slight, it is likely the late development of M. Psoas can be attributed mainly to a lengthening of the muscle fibres, continued until a much later stage of life as contrasted with the Gastrocnemius muscle.

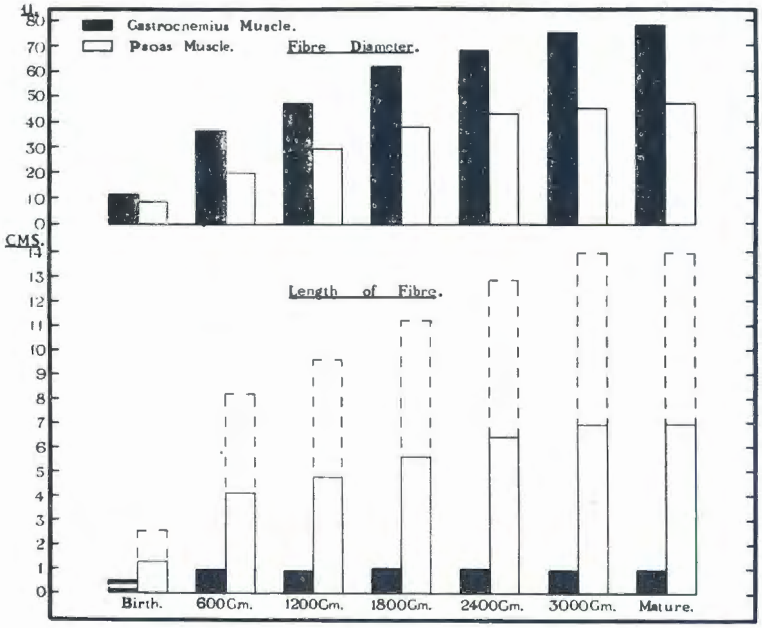

Fig. 23.—Growth of muscle fibre in length and thickness.

A factor which may contribute to a thicker measurement of fibres towards the end of the muscle, than in mid-muscle, may be the presence of innumerable fibre ends within the muscle. No idea can be presented of the relative proportion of ends to fibres at the various sites studied but it appears reasonable that there will be more intrafascicular endings in the vicinity of the mid-muscle. Hence, measurement of these endings of fibres will tend to reduce the mean fibre diameter about this locality. Owing to the great variability in thickness of the Psoas fibres it is not possible during measurement to overlook fine fibres, on the assumption that they represent fibre ends. However, the constant relationship shown to exist in the many individual Psoas muscles studied at different stages of life, seems to indicate a relatively uniform distribution of fibre endings in these different muscles. A specimen taken from the middle of the muscle is likely to give a representative figure, which is slightly less than the mean diameter considered over the whole of the muscle.

Consideration of the muscle function i.e. motile as opposed to postural, appears to account for the relative fineness of Psoas fibres as compared with Gastrocnemius fibres. When the Psoas muscle is called upon to function, relatively slight and quick movement of short duration may be presumed. A large number of small fibres facilitates the task of respiratory exchange in this type of contraction, whereas in M. Gastrocnemius more constantly in use for postural purposes there is possibly an hypertrophy of the fibres, together with the development of an increased amount of myoglobin to meet the respiratory demands.

CHAPTER V.—SUMMARY.

Attention is directed to the paucity of information regarding the morphological growth and development of muscle, particularly in connection with the microscopical elements comprising muscle. Such knowledge is of value, not only in affording a basis for studying meat quality in different species of domestic animals, but also in understanding the principles underlying the function of different muscles.

In a preliminary study, statistical methods were employed in order to ascertain suitability of sampling and measuring muscle bundles and muscle fibres. For sampling the bundle length of a muscle, a selection of ten measurements gives a sufficiently reliable mean. For sampling the diameter of muscle fibres, a selection of one hundred measurements affords a sufficiently reliable mean. Variable results are obtained when a measure of fibre diameter is calculated from cross-sections of muscle, probably due to the difficulty of cutting sections at right angles to the line of the fibres. Measurement of the cross-diameter of short lengths of muscle fibres yields more reliable results, and the values obtained are greater than those obtained by measuring fibre diameter in cross-sections. For calculating the texture of a muscle, a selection of twenty bundles provides a fair estimate of the number of fibres comprising the individual muscle bundle.

