nificance. Aside from the small number of animals experimented on, the most important of these is that we have been unable to produce the disease with more than 70 per cent to 75 per cent of the inoculations. On the other hand, in favor of the hypothesis that these animals were actually immunized, it is our general experience that if one animal of a number inoculated at a given time becomes infected, the rest of the controls usually succumb also, as in the final stage of the experiment just cited.

While this experiment is obviously inconclusive, it is just as obviously suggestive that sodium ricinoleate may be a medium for actively immunizing against poliomyelitis, and we intend to test this idea until we are satisfied that it is either true or false.

[1] Larson, W. P., and Nelson, E., PROC. SOC. EXP. BIOL. AND MED., 1924, xxi, 278. Larson, W. P., Evans, R. D., and Nelson, E., PROC. SOC. EXP. BIOL. AND MED., 1924, xxii, 194. Larson, W. P., Halvorson, H. O., Evans, R. D., and Green, R. G., *Colloid Symposium Monograph*, 1925, iii, 152. Larson, W. P., and Eder, H., *J. Am. Med. Assn.*, 1926, lxxxvi, 998. Larson, W. P., Huenekens, E. J., and Colby, W., *J. Am. Med. Assn.*, 1926, lxxxvi, 1000. Larson, W. P., PROC. SOC. EXP. BIOL. AND MED., 1926, xxiii, 497.

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The Growth of the Spinal Axis of the Human Body in Prenatal Life.

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It has been previously pointed out[1, 2, 3] that the growth of the external dimensions of the human body in the fetal period is directly proportional to the growth in length of the body as a whole. The same law holds true for many of the lineal dimensions of the internal organs and parts, and is particularly well illustrated by the growth of the spinal column in prenatal life.

We have studied these relationships by measurements of the total length of the spine and its parts in 148 specimens ranging from 2.5 to 55.0 cm. in total or crown-heel length, and have placed the results in the form of empirical formulae. These formulae were computed from the mean spine lengths for 5 cm. intervals of crown-heel length by the method of averages, weighting by the square root of the number of cases in each interval.

In all instances we have found that the relationship of the spine and its parts with the total body-length is a rectilinear one which may be represented by the expression:

$$S = aL \pm b \quad (1)$$

where "S" is the length of the spine or any spinal segment, "L" is the total body-length and "a" and "b" are empirically determined constants.

The growth of the total spine is illustrated by the upper curve in figure 1 and may be expressed by the formula:

$$\text{T. S. (mm.)} = 0.4449 \text{ L (mm.)} + 4.46 \text{ mm.} \quad (2)$$

The calculated means of the spine length, as determined by this formula, show a mean weighted absolute deviation of 1.37 mm. from the corresponding observed averages, for the 5 cm. intervals of crown-heel length, which is approximately the same as the mean of the probable errors of these observed averages. The mean, weighted, relative deviation of the observed from the calculated values is 1.29 per cent.

The growth of the cervical spine (shown in the lower curve in figure 1) may be expressed by the formula:

$$\text{C. S. (mm.)} = 0.0830 \text{ L (mm.)} + 2.75 \text{ mm.} \quad (3)$$

The calculated means for the 5 cm. intervals of crown-heel length show a mean weighted absolute deviation of 0.40 mm., which again is approximately the same as the mean of the probable errors of the observed averages. The corresponding mean relative deviation is 2.52 per cent.

The growth of the thoracic spine is illustrated in the middle curve of figure 1 and may be expressed by the formula:

$$\text{Th.S. (mm.)} = 0.1722 \text{ L (mm.)} + 1.56 \text{ mm.} \quad (4)$$

The computed 5 cm. interval averages show a mean, weighted, departure of 0.88 mm. from the corresponding observed values, which is slightly more than the average of the probable errors of these observed means. The corresponding percentage deviations in this instance average 1.95.

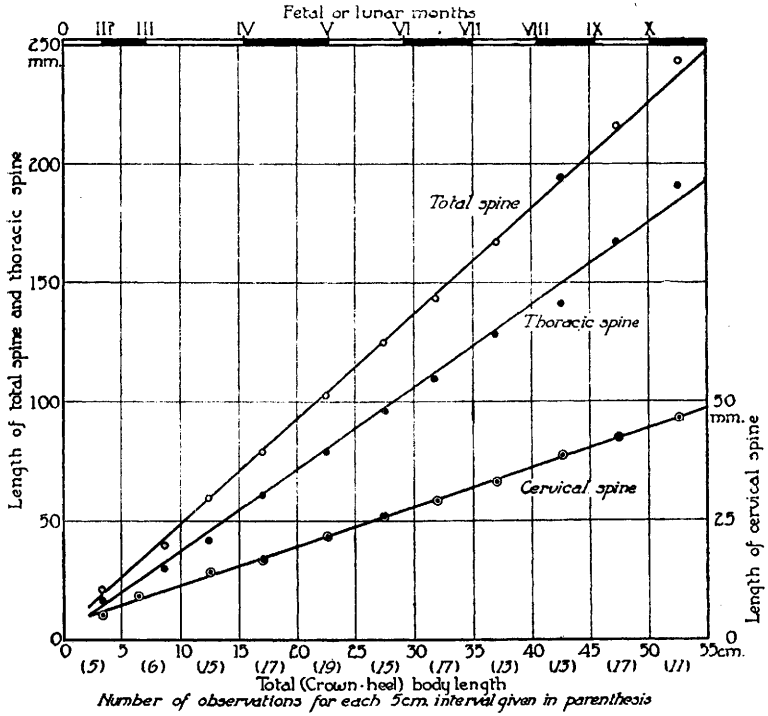
The growth of the lumbar spine may be represented by the empirical formula:

