individual's muscularity without proportionately increasing the interspinous diameter; and therefore we may be led into the error of putting a pelvis of normal configuration down as one of abnormal configuration or rather, what is more likely, of putting a pelvis of abnormally flat configuration down as one of a more normal configuration; which may lead to very serious consequences.

Therefore I say and repeat that we must measure the intercrystal diameter as lying between the summits of the crests. And this statement is not a needless one, as one may be inclined to think. Anatomists measure the diameter between the outer lips of the crests (Quain's Anatomy, Vol. II, Pt I, p.118) and so do Obstetricians. For it is recommended in measuring the intercrystal diameter, to stand before the patient and grasp the arms of the callipers one in each hand so that the handle is towards you, and the arms are towards the patient, each arm being grasped by the thumb and three outer fingers, while the forefinger lies along the arm of the calliper, so that its tip is at the point of the arm. Then the points are run one along each crest, keeping them abreast of one another so as to be always in the same transverse plane, until the widest distance between them is indicated on the gauge, and this is recorded as the intercrystal diameter. See Fig. 3.

Fig 3.



The result of this is, of course, that the widest distance between the outer edges of the crests is indicated as the intercrystal diameter.

What should be done is to place the points of the callipers with the sentient finger tips, above the iliac crests so that they rest upon the summits of the crests which can easily be felt as more or less sharp ridges, and the measurement made by running the callipers backward and forward above the crest till the required diameter is got.

Such a digression is however by the way, and the subject will be taken up later.

The third column gives the intercrystal as measured between the summits of the crests.

The fourth gives the half of the intercrystal diameter so measured.

The fifth is designed so as to be placed by the side of the fourth, ^{and is} the corresponding Transverse diameter of the brim.

The sixth and seventh are bracketed together, both indicating the deviation of the length of the Transverse diameter from half the intercrystal, the sixth in the direction of excess over that amount, and the seventh in the direction of deficiency below that amount.

The third to the seventh are in black ink to throw them more boldly forward.

The other columns are again in red and indicate successively in each pelvis, the Interspinous diameter, the conjugata vera, the conjugata diagonalis, the right and oblique left diameters of the brim and the anteroposterior and Transverse diameters of the outlet. The last ^{column} is in black and describes the general conformation of the pelvis.

Arrangement of the pelvis into groups. As I have stated, the pelvis are arranged in chronological order, first of all. Leaving out the first 28, which were measured in the postmortem room and which I have already discussed, there remain 84 pelvis of different individual characters. These 84 pelvis are classified below.

Relation bet. Trans., and $\frac{1}{2}$ intercrystal

	No. of cases	difference	
		Mean	Average
In all the cases	84	.3 M.M.	4.9 M.M.
Trans., greater than $\frac{1}{2}$ I.C.	43	4 M.M.	6.5 M.M.)
" equal to " "	10	0	0)
" less than " "	31	3 M.M.	4.3 M.M.)
* $\frac{1}{2}$ I.C. = $\frac{1}{2}$ intercrystal.			

A glance at the preceding table shows how close is the correspondence between the two. But we must go further and make a still more minute classification.

	No of cases	No. of cases difference		limits of extent of difference.
		Mean	Average	
In all the cases	84	3 M.M. or $\frac{1}{8}$ in	4.9 M.M. or $\frac{1}{5}$ in	from Tr., greater than $\frac{1}{2}$ I.C. by 2.35 C.M. to Tr., less than $\frac{1}{2}$ I.C. by 1.7 C.M.
Tr., greater than $\frac{1}{2}$ intercrystal	1	1.15		2.35 C.M.
" " " "	7	1.15 C.M. or $\frac{2}{5}$ in.	1.2 C.M. or $\frac{2}{5}$ in.	above 1 C.M. below 2 C.M.
" " " "	35	.4 C.M. or $\frac{1}{4}$ in.	.5 C.M. or $\frac{1}{5}$ in.	less than 1 C.M.
" equal to "	10	0	0	0
Tr less than $\frac{1}{2}$ intercrystal	28	3 M.M. or $\frac{2}{5}$ in	3.4 M.M. or $\frac{1}{7}$ in	less than 1 C.M.
" " " " "	3	1.15 C.M. or $\frac{2}{5}$ in	1.28 C.M. or $\frac{2}{5}$ in.	by more than 1 C.M. less than 2 C.M.

in all the 84 cases

In all the 84 cases the difference between the transverse diameter of the brim and half the intercrystal diameter averaged only $\frac{1}{5}$ inch. The mean difference was $\frac{1}{8}$ inch. In 43 cases or 51.3% the transverse diameter exceeded half the intercrystal by a mean of $\frac{1}{8}$ inch, and

average of $\frac{1}{4}$ inch.

In 10 cases or 12%, the transverse diameter exactly equalled half the intercrystal.

In 31 cases or 36.7% the transverse was less than half the intercrystal.

Analysis of cases with Transverse greater than $\frac{1}{2}$ intercrystal

In the 43 cases or 51.3% of all the cases, where the transverse exceeded half the intercrystal diameter; in only one case (a small, markedly rickety flat pelvis) was it by half an inch. In this case the difference was $\frac{47}{50}$ inches.

51.3%

In 7 of the 43 cases or about 17% it exceeded half the intercrystal diameter by a mean of $\frac{2}{5}$ inch, an average of $\frac{2}{5}$ inch.

In 35 cases of the 43 cases or about 80.5% it exceeded half the intercrystal diameter by a mean of $\frac{1}{6}$ in, an average of $\frac{1}{5}$ in.

Analysis of cases with Transverse less than $\frac{1}{2}$ in-tercrystal 36.7%. In the 31 cases or 36.7% of all the cases, in which the transverse diameter of the brim was less than half the intercrystal, in 28 cases or 90.3% the difference had a mean of $\frac{2}{15}$ in., an average of $\frac{1}{7}$ in.

In 3 cases the difference had a mean of $\frac{2}{3}$ in., and an average of $\frac{2}{5}$ in.

If we examine into the class of cases that compose these groups we find that the closeness of the agreement does not depend on the class of pelvis. For different pelves of the same shape agree in varying degrees with the general rule that half the intercrystal diameter equals the transverse diameter of the brim.

CHAPTER III.

"The Transverse diameter of the Pelvic Brim."

in pelves taken according to their agree-
ment with the ^{normal or} natural pelvis.

Having shewn that there is a very close relationship between the Transverse diameter of the brim and half the intercrystal diameter in pelves thrown together and measured without any reference to their shape, it is now necessary to examine into this relationship in the various groups of pelves.

Included among the 84 pelves were 11 pelves which might be described as normal or natural pelves. In these 11 pelves the relation between the transverse diameter and half the intercrystal diameter is shown in the following synopsis.

In the 11 cases the mean difference was 3 M.M. ($\frac{1}{7}$ in.)
the average 4.5 M.M. ($\frac{1}{5}$ in.)

Of these in 5 cases the transverse exceeded half the intercrystal by a mean of 8 M.M. ($\frac{1}{3}$ in.) and by an average of 8 M.M. ($\frac{1}{3}$ in.)

In 2 case/ the transverse diameter equalled half the intercrystal exactly.

In 4 case/ the transverse diameter was lessthan half the intercrystal by a mean of 2.25 M.M. ($\frac{1}{11}$ in.) and by an average of 2.2 M.M. ($\frac{1}{11}$ in.)

Thus in pelves approx~~i~~mately normal, the agreement

in the relation is very close indeed.

Pelves which are well shaped but abnormally large in size, numbered 10.

In these 10 pelves the mean difference between the transverse and half the intercrystal diameter was 3.2 M.M. ($\frac{1}{4}$ in.) average difference 4.6 M.M. ($\frac{1}{2}$ in.)

Of these in 6 the transverse diameter exceeded half the intercrystal by a mean of 7.5 M.M. ($\frac{3}{10}$ in.) an average of 6 M.M. ($\frac{1}{4}$ in.)

In 1, the transverse diameter equalled half the intercrystal diameter exactly.

In 3, the transverse was less than half the intercrystal by a mean of 1.5 M.M. ($\frac{3}{50}$ in.) and average of 2.3 M.M. ($\frac{1}{2}$ in.)

Justomino
pelves
p. XXI.

Justomino pelves numbered 5.

In these 5 pelves the mean difference between the transverse and half the intercrystal diameter was 5 M.M. ($\frac{1}{5}$ in.) and the average difference 3.8 M.M. ($\frac{1}{6}$ in.)

Of these, in 1, the transverse exceeded half the intercrystal diameter by 1.5 M.M. ($\frac{3}{50}$ in.)

In 4, the transverse was less than half the intercrystal diameter by a mean of 4.5 M.M. ($\frac{1}{5}$ in.) and an average of 4 M.M. ($\frac{1}{6}$ in.)

Funnel-
shaped
pelves.
p. XXII.

Funnel-shaped pelves numbered 11.

In these 11 pelves, mean difference between transverse and $\frac{1}{2}$ intercrystal diameter was 3 M.M. ($\frac{1}{7}$ in.) average

3.8 M.M. ($\frac{1}{6}$ in .)

Of these in 5, the transverse diameter exceeded half the intercrystal by a mean of 3 M.M. ($\frac{1}{7}$ in.) an average of 4 M.M. ($\frac{1}{6}$ in.)

In 1, the transverse diameter equalled half the intercrystal exactly.

In 5, the transverse was less than half the intercrystal by a mean of 2.5 M.M. ($\frac{1}{15}$ in.) an average of 3.7 M.M. ($\frac{1}{6}$ in.)

Obliquely contracted pelves. p. XXIII.

Obliquely contracted pelves numbered 12.

In these the mean difference between the transverse and half the intercrystal diameter was 5 M.M. ($\frac{1}{5}$ in.) the average 6.6 M.M. ($\frac{3}{11}$ in.)

Of these in 8, the transverse exceeded half the intercrystal diameter by a mean of 6 M.M. ($\frac{1}{4}$ in.) an average of 7 M.M. ($\frac{1}{3}$ in.)

In 1, the transverse diameter equalled half the intercrystal diameter.

In 3, the transverse diameter was less than half the intercrystal by a mean of 4 M.M. ($\frac{1}{7}$ in.), an average of 6.2 M.M. ($\frac{1}{4}$ in.)

