

**The Postnatal Growth of the Alimentary Canal
and the main long Bones of the Free-
Extremities in the Albino Rat
(*Mus Norvegicus Albinus*).**

By

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Under the superintendence of Prof. Dr. Tamura, the subject, "The post-natal growth of the various organs and tissues" has been investigated by the colleagues of our laboratory and we have also taken part in this work. We wish first to acknowledge our indebtedness to Prof. Dr. Tamura who liberally allowed us to carry out this paper. Only the morphological findings will be described here and the microscopic appearances will be later detailed.

Material, Method and Literature :—

Both the stock and inbred albino rats (*MUS NORVEGICUS ALBINUS*) have been selected. The animal was fed mainly with abundant supply of wheat and water which were renewed daily and potatoes, fish-bones etc. were occasionally added. This experiment has been done in seven months from June to December, and observed every day from the first to the fifteenth day after birth and every five days from the fifteenth up to the thirtieth day. The total number of rats examined was 108; 6 groups each; male 51 and female 57.

Donaldson¹ viewed that the span of life in the albino rat is three years,—between birth and natural death,—and that this span in the rat is equivalent to ninety years in man. On this assumption, our thirty days-observation on rat is equivalent to about two years and six months in man. It is quite difficult to determine the exact birth time of rat and therefore much attention was paid, watching day and night. Some of the females were mated under observation (rat has a gestation period of some 22 days). King⁵ stated that, as a rule, young rats begin suckling very soon after their birth and not infrequently part of a litter will have suckled before the rest have been born. "The weight of 'new born' animals, therefore, is probably not the same and

to obtain the birth-weight it is necessary that the animals be weighed before they have suckled, since the amount of food consumed during the first few hours of postnatal life very appreciably increases the body-weight." "One can tell very easily whether or not the young rats have suckled, as the skin of the young animals is quite transparent and if milk is present in the stomach or in the intestines it can be seen very clearly through the body wall. The term "first day after birth" in our article covers the period in the life of the animal from the time of birth up to one day. Data for many litters which have been hitherto observed by many show that the body-weight of the young at birth differs considerably in various strains of rats. However, both the stock and inbred albino rats we employed weigh about the same at birth. The albino rat in our cases generally has a range of five to eight fetuses per litter. 'King observed that an unpublished data for over 1000 litters of stock albino rats show that the average litter contains seven young. The diseased young and extremely small ones were excluded from this experiment, and selected only those in which the individuals were of good size and strong and vigorous appearance at birth (rats that are heavy for their length and age are usually in excellent health). It is experienced by Hatai,² etc., that the body-weight of the albino rat depends to some extent on the character of the food. Holt and Howland¹¹ described in the book "Disease of infancy and childhood" that the growth is much modified by the kind of protein furnished in the food. "In certain animals whose diet furnishes the other factors essential for normal nutrition, growth can be accelerated, retarded or arrested by simply varying the kind of protein in the food." "A proper supply of vitamins is also necessary." Stotsenburg⁸ affirmed that the weight would be slightly increased if the mother-rats had all been fed on "bread and milk" and slightly diminished had the mothers all been fed on "scrap." The age and nutrition of the mother-rats considerably affect the young, and the number of the gestation and litters also cannot be disregarded. The climate has an influence on the gestation. Slonaker⁷ stated that the age of the mothers affects not only the number of the young rats in a litter but also their weight at birth; young mothers being less prolific than older ones. King⁶ observed that under the conditions existing in the Wistar Institute animal colony the female albino rat usually has her first litter when she is about three months old, and she is capable of bearing young until she is about fifteen months old.

1. From 90 to 120 days: This is the age when young females are growing very rapidly and the time when the great majority of them cast their first litters.
2. From 120 to 180 days: During this time the female reaches the end of the rapidly growing period and becomes full mature.
3. From 180 to 300 days: The female is at the height of her reproductive power during this period and attains full growth.

4. From 300 to 450 days: In this period there is a dying out of the reproductive powers and attains full growth.

“Very young females and those that have passed their prime have smaller litters, as a rule, than females at the height of their reproductive power.” We also observed two females have brought forth their young at the age of three months but the litters of such a young mother are generally quite small and delicate. Vierordt⁹ noticed that in human beings, the mother’s age affects the new-born infant’s weight. He cited the following table:—

Mother's age (year)	Infant's weight in gm.		Mother's age (year)	Infant's weight in gm.	
	by Ingersleo	by Fassbander		by Ingersleo	by Fassbander
15—19.	3241	3271	30—34.	3375	3367
20—24.	3299	3240	35—39.	3428	} 3292
25—29.	3342	3330	40—44.	3326	

Stotsenburg⁸ pointed out that the albino rats breed throughout the entire year, but the period of greatest sexual activity is in the spring and autumn. As above mentioned, there are many factors to influence on the growth of young animals and therefore, all the rats must be reared under similar environment. It should be strictly avoided to frighten the pregnant or mother rat as well as to feed too many rats together in a small cage. The removal of some young from the nest in the sight of the mother often results the rest in their being destroyed by the mother, especially so far as the young have their eyes closed.

The following tables show the weight and length of the various parts. The body length is measured in centimeter; the distance between the tip of the nose and the proximal end of the tail, placed in the natural position on the table after sacrificed. The weight is estimated in gram.

The bones examined are of five main long bones of the free-extremities; the humerus, ulna, radius, femur and tibia. The fibula and the distal segments comprised many carpus, metacarpus, phalanges, tarsus and metatarsus were excluded as they are quite difficult to measure definitely. Each bone was carefully bared its cortex and examined. The alimentary canal was measured its length in four parts; the stomach, cecum, and both the small and large intestines, and their weights were not estimated. The incisor-teeth appear first on the fifth day after birth and at latest, after eight days. Mishima¹⁴ stated that in human-infant in both sexes, the first incisor-teeth are seen in average at the seventh month after birth. “It appears in the earliest at the fifth month in boys and at the third month in girls and at latest, it comes out at the fourteenth month on both sexes.” The eyes mostly open between the fifteenth and the seventeenth day after birth.

Table I.

First Day after Birth.

Nos of Animal	I	II	III	IV	V	VI	Average	
Sex	♂	♂	♂	♂	♂	♂		
Body	{ length	4.9	5.0	5.1	5.0	5.6	4.9	5.1
	{ weight	4.9	5.3	5.6	5.3	5.9	5.1	5.4
Spinal-length	3.1	3.3	3.4	3.4	3.3	3.3	3.3	
Tail-length	1.7	1.7	1.7	1.7	2.0	1.6	1.7	
Femur	{ length	0.68	0.72	0.68	0.67	0.70	0.65	0.68
	{ weight	0.009	0.0105	0.009	0.009	0.012	0.007	0.0094
Tibia	{ length	0.70	0.68	0.68	0.72	0.72	0.60	0.68
	{ weight	0.007	0.006	0.005	0.0055	0.0075	0.0035	0.0058
Humerus	{ length	0.72	0.73	0.72	0.71	0.7	0.7	0.71
	{ weight	0.010	0.010	0.012	0.0095	0.012	0.009	0.0104
Ulna	{ length	0.71	0.72	0.73	0.73	0.78	0.7	0.73
	{ weight	0.005	0.003	0.0035	0.003	0.004	0.0025	0.0035
Radius	{ length	0.58	0.52	0.55	0.55	0.6	0.48	0.55
	{ weight	0.003	0.002	0.002	0.002	0.002	0.001	0.002

Second Day after Birth.

Nos of Animal	I	II	III	IV	V	VI	Average	
Sex	♀	♂	♀	♀	♀	♀		
Body	{ length	4.7	5.0	5.4	4.9	5.3	5.0	5.1
	{ weight	4.0	5.5	5.6	5.0	4.5	4.4	4.8
Spinal-length	3.0	3.3	3.5	3.4	3.2	3.2	3.3	
Tail-length	1.8	1.9	1.7	1.7	1.9	1.5	1.8	
Femur	{ length	0.64	0.72	0.71	0.67	0.70	0.65	0.665
	{ weight	0.007	0.012	0.012	0.007	0.008	0.009	0.009
Tibia	{ length	0.62	0.70	0.71	0.70	0.72	0.61	0.68
	{ weight	0.004	0.007	0.007	0.0045	0.007	0.005	0.0058
Humerus	{ length	0.70	0.73	0.78	0.72	0.73	0.70	0.73
	{ weight	0.010	0.012	0.012	0.0105	0.009	0.009	0.0104
Ulna	{ length	0.71	0.80	0.81	0.74	0.63	0.63	0.72
	{ weight	0.003	0.005	0.005	0.0035	0.002	0.003	0.0036
Radius	{ length	0.53	0.60	0.61	0.58	0.48	0.48	0.55
	{ weight	0.0015	0.002	0.003	0.002	0.001	0.001	0.0018

Third Day after Birth.

