We have, therefore, developed new expressions involving height and weight, using the Du Bois method of determining constants. We have obtained a number of expressions showing about equal measures of goodness of fit. Among the best are:

$$S = 113.48 \cdot W^{18/27} \cdot H^{5/9} \quad (4)$$
$$S = 452.40 \cdot W^{11/18} \cdot H^{1/6} \quad (5)$$

The mean absolute deviation of the calculated values by (4) from the corresponding observed surfaces is 71.63 sq. cm. and the mean relative deviation is 15.4%. The corresponding deviations of (5) are 70.2 sq. cm. and 15.8%.

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Surface Area and Age in Prenatal Life.

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In a preceding paper we have given a series of empirical formulae for the relation between the surface area and some of the major dimensions of the human body in prenatal life. These formulae are as follows:

$$S = 0.2808 L_{ch}^{2.278} \quad (1)$$
$$S = 0.4545 L_{cr}^{2.401} \quad (2)$$
$$S = 5.188 W^{0.750} \quad (3)$$

In these expressions S is the surface area of the body in square centimeters, L_{ch} is the total or crown heel length in centimeters, L_{cr} is the sitting height or crown rump length, and W is body weight in grams.

The increase in surface area with respect to age in the fetal period may be estimated by the substitution of expressions for time in terms of body length or body weight in this period. We have done this using the empirical formulae of Scammon and Calkins.[1, 2] In these expressions age is given in lunar months (of 28 days) dated from the first day of the last menstruation. These expressions only hold for the fetal period proper (from 3 lunar months to birth).

[1] Scammon, R. E., and Calkins, L. A., PROC. SOC. EXP. BIOL. AND MED., 1923, xxi, 253.

[2] Scammon, R. E., and Calkins, L. A., PROC. SOC. EXP. BIOL. AND MED., 1924, xxii, 157.

The accompanying table gives the calculated values for the surface area of the body at each month of the fetal period, as computed through crown heel length, through crown rump length and

TABLE I.—Calculated Surface Area in the Fetal Period.

Age (lunar months)	Surface area (sq. cm.) as calculated from:			Derivatives [Calculated from (1)]		
	(1) Crown heel length	(2) Crown rump length	(3) Body weight	Velocity (sq. cm. per mo.)	Relative velocity (% per mo.)	Acceleration (sq. cm. per mo. per mo.)
3	24.3	23.5	38.1	72.7	299.5	106.1
4	145.7	136.7	147.5	165.4	113.5	80.0
5	347.8	329.9	336.7	235.8	67.5	62.0
6	612.5	588.8	590.4	291.5	47.6	50.1
7	927.5	902.6	902.6	337.3	36.4	41.9
8	1284.5	1263.6	1262.3	375.9	29.3	35.8
9	1677.6	1666.2	1664.2	409.4	24.4	31.3
10 (birth)	2102.0	2105.4	2102.2	438.8	20.9	27.7

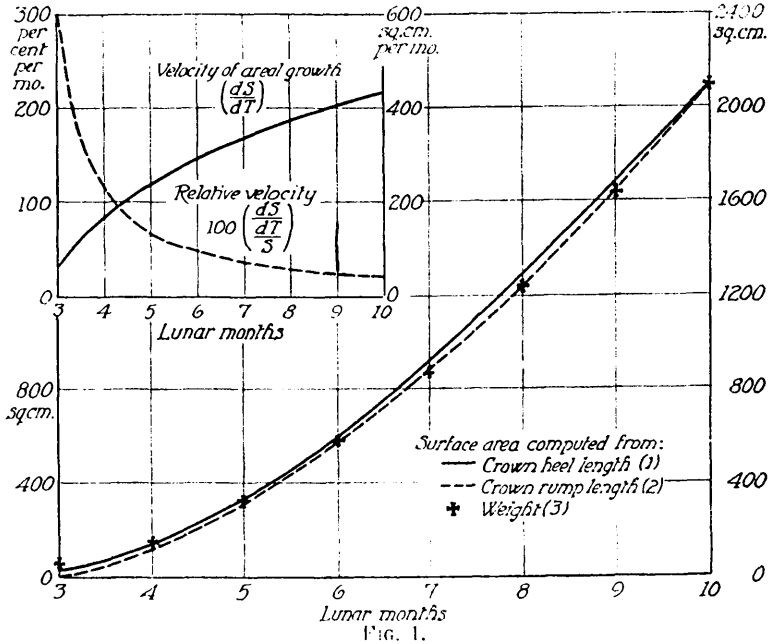

FIG. 1.

Graphs illustrating the growth of the surface area of the body, with respect to age, in the fetal period. The major graph shows the course of growth in surface area as computed from (1) crown heel or total length, (2) crown rump length or sitting height and (3) body weight. The solid line in the minor graph shows the velocity of growth (in square centimeters per month) of surface area as computed from crown heel length. The curve drawn in broken line shows the relative velocity of growth (first differential times 100, divided by attained magnitude) of surface area as computed from crown heel or total body length.

through body weight. The agreement of these figures is quite close —particularly for crown rump length and body weight, with the exception of the values at 3 lunar months.

We have also calculated the velocity, the relative or percentage velocity and the acceleration of areal growth in this period (as estimated through crown heel length). These values are shown in the last 3 columns of the table. The accompanying figure shows the results of these computations in graphic form.

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The Regional Growth in Surface Area of the Human Body in Prenatal Life.

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The surface areas of the chief regions of the body were determined for 12 fetuses ranging from 3.27 to 47.22 cm. in total or crown heel length and from 1.26 to 2463.0 gm. in weight. The details of the material and method employed are described in a preceding paper.

The regions delimitated were head, neck and trunk (including the perineal region and the penis and scrotum in the males), the upper extremities (both sides), and the lower extremities (both sides including gluteal regions). From geometrical considerations, that were found to be applicable to measurements of the surface area of the body as a whole, it was thought that an adequate expression for representing the relation of the surface area of a part to body length might be:

$$S_p = aL^b, \text{ or, } \log S_p = \log a + \log L \cdot b$$

where S_p is the area of the part in question, L is the total or crown heel length of the body and b is an exponent approaching 2. Graphic tests on double logarithmic paper indicated that this surmise was justified.

When fitted by the method of averages the following expressions were obtained:

$$S_h = 0.1767L^{1.997} \quad (1)$$
$$S_t = 0.1191L^{2.207} \quad (2)$$
$$S_u = 0.0244L^{2.449} \quad (3)$$
$$S_l = 0.0216L^{2.632} \quad (4)$$