Am J Obs Dis Women & Child 1915 V-71

ON THE FORTUITOUS ORIGIN OF DEPARTURES FROM THE NORMAL PERIOD OF GESTATION IN MAN.*

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I HAVE recently carried out an investigation which had for its object the determination of the latter portion of the curve of prenatal growth and the first three weeks of the curve of postnatal growth in man from the weights of infants born somewhat prior to or later than the normal period of gestation. The main results of this investigation will be published elsewhere but incidentally, during the course of the investigation, a number of interesting and suggestive facts concerning the variation of the period of gestation in normal females presented themselves and it appears desirable that these facts and the deductions which may be drawn therefrom should be separately placed on record.

It has been shown by Read(1) that a certain period in the intrauterine growth of guinea-pigs, preceding normal birth by a fairly definite interval, constitutes a "critical period" in the growth of these animals, since interruptions to growth and loss of weight of the fetus followed by premature delivery are especially liable to occur at this period in females which would appear to be in every other respect normal. In other words, the frequency curve of the period of gestation in guinea-pigs is "bimodal." On tabulating the percentages of deliveries at different periods of gestation *two* groups of maximum frequency are seen to occur, a smaller "premature" group rather definitely situated and a larger "normal" group separated from the former by a period in which deliveries are relatively infrequent.

I have sought to ascertain whether or not a similar "critical period" occurs during the latter months of pregnancy in man and despite the opinion to the contrary which is, I believe, held by certain obstetricians, I have failed to detect any evidence of "bimodality" in the frequency curve of the period of gestation in *normal* females. The impression that the frequency curve of the period of gestation in man

* From the Rudolph Spreckel's Physiological Laboratory of the University of California.

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is bimodal (*i.e.*, that premature deliveries tend to occur with maximum frequency at a certain period) must take its rise, if it is founded on fact, from a tendency for *abnormal* females (*i.e.*, females afflicted with syphilis or other pathological conditions) to deliver at a period rather definitely antedating the normal term. My data throw no light upon this question since they concern only normal females.

The data which I am about to enumerate were exclusively obtained from "The Queen's Home," a maternity hospital in Adelaide, South Australia, the admirably kept records of which were very kindly placed at my disposal by Dr. H. Gilbert and the Matron, Miss E. C. Sketheway, to whom I desire to express my very great indebtedness. The data cover the years 1909–1913.

Patients, upon admission to this hospital, pay a small and frequently nominal fee, the fee being in many cases adjusted to the income of the patient. The patient secures admission through the recommendation of the doctors in charge of the case. Unmarried mothers are not admitted. The mothers belong, therefore, to the laboring and lower artisan classes.

The mother is usually admitted as near as possible to labor, and then remains in the hospital for fourteen days after the birth of the infant. The infant is weighed without clothing, at birth and again upon discharge. The weights are recorded in ounces (1 ounce = 28.34 grams) to the nearest ½ ounce.

The period of gestation, when ascertainable, is indicated on the patient's record, the date recorded being that of the onset of the last menstruation. In tabulating the data only those (about two-thirds of the actually recorded data) were employed for which this date was accurately indicated to the nearest day.

All cases were excluded in which the mother was suffering during pregnancy from any definitely ascertainable disease, *e.g.*, syphilis, tuberculosis, eclampsia, etc. Also those cases (relatively very few in number) were excluded in which the infant was deformed on delivery or died within one week after delivery. This procedure was necessary in order to exclude abnormal pregnancies in which the duration of the period of gestation might conceivably be affected by factors other than the physiological variables which determine the length of the period in normal females, *e.g.*, pregnancies accompanied by paternal syphilitic infection of the fetus, or pregnancies modified by excessive pelvic deformation in the mother.

The following (Tables I and II) were the results obtained, all infants born during the period between 275 and 285 days being tabulated as having been born at 280 days, all those born between 285 and 295

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days as having been born at 290 days, etc. Those infants which were born upon the limiting day separating two periods (*e.g.*, 285 days) are included in both classes (*e.g.*, the 280-day and the 290-day classes).

TABLE I. MALES.

Period of gestation in days	Number of infants delivered	Period of gestation in days	Number of infants delivered	Period of gestation in days	Number of infants delivered	Period of gestation in days	Number of infants delivered
190	1	230	0	270	38	310	9
200	0	240	1	280	79	320	3
210	1	250	2	290	78	330	1
220	0	260	22	300	16	340	0
Totals	2		25		211		13

TABLE II. FEMALES.