Nos of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♀	♂	♀	♀	♀	
Body { length	5.1	5.5	5.5	5.3	5.5	5.2	5.4
Body { weight	4.5	6.5	6.6	5.7	6.3	5.0	5.8
Spinal-length	3.2	3.3	3.6	3.7	3.7	3.5	3.5
Tail-length	1.8	2.7	2.1	1.9	2.2	1.7	2.1
Femur { length	0.68	0.85	0.78	0.81	0.73	0.70	0.76
Femur { weight	0.007	0.019	0.015	0.014	0.013	0.011	0.013
Tibia { length	0.65	0.97	0.81	0.82	0.85	0.68	0.80
Tibia { weight	0.004	0.014	0.0085	0.008	0.010	0.006	0.0084
Humerus { length	0.71	0.86	0.80	0.80	0.82	0.74	0.79
Humerus { weight	0.008	0.016	0.014	0.0103	0.014	0.010	0.012
Ulna { length	0.71	0.94	0.85	0.81	0.80	0.73	0.81
Ulna { weight	0.0035	0.007	0.006	0.006	0.005	0.004	0.0053
Radius { length	0.52	0.70	0.62	0.64	0.65	0.55	0.61
Radius { weight	0.002	0.004	0.0035	0.003	0.004	0.0015	0.003

Fourth Day after Birth.

Nos of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♀	♂	♀	♀	♀	
Body { length	5.6	6.5	5.6	5.5	5.5	5.4	5.7
Body { weight	7.3	9.5	6.7	6.2	6.8	5.3	6.9
Spinal-length	4.0	3.8	3.6	3.7	3.7	3.7	3.75
Tail-length	2.6	2.9	2.2	2.3	2.5	unknown	2.5
Femur { length	0.82	1.00	0.81	0.80	0.82	0.73	0.83
Femur { weight	0.014	0.03	0.019	0.014	0.018	0.016	0.0185
Tibia { length	0.85	1.02	0.89	0.82	0.90	0.70	0.86
Tibia { weight	0.010	0.026	0.011	0.010	0.012	0.007	0.0126
Humerus { length	0.87	0.98	0.83	0.82	0.85	0.74	0.85
Humerus { weight	0.016	0.023	0.017	0.016	0.017	0.013	0.017
Ulna { length	0.92	1.08	0.93	0.87	0.90	0.75	0.91
Ulna { weight	0.007	0.0095	0.007	0.006	0.009	0.006	0.0074
Radius { length	0.60	0.81	0.68	0.65	0.68	0.53	0.66
Radius { weight	0.0025	0.007	0.004	0.004	0.006	0.003	0.0044

Fifth Day after Birth.

Nos of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♀	♀	♀	♀	♀	
Body { length	5.7	6.5	5.5	5.6	5.6	5.2	5.7
Body { weight	7.4	9.5	5.9	6.6	7.4	5.8	7.1
Spinal-length	4.0	4.0	3.4	3.7	3.7	3.3	3.7
Tail-length	2.6	3.7	2.3	2.6	2.6	2.6	2.7
Femur { length	0.82	1.00	0.81	0.83	0.90	0.80	0.86
Femur { weight	0.015	0.030	0.017	0.017	0.025	0.0165	0.020
Tibia { length	0.85	1.13	0.82	0.90	0.92	0.82	0.91
Tibia { weight	0.009	0.020	0.009	0.012	0.018	0.0095	0.0125
Humerus { length	0.80	1.00	0.83	0.85	0.90	0.82	0.87
Humerus { weight	0.014	0.026	0.017	0.018	0.025	0.0165	0.0194
Ulna { length	0.95	1.10	0.93	0.91	0.98	0.88	0.95
Ulna { weight	0.008	0.0105	0.007	0.0065	0.010	0.007	0.0082
Radius { length	0.63	0.80	0.68	0.70	0.72	0.69	0.70
Radius { weight	0.004	0.007	0.004	0.004	0.007	0.0045	0.0051

Sixth Day after Birth.

Nos of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♀	♀	♀	♂	♂	
Body { length	6.1	6.5	5.7	6.0	5.6	5.4	5.9
Body { weight	8.8	9.3	7.4	7.2	7.5	5.2	7.6
Spinal-length	4.2	4.0	3.7	3.7	3.5	3.5	3.8
Tail-length	2.7	3.8	2.4	2.7	2.3	2.1	2.7
Femur { length	0.90	1.01	0.84	0.91	0.84	0.80	0.88
Femur { weight	0.022	0.033	0.0205	0.024	0.020	0.018	0.023
Tibia { length	0.92	1.17	0.93	1.03	0.95	0.89	0.98
Tibia { weight	0.015	0.020	0.016	0.020	0.015	0.013	0.0165
Humerus { length	0.91	1.03	0.87	0.92	0.93	0.83	0.915
Humerus { weight	0.023	0.025	0.020	0.023	0.022	0.017	0.022
Ulna { length	1.00	1.12	0.94	1.01	0.96	0.86	0.98
Ulna { weight	0.009	0.0095	0.008	0.007	0.009	0.006	0.0081
Radius { length	0.75	0.85	0.71	0.72	0.74	0.70	0.745
Radius { weight	0.006	0.007	0.004	0.005	0.006	0.004	0.0053

Seventh Day after Birth.

Nos of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♂	♂	♂	♀	♀	
Body { length	6.2	7.0	5.9	6.0	6.5	5.7	6.2
Body { weight	9.6	10.5	6.8	8.0	11.7	8.2	9.1
Spinal-length	4.3	4.4	3.4	3.9	3.8	3.6	3.9
Tail-length	3.1	4.2	2.4	2.9	2.6	2.5	2.95
Femur { length	0.92	1.11	0.85	1.00	1.06	0.90	0.97
Femur { weight	0.030	0.035	0.020	0.028	0.038	0.023	0.029
Tibia { length	1.03	1.21	1.00	1.01	1.12	1.01	1.06
Tibia { weight	0.021	0.022	0.012	0.017	0.028	0.015	0.019
Humerus { length	0.93	1.02	0.91	0.95	1.02	0.91	0.96
Humerus { weight	0.027	0.025	0.020	0.025	0.035	0.023	0.026
Ulna { length	1.07	1.13	0.91	1.05	1.02	1.01	1.03
Ulna { weight	0.011	0.009	0.0065	0.010	0.015	0.010	0.013
Radius { length	0.75	0.92	0.71	0.81	0.85	0.74	0.80
Radius { weight	0.008	0.006	0.0055	0.007	0.009	0.006	0.007

Eighth Day after Birth.