Transverse-ly contracted pelves p. XXIV.

Pelves contracted in the transverse diameter numbered 3. One of these was a very small "Roberts'" pelvis. Here the transverse was less than half the intercrystal diameter by 1.7 C.M. and was very small. In a second

the difference was 6 m.m. or $\frac{1}{4}$ in., in favour of half the intercrystal diameter. In the third, the two were equal.

Rickety
pelves.
p. XXV.

Rickety pelves numbered 23, and included many varieties, some markedly some only slightly rickety, and all classes of shapes.

In these, the mean difference between the two measurements was 3.5 M.M. ($\frac{1}{7}$ in.), the average 4.6 M.M. ($\frac{1}{5}$ in.)

Of these in 14, the transverse exceeded half the intercrystal diameter by a mean of 4 m.m. ($\frac{1}{6}$ in.) an average of 5 M.M. ($\frac{1}{5}$ in.).

In 2, they were equal; and in 7, the transverse diameter was less than half the intercrystal by a mean of 2.5 M.M. ($\frac{1}{10}$ in.), and average of 4.5 M.M. ($\frac{1}{5}$ in.)

Unclassified
pelves.
p. XXVI.

Pelves which were not classified numbered 9.

In these, the mean difference between the two measurements was 2.5 M.M. ($\frac{1}{10}$ in.) the average difference 3 M.M. ($\frac{1}{8}$ in.)

Of these, in 4, the transverse diameter exceeded half the intercrystal by a mean of 2.5 M.M. ($\frac{1}{10}$ in.) an average of 3.5 M.M. ($\frac{1}{7}$ in.)

In 2 they were equal and in 3, the transverse was less than half the intercrystal diameter by a mean of 4 m.m. ($\frac{1}{6}$ in.), an average of 3.8 M.M. ($\frac{1}{6}$ in.)

From the preceding facts it will be seen that in each class of pelves, there are some in which the transverse diameter does not quite equal the half of the intercrystal, while in others it is more than equal to it, and in others again it is exactly equal to it. It is however quite certain that the variation from being exactly equal, in the direction of either deficiency or excess is so slight as to scarcely disturb at all, the value of the calculation. And for all practical purposes we can perfectly well assume that the transverse diameter of the pelvic brim is to be got in any pelvis with accuracy by simply dividing the intercrystal diameter by two. any deviation is so slight that it may be disregarded.

I can ^{not} qualify this assumption, that the variation is to be disregarded, in any way; more especially if we compare in the lists of pelvic measurements, the accuracy of this calculation with that by which the true conjugate is usually calculated. The transverse diameter varied in length from half the intercrystal by only a very few millimetres or about $\frac{1}{8}$ inch. The true conjugate sticks no more closely to the rule of being $\frac{1}{2}$ inch less than the diagonal conjugate.

If in the 84 cases we make an average it will be found that in them the difference between the conjugata vera and the conjugata diagonalis varied from being

$\frac{1}{2}$ inch by an average of $\frac{1}{5}$ inch.

It will be clearer perhaps if a table were made shewing in each of the classes of pelves the closeness of the agreement with each of these rules.

Pelves	No.	Trans., & inter cristal.				No.	Conjug. vera & Conj. Diagonalis.			
		1.	2.	3.	4.		1.	2.	3.	4.
(In all the pelves	84	$\frac{1}{5}$				80	$\frac{1}{5}$			
(of these	43		$\frac{1}{4}$			44		$\frac{1}{4}$		
(	10			0		4			0	
(	31				$\frac{1}{6}$	32				$\frac{1}{7}$
(Natural pelves	11	$\frac{1}{5}$				10	$\frac{1}{7}$			
(of these	5		$\frac{1}{3}$			3		$\frac{1}{8}$		
(	2			0		0				
(	4				$\frac{1}{11}$	7				$\frac{1}{10}$
(Large pelves	10	$\frac{1}{5}$				10	$\frac{1}{7}$			
(of these	6		$\frac{1}{4}$			3		$\frac{1}{8}$		
(	1			0		1			0	
(	3				$\frac{1}{12}$	6				$\frac{1}{8}$
(Just minor pelves	5	$\frac{1}{6}$				5	$\frac{1}{8}$			
(of these	1		$\frac{3}{10}$			1		$\frac{1}{10}$		
(	4				$\frac{1}{6}$	4				$\frac{1}{7}$
(Funnel-shaped pel-	11	$\frac{1}{6}$				11	$\frac{1}{8}$			
(ves of these	5		$\frac{1}{6}$			7		$\frac{1}{4}$		
(	1			0		0				
(	5				$\frac{1}{6}$	4				$\frac{1}{10}$
(Obliquely con-	12	$\frac{1}{11}$				12	$\frac{1}{9}$			
(tracted pelves	8		$\frac{1}{3}$			9		$\frac{1}{6}$		
(of these	1			0		0				
(	3				$\frac{1}{4}$	3				$\frac{1}{5}$
(Transversely con-	3					2	$\frac{1}{8}$			
(tracted pelves	1			0		1		$\frac{1}{12}$		
(of these	1				$\frac{1}{4}$	1				$\frac{1}{7}$
(Rickety pelves	23	$\frac{1}{5}$				22	$\frac{1}{4}$			
(of these	14		$\frac{1}{5}$			16		$\frac{1}{2}$		
(	2			0		1			0	
(	7				$\frac{1}{5}$	5				$\frac{1}{10}$
(Unclassified	9	$\frac{1}{8}$				8	$\frac{1}{8}$			
(of these	4		$\frac{1}{7}$			4		$\frac{1}{12}$		
(	2			0		2				
(	3				$\frac{1}{6}$	2				$\frac{1}{4}$

Note.

Measurements are in inches. Averages are given.

Column 1. average variation from the rule over all the cases

" 2. average excess: in the one case of the Transverse over $\frac{1}{2}$ intercrystal: in the other, of difference between the conjugates over $\frac{1}{2}$ inch.

" 3. exact bearing out of rule

" 4. as in 2 but being average deficiency; i.e. amount by which the transverse is less than half intercrystal, or true conjugate less than half an inch less than diagonal conjugate

An examination of the preceding table makes it evident that if the general rule of subtraction of half an inch from the diagonal conjugate is a reliable method of calculating the length of the conjugata vera, that subdivision of the intercrystal diameter by 2 is an equally reliable method of arriving at the length of the transverse diameter of the pelvic brim. *This is so even if*

we merely express their relative accuracy in figures: but it is very evident, as I shall show in Chapter V, that the rule relating to the transverse diameter of the brim, is really a much more accurate actual method of arriving at the length of it, than that relating to the conjugata vera.

CHAPTER IV.

"The reason of this relation between the Transverse diameter of the brim and the Intercristal diameters"

Having established the existence of the relationship between the intercrystal and the transverse diameters and having proved that the former is double the latter, the question must be asked, Why does this relationship exist? Is it a result of the method of construction of the pelvis?

I. Foetal pelvis do not show this relation.
 If that were the cause we would find that it existed during foetal life.

But a glance at p. XVIII of the pelvic measurements will show that there is absolutely no such relation between the transverse diameter of the brim and the intercrystal diameter of the foetal pelvis. Indeed the transverse diameter of the brim is scarcely developed at all and there is almost no pelvic cavity at all in the true pelvis. In the foetus most of the viscera pelvic in the adult, such as the bladder, are not pelvic but abdominal in site and there is no pelvic basin, as such. Thus the transverse diameter of the pelvic brim is very small.

On the other hand, while the transverse diameter of the brim is so reduced, the intercrystal diameter is

greatly expanded. There is no iliac fossa almost at all, and the iliac bones are so flattened and expanded that the widest apart points in the same transverse plane on the iliac crests, coincide with the anterior superior spines. Thus while the one diameter is so greatly reduced, the other is relatively expanded, and so it comes about that in every one of the ten foetal pelves measured by me, the transverse diameter of the pelvic brim was very much less than half the intercrystal diameter.

Of course, the difference was not great considering the figures merely on their own merits, but as the transverse diameter was so small, the difference was very great relatively to the length of that diameter. Thus in these 10 foetal pelves, the transverse diameter of the brim was less than half the intercrystal, in 6 by nearly $\frac{1}{2}, \frac{1}{2}, \frac{1}{3}, \frac{1}{3}, \frac{1}{4}$, and $\frac{3}{5}$ respectively, and ~~$2\frac{1}{2}, 1\frac{2}{3}, 5,$ and 3 times~~ ~~respectively its own length~~ and in 4 by $2\frac{1}{2}, 1\frac{2}{3}, 5,$ and 3 times respectively its own length.

From the absence of relation ^{the} in foetal life it follows that it is not the primary construction of the pelvis that brings it about.

II. If the relation is not present in intrauterine existence, we may fairly look for the relation between the two diameters as being brought about by the influences of extrauterine existence.

We must therefore set forth what these influences

it comes about towards adult life.

are, which do not exist in utero. We may summarise them as the influence.

(1) of the upright posture, which naturally includes the operation of the force of gravity, and necessitates power of equilibration in the stationary upright posture on the insecure basis of two pedestals.

(2) of the development and use of the muscular system.

(3) of the action of walking, which involves equilibration during motion.

(4) of the development of the reproductive organs.

(1) The influence of the upright posture certainly makes itself felt with regard to the establishment of this relation between the two diameters (1) because in the pelves of quadrupeds of various kinds, the horse, dromedary, and so on, which I have measured, it does not exist; and also there is no distinct iliac fossa or curvature of the iliac crest in quadrupeds, their ilia resembling the human foetal ilia in this respect.

(2) Because in a human idiot of over 30, who never assumed the upright posture, (see p. XVII) it did not exist.

(2) The influence of the development and use of the muscles must certainly affect it. If p. XVIII be examined, it will be seen that as the foetus grows older and older while still in utero, so the divergence from this relationship diminishes, and as it does not exist in the fully

developed foetus at full time; so it must develop between that period and the period of adolescence.

(3) The influence of the action of walking must also have its effect, And in the idiot who never walked, the relation did not exist.

(4) On the contrary, "perse" the development of the reproductive organs can have little effect. For in 3 male pelves which I have measured (see P. XVI) the relation between the two diameters existed in them, to a close degree of accuracy. Thus the conclusion is only fair that the female reproductive organs can take no part in the process which brings about the relation.