With the object of establishing the general principles of morphological development during post-natal life, the relative changes were studied in the tissues and anatomical units of M. Gastrocnemius medialis and M. Psoas major, in a series of male rabbits killed at intervals from birth to fourteen months of age. Throughout this study, the quantitative data were subjected to statistical analysis. Qualitative changes were not considered. The work is to be regarded as a preliminary investigation, with the purpose of drawing attention to the main principles involved in the growth of the muscles studied.

Both muscles undergo extensive enlargement during the growth of the rabbit. Relative to the Psoas muscle, M. Gastrocnemius makes a greater proportion of its growth in mass early in life.

Although no important differences were revealed in the mechanism of lengthening of these muscles, there is a striking difference in the manner whereby the individual muscle bundles contribute to this length increase. Whereas the Psoas muscle lengthens by virtue of a persistent increase in the length of its component bundles, Gastrocnemius bundles do not lengthen after the first two months of life. During the remainder of the lifetime of the rabbit, they do not contribute to the appreciable degree of lengthening which is still manifested by the Gastrocnemius muscle. Because of the oblique position of the bundles, thickening of these bundles appears to be the principal factor promoting this increase in length of the muscle. A change in the relative position of these bundles within the Gastrocnemius muscle tends to increase the depth of the muscle.

Both muscles vary appreciably in form. M. Gastrocnemius is short, with a pronounced belly, and is more or less uniformly deep. M. Psoas is long, with a less marked belly formation, and becomes progressively thicker along its length from origin to insertion. In the absence of information regarding the working of these muscles, the advantages of the respective variations in form in promoting muscular efficiency cannot be discussed. Contrary to expectation, the muscles do not widen or deepen during a later stage of the lifetime of the animal than they increase in length.

Within M. Gastrocnemius, the individual bundles show well-defined differential length relationships. In the young rabbit, the bundles show a progressive increase in length along the length of the muscle from its origin to its insertion. In the older rabbit, the bundles are shorter a little distance beyond the muscle origin than at the origin itself, then exhibit a similar increase in length along the muscle to its insertion. The change from one system to the other occurs between 320–480 gm. live-weight, at about 3–4 weeks of age.

In both muscles the bundles continue to thicken throughout the period of growth. Although there is only a slight difference in bundle thickness in the new-born rabbit, Gastrocnemius bundles subsequently thicken at a greater rate and become increasingly thicker than the Psoas bundles, as the animal becomes older. Hence M. Gastrocnemius assumes a coarse texture relative to the Psoas muscle.

The bundles comprising the Psoas muscle contain a larger number of individual fibres than the Gastrocnemius bundles. However, as regards muscle texture, this numerical superiority is more than offset by the greater fineness of the fibre in the Psoas bundles.

No evidence was obtained of any decrease in the number of muscle fibres during the post-natal life. Hence, the enlargement in form and the increasing weight of the muscles must be considered to be due mainly to an increase in the size of the existing muscle fibres.

Length of Gastrocnemius muscle fibre is an extremely early developing character. In the Psoas muscle the fibres continue to lengthen throughout the period of growth. This increase in the length of Psoas fibres is largely responsible for the increase in bulk of the muscle.

Within each muscle, the fibres show a well-defined thickness relationship. In M. Gastrocnemius, the fibres at birth are thinner in mid-muscle than at both ends of the muscle. At all succeeding stages the Gastrocnemius fibres are thinnest near the origin, then become progressively thicker along the muscle to a point near the muscle insertion. By contrast, the Psoas fibres are at all stages thinnest in the middle of the muscle. Presumably these differences in the relative size of the contractile units are dictated by functional considerations.