Nos of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♂	♂	♀	♀	♂	
Body { length	6.3	6.8	5.9	6.3	6.6	8.5	6.3
Body { weight	9.3	10.3	7.9	9.1	11.8	7.6	9.3
Spinal-length	4.1	4.0	3.7	3.8	4.1	3.7	3.9
Tail-length	2.9	3.0	2.9	3.2	3.2	2.4	2.9
Femur { length	0.94	1.00	0.88	1.01	1.01	0.91	0.96
Femur { weight	0.027	0.033	0.020	0.032	0.038	0.023	0.029
Tibia { length	1.03	1.11	0.92	1.11	1.20	1.02	1.065
Tibia { weight	0.019	0.021	0.016	0.021	0.029	0.017	0.0205
Humerus { length	0.92	1.00	0.88	0.98	1.04	0.92	0.96
Humerus { weight	0.026	0.025	0.019	0.024	0.039	0.024	0.026
Ulna { length	1.00	1.11	0.93	1.04	1.17	1.03	1.05
Ulna { weight	0.010	0.0095	0.0075	0.009	0.016	0.010	0.0103
Radius { length	0.80	0.92	0.73	0.80	0.90	0.75	0.82
Radius { weight	0.006	0.006	0.005	0.005	0.011	0.0050	0.006

Nineth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average	
Sex	♂	♂	♂	♂	♀	♂		
Body	{ length	6.4	6.9	6.9	6.4	7.0	6.3	6.7
	{ weight	9.4	13.3	12.5	9.2	13.5	9.5	11.2
Spinal-length	4.1	4.5	4.2	3.8	4.5	4.0	4.2	
Tail-length	3.1	3.8	3.6	3.2	3.9	3.0	3.4	
Femur	{ length	0.94	1.09	1.11	1.02	1.10	0.97	1.04
	{ weight	0.030	0.041	0.040	0.033	0.045	0.032	0.037
Tibia	{ length	1.02	1.23	1.20	1.17	1.25	1.11	1.16
	{ weight	0.020	0.034	0.030	0.023	0.031	0.021	0.0265
Humerus	{ length	0.95	1.06	1.03	1.01	1.10	0.97	1.02
	{ weight	0.027	0.037	0.032	0.028	0.043	0.029	0.033
Ulna	{ length	1.05	1.21	1.17	1.14	1.25	1.13	1.16
	{ weight	1.011	0.016	0.015	0.012	0.016	0.012	0.014
Radius	{ length	0.80	0.92	0.74	0.86	0.97	0.82	0.85
	{ weight	0.007	0.010	0.006	0.008	0.011	0.0085	0.0084

Tenth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average	
Sex	♀	♀	♂	♀	♀	♂		
Body	{ length	6.7	6.7	6.8	6.2	7.3	7.3	6.8
	{ weight	10.7	13.0	10.5	8.3	15.4	14.3	12.0
Spinal-length	4.4	4.2	4.2	3.9	4.9	4.4	4.3	
Tail-length	3.2	3.8	3.4	3.3	4.1	4.0	3.6	
Femur	{ length	1.00	1.10	1.07	1.00	1.18	1.20	1.09
	{ weight	0.032	0.040	0.037	0.032	0.054	0.051	0.041
Tibia	{ length	1.11	1.25	1.20	1.12	1.33	1.40	1.235
	{ weight	0.024	0.030	0.025	0.023	0.038	0.039	0.030
Humerus	{ length	1.00	1.07	1.03	0.98	1.12	1.12	1.05
	{ weight	0.028	0.031	0.033	0.028	0.046	0.046	0.035
Ulna	{ length	1.10	1.16	1.14	1.05	1.32	1.33	1.18
	{ weight	0.012	0.014	0.012	0.012	0.019	0.019	0.015
Radius	{ length	0.85	0.90	0.85	0.88	0.98	1.01	0.91
	{ weight	0.008	0.008	0.007	0.007	0.012	0.012	0.009

Eleventh Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♂	♀	♂	♀	♀	
Body { length	6.8	7.8	7.2	6.8	7.6	7.4	7.3
Body { weight	11.5	19.0	14.0	11.2	17.8	14.8	14.7
Spinal-length	4.4	4.8	4.4	4.5	4.9	4.8	4.6
Tail-length	3.2	4.0	4.6	4.0	4.3	4.1	4.0
Femur { length	1.00	1.21	1.16	1.08	1.18	1.20	1.14
Femur { weight	0.032	0.055	0.048	0.040	0.062	0.053	0.048
Tibia { length	1.13	1.42	1.34	1.25	1.47	1.42	1.34
Tibia { weight	0.025	0.045	0.034	0.031	0.045	0.049	0.035
Humerus { length	1.00	1.13	1.10	1.03	1.17	1.15	1.10
Humerus { weight	0.028	0.046	0.038	0.032	0.050	0.045	0.040
Ulna { length	1.10	1.40	1.26	1.17	1.36	1.34	1.27
Ulna { weight	0.011	0.021	0.015	0.012	0.022	0.019	0.017
Radius { length	0.80	1.05	0.95	0.96	1.05	1.01	0.97
Radius { weight	0.0075	0.014	0.009	0.009	0.015	0.011	0.011

Twelfth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♀	♀	♂	♂	♂	
Body { length	7.6	7.8	7.5	6.6	8.2	7.6	7.6
Body { weight	16.0	19.0	14.8	11.0	18.3	15.5	15.8
Spinal-length	4.7	4.9	4.5	4.2	4.9	4.9	4.7
Tail-length	3.9	4.4	4.7	3.2	4.6	4.5	4.2
Femur { length	1.13	1.26	1.20	1.08	1.28	1.26	1.20
Femur { weight	0.051	0.066	0.049	0.040	0.066	0.057	0.055
Tibia { length	1.31	1.50	1.40	1.15	1.53	1.48	1.40
Tibia { weight	0.035	0.049	0.035	0.025	0.053	0.043	0.040
Humerus { length	1.10	1.10	1.08	1.02	1.21	1.20	1.12
Humerus { weight	0.041	0.052	0.037	0.034	0.055	0.048	0.0445
Ulna { length	1.24	1.40	1.24	1.17	1.40	1.40	1.31
Ulna { weight	0.017	0.020	0.015	0.014	0.021	0.020	0.018
Radius { length	0.94	1.08	0.95	0.86	1.06	1.03	1.00
Radius { weight	0.010	0.014	0.011	0.010	0.015	0.013	0.012

Thirteenth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average	
Sex	♀	♀	♂	♂	♀	♂		
Body	length	8.0	8.4	7.5	7.8	8.4	7.8	8.0
	weight	18.1	23.4	15.2	18.5	21.8	18.6	19.3
Spinal-length	5.2	5.4	4.7	4.8	5.2	5.0	5.05	
Tail-length	4.5	4.9	4.5	4.5	5.1	5.0	4.9	
Femur	length	1.26	1.32	1.20	1.22	1.30	1.31	1.27
	weight	0.066	0.075	0.061	0.054	0.076	0.067	0.0665
Tibia	length	1.50	1.61	1.43	1.47	1.55	1.52	1.51
	weight	0.051	0.063	0.055	0.042	0.058	0.057	0.054
Humerus	length	1.21	1.25	1.13	1.13	1.23	1.22	1.195
	weight	0.053	0.060	0.041	0.045	0.072	0.050	0.055
Ulna	length	1.42	1.48	1.28	1.40	1.50	1.45	1.42
	weight	0.022	0.026	0.019	0.017	0.026	0.022	0.022
Radius	length	1.10	1.13	1.00	1.03	1.13	1.10	1.08
	weight	0.017	0.018	0.011	0.012	0.017	0.015	0.015

Fourteenth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average	
Sex	♂	♂	♂	♀	♀	♀		
Body	length	8.5	9.0	7.6	8.1	8.6	7.9	8.3
	weight	23.3	27.0	16.8	19.7	19.3	18.2	20.7
Spinal-length	5.5	5.6	5.0	5.0	5.5	5.0	5.3	
Tail-length	5.3	5.3	5.0	4.8	5.5	4.8	5.1	
Femur	length	1.41	1.45	1.23	1.30	1.36	1.30	1.34
	weight	0.084	0.096	0.057	0.061	0.081	0.064	0.074
Tibia	length	1.60	1.71	1.43	1.58	1.67	1.55	1.59
	weight	0.070	0.069	0.045	0.048	0.065	0.052	0.058
Humerus	length	1.30	1.32	1.13	1.18	1.28	1.21	1.24
	weight	0.069	0.071	0.040	0.045	0.060	0.051	0.058
Ulna	length	1.60	1.57	1.40	1.42	1.52	1.49	1.50
	weight	0.030	0.031	0.019	0.017	0.026	0.022	0.024
Radius	length	1.17	1.20	1.04	1.10	1.12	1.11	1.12
	weight	0.020	0.023	0.010	0.011	0.015	0.014	0.0155