We therefore have left three influences, those of the upright posture and gravity, of muscular action, ^{and of ambulation} which combine to bring about the relationship between the two diameters.

I. The influence of the upright posture on the conformation of the human pelvis.

We have only to compare the foetal pelvis with the pelvis of the idiot of 30 years of age who never walked, to estimate the changes in conformation of the pelvis which are due to the growth of the individual alone. We are, as it were, undergoing a process of development always, until the "grand climacteric" is reached; after which retrogression sets in. After birth so many influences

act upon our every system that it is impossible to ascribe to each its proper effect. In the case of this idiot we have, however, the exclusion of almost every force or energy, except that of "growth". In this connection, we must look upon "growth" as a form of energy because we know that every bone has an inherent tendency to assume in the course of its growth a certain shape or conformation. It is not the "growth" that is the "energy". The growth is really only the outward, visible or tangible effect of the energy, whatever that energy is. Thus a rounded nodule of cartilage ultimately assumes a certain shape. This is due to some inherent cause which gives one part of the cartilage a greater power of growth or eats away another portion of it. The growth, or change of shape, or assumption of shape, is not the cause, it is the effect. For the purpose of this essay we may name the effect by the cause, and called the energy by the name of growth.

We have seen that as the embryo becomes older, the transverse diameter of the foetal brim becomes more nearly proportionate in the relation of 1 to 2, to the inter-cristal diameter. In the case of this idiot, all other forces except growth were excluded, and so we got a certain shape of pelvis.

This pelvis resembled the foetal pelvis (1) in the absence of the true relation between the transverse and intercrystal diameters. (2), in the absence of curvature of the ilia, (3), in the straightness of the pelvic canal, (4) and in the contracted state of the pelvic outlet.

It differed from it (1), in the circular nature of the brim, so that the transverse diameter of the brim exceeded half the intercrystal, and as a result of this (2) in the front to back or vertical sagittal position of the ilia, instead of the side to side or vertical transverse position of the foetal ilia.

So that we may put down to the energy causing growth, the development of the brim in the transverse direction.

Other forces are responsible for the curvature of the ilia and for the curvature of the pelvic canal.

These other forces are the upright posture, the muscular system, and the action of walking.

Now the quadruped has muscles, and he walks. He does not stand upright.

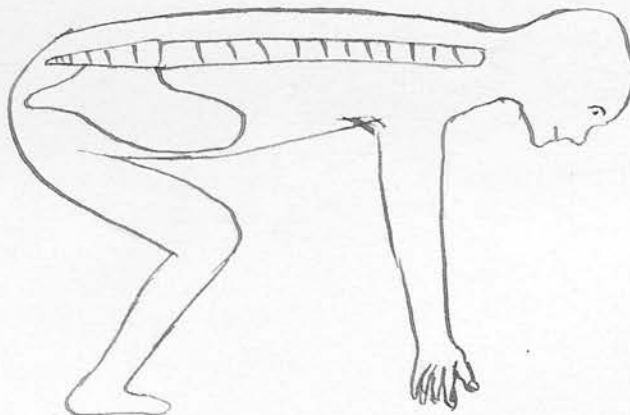
Let us therefore compare his pelvis with that of the idiot. They agree (1) in the more or less circular outline of the brim, (2), in the straightness of the pelvic canal, and (3), in the flattening of the

ilia; with one another.

Therefore pelv es which have the power of growth, and are acted upon by the forces of the muscular system and of ambulation, but not of the upright ^{posture} differ from those that stand upright by the absence of curvature of the ilia and curvature of the canal.

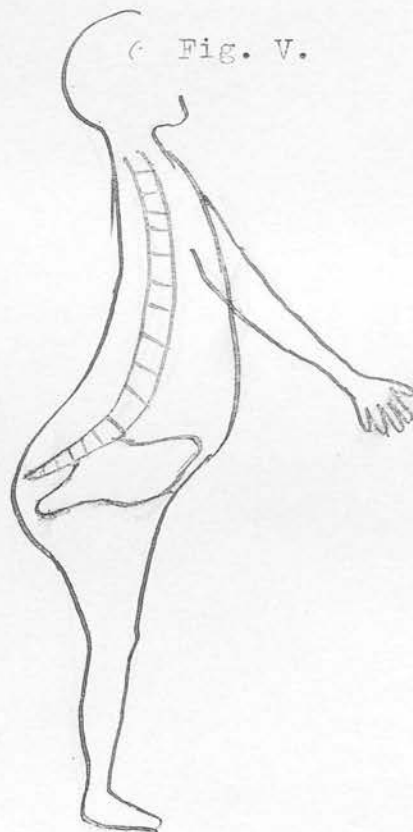
From this we can deduce that the upright posture brings about curvature of the ilia and alters the pelvic canal. We can easily see how this happens. Suppose that a man walked on his arms and legs like a quadruped, and that his pelvic cavity lay in the same line and had the same axis as the abdominal cavity. We would then get a figure such as the following figure.

Fig. IV.



If then he reared himself upright, the result would be (1) a slight rotation of the sacrum on a transverse

horizontal axis, so that it became slightly more vertical, instead of being completely horizontal, the amount of movement being limited by the necessity for strong joints between it and the ilia. (2) As this was so limited, by the small amount of movement at the sacroiliac joints, the vertebral column above the sacrum, when the man stood with his head vertically over his feet would have a curve, with the concavity backwards thus:-- See Fig. V.



It is obvious that this long concave curve would be a weak one, and would tend to give and to become more and more concave, just as a "saddle-backed horse"

becomes more and more "saddlebacked" the harder it is worked. Its effect however is to throw the axis of the pelvic canal out of the same line as the axis of the abdominal cavity.

(3) To strengthen the back, the curve concave backwards, was confined to the dorsal and lumbar vertebrae, and the vertebrae higher up assumed a curve with the concavity forwards, some of the vertebrae being thus in front; some of them behind the vertical axis, and the spinal column assuming the shape of an S spring.

Fig VI.



As a consequence of these curvatures, one throwing body weight in front and one throwing body weight behind the vertical axis of the body, we have, as it were, balancing weights on either side of the centre of gravity which help us to equilibrate, and to maintain our upright posture on the small pedal area. If the vertical column were perfectly straight, any movement out of the true vertical would tend to throw all the body weight on to one side, and so to upset us.

Again a straight spine would involve a much more direct transmission of shocks from the feet to the skull. Whereas the interposition of two curves which can be varied, interposes buffers between the feet and the skull.

As I have stated we can easily see how this throws the pelvic axis out of line with the abdominal axis; and we can also see how it will cause curvature of the iliac crests. For while the pelvic axis is in a line with the abdominal axis, the muscles will pull in lines parallel with the long axis of the bone on every point on the iliac crests. But when once the agreement in direction between their axes is altered, the strain of the muscles is thrown obliquely across the long axis of each innominate bone; and as it is a flat bone tend to crumple it together from front to back..

(4) In addition to this it is necessary to have the

pelvic floor relieved from direct strain of the weight of the abdominal contents. Therefore the sacrum curls forward below, in order to support the pelvic contents; ^{and} the throwing of the abdominal axis out of line with the pelvic, causes an indirect and only partial throwing of the strain on to the pelvic contents, as the anterior pelvic wall receives the most part ^{of the weight of the viscera}; and the hollowing out of the ilia into fossa forms a splendid cavity for the reception of the weight of the viscera.

II. The influence of muscular action on the pelvic conformation is ^{partly} defined above, and it ^{also} is included in that of ambulation.

III. The influence of ambulation and the necessity of equilibration during motion.

The above remarks have shown that there is a tendency towards the establishment of this relation between the transverse diameter and the intercrystal diameter; but they give no definite reason why it should exist.

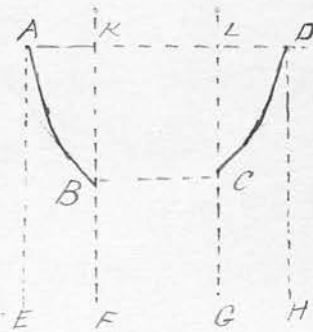
It does not exist in those who do not stand upright and do not walk, ^{if does exist} and ^{equally} in females and males. We have seen the amount of influence due to the upright posture in its causation, but we must look to the influence of ambulation for its effect.

Naturally the question rises in one's mind - Why should this definite numerical relation exist? It is so simple a relation as to cause a doubt of its

existence. I sought at first to find a reason for it, in the direction of architecture. I applied to an architect. But he could advise me in no way, and could suggest no explanation to meet the difficulty.

I laid before him as he did not understand the human pelvis, the following figure.

Fig. VII.



In Fig. VII, above, A B C D represents the false pelvis and the pelvic brim. It follows that since the intercrystal diameter is double the transverse diameter of the brim, If A D represent the former and B C the latter, the distances between the dotted lines A E & B F, C G & D H must be equal. So that a transverse vertical

* That is to say $AK + LD = BC$

section of the human pelvis would be divided into three ~~equal~~ sections by vertical lines passing through the extremities of these diameters.

It struck me as possible that one might regard F B C G as a substructure on which a wider superstructure B A D C was built and that some law of architecture might forbid the lateral expansion of such a superstructure further than to such an extent as would carry its sides to vertical lines distant from each side of the substructure by a distance equal to the ^{half the} breadth of that substructure. ^{on either side of it}

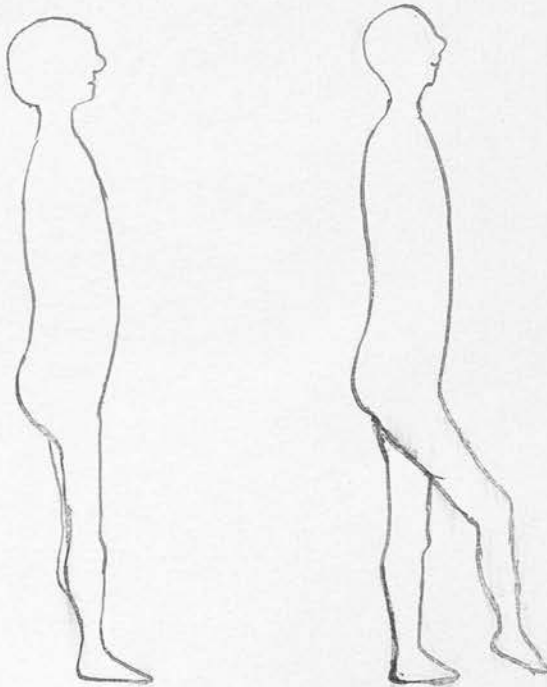
I was assured by my friend the architect, that no such law existed to his knowledge, and was advised to try a professor or a book on statics. I could however get no further in this direction. I have devised the following explanation of its occurrence by a reasoning based on dynamics.