The Gastrocnemius fibres thicken to a greater degree and become much thicker than the fibres in M. Psoas. Because of the early cessation of length growth in the Gastrocnemius muscle fibre, this thickening of the component fibres largely accounts for the increase in the bulk of M. Gastrocnemius.

Any application of the data to a different species of animal, or to different muscles, will naturally require caution. However, the general principles for the two basically different classes of muscle studied are probably similar in allied types of a wide variety of muscle. The essential structural difference of these two types is the direction of the muscle fibres. In M. Gastrocnemius, of pinnate structure, the short muscle fibres join the tendon at an acute angle, whereas in the Psoas muscle, the fibres are characterised by their parallel arrangement from end to end of the muscle. For a large bulk of muscle, the general conclusions may be of value in providing a basis for further study of muscle belonging to either of these types.

No mention has been made whether the data collected for the various measurements obey Huxley's allometric law. This aspect of the work is undergoing investigation, and will be presented in a future publication. At this stage, it can be stated that a straight-line relationship in logs. can be fitted to all the data by the method of least squares (i.e. allometric growth), excepting Gastrocnemius weight, Gastrocnemius depth, and muscle length and bundle length for both muscles. However, graphical analysis by means of confidence-regions eliminates in addition a number of the measurements showing a straight-line relationship in logs. by the least squares method. Thus, the method of curve-fitting *completely* satisfying the confidence region criterion shows that M. Gastrocnemius grows in allometric manner only for fibre diameter. Similar treatment for the Psoas muscle leaves only weight, width, and depth of muscle in the category of measurements which obey Huxley's law. Until it is possible to elaborate the reasons for the discrepancies, as well as the dissimilarities in the muscles studied, no useful purpose can be served by discussion or comparison.

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TABLE A

	250	125	125	100	100
Site A.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	18·97	19·06	18·88	18·83	18·84
Standard Error	±0·2531	±0·3436	±0·3731	±0·3931	±0·4138
Standard Deviation	4·0024	3·8411	4·1709	3·9314	4·1383
Coefficient of Variability	21·1%	20·2%	22·1%	20·9%	22·0%
Site B.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	19·34	19·06	19·62	19·12	19·37
Standard Error	±0·2155	±0·3157	±0·2924	±0·3566	±0·3193
Standard Deviation	3·4069	3·5294	3·2693	3·5655	3·1930
Coefficient of Variability	17·6%	18·5%	16·7%	18·7%	16·5%
Site C.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	20·32	19·87	20·76	20·06	20·50
Standard Error	±0·2937	±0·4078	±0·4207	±0·4476	±0·4994
Standard Deviation	4·6440	4·5596	4·7031	4·4762	4·9939
Coefficient of Variability	22·9%	23·0%	22·7%	22·3%	24·4%
Site D.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	25·12	24·90	25·34	24·73	25·45
Standard Error	±0·3793	±0·5129	±0·5604	±0·5881	±0·6222
Standard Deviation	5·9975	5·7339	6·2656	5·8807	6·2221
Coefficient of Variability	23·9%	23·0%	24·7%	23·8%	24·5%
Site E.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	22·11	22·61	21·62	22·17	22·07
Standard Error	±0·2750	±0·4043	±0·3691	±0·4801	±0·4071
Standard Deviation	4·3478	4·5204	4·1266	4·8012	4·0707
Coefficient of Variability	19·7%	20·0%	19·1%	21·7%	18·4%

433-434b →

TABLE A. (cont.)

Analysis of Measurements of Fibre Diameter. Right Gastrocnemius Muscle. Rabbit No. 16. Cross-section Method (Diameter calculated from Mean of Horizontal and Vertical Dimensions of Fibre).

NUMBER OF FIBRES COMPRISING EACH SELECTION.