Fifteenth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average	
Sex	♀	♀	♂	♂	♀	♀		
Body	length	8.2	9.8	8.5	8.8	8.7	8.3	8.7
	weight	22.8	31.5	21.1	23.2	20.1	19.3	23.0
Spinal-length	5.2	6.6	5.1	5.8	5.5	5.3	5.6	
Tail-length	5.4	6.0	5.3	5.3	6.3	5.5	5.6	
Femur	length	1.40	1.47	1.30	1.40	1.43	1.41	1.40
	weight	0.082	0.102	0.077	0.077	0.089	0.082	0.085
Tibia	length	1.67	1.80	1.60	1.67	1.77	1.70	1.70
	weight	0.064	0.081	0.061	0.060	0.073	0.062	0.067
Humerus	length	1.29	1.37	1.21	1.27	1.31	1.30	1.29
	weight	0.066	0.078	0.052	0.055	0.068	0.060	0.063
Ulna	length	1.55	1.61	1.44	1.53	1.52	1.60	1.54
	weight	0.027	0.032	0.020	0.025	0.027	0.027	0.026
Radius	length	1.16	1.23	1.10	1.13	1.20	1.18	1.17
	weight	0.018	0.024	0.015	0.014	0.016	0.017	0.017

Twentieth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average	
Sex	♀	♀	♀	♀	♀	♀		
Body	length	9.4	9.0	9.5	9.4	9.0	9.3	9.3
	weight	22.4	20.3	23.2	22.7	20.0	22.0	21.8
Spinal-length	6.0	5.2	6.7	6.0	5.5	6.0	5.9	
Tail-length	6.4	6.5	7.0	6.8	6.3	6.9	6.65	
Femur	length	1.50	1.43	1.52	1.47	1.48	1.45	1.475
	weight	0.094	0.078	0.102	0.098	0.089	0.095	0.093
Tibia	length	1.90	1.78	1.90	1.81	1.82	1.90	1.85
	weight	0.076	0.071	0.085	0.081	0.080	0.080	0.079
Humerus	length	1.30	1.25	1.35	1.32	1.36	1.32	1.32
	weight	0.058	0.063	0.065	0.061	0.065	0.058	0.062
Ulna	length	1.70	1.56	1.64	1.63	1.62	1.57	1.62
	weight	0.025	0.020	0.028	0.028	0.027	0.024	0.025
Radius	length	1.23	1.20	1.25	1.23	1.23	1.20	1.22
	weight	0.016	0.014	0.017	0.015	0.017	0.017	0.016

Twenty-fifth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average	
Sex	♀	♀	♂	♂	♂	♂		
Body	{ length	9.3	9.3	10.0	10.4	10.5	10.4	10.0
	{ weight	26.0	28.6	30.3	32.2	29.2	31.3	29.6
Spinal-length	6.0	6.0	6.8	6.9	6.3	6.2	6.4	
Tail-length	8.6	8.9	9.0	8.6	7.7	7.8	8.4	
Femur	{ length	1.60	1.60	1.70	1.71	1.63	1.63	1.65
	{ weight	0.101	0.106	0.119	0.123	0.113	0.118	0.113
Tibia	{ length	2.00	2.30	2.10	2.10	2.01	2.03	2.09
	{ weight	0.075	0.082	0.098	0.093	0.090	0.088	0.088
Humerus	{ length	1.31	1.32	1.43	1.43	1.45	1.30	1.37
	{ weight	0.054	0.059	0.070	0.066	0.075	0.067	0.065
Ulna	{ length	1.60	1.70	1.75	1.80	1.73	1.73	1.72
	{ weight	0.019	0.027	0.030	0.029	0.029	0.029	0.027
Radius	{ length	1.25	1.28	1.36	1.46	1.32	1.32	1.33
	{ weight	0.015	0.014	0.020	0.018	0.019	0.020	0.018

Thirtieth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average	
Sex	♂	♂	♀	♂	♂	♂		
Body	{ length	10.3	11.5	10.5	11.3	9.8	12.0	10.9
	{ weight	34.4	42.0	39.0	52.4	33.0	53.0	42.3
Spinal-length	7.0	7.8	7.1	7.2	7.0	8.5	7.5	
Tail-length	9.5	9.9	8.0	9.2	8.4	9.2	9.0	
Femur	{ length	1.87	1.91	1.72	1.92	1.72	2.00	1.86
	{ weight	0.129	0.175	0.143	0.187	0.131	0.195	0.16
Tibia	{ length	2.20	2.30	2.15	2.36	2.10	2.50	2.27
	{ weight	0.111	0.131	0.116	0.141	0.100	0.150	0.125
Humerus	{ length	1.53	1.60	1.48	1.55	1.50	1.65	1.55
	{ weight	0.068	0.091	0.086	0.097	0.080	0.100	0.087
Ulna	{ length	1.70	1.93	1.80	1.90	1.80	1.98	1.85
	{ weight	0.025	0.039	0.034	0.044	0.031	0.042	0.036
Radius	{ length	1.40	1.51	1.41	1.50	1.42	1.53	1.46
	{ weight	0.020	0.031	0.024	0.029	0.021	0.027	0.025

Table II.

First Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♂	♂	♂	♂	♂	$\frac{\text{♂}}{6} \frac{\text{♀}}{0}$
Body-weight	4.9	5.3	5.6	5.3	5.9	5.1	5.4
Body-length	4.9	5.0	5.1	5.0	5.6	4.9	5.1
Stomach	0.8	0.8	0.9	0.7	1.2	1.0	0.9
Small intestine	16.5	21.5	20.8	20.0	24.5	18.0	20.2
Cecum	0.3	0.3	0.4	0.3	0.7	0.5	0.4
Large intestine	2.5	2.5	3.2	3.0	3.0	3.0	2.9

Second Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♂	♀	♀	♀	♀	$\frac{\text{♂}}{1} \frac{\text{♀}}{5}$
Body-weight	4.0	5.5	5.6	5.0	4.5	4.4	4.8
Body-length	4.7	5.0	5.4	4.9	5.3	5.0	5.1
Stomach	0.8	0.8	1.0	0.8	1.2	1.0	0.9
Small intestine	18.0	18.0	21.3	20.5	24.6	22.0	20.8
Cecum	0.3	0.3	0.4	0.4	0.8	0.6	0.5
Large intestine	2.5	2.5	3.2	2.5	3.0	3.0	2.8

Third Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♀	♂	♀	♀	♀	$\frac{\text{♂}}{1} \frac{\text{♀}}{5}$
Body-weight	4.5	6.5	6.6	5.7	6.3	5.0	5.8
Body-length	5.1	5.5	5.5	5.3	5.5	5.2	5.4
Stomach	1.0	1.2	1.1	0.8	1.3	1.1	1.1
Small intestine	19.0	25.4	21.5	21.0	24.6	22.0	22.3
Cecum	0.3	0.5	0.4	0.4	0.8	0.6	0.5
Large intestine	3.0	3.6	3.5	3.0	3.0	3.3	3.2

Fourth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♀	♂	♀	♀	♀	$\frac{\text{♂}}{2} \quad \frac{\text{♀}}{4}$
Body-weight	7.3	9.5	6.7	6.2	6.8	5.3	6.9
Body-length	5.6	6.5	5.6	5.5	5.5	5.4	5.7
Stomach	1.3	1.2	1.1	0.8	1.3	1.1	1.1
Small intestine	29.5	24.0	24.0	20.8	24.7	22.0	24.1
Cecum	0.5	0.5	0.5	0.4	0.8	0.7	0.6
Large intestine	3.5	4.0	4.0	3.5	3.1	3.4	3.6

Fifth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♀	♀	♀	♀	♀	$\frac{\text{♂}}{1} \quad \frac{\text{♀}}{5}$
Body-weight	7.4	9.5	5.9	6.6	7.4	5.8	7.1
Body-length	5.7	6.5	5.5	5.6	5.6	5.2	5.7
Stomach	1.3	1.3	1.0	1.0	1.3	1.3	1.2
Small intestine	30.4	26.0	22.5	23.0	25.5	21.0	24.7
Cecum	0.6	0.6	0.5	0.5	0.9	0.9	0.7
Large intestine	3.6	4.0	3.5	4.0	3.5	4.0	3.8

Sixth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♀	♀	♀	♂	♂	$\frac{\text{♂}}{3} \quad \frac{\text{♀}}{3}$
Body-weight	8.8	9.3	7.4	7.2	7.5	5.2	7.6
Body-length	6.1	6.5	5.7	6.0	5.6	5.4	5.9
Stomach	1.4	1.3	1.2	1.0	1.3	1.2	1.2
Small intestine	31.0	27.0	22.0	24.0	24.5	22.8	25.2
Cecum	0.6	0.6	0.5	0.6	0.8	0.9	0.7
Large intestine	4.0	4.0	4.0	4.0	3.5	3.5	3.8