It must be realised that the meaning of this relation is that in the preceding figure the iliac crests cannot lie on a line outside the verticals A E, D H. Therefore A B, and D H (or the ilia) may be set at any angle on B F and C G (or the ischia and pubes) but are shorter or longer according as the angle is less or greater than the angles F B A, G C D, by an amount necessary to place the points A and D no further than on the lines A E and d H.

Now when we walk we throw our weight separately on

each leg. That is to say, we as it were stand on each leg separately for a short time. Combined with this, however, is as it were a rotation of our body on a transverse horizontal axis through the hip joint, as in Fig. VIII below.

Fig. VIII.



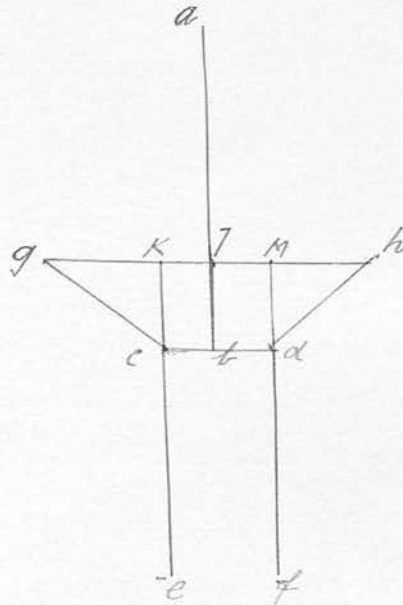
So that we have two movements, (1) A swing forward of the thigh, or rotation of the body on the hip joint on a transverse horizontal axis. (2) A balancing of the body weight on each leg separately, the other being partly used to propel the body forward.

This second necessity involves a mechanical arrangement to suit it. And I maintain that we shall find in this relation between the transverse and half the intercrystal diameters one of those natural arrangements of

the bony structure to enable us to walk by conforming to dynamical laws, without the expenditure of more muscular effort than is absolutely necessary. In fact, that it is one of Nature's conservative arrangements.

The body weight is transmitted through the sacrum to the ilia and thence through the innominate bones to the femora. When we stand on two legs, our basis of support is as indicated roughly in Fig IX.

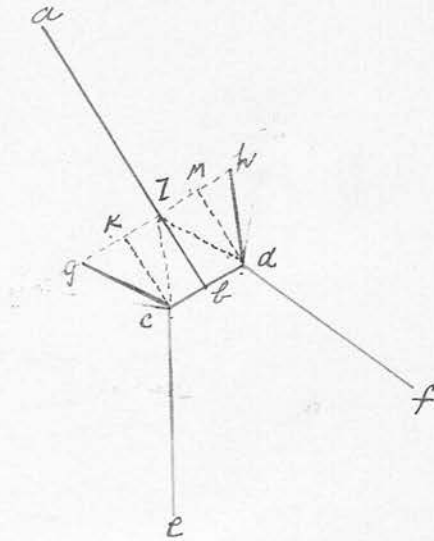
Fig. IX.



a b is the body weight transmitted through the sacrum and innominate bone c d to the femora c e and d f.

When we stand on one leg, our condition is indicated in a similar figure (Fig. X.)

Fig. X.



$g c$ and $h d$ are the ilia and $g h$ is the inter-
 cristal diameter, divided into 3 parts at the points k
 and m by two perpendiculars drawn from c and d . This
 gives the true relation between the intercrystal and
 the transverse diameter of the brim as represented by
 $c d$; because $k m = c d$ and $(g k \text{ and } m h) = c d$.
 If c and d are joined to l the point where $a b$ cuts $g h$,
 we get the triangles $g k c$, $c k l$, $l m d$ and $h m a$ all
 equal to one another. Therefore also triangle $c g l =$
 triangle $a h l$. When we walk, if the body is swung

so that $c l$ comes in a vertical line over $c e$, (and $c l$ is a line from the acetabulum to the point where the body weight is transmitted to the innominate bones) then ^{on} one side of the basis of support $c e$ we have the body $c g l$, balanced on the other side by the equal triangle $a h l$. But the triangle $a h l$ being further from $c e$ acts on the longer arm of a lever with the fulcrum at c than $c g l$. This is counteracted by the body weight represented by $a b$ which acting on the same side of $c e$ as $c g l$, works on the longer arm of a lever with its fulcrum at c than the body $c l d$ which acts as its counterpoise on the opposite side of $c e$ and on the same side as $a h l$.

Thus we have:-

On one side of $c e$

On the other side of $c e$.

($c g l$ acting through short)
(arm of lever.)

by (a $h l$ acting through long
(arm of lever.)

($a b$ acting through long
(arm of lever.)

counterpoised
($c l d$ acting through short
(arm of lever.)

Thus we see the reason why the widest intercrystal diameter must necessarily be double the transverse diameter of the brim. If it were not so and they varied in their relation, then different persons would roll to a different degree in their walk, and stable equilibrium would be a more difficult feat.

The establishment of this relation involves the fact that the ilia must be set at such an angle that

they may just reach to the vertical lines between which the intercrystal will be double the transverse diameter of the brim. So that the angle between the ilia and the rest of the innominate bones and the length of the ilia, are so adjusted that the iliac crests just extend to such a distance on each side of the transverse diameter of the brim as will double that diameter.

We may fairly consider the two halves of our bodies ^{of} as being equal weight, and any portion on one side as being equal in weight to a corresponding cube cut from the other side, ^{and} we have areas, so arranged by means of this relation between the intercrystal diameter and the transverse diameter of the brim, that if they were considered as weights, they would enable us to equilibrate during walking. These areas do support columns of the body weight; and therefore do so act as balances to enable us to walk with as great a conservation of muscular energy as possible.

CHAPTER V.

"The true conjugate."

It has been shown in the preceding pages that there is a very fairly close adhesion to the rule which states that half an inch subtracted from the length of the diagonal conjugate, will give the length of the conjugata vera. This therefore may be accepted as a fact.

We must remember, however, that these measurements were made on the dried pelvis, with all the soft structures removed; so that there was no difficulty in making the measurements. It is herein, that one of the differences between this method and the method of estimating the length of the transverse diameter of the brim, lies. Both are cut and dried rules. But while it is a perfectly easy, and perfectly simple and accurate manipulation, that is required to calculate the length of the inter-cristal diameter, in the living subject, it is neither a very easy, nor very simple and accurate manipulation that is necessary to find the length of the diagonal conjugate, in the living being.

The second difference lies in the fact that, while both rules for the estimation of these two diameters *looking only at the figures* are equally accurate, in the case of the estimation of the transverse diameters of the brim we are dealing with



a large measurement which on being subdivided into two equal parts gives us an accurate result. Not only so, but any variation from that exact rule is halved and made less. What I mean is this. Supposing the intercrystal diameter in a certain case is 10 inches, and in the same case the transverse is $4\frac{1}{2}$ inches, the difference between half the intercrystal diameter and the transverse diameter of the brim is only half an inch. On the other hand, the difference between double the transverse diameter of the brim, and the intercrystal diameter is 1 inch. So that the method of calculation of the transverse diameter of the brim by halving the intercrystal diameter is not only the only one possible, as the 1st is the unknown quantity, but is also the more rational, as it reduces any variation from that rule by half.

In the case of the estimation of the conjugata vera by subtracting half an inch from the diagonal conjugate, we are dealing with two diameters not differing greatly in length. Therefore if there is any divergence from this rule, it shows that it is not so accurate, as a calculation in the other rule, where, dealing with two diameters widely divergent in length, the actual accuracy, *in figures* is just as exact. Not only so, but the effect of the variation is felt to its fullest extent. What I mean is clearly but roughly stated, if we remember that $\frac{1}{4}$ inch added on to the ordinary sized nose of a very tall and big man,

would not be nearly so noticeable if $\frac{1}{4}$ inch were added on to the nose of a very small man.

The second difference being thus stated, I shall show a little more definitely how the first difference exists.

To calculate the transverse diameter of the pelvic brim, all we have to do is to ascertain the widest inter-crystal measurement, which is an easy simple and accurate manipulation. To get at the length of the true conjugate we have to estimate the length of the diagonal conjugate, which is by no means an easy manipulation, for the following reasons. (1) The sacral promontory, always difficult to touch, in most cases where we desire to touch it, is still more difficult of access. (2) The foetal parts also tend to make access to the sacral promontory difficult. (3) Being an internal examination, forcible attempts to touch it are painful, are resented more, and may damage the parts, or irritate them, or rupture membranes. And (4) when it is touched, then we are reduced to measuring its distance from the subpubic ligament by placing another ^{on the} finger on examining hand at this point, and then using a measure for that. This admits of many sources of error even in the original measurement, that of the diagonal conjugate, which is our basis for calculating the true conjugate.

Thus it is evident that when we have once got the diagonal conjugate, from the roughness of the ^{method of indicating the extremities of it} measurement

we are by no means sure of ~~the~~ accuracy of *the measurement.*

Consequently our calculation of the length of the true conjugate from the diagonal, accurate though it may be, and is, on the bony pelvis alone, becomes a very doubtful truth when made on the living subject.

It behoves us therefore to see if some more reliable method of estimating the true conjugate can be found than by this merely manual examination.

In considering this point, I have tried many devices, and pondered much over the bony pelvis. It is easy to see that the brim of the pelvis is a ring of a kidney shape and is surrounded by the false pelvis, the edge of which presents itself readily to digital examination. The idea naturally suggests itself, of measuring the true conjugate by reference to the false.

Necessary points for measuring the true conjugate directly.

