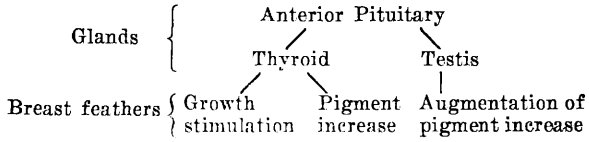

7255 C

Growth of Bone Shafts in the Human Fetus.

ROBERT ROBB AND JOHN CLARKE. (Introduced by Frank P. Knowlton.)

From Syracuse University College of Medicine.

If individual bones differ in their rates of growth and if each of the major long bones is the product of 3 to 8 centers of ossification one may feel surprised at the linear relationships reported by Scammon and Calkins[1] between diverse *external* dimensions of the human fetus. We need assurance that the simplicity of these gross observations does not mask a greater complexity in the constituent tissues.

In this fetal series we report the lengths of the bone shafts alone, before the appearance of osseous epiphyses, from dried preparations in the Department of Embryology. The observations are well distributed through fetal life, their variability is small, and the error of measurement is less than 2%, but we do not know what change took place in drying.

The rectilinear relationships in Fig. 1 demonstrate our confirmation, by a different technique, of Scammon and Calkins'[1] belief that the relative growth of human fetal long bones is approximately linear. This interpretation applies also to fetal skull growth in the horse[2] but fetal limb growth in the horse (to be published) required a second degree equation. We have also replotted the data of Schmalhousen and Stepanowa[3] concerning bone growth in the chick embryo. Here we find that lengths, as well as weights are interrelated as power functions and thus exhibit growth partition.[4, 5] The chick humerus length is a function of femur length with exponent 0.87, and approximately the same exponent, 0.88 describes

[1] Scammon, R. E., and Calkins, L. A., Growth in the Fetal Period. 1929. U. of Minn. Press.

[2] Robb, R. C., *Proc. Sixth Internat. Cong. Gen.*, 1932, **2**, 166.

[3] Schmalhousen, I., and Stepanowa, J., *Arch. Entw. d. Organ.*, 1926, **108**, 721.

[4] Huxley, J. S., Problems of Relative Growth, 1932. Dial Press, New York.

[5] Robb, R. C., *Brit. J. Exp. Biol.*, 1929, **6**, 311.

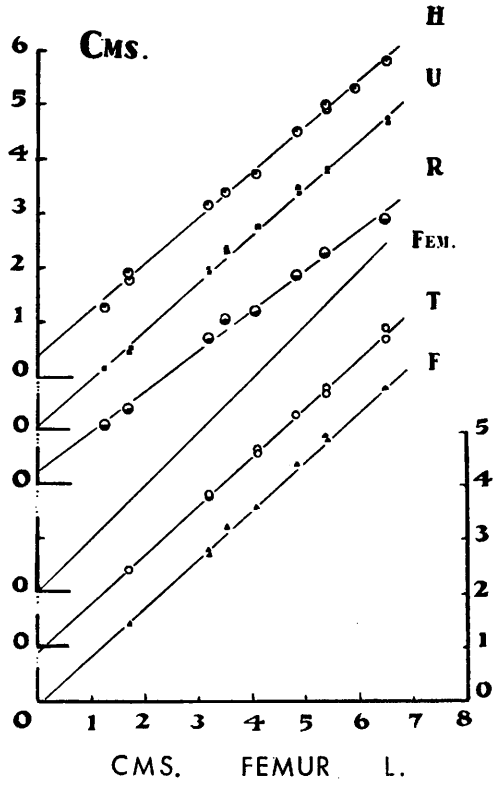

FIG. 1.

Lengths of bone shafts (diaphyses only) plotted against that of the femur in the human fetus. H—humerus, U—ulna, R—radius, Fem.—femur itself, T—tibia, F—fibula.

TABLE I.
Dimensions of Human Fetal Bone Shafts.

	Human Fetus							
	I	II	III	IV	V	VI	VII	VIII
CM. LENGTH								
Crown-Heel	9.0	13.0	18.0	22.	25.	30.	32.	37.5
Humerus, Right	1.29	1.80	3.19	3.40	3.81	4.56	5.04	5.83
Left	1.27	1.90	3.19	3.42	3.75	4.56	5.04	5.82
Ulna, Right	1.16	1.49	2.95	3.37	3.78	4.43	4.85	5.80
Left	.....	1.50	2.98	3.38	3.78	4.49	4.85	5.80
Radius, Right	1.1	1.40	2.70	3.05	3.20	3.87	4.28	4.87
Left								
Femur, Right	1.29	1.71	3.20	3.52	4.10	4.84	5.40	6.50
Left	1.25	1.70	3.18	3.55	4.10	4.88	5.40	6.60
Tibia, Right	.....	1.40	2.80	3.23	3.66	4.30	4.70	5.70
Left	.....	1.40	2.70	3.21	3.59	4.31	4.80	5.90
Fibula, Right	.....	1.40	2.75	3.20	3.60	4.37	4.88	5.80
Left	.....	1.40	2.80	3.19	3.60	4.35	4.85	5.80
INDEX								
Humero-Femoral	1.01	1.08	1.00	0.96	0.92	0.92	0.93	0.89

radius or ulna growth, whereas in the hind limb the exponent for tibia or for tarso-metatarsus is 1.05. In view of these facts we cannot eliminate the possibility that our "straight lines" are but segments of power curves with exponents close to unity.