Seventh Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♂	♂	♂	♀	♀	$\frac{\text{♂}}{3}$ $\frac{\text{♀}}{3}$
Body-weight	9.6	10.5	6.8	8.0	11.7	8.2	9.1
Body-length	6.2	7.0	5.9	6.0	6.5	5.7	6.2
Stomach	1.6	1.3	1.3	1.1	1.5	1.5	1.4
Small intestine	31.5	28.3	23.5	23.8	36.8	26.5	28.4
Cecum	0.7	0.6	0.5	0.6	0.8	0.7	0.6
Large intestine	4.5	4.7	4.0	4.2	5.2	4.5	4.5

Eighth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♂	♂	♀	♀	♂	$\frac{\text{♂}}{4}$ $\frac{\text{♀}}{2}$
Body-weight	9.3	10.3	7.9	9.1	11.8	7.6	9.3
Body-length	6.3	6.8	5.9	6.3	6.6	5.8	6.3
Stomach	1.6	1.2	1.5	1.1	1.3	1.3	1.3
Small intestine	32.4	26.0	26.0	25.7	29.8	26.0	27.7
Cecum	0.8	0.5	0.7	0.6	0.8	0.6	0.7
Large intestine	4.6	5.0	4.2	4.3	4.2	4.0	4.4

Ninth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♂	♂	♂	♀	♂	$\frac{\text{♂}}{5}$ $\frac{\text{♀}}{1}$
Body-weight	9.4	13.3	12.5	9.2	13.5	9.5	11.2
Body-length	6.4	6.9	6.9	6.4	7.0	6.3	6.7
Stomach	1.5	1.5	1.4	1.0	1.3	1.0	1.3
Small intestine	32.0	31.0	25.0	24.5	32.0	28.0	28.8
Cecum	0.7	0.5	0.9	0.6	0.8	0.6	0.7
Large intestine	4.5	6.0	5.0	4.5	5.0	4.5	4.9

Tenth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♀	♂	♀	♀	♂	$\frac{\text{♂}}{2}$ $\frac{\text{♀}}{4}$
Body-weight	10.7	13.0	10.5	8.3	15.4	14.3	12.0
Body-length	6.7	6.7	6.8	6.2	7.3	7.3	6.8
Stomach	1.7	1.5	1.3	1.2	1.2	1.5	1.4
Small intestine	32.8	30.0	25.5	19.5	30.5	28.0	27.6
Cecum	0.8	0.5	0.8	0.6	0.8	0.6	0.7
Large intestine	4.7	5.0	4.5	4.5	4.5	5.0	4.7

Eleventh Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♂	♀	♂	♀	♀	$\frac{\text{♂}}{2}$ $\frac{\text{♀}}{4}$
Body-weight	11.5	19.0	14.0	11.2	17.8	14.8	14.7
Body-length	6.8	7.8	7.2	6.8	7.6	7.4	7.3
Stomach	1.8	1.2	1.4	1.3	1.3	1.3	1.4
Small intestine	32.1	32.0	27.0	25.6	31.0	30.5	29.7
Cecum	0.7	1.0	0.8	0.9	0.9	0.8	0.9
Large intestine	4.9	6.0	5.0	4.5	5.0	5.0	5.1

Twelfth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♀	♀	♂	♂	♂	$\frac{\text{♂}}{4}$ $\frac{\text{♀}}{2}$
Body-weight	16.0	19.0	14.8	11.0	18.3	15.5	15.8
Body-length	7.6	7.8	7.5	6.6	8.2	7.6	7.6
Stomach	1.8	2.0	1.4	1.3	1.3	1.2	1.5
Small intestine	31.5	37.0	29.0	28.5	34.0	29.0	31.5
Cecum	0.8	1.0	0.8	0.9	0.9	1.0	0.9
Large intestine	6.5	6.0	5.0	4.5	5.0	6.0	5.5

Thirteenth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♀	♂	♂	♀	♂	$\frac{\text{♂}}{3}$ $\frac{\text{♀}}{3}$
Body-weight	18.1	23.4	15.2	18.5	21.8	18.6	19.3
Body-length	8.0	8.4	7.5	7.8	8.4	7.8	8.0
Stomach	1.5	2.1	1.3	1.8	1.4	1.3	1.6
Small intestine	32.5	37.0	28.5	34.0	35.5	31.5	33.2
Cecum	0.9	0.9	1.0	1.0	1.0	1.0	1.0
Large intestine	5.0	6.0	5.5	6.0	5.5	5.5	5.6

Fourteenth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♂	♂	♀	♀	♀	$\frac{\text{♂}}{3}$ $\frac{\text{♀}}{3}$
Body-weight	23.3	27.0	16.8	19.7	19.3	18.2	20.7
Body-length	8.5	9.0	7.6	8.1	8.6	7.9	8.3
Stomach	1.5	2.1	1.4	1.5	1.4	1.5	1.6
Small intestine	34.0	41.0	37.0	35.0	34.9	34.5	36.1
Cecum	1.0	1.2	1.0	1.2	1.0	1.3	1.1
Large intestine	6.0	6.5	5.0	6.0	5.6	5.5	5.8

Fifteenth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♀	♂	♂	♀	♀	$\frac{\text{♂}}{2}$ $\frac{\text{♀}}{4}$
Body-weight	22.8	31.5	21.2	23.2	20.1	19.3	23.0
Body-length	8.2	9.8	8.5	8.8	8.7	8.3	8.7
Stomach	1.8	1.8	1.7	1.4	1.2	1.3	1.5
Small intestine	40.0	37.0	44.0	39.0	31.0	33.0	37.3
Cecum	1.0	1.0	1.0	1.2	0.9	1.1	1.1
Large intestine	6.0		6.0	7.0	7.0	6.0	6.5

Twentieth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♀	♀	♀	♀	♀	$\frac{\text{♂}}{0} \frac{\text{♀}}{6}$
Body-weight	22.4	20.3	23.2	22.7	20.0	22.0	21.8
Body-length	9.4	9.0	9.5	9.4	9.0	9.3	9.3
Stomach	2.0	1.7	1.7	2.0	2.0	2.0	1.9
Small intestine	42.0	37.0	36.0	34.5	46.0	39.0	38.1
Cecum	1.2	1.3	1.3	1.2	1.6	1.3	1.3
Large intestine	6.0	8.0	7.0	6.5	7.0	7.0	6.9

Twenty-fifth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♀	♀	♂	♂	♂	♂	$\frac{\text{♂}}{4} \frac{\text{♀}}{2}$
Body-weight	26.0	28.6	30.3	32.2	29.2	31.3	29.6
Body-length	9.3	9.3	10.0	10.4	10.5	10.4	10.0
Stomach	2.3	2.3	2.5	2.2	2.3	2.2	2.3
Small intestine	42.7	43.0	52.0	51.0	41.0	53.2	47.2
Cecum	1.3	1.5	1.5	1.4	1.8	1.5	1.5
Large intestine	5.5	6.0	7.0	8.0	9.0	8.0	7.3

Thirtieth Day after Birth.

Nos. of Animal	I	II	III	IV	V	VI	Average
Sex	♂	♂	♀	♂	♂	♂	$\frac{\text{♂}}{5} \frac{\text{♀}}{1}$
Body-weight	34.4	42.6	39.0	52.4	33.0	53.0	42.3
Body-length	10.3	11.5	10.5	11.3	9.8	12.0	10.9
Stomach	2.8	2.3	2.4	2.8	2.5	2.5	2.6
Small intestine	41.0	48.0	51.0	63.0	61.5	57.0	53.6
Cecum	2.0	1.5	2.0	3.0	2.5	2.8	2.3
Large intestine	8.5	12.0	8.0	9.0	8.5	10.0	9.3

The mean-weight and -length of both the alimentary canal and the main bones of the above six groups are as follows :—

Table III.

The mean weight and length of above six groups.