To estimate the true conjugate we must fix its either extremity and measure the distance between these two points. These extremities are of course the centre of the sacral promontory and the posterior margin of the upper end of the symphysis pubis. We can touch these two extremities separately but cannot measure directly between them, or with any instrument at present in use definitely fix the distance of these two points apart, because of the intervention of the tissues between them. We can touch the sacral promontory internally by

digital examination, as is done when we measure the diagonal conjugate, but we cannot touch the upper end of the symphysis pubis at the same time and keep the relative distance accurately till it is measured, and thus get the distance between them. Similarly if we touch the upper end of the symphysis pubis we have no means of touching at the same time the sacral promontory and keeping the distance thus measured off, fixed and accurate, until a measuring tape can be applied to it.

I do not intend to go into all the different devices that have been recommended to measure, either by relation to other diameters, or by direct measurement the conjugata vera. I shall merely give the course of my own thoughts on the subject.


First of all then, we must abandon, as being inaccurate, all those devices that measure it by relation to other diameters. Therefore we must measure it directly.

To do so, we must fix in space each of these points relatively to one another, so that by mapping out the relation between them we can definitely measure the distance between them.

Now we might take the upper end of the symphysis pubis as one definite point, and define the relation of the sacral promontory to that in some way. That is to

say we might find the relation of the upper end of the symphysis pubis to some accessible part of the pelvis. Then find the relation of the sacral promontory also to that accessible part; and by the relation of these two to the same part their relation to one another.

The accessible portion of the pelvis is the false pelvis. We can easily define the relation between the upper end of the symphysis pubis and any point on the crests of the ilia. Therefore it remains to find the relation of the iliac crests to the sacral promontory.

This I endeavoured to do by finding out if there were any two lines which being drawn one from each side of the pelvis to the opposite side would, at their point of intersection with one another mark out the centre of the sacral promontory. If the iliac crests be examined it will be seen that they are somewhat  shaped. The anterior part is concave inwards, and the posterior part is concave outwards. The junction of these two curves posteriorly, is a well marked point on the iliac crest. If lines be drawn from each of these points on the iliac crests to the opposite anterior inferior spine, it will be found that in some pelvises, the point of intersection of them corresponds to the sacral promontory.

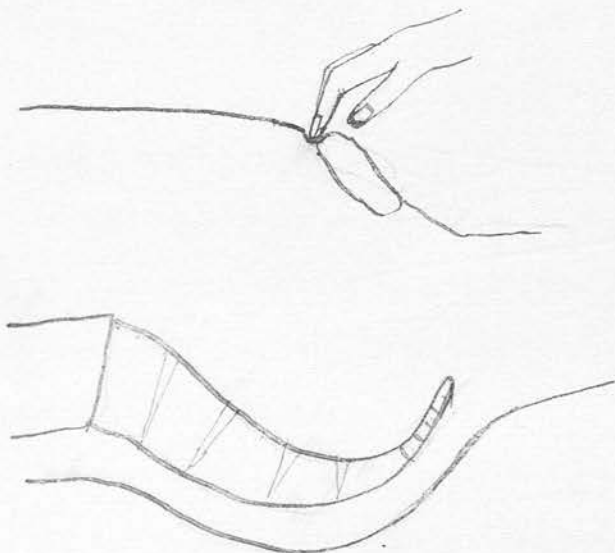
I then thought that by measuring the length of each of these intersecting lines by placing callipers on their extremities, and by measuring the distance of these points on the iliac crests from one another and from the anterior inferior spine on the same side and from the upper end of the symphysis pubis, we would thus fix the sacral promontory in its actual distance from the upper end of the symphysis pubis, and could map it out on paper and measure the distance between the two.

This plan had to be given up for the all sufficient reason, besides other reasons, that these intersecting lines do not, at all, always correspond at their point of intersection, to the centre of the sacral promontory. Thus, in flat pelves, they do not come near the centre of the sacral promontory. While accurate enough for some normal pelves, more often than not, it did not work out at all correctly. I have therefore devised an instrument which I have called a conjugimeter, because its purpose is to directly fix the distance apart of the sacral promontory and the upper end of the symphysis pubis.

Its accuracy is dependant on two factors: (1) That by vaginal examination we can touch the sacral promontory: and (2) that we can touch the other extremity of the true conjugate, above the symphysis pubis externally.

When the patient is lying on her **back or side**, a pointer placed above the symphysis pubis vertically, by slight pressure can dimple the skin, and easily come to the upper end of the symphysis pubis and by only slight pressure, to its inner or posterior margin (See Fig XI .)

Fig. XI.



We cannot measure directly between these two points. What is needed is an instrument which, when one point is placed, per vaginam, on the centre of the sacral promontory, will come down, through the vaginal orifice and then bend up over the pubes and touch the posterior edge of the upper end of the symphysis pubis.

Being fixed in this position, the instrument is withdrawn and then a measurement between its two extremities gives the exact length by direct measurement, of the conjugata vera.

The Conjugimeter.

The instrument which I have devised and which has been made to my order and specifications, by Messrs. Archibald Young & Son, Forrest Road, Edinburgh, accompanies this thesis, and as I have said, I have called it the conjugimeter. It consists of a straight steel rod about the thickness of a uterine sound, and probe pointed at its free end so as to do no damage to the tissues. This rod for between 6 and 7 inches long is straight and for $1\frac{3}{4}$ inches towards its attached end beyond that, is curved up at almost at a right angle to meet the other leg. The rod is held with the probe end at the tips of the extended index and middle fingers of the right hand, and is grasped and steadied by the thumb and ring and little fingers of the same hand. A vaginal examination is made, and the tips of the examining fingers with the ball end of the rod are placed against the centre of the sacral promontory. The rod is made long so that it passes as we go towards its other extremity, under the wrist, and then curving suddenly upwards at the radial margin of the wrist, ends in a joint. This joint is capable of being fixed perfectly rigid or of

being loosened by a fixation screw, on which is pivoted the other leg of the instrument. This leg, leaving the joint bends on itself at a right angle in a gradual curve ^{for} ~~at~~ a distance of about 2 inches from the joint. At a distance of 3 inches or so from that, this part of the leg ends. It consists of a hollow cylinder, in which rotates on its long axis, the other portion of the leg. This part can be moved up or down in, that is to say protruded from or retracted within, the first part, as well as rotated on its long axis. It can be fixed at any point by a screw. It finishes by gradually curving round with the concavity of the curve towards the other leg, and ends in a ^{blunt} ~~probe~~ point.

By loosening the two screws, the intravaginal end remaining in situ with the right finger tips on the sacral promontory, the left hand can adjust the extravaginal leg at any angle and with any length, till the ^{blunt} ~~probe shaped~~ end is pressed inwards above the symphysis pubis externally, and rests on the anterior extremity of the true conjugate. Then by tightening up the screws with the left hand, the ends of the rods are fixed in these positions, and a very slight manipulation withdraws them from the patient. The application of a measuring tape to the extremities of the legs gives the exact length of the true conjugate.

The advantages of this instrument lie—(1) in its simplicity (2) in its power of perfect sterilization, (3) in its harmlessness, (4) in the fact that the rotation of the free half of the external leg on its long axis in its sheath, enables us to turn it sideways and so bring its point back to the middle line, from which it may be kept by the edge of the examining hand; (4) in the fact that it gives a direct measurement of the true conjugate; and (5) in the fact that it does away with the necessity for calculating the true conjugate by subtracting a variable $\frac{1}{2}$ inch from the length of the diagonal conjugate, and (6) that it does away with the inaccurate method by which that very diagonal conjugate was estimated, namely by putting a finger against the point where the examining hand lay against the subpubic arch; and (7) finally, in the fact that there is no more difficult manipulation or greater skill required in connection with it, than is required in the ordinary method of measuring the conjugata diagonalis.

I hope therefore, that the conjugimeter will prove no unacceptable contribution to the armamentarium of the obstetrician. I am sure that it will not be an expensive item; and I trust that by the confidence that it will give to the physician in the accuracy of his estimation of the length of the true conjugate it will

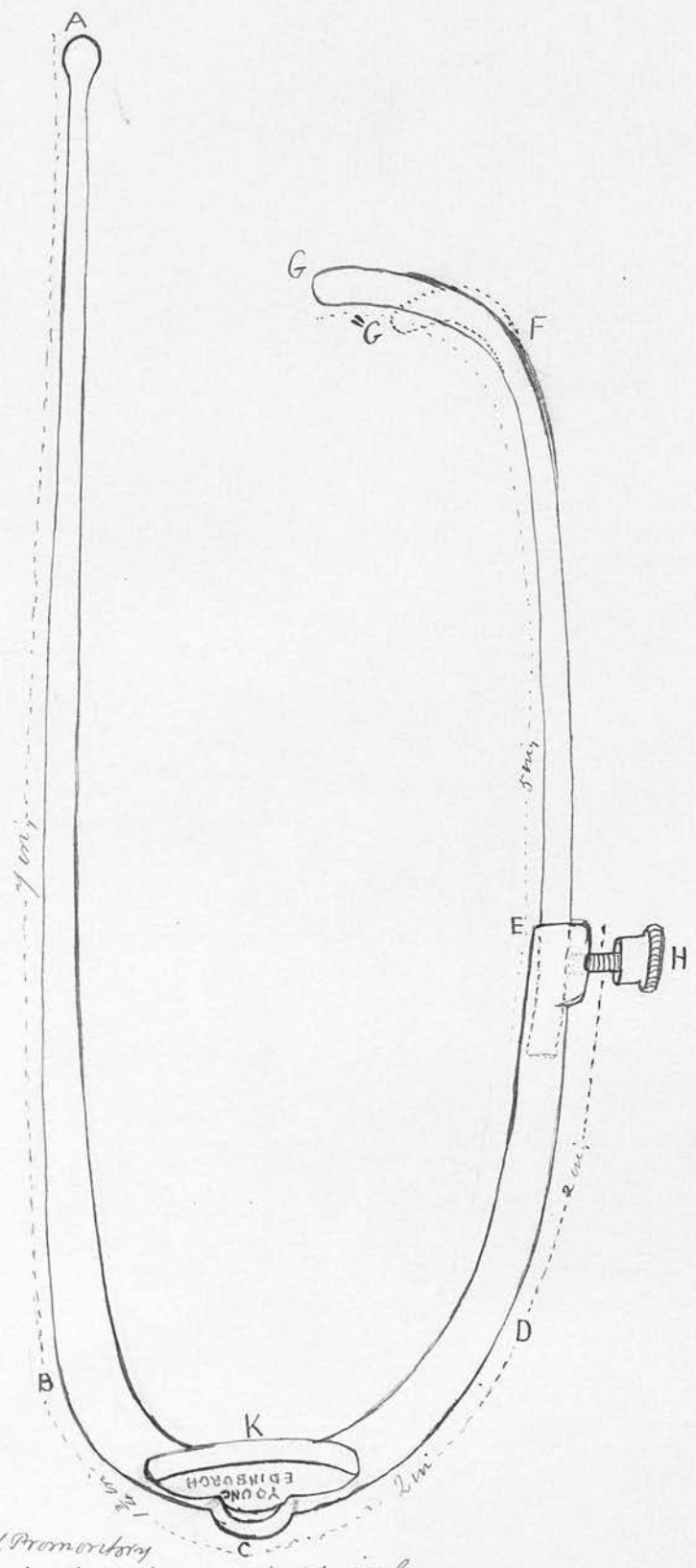
supply a want, the magnitude and urgency of which, has been only hitherto obscured.