Period of gestation in days	Number of infants delivered	Period of gestation in days	Number of infants delivered	Period of gestation in days	Number of infants delivered	Period of gestation in days	Number of infants delivered
190	1	230	2	270	32	310	14
200	2	240	3	280	80	320	3
210	0	250	6	290	86	330	1
220	1	260	10	300	31	340	0
Totals	4		21		229		18

In attempting to determine the mean or "normal" period of gestation from these figures we might employ the average of all of the different periods of gestation enumerated in the above tables. But in so doing we would incur the risk of including some few marked deviations from the average representing departures from the mean period of gestation which are not purely fortuitous and intrinsic in origin, but due to the intrusion of definite extrinsic variables such as undetected pathological conditions of the mother or infant or large errors, of which the most probable is an error of one month, in the estimation of the observed periods.

We might employ some arbitrary criterion, such as excessive subnormality in the weight of the infant delivered, for the exclusion of extreme deviations. But such a criterion would depend, not upon the magnitude of the period itself, but upon the magnitude of another variable, for example, the weight of the infant after delivery. For the purpose of obtaining the most probable estimate of the length of the normal period of gestation, however, such a procedure would not be strictly justifiable, since abnormal development of the infant may not necessarily influence the length of the period of gestation.

We are therefore led to inquire what procedure we can employ, depending solely upon the magnitude of the observed and apparently normal periods of gestation, which will enable us to exclude from the

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data enumerated in Tables I and II those of which the deviations from the mean are more probably due to extrinsic than to intrinsic variables, *i.e.*, which are probably due to determinate but undetected large errors of estimation, or to pathological conditions.

Such a procedure, determined solely by the observed magnitudes and not dependent upon any *a priori* considerations added thereto, is afforded by Chauvenet's criterion for the rejection of extreme variates,(2) which is widely employed in statistical investigations and physical measurements which involve a large number of determinations.(3) This criterion is evaluated in the following manner:

Referring to Table I, we observe that out of a total of 251 male infants, one was born at 190 days, one at 210 days, one at 240 days, two were born at 250 days, and so forth, the average period of gestation for all of these infants being 281.8 days.

We now determine the deviation of each of the observed periods of gestation from the above average. Thus the deviation of the 190-day period is 91.8 days, that of the 330-day period is 48.2 days, and so forth. Square each of these deviations, multiply each of these squares by the number of individuals displaying the deviation in question, and add the products together. Thus Table I yields:

$$91.8^2 \times 1 + 71.8^2 \times 1 + 41.8^2 \times 1 + 31.8^2 \times 2 + 21.8^2 \times 22 + 11.8^2 \times 38 + 1.8^2 \times 79 + 8.2^2 \times 78 + 18.2^2 \times 16 + 28.2^2 \times 9 + 38.2^2 \times 3 + 48.2^2 \times 1 = 74{,}319.$$

Divide this sum by the total number of infants (= 251) and take the square root of this quotient. The value thus obtained, 17.2, is the *standard deviation* of the period of gestation for the male infant. The standard deviation (usually denoted by the symbol σ) is a measure of the *variability* of any quantity provided that quantity only varies accidently, that is to say, in accordance with the laws of probability indifferently in excess and in defect of its mean value.(4)

When a series of magnitudes which deviate fortuitously from the mean are tabulated in classes, as we have tabulated periods of gestation in Tables I and II, we find that those classes (in Table I the 280- and 290-day classes) which lie nearest in magnitude to the mean contain the greatest number of examples, *i.e.*, exhibit the greatest "frequency." If we plot the frequencies of the classes vertically, employing their deviations from the mean as abscissæ, we obtain, as is well known, the "probability curve:"

$$y = \frac{n}{\sigma\sqrt{2\pi}}\, e^{-\frac{x^2}{2^2\sigma}}$$

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in which n is the total number of variates (in this instance 251, the total number of infants), σ is the "standard deviation" determined in the manner outlined above, y and x are the ordinate and abscissa respectively, and e is the base of the Napierian logarithms.

The general form of this curve is familiar. The majority of the variates lie close in magnitude to the mean, and therefore the greater part of the area enclosed between the curve and the axis of the abscissæ lies close to the maximum ordinate, *i.e.*, that expressing the number of variates exactly equal in magnitude to the mean. The curve slopes away upon either side of the mean, at first rapidly and then more slowly. The abscissa of the point of inflexion is σ, the standard deviation.