Day	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	20th	25th	30th
Body-length	5.1	5.1	5.4	5.7	5.7	5.9	6.2	6.3	6.7	6.8	7.3	7.6	8.0	8.3	8.7	9.3	10.0	10.9
Body-weight	5.4	4.8	5.8	6.9	7.1	7.6	9.1	9.3	11.2	12.0	14.7	15.8	19.3	20.7	23.0	21.8	29.6	42.3
Spinal-length	3.3	3.3	3.5	3.75	3.7	3.8	3.9	3.9	4.2	4.3	4.6	4.7	5.05	5.3	5.6	5.9	6.4	7.5
Tail-length	1.7	1.8	2.1	2.5	2.7	2.7	2.95	2.9	3.4	3.6	4.0	4.2	4.9	5.1	5.6	6.65	8.4	9.0
Femur-length	0.68	0.665	0.76	0.83	0.86	0.88	0.97	0.96	1.04	1.09	1.14	1.20	1.27	1.34	1.40	1.475	1.65	1.86
Femur-weight	0.0094	0.009	0.013	0.0185	0.020	0.023	0.029	0.029	0.037	0.041	0.048	0.055	0.0665	0.074	0.085	0.093	0.113	0.16
Tibia-length	0.68	0.68	0.80	0.86	0.91	0.98	1.06	1.065	1.16	1.235	1.34	1.40	1.51	1.59	1.70	1.85	2.09	2.27
Tibia-weight	0.0058	0.0058	0.0084	0.0126	0.0125	0.0165	0.019	0.0205	0.0265	0.030	0.035	0.040	0.054	0.058	0.067	0.079	0.088	0.125
Humerus-length	0.71	0.73	0.79	0.85	0.87	0.915	0.96	0.96	1.02	1.05	1.10	1.12	1.195	1.24	1.29	1.32	1.37	1.55
Humerus-weight	0.0104	0.0104	0.012	0.017	0.0194	0.022	0.026	0.026	0.033	0.035	0.040	0.0445	0.055	0.058	0.063	0.062	0.065	0.087
Ulna-length	0.73	0.72	0.81	0.91	0.95	0.98	1.03	1.05	1.16	1.18	1.27	1.31	1.42	1.50	1.54	1.62	1.72	1.85
Ulna-weight	0.0035	0.0036	0.0053	0.0074	0.0082	0.0081	0.013	0.0103	0.014	0.015	0.017	0.018	0.022	0.024	0.026	0.025	0.027	0.036
Radius-length	0.55	0.55	0.61	0.66	0.70	0.745	0.80	0.82	0.85	0.91	0.97	1.00	1.08	1.12	1.17	1.22	1.33	1.46
Radius-weight	0.002	0.0018	0.003	0.0044	0.0051	0.0053	0.007	0.006	0.0084	0.009	0.011	0.012	0.015	0.0155	0.017	0.016	0.018	0.025

Table IV.

Days after birth	Body length	Stomach length	Small intestine length	Cecum length	Large intestine length
1st	5.1	0.9	20.2	0.4	2.9
2nd	5.1	0.9	20.8	0.5	2.8
3rd	5.4	1.1	22.3	0.5	3.2
4th	5.7	1.1	24.1	0.6	3.6
5th	5.7	1.2	24.7	0.7	3.8
6th	5.9	1.2	25.2	0.7	3.8
7th	6.2	1.4	28.4	0.6	4.5
8th	6.3	1.3	27.7	0.7	4.4
9th	6.7	1.3	28.8	0.7	4.9
10th	6.8	1.4	27.6	0.7	4.7
11th	7.3	1.4	29.7	0.9	5.1
12th	7.6	1.5	31.5	0.9	5.5
13th	8.0	1.6	33.2	1.0	5.6
14th	8.3	1.6	36.1	1.1	5.8
15th	8.7	1.5	37.3	1.1	6.5
20th	9.3	1.9	38.1	1.3	6.9
25th	10.0	2.3	47.2	1.5	7.3
30th	10.9	2.6	53.6	2.3	9.3

Still the following graphs clearly illustrate the above tables :—

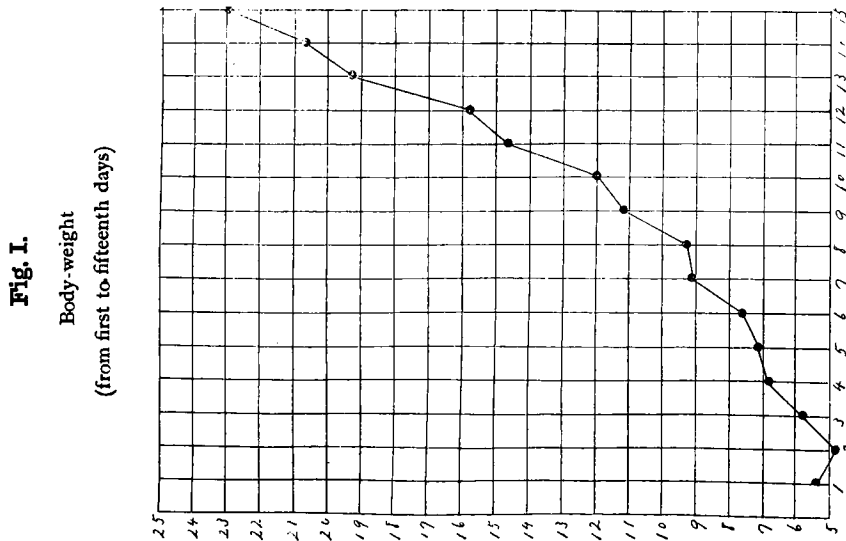


Fig. III.
Lengths of
Body, Spine and Tail

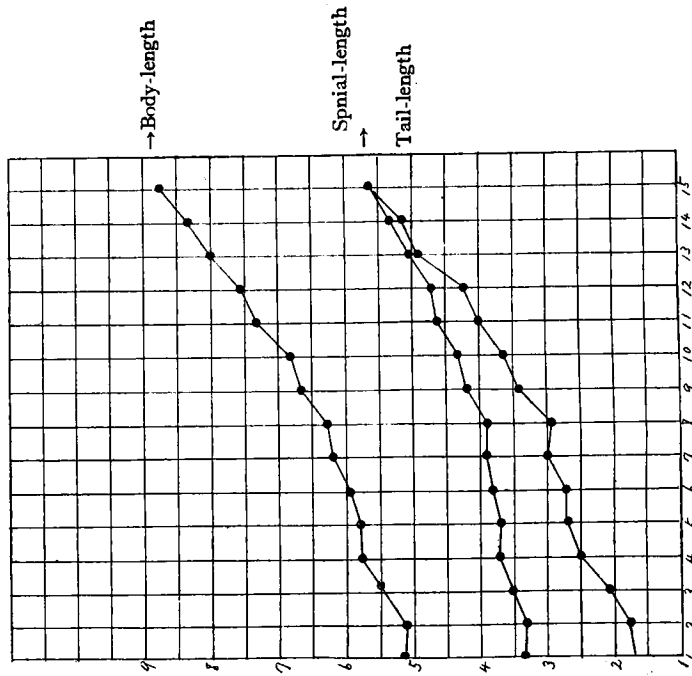
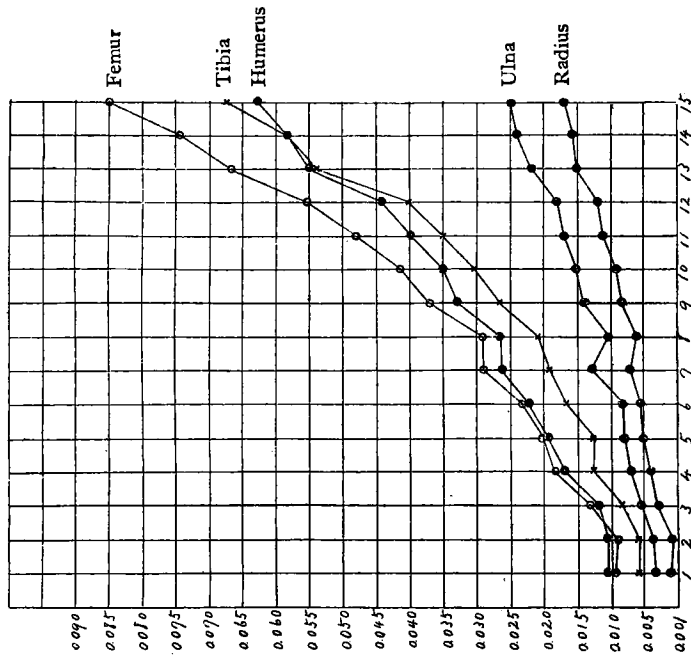
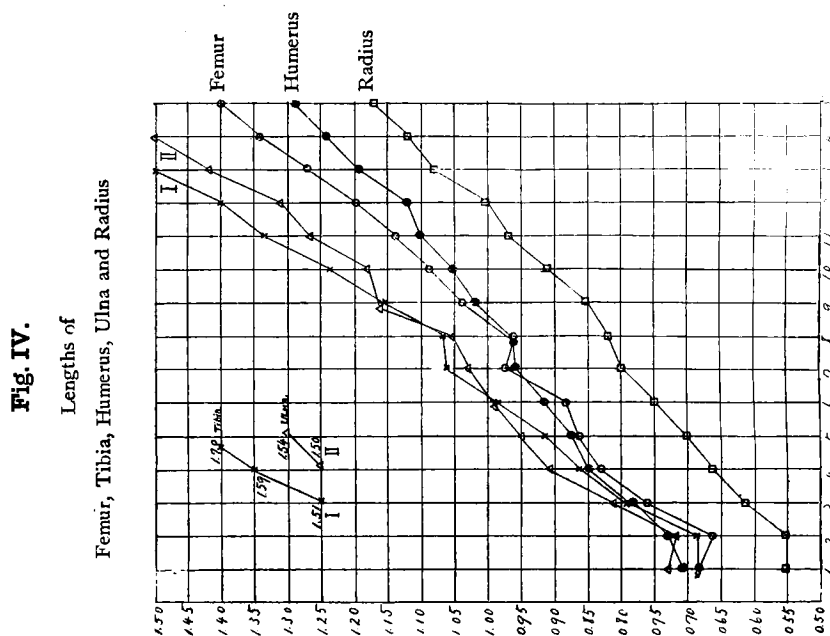