75	75	75	50	50	50	50	50	25
18·93 ±0·4545 3·9364 20·8%	18·21 ±0·4632 4·0111 22·0%	19·72 ±0·4594 3·9782 20·2%	19·10 ±0·5885 4·1613 21·8%	19·48 ±0·4884 3·4537 17·7%	19·62 ±0·5510 3·8960 19·9%	17·98 ±0·5514 3·8992 21·7%	18·68 ±0·6321 4·4693 23·9%	18·76 ±0·7837 3·9187 20·9%
19·27 ±0·3997 3·4615 18·0%	19·55 ±0·3997 3·4613 17·7%	18·95 ±0·3959 3·4284 18·1%	19·46 ±0·4825 3·4119 17·5%	18·82 ±0·4871 3·4445 18·3%	19·70 ±0·5184 3·6659 18·6%	19·92 ±0·4168 2·9474 14·8%	18·80 ±0·4957 3·5051 18·6%	18·72 ±0·7130 3·5651 19·0%
20·61 ±0·5083 4·4018 21·4%	21·32 ±0·5479 4·7453 23·4%	20·00 ±0·5730 4·9620 24·8%	20·00 ±0·6497 4·5937 23·0%	20·56 ±0·6122 4·3291 21·1%	21·46 ±0·7023 4·9660 23·1%	19·52 ±0·6702 4·7391 24·3%	20·04 ±0·6389 4·5174 22·5%	20·88 ±0·9752 4·8761 23·4%
24·76 ±0·6578 5·6969 23·0	25·37 ±0·7322 6·3411 25·0%	24·97 ±0·7273 6·2988 25·2%	23·32 ±0·7615 5·3849 23·1%	25·40 ±0·9398 6·6455 26·2%	25·24 ±0·8445 5·9712 23·7%	24·86 ±0·7661 5·4173 21·8%	26·78 ±0·8757 6·1918 23·1%	25·22 ±1·1500 5·7499 22·7%
21·55 ±0·5066 4·3876 20·4%	22·25 ±0·4643 4·0205 18·1%	22·01 ±0·5099 4·4159 20·1%	21·72 ±0·6055 4·2812 19·7%	21·98 ±0·5588 3·9512 18·0%	22·14 ±0·6048 4·2762 19·3%	22·10 ±0·6739 4·7649 21·6%	22·62 ±0·6433 4·5486 20·1%	22·04 ±0·8376 4·1881 19·0%

← 433-434a

433-434c →

TABLE A *(cont.)*

25	25	25	25	25	25	25	25	25
19·56 ±0·8487 4·2434 21·7%	18·32 ±0·8789 4·3943 24·0%	18·48 ±0·7419 3·7095 20·1%	19·68 ±0·9032 4·5159 23·0%	19·12 ±0·8110 4·0550 21·2%	20·04 ±0·6721 3·3606 16·8%	18·60 ±0·7572 3·7859 20·4%	19·44 ±0·8228 4·1138 21·2%	17·72 ±1·1134 5·5670 31·4%
19·96 ±0·7756 3·8781 19·4%	18·08 ±0·6926 3·4631 19·2%	19·92 ±0·7723 3·8614 19·4%	20·00 ±0·6633 3·8166 16·6%	19·76 ±0·6279 3·1395 15·9%	20·12 ±0·6009 3·0044 14·9%	18·72 ±0·6312 3·1550 16·9%	19·00 ±0·7188 3·5940 18·9%	19·12 ±0·5783 2·8914 15.1%
21·44 ±0·7748 3·8738 18·1%	19·52 ±0·8701 4·3505 22·3%	20·76 ±1·0445 5·2224 25·2%	20·44 ±0·9453 4·7265 23·1%	20·04 ±0·8669 4·3347 21·6%	20·36 ±0·8503 4·2513 20·9%	19·56 ±1·1418 5·7088 29·2%	20·00 ±0·9074 4·5369 22·7%	20·16 ±0·9603 4·8017 23.8%
26·32 ±1·3462 6·7312 25·6%	25·88 ±1·0105 5·0524 19·5%	25·08 ±1·3265 6·6327 26·5%	25·08 ±1·2164 6·0822 24·3%	24·72 ±1·1526 5·7628 23·3%	25·52 ±1·3603 6·8014 26·7%	24·32 ±1·2379 6·1895 25·5%	23·76 ±0·9261 4·6303 19·5%	25·20 ±1·3266 6·6332 26·3%
21·48 ±0·9149 4·5746 21·3%	22·28 ±0·9635 4·8177 21·6%	20·88 ±0·6839 3·4195 16·4%	21·72 ±1·0840 5·4200 25·0%	21·16 ±0·5588 2·7940 13·2%	23·68 ±0·9621 4·8107 20·3%	21·32 ±0·7631 3·8157 17·9%	23·32 ±0·8098 4·0489 17·4%	23·24 ±0·9439 4·7195 20·3%