Assuming for the moment what will be proven later, namely, that the observed deviations of the period of gestation from the mean are for the most part purely fortuitous and therefore lie upon or near to the probability curve, and having determined the "standard deviation" of the observed periods, we can now proceed to determine which, if any, of the observed deviations from the mean are probably not fortuitous in the following way:

Let x_1 be the magnitude of a given deviation, a, expressed in terms of the standard deviation, so that $\frac{a}{\sigma} = x_1$, then the integral:

$$\varphi(\sigma x_1) = \frac{2}{\sigma\sqrt{2\pi}} \int_0^{\sigma x_1} e^{-\frac{x^2}{2\sigma^2}}\, dx$$

expresses the proportion of variates of which the deviation from the mean is *less* than a. If we multiply this by n, the total number of variates, we obtain $n\varphi(\sigma x_1)$ which is the actual number of variates of which the deviation from the mean is less than a. Subtracting this from n we have:

$$n - n\varphi(\sigma x_1) = n[1 - \varphi(\sigma x_1)]$$

which is the number of deviations which must be expected to be *greater* than a. If now this quantity is less than ½ it will follow that a deviation of magnitude a has a greater probability against it than for it, and we may infer that among a limited number of *purely fortuitous* deviations it would not occur. Such a deviation from the mean we may therefore reject as being improbably fortuitous. The criterion for rejection is therefore obtained from the equation:

$$\varphi(\sigma x_1) = \frac{2n - 1}{2n}.$$

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We have now to find the value of σx_1 which corresponds to an area of the probability curve equalling $\frac{2n - 1}{2n}$, where n is the total number of observations, in this instance 251. We can ascertain the value of x_1 by referring to tables of probability integrals (such as, for example, Table IV in Davenport's "Statistical Methods" referred to above).

We have $\frac{2 \times 251 - 1}{2 \times 251} = 0.99801$. One-half of this area lies on either side of the mean, while the tables of probability-integrals give the values of x_1 corresponding to given areas on *one* side of the mean. We therefore divide the above area by two, obtaining the area 0.49900. The table of probability-integrals shows that the value of x_1 which corresponds to this area is 3.09. Hence the limit of allowable deviation from the mean is given by:

$$a = \sigma x_1 = 17.2 \times 3.09 = 53.$$

This is therefore the maximum deviation from the mean period of gestation which may be expected to occur among 251 observations provided all of the observed deviations are fortuitous. Any period of gestation greater than $282 + 53 = 335$ days, or less than $282 - 53 = 229$ days may therefore be eliminated from the observations as being probably attributable to the intrusion of factors which are normally extrinsic. Referring again to Table I, we see that the 190- and 210-day periods may be rejected in computing the average magnitude of the period of gestation for males.

But in computing this maximum allowable deviation we began by assuming (in determining the "standard deviation") that the observed deviations from the mean were all fortuitous in origin. Nevertheless we have found that two of the observed deviations were probably not fortuitous, but due to the intrustion of some extrinsic undetected variable into the system of physiological variables which normally determine the length of the period of gestation. This renders a new application of Chauvenet's criterion necessary, in the carrying-out of which we exclude these two observations and treat the remainder of the observed periods as the basis of a fresh estimate of the "standard deviation," the area of the probability curve corresponding to the extreme allowable deviation, and so forth, until finally, by successive applications of Chauvenet's criterion, we eliminate all the observations of which the deviation from the mean (corrected by the omission of these values) are too great to be merely fortuitous,

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and obtain a series of estimates of the period of gestation, all of which may legitimately be regarded as representing fortuitous deviations from a fixed average value.

Treating data enumerated in Table I in this manner, we find that the *first* application of Chauvenet's criterion yields the limiting classes 229–335 days. The infants born at 190 and 210 days are therefore excluded. The *second* application of Chauvenet's criterion yields the limiting classes 242–322 days. The infants born at 240 and 330 days are therefore excluded. The *third* application of Chauvenet's criterion yields the limiting classes 243–321 days and leads to no further exclusions. We conclude therefore that with only four exceptions, namely the 190-, 210-, 240- and 330-day periods, all of the periods of gestation enumerated in Table I may be regarded as fortuitous departures from the true mean.

The number (N) of observed periods with the exception of those excluded by the above process is 247. The standard deviation (σ) for these periods is 12.7. The average of these periods is 282.5 days. The "probable error" of this estimate is given by $\pm 0.6745 \frac{\sigma}{\sqrt{N}} = \pm 0.55$, which means that the chances are even (1 to 1), that the true value of the mean period of gestation for males lies between 281.95 and 283.05 days(5).