Fig. II.
Weights of
Femur, Tibia, Humerus, Ulna and Radius





The following table in human beings is shown for comparison :—

Average net weight and height of healthy children (in America) from birth to three years. (by Holt and Howland¹¹)

	Weight in kgm.	Height in c.m.		Weight in kgm.	Height in c.m.
Birth :	{ boys 3.43	52.5	2 years :	{ boys 12.27	85.1
	{ girls 3.26	52.0		{ girls 11.81	83.8
6 months :	{ boys 7.26	67.4	2 ½ years :	{ boys 13.50	90.2
	{ girls 7.03	66.1		{ girls 13.04	89.0
12 months :	{ boys 9.54	75.0	3 years :	{ boys 14.54	94.0
	{ girls 9.31	73.7		{ girls 14.09	92.8
18 months :	{ boys 11.13	80.0			
	{ girls 10.77	78.8			

In our cases, the mean body weight on the first day after birth measures 5.4 gms. Donaldson¹ affirmed that the average weight of 40 young male albino rats at birth is 5.4 gms. same as in our cases and that of 17 females is 5.2 gms. Jackson's larger¹⁰ series in 63 young male albino rats is given as 5.13 gms. and that of 66 females is 4.89 gms. and the smaller series in 44 young males is given as 5.06 gms. and that of 43 females is 4.82 gms.

The body weight given above covers the period in the life of the animal from the time of birth up to one day. As previously mentioned, to obtain the real birth-weight, it is necessary to weigh the animals as soon as they were born and before they have suckled. With this care, King⁵ measured the birth-weight; the average body-weight of stock albion males at birth is 4.6 gms. and that of females is 4.5 gms. The male always exceeds the female in body-weight at all ages, and this difference becomes more marked as the animals grow older, but in our thirty days' observation, there is not remarkable difference in the two sexes. On the second day after birth, it is seen a slight loss of the body-weight. This is of much interest. In human beings, the attention was first drawn by Burdach⁹ and Chaussier⁹ a century ago, that during the first few days after birth there is normally a considerable loss of the infant's body-weight. Feldman⁹ cited that in animals it was said that there is no such loss but Sadofsky among others, found a constant loss in all animals examined. He still stated that the factor causing the loss of weight in the new-born infant in the human beings are :—

- a. Mechanical
- b. physiological.

For the former (a) he cited Sadofsky's figures as follows :—

Days	Amount of milk ingested in 24 hours (in gm.)		Infants gain or loss in weight (in gm.)		Meconium and Urine (in gm.)	
	Fed by mother	Fed by wet-nurse	Fed by mother	Fed by wet-nurse	Fed by mother	Fed by wet-nurse
1st	0. to 9.	37. to 99.	-79. to -174.	-50. to -165.	33. to 51.	37. to 119.
2nd	4. to 49.	130. to 201.	-86. to -150.	+16. to - 49.	30. to 82.	53. to 127.
3rd	32. to 106.	81. to 264.	-13. to - 36.	+32. to + 57.	22. to 59.	0. to 128.

For the latter (b), he viewed that as soon as the infant begins to breathe, oxidation of body tissues commences. "The substance burned off disappears in the form of CO₂ and H₂O." He cited Benedict and Tulbot's consideration as follows:— The daily heat output of a resting new-born baby of 3.75 kgms. is about 170 calories, corresponding to the oxidation of about 17 gms. of fat, or of about 40 gms. of carbohydrate. "But as the total loss of weight during the first few days is 200 to 300 gms, it is clear that the oxidation of fat, or even of carbohydrate can account only for a small portion of the loss." "The relatively small amount of protein burned up may be disregarded, and hence one concludes that the principal loss of weight is due to the loss of a large amount of water from the lungs and skin, the same as occurs in the earlier stages of experimental inanition in animals." On the seventh day after birth, it reaches to 9.1 gms. in our cases.

Donaldson's¹ series in 11 males is 9.2 gms. and that of 8 females, 8.7 gms. Jackson's¹⁰ series in 86 males is 10.57 gms. and that of 91 females is 10.39 gms. On the thirtieth day, the body-weight becomes nearly eight times as heavy as that of the first day after birth. In human beings, the weight of the new-born infant in both sexes is in average 3,000 gms. and it doubles itself at about fifth to sixth month after birth and trebles itself at the 12th month. At five years old, it becomes five times as heavy as that of the new-born infant and ten times, at the 13th to 14th year in boys and at the 12th to 13th year in girls. Holt and Howland¹¹ described that the weight at birth as following figures is from consecutive cases taken in nearly equal proportion from the records of the Nursery and Child's Hospital, the Sloane Hospital, and the New York Infant Asylum and includes only fully-term children:—

Average weight of 568 females.....	3,260 gms.
„ „ 590 males.	3,400 gms.
Average in both sexes, 1,158.....	3,330 gms.

The weights of the five main long bones are shown clearly in graph-figure II. On the first and second day after birth, the weight of the humerus is in the highest and those of the femur, tibia, ulna and radius are followed in turn. On the third day the femur outstrips the humerus and the others are in the same proportion. On the fourteenth day the weight of humerus is situated in the same line with the tibia, on the fifteenth day, the former is outstripped by the latter and the femur, is still in the highest. Thus, after the fifteenth day, the femur retains the highest position, followed by tibia, humerus, ulna and radius in turn, and this order will not alter as long as it normally develops to the adult-rat. In human beings, the order of the weight of the above five bones is as follows:—

The femur, tibia, humerus, ulna and radius and this order is not alter as long as it is normally developed.

The body-length as well as the lengths of five bones are well illustrated in graph-figures III and IV. Hatai³ measured the distance between the tip of the nose and the anal opening for the body-length and still the distance between the tip of the nose and the tip of the tail for the total length. We measured the distance between the tip of the nose and the proximal end of the tail for the body-length as previously mentioned. For the total length, there is no question to afford for discussion. In comparing the body-length of the above two, the former is a little longer than the latter, as the anus is opened rather in the region of the tail slightly apart from the proximal end of the tail. If the proximal end of the tail is used for the cardinal point on the body-length as in our

cases it is very convenient and reasonable in measuring the tail- and spinal-lengths. By Hatai's way it may be hard to determine the length of the tail and spine. In figure III the body-length is always superior to that of the tail and spine. The length of the tail is shorter than that of the spine until they have become in the same length on the fifteenth day, and later on the former outstrips the latter. On the thirtieth day, the body-length is 10.9 c. m. and those of the tail and spine are measured 9.0 and 7.5 c. m. respectively.