$$\text{L.S. (mm.)} = 0.1005 \text{ L (mm.)} - 0.27 \text{ mm.} \quad (5)$$

The mean, weighted, deviation in this instance is 0.22 mm., which is about half of the mean of the probable errors of the observed averages of this series. The mean weighted, relative deviation is 1.79 per cent.

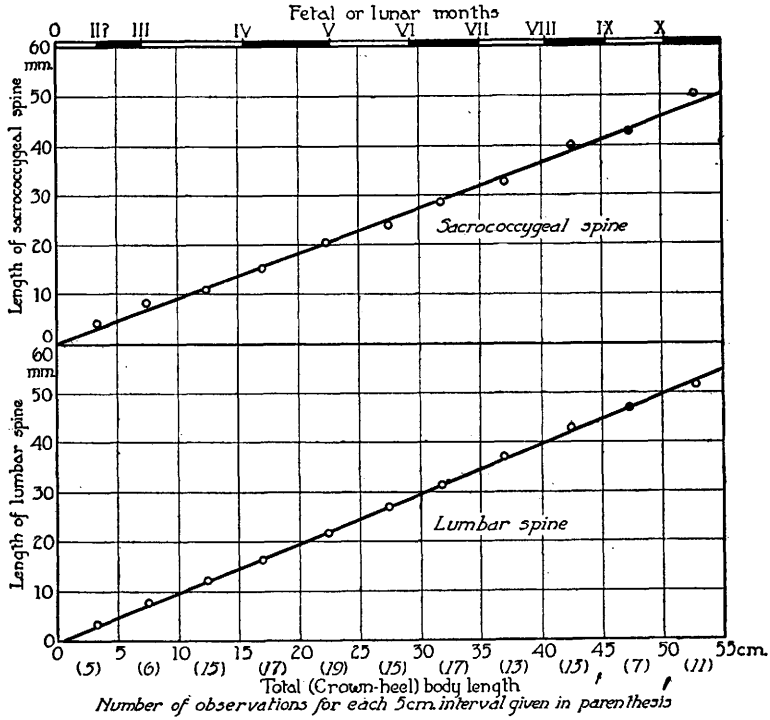
These figures indicate that the law of developmental direction holds good for the spine as a whole, and the various spinal segments, with the exception of the sacrum and coccyx, which show a relatively great growth in early prenatal life and a relatively slow velocity of growth thereafter. This exception falls in line with our knowledge of the phylogenetic reduction of the sacrocaudal vertebrate in the higher primates. A more detailed quantitative analysis of the rates of growth of the spinal column will be presented in the near future.

FIG. 1.



A graph illustrating the growth of the total spine, the cervical and the thoracic spine in prenatal life. The spine lengths (in mm.) are plotted against the total body-length (in cm.). The observed means for the 5 cm. intervals of body-length are represented by dots or circles, and the lines drawn through them represent the analytical expressions given in this paper. The total body-length is given on the base-line of the graph. The panels along the upper margin represent the age in fetal or lunar months. The latter are computed by the empirical formula of Scammon and Calkins[1] for the relation of fetal age to body-length (except for the value for two months which has been estimated by arithmetic interpolation from Mall's data[2]).

FIG. 2.



A graph illustrating the growth of the sacrococcygeal and lumbar spine in prenatal life. Symbols and conventions as in figure 1.

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[1] Calkins, L. A., *Anat. Record,* 1921, xxi, 47.

[2] Calkins, L. A., and Scammon, R. E., PROC. SOC. EXP. BIOL. AND MED., 1925, xxii, 353.

[3] Akiba, T., *Folia Anat. Japonica,* 1924, ii, 89.

[4] Scammon, R. E., and Calkins, L. A., PROC. SOC. EXP. BIOL. AND MED., 1924, xx, 353.

[5] Mall, F. P., *Man. Human Embryol.,* 1910, i, 180-201.

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The Growth of the Gastro-Intestinal Tract of the Human Fetus.

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A quantitative study has been made of the lineal growth of the gastro-intestinal tract in human fetuses, ranging from 2.35 to 37.5