Applying the same methods of computation to the data for female infants enumerated in Table II we find that the *first* application of Chauvenet's criterion yields the limiting classes 228–338 days. The infants born at 190, 200 and 220 days are therefore excluded. The *second* application of Chauvenet's criterion yields the limiting classes 241–329 days. The infants born at 330 days are therefore excluded. The *third* application of Chauvenet's criterion yields the limiting classes 241–327 days and leads to no further exclusions. We conclude, therefore, that with only seven exceptions, comprising the 190-, 200-, 220- and 330-day periods, all of the periods of gestation enumerated in Table II may be regarded as fortuitous departures from the true mean.

The number (N) of observed periods, with the exception of those excluded by the above process, is 264. The standard deviation (σ) for these periods is 13.8. The average of these periods is 284.5 days. The "probable error" of this estimate is ± 0.57. The chances are therefore even that the true period of gestation for female infants lies between 283.93 and 285.07 days.

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From these results it appears that the *mean period of gestation for female infants is longer than that for male infants.* The probability of the truth of this conclusion, based upon the above number of weighings, is the inverse of the probability that either of the above estimates, namely, that of the period of gestation for male infants or that of the period of gestation for female infants, differs from the true mean by four times the "probable error" of the estimate of either mean, which is the extent of the divergency of the two estimates. Hence the probability of the truth of the conclusion derived from the above figures that the period of gestation is longer for female infants than for male infants is 142 to 1.(6)

It should be noted that the ordinary method of estimating the probable period of gestation, namely, that of adding seven days to the date of the onset of the last menstruation and subtracting three calendar months from that date in the following year, yields periods which vary in length between 280 and 283 days.

We have seen that with the exception of a very few extreme deviations from the mean, which there is every reason to suppose are not "physiological" in origin, all of the periods of gestation enumerated in Tables I and II are *not improbably* fortuitous deviations from the mean period. I will now proceed to show that the observed deviations constitute a fortuitous distribution of variates about a *single* maximum frequency.

The *unimodality* of the frequency curve(7) for the period of gestation is very clearly displayed by the following figures (Tables III and IV) derived from Tables I and II.

TABLE III. MALES.

Period of gestation in days	Percentage of all infants not excluded by Chauvenet's criterion (247) born at the designated period
250	0.8
260	8.9
270	15.4
280	32.0
	Mode
290	31.6
300	6.5
310	3.6
320	1.2
Total	1.00

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TABLE IV. FEMALES.

Period of gestation in days	Percentage of all infants not excluded by Chauvenet's criterion (264) born at the designated period
240	1.1
250	2.3
260	3.8
270	12.1
280	30.3
	Mode
290	32.6
300	11.4
310	5.3
320	1.1
Total	100.0

There is evidently only *one* period, the "normal" period, at which the percentage of infants delivered by normal mothers attains a maximum. Subsequently to a very early period in the development of the fetus, there is no evidence of a "critical period" in the intra-uterine growth of man.*

The fortuitous character of the distribution of the observed periods about their mean may be demonstrated by comparing the distributions of frequencies enumerated in Tables III and IV with those of the "theoretical" frequency curve:

$$y = \frac{n}{\sigma\sqrt{2\pi}} e^{-\frac{x^2}{2\sigma^2}}$$

the constants n and σ being the number of variates and the standard deviation respectively the values of which have been evaluated

* It may be contended that by excluding those infants which died within one week of birth I have excluded the very group of deliveries which might be expected to reveal bimodality of the frequency curve of the period of gestation. The deliveries thus rejected were, however, relatively few in number and displayed no special tendency to occur at a period differing from the "normal" period of gestation. Their rejection is rendered necessary by the fact that they represent not infrequently the fruit of pregnancies which are affected by maternal abnormality. Were there any decided tendency, however, for deliveries within the limits comprised in the accompanying tables (3 and 4), to fall into two groups, a certain proportion of the infants delivered at the abnormal period would certainly survive, since premature delivery within these or even more extreme limits is not an insuperable obstacle to subsequent development, and maldevelopment at a "critical period" of intrauterine growth, might be expected to occur in varying degrees, resulting in the delivery of many infants not sufficiently maldeveloped to render the maintenance of life impossible.

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above, y the frequency of a given class and x its deviation from the mean.

This comparison is carried out in the accompanying tables (V and VI).(8)

TABLE V. MALES.

$\sigma = 12.7$; N = 247.