The measurement of the true conjugate by the conjugimeter, in itself alone, but much more also, taken along with the estimation of the transverse diameter of the brim by halving the widest intercrystal diameter, will afford precise and reliable data for the determination in difficult cases, of the method of delivery or procedure to be adopted.

A short description of the conjugimeter, ^{is appended} with the accurate measurements of its various parts; and a ~~model~~ model of it goes along with this thesis.

I have only to conclude this volume, with the hope that I may have contributed something towards the satisfactory solution of the problem than besets every obstetrician.

CONJUGIMETER.



- A rests on Sacral Promontory
- AB = intravaginal rod, and is 7 inches.
- BC = curved end of AB, " " 1 3/4 inches.
- K = Fixation screw which fixes the point at C and keeps the points A & G at any distance apart.
- GD = extravaginal part. G rests on upper end of Symphysis pubis externally.
- GE is 5 inches long and slides up and down at will in ED (2 in. long) and can be fixed at any point by screw H. It rotates also in ED into any position such as G.
- DC = 2 inches.

1	INTERCISTAL		Between the outer edges of the cista	Between the pinnules of the cista	Half the length of the intercostal	Transverse diameter of the brim	Greater than half the intercostal	Less than half the intercostal	INTERPHONOUS	Conjugata vera	Conjugata diagonalis	Brim		ANTEROPOSTERIOR	Transverse
	Between the outer edges of the cista	Between the pinnules of the cista										Right Oblique	Left Oblique		
1		26.	13.	12.1	.9	21.	11.3.	13.	12.5	11.					
2		28.	14.	13.2	.8	24.6	8.6	11.	12.5	11.5					
3		23.6	11.8	12.5	.7	20.3	12.	13.1	12.1	12.					
4		24.9	12.45	14.7	2.25	23.8	11.25	12.6	13.1	14.					
5		24.9	12.45	13.35	.9	21.9	12.5	13.9	12.9	12.85					
6		27.05	13.5	14.5	1.	22.8	10.7	12.1	13.9	13.15					
7		26.2	13.1	12.35	.75	23.8	10.3	11.5	12.	12.					
8		25.9	12.95	13.35	.4	23.5	13.9	14.9	13.5	13.					

Original measurements

INTER - CRISTAL	Between the outer edges of the crista		Between the crista		Half the length of the intracristal.		Transverse diameter of crista		Greater than half the intracristal		Less than half the intracristal		INTERSPINOUS	CONJUGATA VERA		CONJUGATA DIAGONALIS		Brim		ANTERO-POSTERIOR		Transverse
	Amount of	the crista	Half the	the	length of	the	intracristal.	transverse	diameter of	crista	intracristal	less than		half the	intracristal	24-4	10-5	12-2	13-4	13	12-8		13-6
9	27.7		13.85	14.4	5.5								24.4	10.5	12.2	13.4	13					
10	24.1		12	14.1	2.1								22.2	11.5	12.2	12.8	13.6					
11	26.85		13.4	14.2	.8								24.8	14.5	16.3	14	14					
12	24.3		12.15	13.25	1.1								21.4	10.4	12.8	12	10.8					
13	23.5		11.75	13.5	1.75								20.5	11.1	13	12.1	12					
14	25.8		12.75	13.5	.75								23.8	10.5	12.2	12.9	12.9					
15	24.2		12.1	13.1	1								20.9	10.5	12.4	12	12.4					
16	30.5		15.25	14.5							.75		28	12.3	14.5	14	13.0					

Original measure cont'd

No.	INTEP - CTISTAL		Half the length of the intercrystal	Transverse diameter of brown	Between the outer edges of the crystals	Between the summits of the crystals	And, by w.k. Transverse		INTERPINOUS	Conjugata vera	Conjugata diagonalis	Prim.		Outlet	
	the outer edges of the crystals	Between the summits of the crystals					the crystals	Between the summits of the crystals				the crystals	the crystals	Right Oblique	Left Oblique	ANTERO-POSTERIOR	Transverse
17		24.4	12.2	12.			has trans half	.2	21.1	10.3	12.5	11.5			
18		24.3	12.15	12.6	.45		the intercrystal		19.5	11.25	12.95	12.5			
19		27.9	13.95	14.	.05		greater than half		24.9	12.9	15.1	14			
20		26.1	13.05	13.3	.25		the intercrystal		24.6	11.1	12.8	13			
21		24.6	12.3	12.35	.05				20.	10.	11.8	11.3			
22		26.85	13.45	14.	.55				22.5	10.3	12.1	12.6			
23		26.	13.	14.2	1.2				22.2	10.8	12.5	12.8			
24		29.1	14.55	14.				.55	25.	11.5	14.5	13.4			

No.	INTER-CRISTAL				Ant. by wh. transverse is				INTERSPINOUS				CONJUGATA VERA				CONJUGATA DIAGONALIS				Brain outlet						
	Between the outer edges of the crista	Between the hummbs of the crista	Half the length of the intercrystal	Transverse diameter of crum	Greater than half the intercrystal	Less than half the intercrystal.	20.65	12.5	14.1	13.5	12.2	11.9	12.2	11.5	12.2	11.5	12.2	11.5	12.2	11.5	12.2	11.5	12.2	11.5	12.2	11.5	12.2	11.5
25		26.	13.	13.3	.3	intercrystal.	22.	12.5	14.1	13.	13.3																
26		22.	11.	12.8	1.8	intercrystal.	20.65	9.1	11.45	11.9	12.1																
27		25.4	12.4	13.5	.8	intercrystal.	23.	12.	14.	12.2	11.5																
28		24.4	12.2	12.8	.6	intercrystal.	18.4	12.4	15.	12.8	12.8																
29	23.5	21.8	10.9	11.4	.8	intercrystal.	20.2	9.4	10.4	12.	11.																normal
30	28.0	27.0	13.5	12.5	.1	intercrystal.	23.7	10.9	12.3	11.5	12.																large variety

* Original measures cont.
 ** Subsequent investigations begin here and include all the numbers that follow. 29 - 49 Professor Simpson's

31	Between the edges of the crests		Between the summits of the crests		Half the length of the INTERCRISTAL	Transverse diameter of brim	Greater than half the intercrystal		Less than half the intercrystal		Interspinous	Conjugata Vera	Conjugata Diagonalis	Brim		Outlet		Description of pelvis
	29.4	29.	14.5	14.7			.2	Greater than half the intercrystal	Less than half the intercrystal	Right Oblique				Left Oblique	Antero-posterior	Transverse	12.8		13.4	12.	10.24	flat rickety
32	26.5	25.9	12.95	12.8		.15					21.5	11.55	11.9	12.	13.5	9.5	7.2	rickety large
33	28.4	27.	13.5	14.3		.8					24.9	10.6	12.9	12.	13.6	12.4	11.9	large
34	24.8	23.6	11.8	12.8		1.					19.5	11.	12.	12.	12.	11.	11.	normal.
35	28.	27.	13.5	13.3		.2					24.	10.4	12.	12.7	12.4	12.	11.5	normal
36	26.9	26.	13.	13.5							23.2	10.3	11.2	12.8	13.1	12.4	11.	funnel & deep
37	30.	28.7	14.35	15.5		.5					24.4	8.4	8.9	13.3	13.3	13.4	13.3	marked rickety flav
38	23.5	22.7	11.35	12.4		1.05					21.5	9.9	12.5	11.6	11.	8.4	8.	small funnel.

* All figures are metric.

No.	I N T E R C R I S T A L .				amts, by wh, Transverse is				Interstices				Brim.				OUTLET			
	Between the order edges of the crystals	Between the summits of the crystals	Half the length of the intercrystal diameter of brmv.	greater than half of the intercrystal diameter	less than half the intercrystal diameter	Interstices funicous	Conjugata vera	Conjugata diagonals	Right Oblique	Left Oblique	Antero-posterior	Transverse.	funnel	normal	justomino	large	funnel deep	normal	normal	naeyle.
39	26.2	25.3	12.65	11.5	1.15	22.8	11.	12.3	11.3	11.1	10.7	7.	funnel	normal	justomino	large	funnel deep	normal	normal	naeyle.
40	28.2	24.5	13.75	14.8	1.15	24	11.2	12.	13.6	13.3	11.7	10.8	normal	normal	justomino	large	funnel deep	normal	normal	naeyle.
41	22.5	21.7	10.85	10.8	1.05	18.5	9.1	10.	10.3	10.3	9.3	7.5	normal	normal	justomino	large	funnel deep	normal	normal	naeyle.
42	27.9	26.6	13.3	14.	.7	22.3	10.8	12.2	13.2	13.3	13.	11.	normal	normal	justomino	large	funnel deep	normal	normal	naeyle.
43	27.5	26.1	13.05	13.	.05	22.	10.9	12.	12.3	11.7	9.	8.1	normal	normal	justomino	large	funnel deep	normal	normal	naeyle.
44	27.	26.5	13.25	13.	.25	23.	11.2	12.	12.5	12.			normal	normal	justomino	large	funnel deep	normal	normal	naeyle.
45	29.2	28.2	14.1	13.8	.3	25.	10.2	12.	12.	12.5	10.5	9.7	normal	normal	justomino	large	funnel deep	normal	normal	naeyle.
46	21.1	20.3	10.15	10.9	.75	16.5	10.3	11.	10.5	11.5	11.8	12.5	normal	normal	justomino	large	funnel deep	normal	normal	naeyle.