← 433-434b

TABLE B

Analy

	250	125	125	100	100	75
Site A.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	21·84	21·01	22·67	21·55	22·00	21·75
Standard Error..............................	±0·3910	±0·5225	±0·5744	±0·6193	±0·6689	±0·6438
Standard Deviation..........................	6·182	5·841	6·422	6·193	6·689	5·575
Coefficient of Variability.....................	28·3%	27·8%	28·3%	28·7%	30·4%	25·6%
Site B.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	21·36	20·85	21·87	20·90	21·00	21·12
Standard Error..............................	±0·3609	±0·4796	±0·5374	±0·5215	±0·5802	±0·6584
Standard Deviation..........................	5·706	5·362	6·008	5·215	5·802	5·702
Coefficient of Variability.....................	26·7%	25·7%	27·5%	25·0%	27·6%	27·0%
Site C.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	24·26	24·09	24·44	24·51	24·93	24·61
Standard Error..............................	±0·4085	±0·5676	±0·5895	±0·6733	±0·6387	±0·7280
Standard Deviation..........................	6·459	6·346	6·591	6·733	6·387	6·305
Coefficient of Variability.....................	26·6%	26·3%	27·0%	27·5%	25·6%	25·6%
Site D.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	28·34	28·42	28·26	28·26	28·12	28·16
Standard Error..............................	±0·4946	±0·7171	±0·6842	±0·7632	±0·8543	±0·8948
Standard Deviation..........................	7·820	8·017	7·649	7·623	8·543	7·749
Coefficient of Variability.....................	27·6%	28·2%	27·1%	27·0%	30·4%	27·5%
Site E.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	26·85	27·42	26·28	26·21	26·66	26·96
Standard Error..............................	±0·4584	±0·6628	±0·6319	±0·6998	±0·7395	±0·7116
Standard Deviation..........................	7·248	7·410	7·065	6·998	7·395	6·163
Coefficient of Variability.....................	27·0%	27·0%	26·9%	26·7%	27·7%	22·9%

435-436b →

Table B. *(cont.)*

Analysis of Measurements of Fibre Diameter. Right Gastrocnemius Muscle. Rabbit No. 16.
Hammond's Method (Diameter measured directly across short lengths of Fibre).

NUMBER OF FIBRES COMPRISING EACH SELECTION.