Period of gestation in days	Percentage of infants born at this period		δ = deviation of the observed from the theoretical value	$\left(\frac{\delta^2}{y}\right)$
	y = theoretical	y_1 = observed		
240	0.2	0.0	−0.2	....
250	1.5	0.8	−0.7	0.33
260	7.4	8.9	+1.5	0.30
270	19.8	15.4	−4.4	0.98
280	30.7	32.0	+1.3	0.06
290	25.1	31.6	+6.5	1.68
300	11.9	6.5	−5.4	2.45
310	3.0	3.6	+0.6	0.12
320	0.4	1.2	+0.8	....
Totals	100.0	100.0	±0.0	5.92

TABLE VI. FEMALES.

$\sigma = 13.8$; $N = 264$.

Period of gestation in days	Percentage of infants born at this period		δ = deviation of the observed from the theoretical value	$\left(\frac{\delta^2}{y}\right)$
	y = theoretical	y_1 = observed		
240	0.2	1.1	+0.9	....
250	1.6	2.3	+0.7	0.31
260	6.6	3.8	−2.8	1.19
270	17.4	12.1	−5.3	1.62
280	27.0	30.3	+3.3	0.40
290	26.0	32.6	+6.6	1.67
300	14.8	11.4	−3.4	0.77
310	5.2	5.3	+0.1	0.00
320	1.1	1.1	±0.0	0.00
Totals	100.0	100.0	+0.1	5.96

We have now to inquire what is the probability that the above "theoretical" curves of frequency truly represent the observed frequency distributions? In other words, what is the probability P that in a random selection of a like number of periods of gestation

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(247 in the case of males, 264 in the case of females) a series of deviations from the above "theoretical" frequencies will be obtained which is as great or greater than that actually observed?

According to Pearson(9) in order to compute this probability it is necessary first of all to compute X^2, where:

$$X^2 = \text{sum}\left[\frac{\text{squares of deviation of observed from theoretical frequencies}}{\text{theoretical frequency}}\right]$$

excluding those deviations which correspond to "theoretical" frequencies of less than unity, *i.e.*, to percentage frequencies of less than 0.41 for the periods yielding males and of less than 0.38 for periods yielding females.

The value of P is then given by:

$$P = \sqrt{\frac{2}{\pi}}\int_x^\infty e^{-\frac{1}{2}X^2}\,dX + \sqrt{\frac{2}{\pi}}e^{-\frac{1}{2}X^2}\left(\frac{X}{1} + \frac{X^3}{1.3} + \frac{X^5}{1.3.5} + \ldots + \frac{X^{n-3}}{1.3.5\ldots(n-3)}\right)$$

if n be even, and by:

$$P = e^{-\frac{1}{2}X^2}\left(1 + \frac{X^2}{2} + \frac{X^4}{2.4} + \ldots + \frac{X^{n-3}}{2.4.6\ldots(n-3)}\right)$$

if n be odd, where n is the number of classes (7 for the periods yielding males, 8 for the periods yielding females) of which the theoretical frequency is greater than unity.

The values of P computed from the above formulæ corresponding to various values of X and n have been tabulated by Elderton.(10) Now for the periods of gestation yielding males we have found (excluding the 240- and 320-day periods of which the theoretical frequencies are less than unity = 0.41 per cent.) that $X^2 = 5.92$, while $n = 7$. The value of P in Elderton's table corresponding to these values of X^2 and n is 0.43; in other words, out of 100 random samples of 247 deliveries yielding males, forty-three of the samples will yield a series of deviations from the theoretical frequencies as great or greater than the sample actually observed. This means that the chances are forty-three in 100 that no theoretical frequency distribution could be found which would fit the observed frequencies better than that which we have employed. This means, of course, that the observed frequency distribution is probably correctly represented by a frequency curve of the type employed, namely, the normal "probability curve."(11) In other words, *the observed deviations of "Physiological" periods of gestation from their mean are fortuitous in origin.*

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The corresponding figures for the periods of gestation which yield females are:

$$X^2 = 5.96; n = 8; P = 0.54.$$

The probability that this group of frequency distribution is correctly represented by the "probability curve," *i.e.*, is fortuitous, being even greater than in the case of the group yielding males.

From the above "theoretical" curves of frequency which, as we have seen, correspond very closely to the "observed" curves of frequency, we can readily calculate with the aid of tables, such as Table IV in Davenport's "Statistical Methods," what proportion of infants may be expected to be born at any given departure from the mean period. Hence we obtain, for males:

TABLE VII. MALES.