Holt and Howland¹¹ described that on the height of the human new-born infants born at term taken in about equal number, from the records of the New York Infant Asylum and the Sloane Hospital gave the following results:—

Average length of 231 male infants born at term52.5 c.m.
 Average length of 211 females52.2 c.m.
 Total 442 infants52.35 c.m.

In observing the lengths of the five main long bones, on the first day after birth the ulna is the longest and the humerus, both the tibia and femur in the same line, and radius are followed in turn. On the second day, the humerus gains the highest and the ulna, tibia, femur and radius are followed in turn. From the third to fifth day the ulna regains the highest position and the tibia, humerus, femur and radius follow. On the sixth day, both the ulna and the tibia occupy the highest rank and the humerus, femur and radius follow to them. From the seventh up to the thirtieth day, the order is as follows; the tibia in the highest and the ulna, femur, humerus and radius accompany to it and thenceforth the tibia still takes the highest rank and the femur, ulna, humerus and radius are followed in turn as long as the animal normally develops to the adult-rat. In human new-born infant, the length of the above five bones is as follows:— by Komi-nami¹⁵, Takata¹⁷ etc.

Femur96 m.m. Tibia.....81 m.m. Humerus.....78 m.m.
 Ulna.....76 m.m. Radius63 m.m.

This order of the lengths does not alter as long as the infant develops normally. The following tables V and VI show the proportional weight and length of the five main long bones, compared with body-weight and the body-length respectively.

Table. V.

Day after birth	Body weight	Femur weight	Tibia weight	Humerus weight	Ulna weight	Radius weight
1st	1.	0.0017	0.0011	0.0019	0.0006	0.0004
2nd	1.	0.0019	0.0012	0.0022	0.0008	0.0004

Day after birth	Body weight	Femur weight	Tibia weight	Humerus weight	Ulna weight	Radius weight
3rd	1.	0.0022	0.0014	0.0020	0.0009	0.0005
4th	1.	0.0027	0.0018	0.0024	0.0011	0.0006
5th	1.	0.0028	0.0018	0.0027	0.0012	0.0007
6th	1.	0.0030	0.0022	0.0029	0.0011	0.0007
7th	1.	0.0032	0.0021	0.0029	0.0014	0.0008
8th	1.	0.0031	0.0022	0.0028	0.0011	0.0007
9th	1.	0.0033	0.0024	0.0030	0.0012	0.0008
10th	1.	0.0034	0.0025	0.0029	0.0013	0.0008
11th	1.	0.0033	0.0023	0.0027	0.0012	0.0007
12th	1.	0.0035	0.0025	0.0028	0.0011	0.0008
13th	1.	0.0034	0.0027	0.0028	0.0011	0.0008
14th	1.	0.0036	0.0028	0.0028	0.0012	0.0007
15th	1.	0.0037	0.0029	0.0027	0.0011	0.0007
20th	1.	0.0042	0.0036	0.0029	0.0011	0.0007
25th	1.	0.0038	0.0030	0.0022	0.0009	0.0006
30th	1.	0.0038	0.0030	0.0021	0.0009	0.0006

Table VI.

Day after birth	Body length	Femur length	Tibia length	Humerus length	Ulna length	Radius length
1st	1.	0.12	0.12	0.14	0.14	0.11
2nd	1.	0.13	0.13	0.13	0.14	0.11
3rd	1.	0.14	0.15	0.15	0.15	0.11
4th	1.	0.15	0.15	0.15	0.16	0.12
5th	1.	0.15	0.16	0.15	0.17	0.12
6th	1.	0.15	0.17	0.16	0.17	0.13
7th	1.	0.16	0.17	0.16	0.17	0.13
8th	1.	0.15	0.17	0.15	0.17	0.13
9th	1.	0.16	0.17	0.15	0.17	0.13
10th	1.	0.16	0.18	0.15	0.17	0.13
11th	1.	0.16	0.19	0.15	0.17	0.13
12th	1.	0.16	0.18	0.15	0.17	0.13
13th	1.	0.16	0.19	0.15	0.18	0.14
14th	1.	0.16	0.19	0.15	0.18	0.14
15th	1.	0.16	0.20	0.15	0.18	0.13
20th	1.	0.16	0.20	0.14	0.17	0.13
25th	1.	0.17	0.21	0.14	0.17	0.13
30th	1.	0.18	0.20	0.14	0.17	0.13

Considering this table, the ratio between the body-length and those of the femur and tibia is indefinite; the femur ranges from 0.12 to 0.18 and the tibia, from 0.12 to 0.20. On the contrary, the length of humerus, ulna and radius has nearly a definite proportion with the body-length. The humerus ranges from 0.14 to 0.16; the ulna, from 0.14 to 0.18 and the radius, from 0.11 to 0.14;— the average numbers are 0.148, 0.167, 0.127 respectively. Therefore, these numbers are used as the coefficients and consequently the body-length can be calculated when the length of one of these three bones is obtained.

The average total body-length; the mean body-length plus the mean tail-length is as follows :—

Day after birth	Length in c.m.	Day after birth	Length in c.m.
1st day	6.8	10th day	10.4
2nd day	6.9	11th day	11.3
3rd day	7.5	12th day	11.8
4th day	8.2	13th day	12.9
5th day	8.4	14th day	13.4
6th day	8.6	15th day	14.3
7th day	9.15	20th day	15.95
8th day	9.2	25th day	18.4
9th day	10.1	30th day	19.9

Still, the proportional length of the five bones with the total body-length is tabulated as follows :—

Table VII.

Day :	Total body-length	Femur	Tibia	Humerus	Ulna	Radius
1st	1.	0.10	0.10	0.10	0.11	0.08
2nd	1.	0.10	0.10	0.11	0.10	0.08
3rd	1.	0.10	0.11	0.11	0.11	0.08
4th	1.	0.10	0.11	0.10	0.11	0.08
5th	1.	0.10	0.11	0.10	0.11	0.08
6th	1.	0.10	0.11	0.11	0.11	0.09
7th	1.	0.11	0.11	0.10	0.11	0.09
8th	1.	0.10	0.11	0.10	0.11	0.09
9th	1.	0.10	0.11	0.10	0.11	0.08
10th	1.	0.11	0.12	0.10	0.11	0.09

Day :	Total body-length	Femur	Tibia	Humerus	Ulna	Radius
11th	1.	0.10	0.12	0.10	0.11	0.09
12th	1.	0.10	0.12	0.09	0.11	0.08
13th	1.	0.10	0.12	0.09	0.11	0.08
14th	1.	0.10	0.12	0.09	0.11	0.08
15th	1.	0.10	0.12	0.09	0.11	0.08
20th	1.	0.09	0.12	0.08	0.10	0.08
25th	1.	0.09	0.11	0.07	0.09	0.07
30th	1.	0.09	0.11	0.07	0.09	0.07

The deviation of the length of each bone to the total body-length is very slight as above tabulated and therefore, the following average number in each bone is formulated for a coefficient to calculate the total body-length or each bone-length whenever either the one of the bone-lengths or the total body-length is known.

Coefficient :	Femur	Tibia	Humerus	Ulna	Radius
	0.10	0.11	0.095	0.11	0.08

Although the coefficient of the tibia and ulna is the same, in fact, the above table shows that the former is slightly longer than the latter.

Étienne Rollet¹⁶ devised the following coefficient from which the body-length of Frenchman can be calculated (from Ando's article)

Name of bone :	man (coefficient)	woman (coefficient)	Name of bone :	man (coefficient)	woman (coefficient)
Femur	3.66	3.71	Humerus	5.06	5.22
Tibia	4.53	4.61	Radius	6.86	7.16
Fibula	4.58	4.66	Ulna	6.41	6.66

Still in human beings, Wilder and Wentworth¹⁶ affirmed that the body-length is equivalent to 3.7 times of the femur-length in man and 3.6 times in woman and the humerus is one fifth of the body-length in both sexes. (from Ando's article)

(To be continued.)