No.	INTER CRISTAL										Brim				Out let		Remarks
	Between the outer edges of the crests.	Between the summits of the crests	Half the length of the intercrystal	Diameter of the diameter of the	greater than half the intercrystal	less than half the intercrystal	Inter-spinous	Conjugata vera	Conjugata diagonalis	Right Oblique	Left Oblique	Antero-posterior	Transverse				
44	25.2	24.4	12.2	12.		.2	22.	10.5	11.3	11.5	11.6	11.	8.4	8.4	Small funic & spinous		
48	23.6	22.5	11.25	11.4	.15		20.5	8.5	9.8	10.5	10.8	10.1	8	8	Just minor		
49		26.4	13.2	13.5	.3		26.4	5.1				11.	11.8	11.8	extreme rocky flat		
50	14.	16.4	8.2	6.5		1.4	13.1	8.5							Roberts' pill		
51	24.	26.2	13.1	12.5		.6	14.	13.6	14.	12.	12.	11.	5.	5.	Kyphotic		
52	24.4	26.4	13.35	14.1	.45		24.	10.4	11.	12.5	13.6	11.	11.6	11.6	normal		
53	30.	28.2	14.1	14.3	.2		23.4	9.	10.9	13.5	13.3	9.	11.4	11.4	flat rocky		
54	25.6	24.6	12.3	11.8		.5	21.4	9.5	10.5	10.5	10.9	9.3	10.3	10.3	Small & spinous		

No.	INTER CRISTAL.				Between the outer edges of the crabs	Between the punnicks of the crabs	Half the length of the intercrystal	Diameter of transverse of crabs	Greater than half of the intercrystal	Less than half the intercrystal	Amt., by wh. Transverse	Sintercrystallous		Coryngata vera	Coryngata	Aragonalis	Bright Mica		Bronze		Fibrous/boxlike		Description of fabrics
	Between the outer edges of the crabs	Between the punnicks of the crabs	Half the length of the intercrystal	Diameter of transverse of crabs								Greater than half of the intercrystal	Less than half the intercrystal				Light Mica	Dark Mica	Light Mica	Dark Mica	Light Mica	Dark Mica		Outlet	Transverse
55	23.14	22.5	11.25	13.6	2.35		22.2	7.1	9.5	11.5 12.3	12	13.9	marked nickety flat - small										
56	24	26.2	13.1	13.4	.3		23.5	13.2	14.9	13.5 13.2	12.5	10.4	funnel										
57	24.1	26	13	12.6		.4	24.1	11	11.8	12.2 12.25	11.4	10.5	large										
58	22	19.4	9.7	9.9	.2		18.3	10	12	10.3 9.5	10.5	10.2	small nickety not flat.										
59	25.5	24.4	12.35	12.35			22.5	10.4	12	12.2 11.4	10	9.5	funnel										
60	29	28	14	15.2	1.2		24.5	12.9	14.2	14.5 14	13.2	12.5	large										
61		24	12	12			24	5.4	6.8	11 11.3	11	12	small nickety.										
62	24.6	26.9	13.45	13.4			24	11.2	13	12.8 12.9	10.4	12	large pellets. minor nickety not flat.										

No.	IN TER CRISTAL				Hered the length of the intercrystal	Diameter of the crystals	amt. by wh. Transverse			Interdiameter	Bonygata vera.	Bonygata aequivalis	Brim		Outlet		Description of fossils
	Between the outer edges of the crista	Between the summits of the crista	Greater than	Intercrystal			Less than	Half the	Right oblique				Left oblique	Inter-protuberance	Transverse		
63	24.4	26.3	13.15	13.1		22.4	12.8	13.	13.5	12.6	10.8	12.5	10.8	12.5	12.5	10.8	large - a little funnel
64	25.5	24.4	12.2	11.4	.5	22.5	9.5	10.5	11.	10.6	11.	9.	11.	9.	11.	11.	pushmirror
65	26.	25.	12.5	12.2	.3	21.6	9.5	12.	10.9	11.	9.	4.5	9.	4.5	11.	11.	funnel
66	29.6	28.5	14.25	14.4	.15	24.	10.1	11.5	13.4	13.4	11.5	11.	11.5	11.	11.	11.5	funnel
67	30.	28.6	14.3	14.4	.1	23.8	12.5	13.4	13.9	12.8	11.1	10.	11.1	10.	11.1	11.1	large
68	24.	22.5	11.25	11.6	.35	18.	11.5	12.	12.	10.6	13.4	10.	13.4	10.	13.4	13.4	Obliquely contracted
69	29.8	28.5	14.25	14.	.25	26.5	12.4	13.2	13.5	13.4	12.	10	12.	10	12.	12.	funnel
70	25.	24.	12.	11.3	.7	21.9	9.2	12	11.	10.6	8.1	4.3	8.1	4.3	8.1	8.1	pseudo-malacosteon

	INTERCRISTAL		How the length of the interstitial	Transverse diameter of brim.	greater than half interstitial	has than half the interstitial	Interstomous	Conjugata vera.	Conjugata	Diagonals	Brim.	Outlet.	Transverse.	of	of
	Between the outer edges of crests	Between the summits of crests.								Right-Oblique	Left-Oblique	Anteoposterior		of	of
41	25.6	24.7	12.35	13.6	.25		21.5	10.4	12	12.4 / 12	10.	11.5		of	of
42	28.6	26.5	13.25	13.4	.15		21.7	12	13.5	13.2 / 13.3	11.5	10.5		of	of
43	26.	24.6	12.3	11.9		.4	21.7	9.2	12.2	11.5 / 11.4	10.5	8.7		of	of
44	28.	26.7	13.35	13.6	.25		22.6	11.7	12.5	13.4 / 13.3	12.3	11.6		of	of
45	26.9	26.3	13.15	12.3		.85	25.7	10.6						of	of
46	29.4	28.3	14.15	14.1			23.9	9.7	11.1	12.5 / 12.6			11.	of	of
47	26.6	25.4	12.7	12.5		.2	21.1	9.7	10.1	11.3 / 11.6	10.5	10.5		of	of
48	24.9	23.3	11.65	12.4	.75		19.6	11.4	13.4	12.8 / 12.3	11.2	11.6		of	of

amlt. by wt, Vanvortscii

Brim.

Outlet.

Between the outer edges of crests

Between the summits of crests.

How the length of the interstitial

Transverse diameter of brim.

greater than half interstitial

has than half the interstitial

Interstomous

Conjugata vera.

Conjugata

Diagonals

Right-Oblique

Left-Oblique

Anteoposterior

Transverse.

of

of

	Behave the under edge of the creaks.	Between the summit of creaks	Half the length of intercostal	Transverse diameter of stem	Greater than intercostal half the intercostal	Less than half the intercostal	Interspinous	Conjugata vera	Conjugata diagonalis	Right oblique	Left oblique	Anter. posterior	Transverse	Description of pelvis.
49.	26.9	25.7	12.85	12.8	.	.	22.5	9.5	11.5	11.4	11.5	11.	4.4	Large
80	29.4	28.3	14.15	14.	.	.15	26.	12.3	13.4	13.5	13.5	13.	12.2	Justo minor flattened
81	25.2	23.8	11.9	12.4	.	.5	21.8	8.9	10.5	11.9	11.9	12.4	10.	Justo minor
82	26.4	25.6	12.8	12.4	.	.4	24.	9.9	10.4	11.5	11.5	8.	9.	Justo minor
83	23.8	22.9	11.45	11.4	.	.	19.6	10.4	11.5	11.7	8.5	12.3	8.2	Staegele (right)
84		22.4	11.2	11.7	.	.5	21.5	8.5	10.	10.	12.3	9.	10	Scoliotic Left. right hip joint broad.
85	29.9	28.7	14.35	14.35	.	.	25.2	10.5	12.	14	13.3	11.	12.3	normal
86	27.5	26.4	13.2	13.	.	.2	24.8	7.5	8.6	12	12.5	9.5	13.	flat rectely.

* 80-94 Dr. Barbour's.

INTER CRISTAL

Between the outer edges of the crests.
 Between the pyramids of crests.
 Half the length of intercrystal diameter
 Transverse diameter of form.
 greater than half the intercrystal
 all have the intercrystal
 width by which, transverse

Interstices
 Conjugata Vera
 Conjugata Diagonalis
 Right Oblique
 Left Oblique
 Antero-posterior
 Transverse

Description of fossils

84	31.	29.9	14.95	15.2	.25		26.2	11.5	12.5	14	14	14	large shallow
88	24.8	26.2	13.1	13.5	.4		23.2	8.2	9.5	13.1	13.1	11.2	flat rocky.
89	30.1	29.5	14.75	15.6	.85		22.9	11.	12.2	14.9	14.4	12	large
90	29.7	28.5	14.25	14.1		.15	24.	12.1	13.4	13.5	12.8	12	large
91	24.6	24.5	12.25	12.		.25	24.1	8.	9.8	11	10.8	11.2	flat rocky
92	24.75	26.6	13.3	15.1	1.8		25.	9.8	11.6	13.1	13.6	12.	sculpted
93	24.	23.3	11.65	10.9		.75	19.5	8.5	9.	10.3	10.	9.1	pendonal-acoston.
94	24.	26.4	13.2	12.2		1.	24.8	10.5	12.2	11.7	11.7	9.3	rocky and funnel

No.	INTER CRISTAL										Description of foramina			
	Between the outer edge of forams.	Between the summits of the crest	Half the length of the intercrystal	Transverse diameter of forams.	Greater than half the intercrystal	Less than half the intercrystal	Amount by which transverse is	Interapertures	Conjugata vera	Conjugata diagonalis	Right Oblique	Left Oblique	Antero-posterior	Transverse
95	26.6	25	12.5	12.1	4	.		20.2	10.1	11	11.9	12	9.8	normal
96	25	24	12	12	.	.	21.2	9.7	10.7	11.6	11.5	9.5	9.7	normal
97		25.6	12.8	13.3	.5	.	24.2	8.4	10.4	12.3	11.5	9.6	11.1	flat vicinity
98	28.4	27.2	13.6	13.5	.	.1	25.3	11	12.4	13.1	12.7	11.5	9.7	normal
99	29.1	28.4	14.2	14.5	.3	.	26.3	11.9	13.6	13.9	13.2	11	10.2	flattened large
100	23	22.2	11.1	11.1	.	.	20.9	14	14.9	11.2	11.1	9.4	9	Asymmetrical
101		26.6	13.3	14.3	1	.	25.4	12.5	14	12.6	13.4		11	Asymmetrical
102		26.5	13.25	13.4	.15	.	24.2	10.9	12.8	12	11.5	10.4	9	Asymmetrical

* 95-102, males, foetal &c. Royal College of Surgeons' museum.