Among the following number of infants	One will be born Before or at	After or at
1,000	249 days	316 days
10,000	239 days	326 days
100,000	232 days	334 days
1,000,000	224 days	340 days

Hence the chances are *a million to one* against a male child being delivered at the termination of an otherwise normal pregnancy before 224 days after the onset of the last menstruation. It would appear legitimate to conclude, therefore, that *all seven-month children* (210 days) are the fruit of pathological pregnancies, *i.e.*, delivery is due to an abnormal condition of the fetus or parent induced by extrinsic occurrences, such as infection of the parent or fetus, mechanical injury or nervous shock to the mother, etc. It may be noted here, that according to Williams(12) well-developed children may be born at as early as 240 or as late as 320 days; presumably these, in his experience, are the extreme limits.

The corresponding figures for periods yielding females are given in the accompanying table:

TABLE VIII. FEMALES.

Among the following number of infants	One will be born Before or at	After or at
1,000	249 days	320 days
10,000	238 days	331 days
100,000	229 days	340 days
1,000,000	222 days	347 days

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Hence the chances are *a million to one* against a female child being delivered at the termination of an otherwise normal pregnancy before 222 days after the onset of the last menstruation.

From the variability of the physiological period of gestation it is possible to draw important conclusions. We have seen that for periods yielding males the variability (standard deviation) is represented by 12.7 days which is 4.47 per cent. of the mean period (282.5 days). This means that 68.27 per cent. or, almost exactly, two-thirds of the observed periods of gestation are within 4.47 per cent. of the length of the mean period.* For periods yielding females the percentage variability is 4.85 per cent., which means that two-thirds of the observed periods of gestation yielding females deviate from the mean period by no more than 4.85 per cent. In this connection it is of interest to note that Williams(13) states that in his experience *two-thirds* of the young women who miss the first menstrual period after marriage give birth to a fully developed child at 280 days after the onset of the last menstrual period. This quantitative correspondence is assuredly not accidental.

Now I have also estimated the *percentage variability in weight* of the infants which were the fruit of the pregnancies enumerated in the above tables. Excluding infants delivered at the termination of the periods rejected by Chauvenet's criterion I find that the variability in weight of the male infants at delivery is 14.3 per cent., while the variability in weight of the female infants at delivery is 14.5 per cent. From these figures it is at once evident that *the period of gestation is very much less variable, in normal females, than the weight of the infant which is delivered.* This means that subnormally developed infants are delivered relatively earlier and supernormally developed infants relatively later than their stage of development would warrant were the length of the period of gestation determined primarily, or to any great extent, by the stage of development attained by the fetus. We must conclude, therefore, that the length of the period of gestation in normal females is primarily determined, not by the fetal development, but *by a maternal cycle of events* which is to a considerable extent independent of the stage of development attained by the fetus.

SUMMARY.

From a statistical investigation of 511 normal confinements of South Australian females, comprising 247 confinements yielding

* Since 68.27 per cent. of the area of the probability curve lies between the abscissæ of the points of inflexion.

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male infants and 264 confinements yielding female infants, it is concluded:

(1) That the mean length of periods of gestation yielding males is 282.5 days with a probable error of ± 0.55 days and a variability of 4.47 per cent.

(2) The mean length of periods of gestation yielding females is 284.5 days with a probable error of $\pm$ 0.57 days and a variability of 4.85 per cent.

(3) The probability of the truth of the conclusion, based upon the above estimates, that the periods of gestation yielding females are longer than those yielding males is 142 to 1.

(4) There is only *one* period, the "normal" period at which the percentage of infants delivered by normal mothers attains a maximum. Subsequently to a very early period in the development of the fetus, there is no evidence of a "critical period" in the intrauterine growth of man such as occurs in the intrauterine growth of guinea-pigs.

(5) The deviation of normal periods of gestation from the mean are fortuitous in origin.

(6) The chances are a million to one against a male child being delivered at the termination of an otherwise normal pregnancy before 224 days or of a female child before 222 days after the onset of the last menstruation. Hence all seven-month children (210 days) may legitimately be regarded as the fruit of pathological pregnancies.

(7) The length of the period of gestation is very much less variable in normal females, than the weight of the infant which is delivered. From this fact it is inferred that the length of the period of gestation in normal females is primarily determined, not by the fetal development, but by a maternal cycle of events which is to a considerable extent independent of the stage of development attained by the fetus.

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