No	INTEGRAL CRISTAL		Half the length of the intercrystal		Transverse diameters of stem		amt. by wh. Transverse		Interfibrinous		Conjugata vera		Conjugata diagonalis		Brim		Outlet		Description of folios
	Between the	of the crabs	Between the	of the crabs	Between the	of the crabs	Between the	of the crabs	Between the	of the crabs	Between the	of the crabs	Between the	of the crabs	Between the	of the crabs	Between the	of the crabs	
103	26.5	25.6	12.8	12.4	12.4	4	22.9	10.5	12.5	12.5	12	11.9	9.8	10.4	10.4	10.4	10.4	early lateral curvature	
104	30.3	29.5	14.45	14.4	14.4	3.5	28	9.2	11.4	11.4	13.6	13.	11.	11.4	11.4	11.4	11.4	lateral curv., *to left advanced	
105	26.5	25.8	12.9	13.4	13.4	5	23.4	13.6	15.2	15.2	13.6	13.	10.5	11.1	11.1	11.1	11.1	advanced lat. *curv. dorsal to right	
106		26.8	13.4	12.9	12.9	5	25.2	9.8	12.5	12.5	11.9	13.	10.3	11.	11.	11.	11.	Adv., lat, curv., *higher lumbar & lower dorsal	
107		24.5	12.25	12.9	12.9	6.5	19.9	9.9	11.6	11.6	12.	11.4	11.5	9.	9.	9.	9.	*advancing lateral curv., Rictary.	
108		25.4	12.7	13.	13.	3	24.2	7.9	9.4	9.4	12.	12.3	10.5	13.5	13.5	13.5	13.5	Protonoid Rictary.	
109		20.4	10.2	10.6	10.6	4	19.2	4.5	7.5	7.5	10	7.2	7.5	9	9	9	9	Protonoid Rictary.	
110		27	13.6	14.	14.	4	26.1	7.	8.5	8.5	12.6	12.4	9.3	10.6	10.6	10.6	10.6	Rictary.	

* Tuberculat.

INTERCRISTAL

	Between the cristae of each.	That the length of interstitial	Transverse diameter of brim.	greater than that the interstitial	also have that the interstitial	Intersternum	Conjugata vera	Conjugata diagonalis	Brim	Outlet	Description of fish.	
									Right Oblique	Left Oblique	Andropterion	Transverse
26.8	25.5	12.45	12.2		5.5	22.8	11.	12.6	12	12.2	9.	10.2
26.1	25.5	12.75	12.5		2.5	23.2	9.2	11.	11	11.8	10.2	11.1
	24.9	12.45	12.5	0.5		22.	9.	10.	12	11.5	11.8	9.2
	Extreme	richly	female	idiot	of	30yrs	who	never	walked			
	14.2	7.1	11.2	4.1		14.2	9.5	11.9	11.3	11.3	5.	13.1

Fins were almost erect and curved. The pectoral pterygoid was almost vertical.

There was lateral dorsal curvature. The limits were touched etc.

XVII

157

Large pelvis (10)

XX

	Between outer edge of creck	Between the summit of the creck	What the length of	of intercostal	distance bet. of trun.	greater than the half of intercostal	less than half	intercostal trun. is	Inferopneuro	longitudina trun.	longitudina diagonal	Right oblique	Left oblique	Inferopneuro	Outlet
60	29	28	14	14	15.2	1.2			24.3	12.9	14.2	14.5 14	14.9 14	13.2	12.5
89	30.1	29.5	14.75	14.75	15.6	.85			22.9	11.6	12.2	14.9 14	14.9 14	11.4	12
33	28.7	27	13.5	13.5	14.3	.8			24.9	10.6	12.9	12 13.6	12 13.6	12.4	11.9
42	27.9	26.6	13.3	13.3	14	.7			22.3	10.8	12.2	13.2 13.3	13.2 13.3	13	11
87	31	29.9	14.95	14.95	15.2	.25			26.2	11.5	12.5	14 14.5	14 14.5	11.6	14
67	30	28.6	14.3	14.3	14.4	.1			23.8	12.5	13.4	13.9 12.8	13.9 12.8	11.1	10
63	27.4	26.3	13.15	13.15	13.1	.			22.4	12.8	13	13.5 12.6	13.5 12.6	10.8	12.5
80	29.4	28.3	14.15	14.15	14		.15		26	12.3	13.4	13.5 13.5	13.5 13.5	13	12.2
90	29.7	28.5	14.25	14.25	14.1		.15		24	12.1	13.4	13.5 12.8	13.5 12.8	12.9	12
57	27.1	26	13	13	12.6		.4		24.1	11	11.8	12.2 12.5	12.2 12.5	11.4	10.5

shallow

Funnel-shaped pelvis (III)

No.	Subcrucial		of crest	Between Pinnac of crests.	Transverse of stem	Greater than half intercrucial	Less than back the intercrucial	Ant. sym. Struts in intercrucial	Anteroposterior	Congruent area	Congruent diagonal	Stem Outlet		Small funnel deep.
	Between outer edge of crest	Between Pinnac of crests.										Right Wings	Front Post	
38	23.5	22.7	12.4	1.05	.8	21.5	9.9	12.5	11.6	8.4	8	Small funnel deep.		
36	26.9	26.	13.5	.5	23.2	10.8	11.2	12.8	13.1	12.4	11	funnel & deep.		
56	27.	26.2	13.4	.3	23.5	13.2	14.9	13.5	13.2	12.5	10.4	Large funnel		
99	29.1	28.4	14.5	.3	26.3	11.9	13.6	13.9	13.4	11	10.2			
66	29.6	28.5	14.4	.15	24	10.1	11.5	13.4	13.4	11.5	11			
59	25.5	24.4	12.35	.	22.5	10.4	12	12.2	11.7	10.	9.5	funnel deep.		
43	27.5	26.1	13.	.	22	10.9	12	12.2	11.7	9.	8.1	Small funnel refinors		
47	25.2	24.4	12.		22	10.5	11.3	11.5	11.6	11.	8.4			
69	29.8	28.5	14.25		26.5	12.4	13.2	13.5	13.4	12.	10			
65	26.	25.	12.2		21.6	9.5	12.	10.9	11.	9.	7.5			
39	26.2	26.3	11.5		22.8	11.	12.3	11.3	11.1	10.4	7.			

Picky pedes (23)
 empty, no. granisio
 keep them
 frisky the
 intracostal
 greater than
 half the
 intracostal
 diameter of
 trunk

Intracostal
 between
 outer
 edges of
 crests.
 between
 summit
 crest

55	23.4	22.5	11.25	13.6	2.35	22.2	7.1	9.5	11.5	12.3	12.9	13.9	small, marked flat
57	30.	28.7	14.35	15.5	1.15	27.7	8.4	8.9	13.3	13.3	13.4	13.3	fractonm flat
81	25.2	23.8	11.9	12.4	.5	21.8	8.9	10.5	11.9	11.9	12.4	10.	"
97		25.6	12.8	13.3	.5	24.2	8.4	10.4	12.2	11.8	9.6	11.1	"
88	27.8	26.2	13.1	13.5	.4	23.2	5.2	9.5	13.	13.	11.	11.2	"
109		20.4	10.2	10.6	.4	19.2	4.5	4.5	10.9	10.9	7.5	9.	richly
116		27	13.6	14.	.4	26.1	7.	8.5	12.6	12.4	9.3	10.6	" extreme
111		25.6	11.8	12.2	.4	24.5	4.3	4.3			10.	10.	flat
49		26.4	13.2	13.5	.3	26.4	5.1				11.	11.8	"
108		25.4	12.7	13.	.3	24.2	7.9	9.4	12.	12.3	10.5	13.5	"
31	29.7	29.	14.5	14.7	.2	27.	8.38	10.5	12.8	13.7	12.	10.4	"
58	22.	19.4	9.7	9.9	.2	18.3	10.	12.	10.3	9.5	10.5	10.2	small not flat.
53	30.	28.2	14.1	14.3	.2	23.4	9.	10.9	13.3	13.3	9.	11.4	flat richly
112		24.	12.	12.1	.1	24.2	9.5	11.9	11.3	11.3	8.	13.1	extreme
61		24	12.	12.	.	24.	3.7	6.8	11.	11.3	11.	12.	small
62	24.6	26.9	13.25	13.4	.	24	11.2	13.	12.8	12.9	10.4	12.	large minor
30	28	27	13.5	12.5	.	23.7	10.9	12.3	15	12.	11.5	8.	large sketchy
32	26.5	25.9	12.95	12.8	.15	21.5	11.55	11.9	12.	13.5	9.5	7.2	large richly
86	27.5	26.4	13.2	13.	.2	24.8	7.5	8.6	12.	12.5	9.5	13.	flat
91	27.6	24.5	12.25	12.	.25	24.1	8	9.8	11.	10.8	9.1	11.2	"
40	25.	24.	12.	11.3	.7	21.9	9.2	12.	11.	10.6	8.1	4.3	as random calcation
93	24.	23.3	11.65	10.9	.75	19.5	8.5	9.	10.3	10.	8.6	9.1	as random calcation
94	27	26.4	13.2	12.3	1.0	24.8	10.5	12.3	17	11.7	10.8	9.3	richly framed

XX