75	75	50	50	50	50	50	25
21·09 ±0·7725 6·690 31·7%	23·08 ±0·7571 6·557 28·4%	21·16 ±0·8074 5·709 27·0%	22·08 ±0·7964 5·631 25·5%	21·26 ±0·9562 6·761 31·8%	21·20 ±0·9806 6·934 32·7%	23·50 ±0·8006 5·661 24·1%	22·48 ±1·1432 5·716 25·4%
20·71 ±0·6383 5·528 26·7%	21·47 ±0·6525 5·651 26·3%	21·04 ±0·7108 5·026 23·9%	20·46 ±0·8365 5·915 28·9%	21·50 ±0·7501 5·304 24·7%	22·44 ±0·9648 6·822 30·4%	21·36 ±0·7536 5·329 25·0%	20·88 ±0·7688 3·844 18·4%
23·24 ±0·7787 6·744 29·0%	24·52 ±0·7686 6·656 27·1%	25·04 ±0·9441 6·676 26·7%	23·94 ±0·8434 5·964 24·9%	23·46 ±0·9597 6·786 28·9%	23·78 ±0·8606 6·085 25·6%	25·10 ±0·9639 6·816 27·2%	23·32 ±1·1926 5·963 25·6%
28·53 ±0·8216 7·115 24·9%	27·91 ±0·9172 7·943 28·5%	28·64 ±1·3354 9·443 33·0%	28·16 ±1·0279 7·268 25·8%	27·84 ±0·9908 7·006 25·2%	29·82 ±1·1065 7·824 26·2%	27·24 ±1·0453 7·391 27·1%	27·72 ±1·5984 7·992 28·8%
26·83 ±0·8812 7·631 28·4%	26·99 ±0·8922 7·727 28·6%	26·68 ±0·9430 6·668 25·0%	27·38 ±0·9680 6·845 25·0%	25·98 ±1·0658 7·536 29·0%	27·22 ±1·1479 8·117 29·8%	27·00 ±1·0165 7·188 26·6%	2·704 ±1·3946 6·973 25·8%

← 435-436a

435-436c →

TABLE B

ION.

25	25	25	25	25	25	25	25	25
22·28 ±1·1142 5·571 25·0%	23·64 ±1·3832 6·666 28·2%	19·48 ±1·1548 . 5·774 29·6%	20·48 ±1·0880 5·440 26·6%	20·16 ±1·4126 7·063 35·0%	22·60 ±1·2570 6·285 27·8%	20·64 ±0·9396 4·698 22·8%	23·08 ±1·6236 8·118 35·2%	23·56 ±1·0328 5·164 21·9%
20·52 ±1·0002 5·001 24·4%	23·72 ±1·2254 6·127 25·8%	20·64 ±1·2396 6·198 30·0%	21·72 ±1·1726 5·863 27·0%	21·52 ±1·5046 7·523 35·0%	20·40 ±0·9166 4·583 22·5%	20·96 ±1·1084 5·542 26·4%	22·28 ±1·2826 6·413 28·8%	20·96 ±1·0700 5·350 25·5%
24·88 ±1·4274 7·137 28·7%	25·60 ±1·5450 7·725 30·2%	25·64 ±1·1516 5·758 22·5%	21·16 ±1·0594 5·297 25·0%	25·52 ±1·0570 5·285 20·7%	24·24 ±1·2320 6·160 25·4%	23·92 ±1·4696 7·348 30·7%	23·72 ±1·2172 6·086 25·7%	24·64 ±1·4304 7·152 29·0%
27·84 ±1·2092 6·046 21·7%	29·20 ±1·6022 8·011 27·4%	30·04 ±1·4646 7·323 24·4%	29·04 ±1·5794 7·897 27·2%	27·40 ±1·3552 6·776 24·7%	29·60 ±1·9622 9·811 33·1%	26·28 ±1·8678 9·339 35·5%	27·56 ±1·4888 7·444 27·0%	28·72 ±1·5018 7·509 26·1%
28·28 ±1·3898 6·949 24·6%	24·72 ±1·3070 6·535 26·4%	27·08 ±1·6216 8·108 29·9%	23·48 ±1·2834 6·417 27·3%	28·20 ±1·6432 8·216 29·1%	27·80 ±1·4910 7·455 26·8%	24·36 ±1·4478 7·239 29·7%	28·72 ±1·3436 6·718 23·4%	28·84 ±1·2958 6·479 22·5%

← 435-436b

TABLE C

	250	125	125	100	100
Site A.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	17·98	18·03	17·94	18·14	17·95
Standard Error............................	±0·2368	±0·3146	±0·3552	±0·3146	±0·4130
Standard Deviation.........................	3·7438	3·5171	3·9712	4·1463	4·1301
Coefficient of Variability.....................	20·82%	19·51%	22·14%	17·34%	23·01%
Site B.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	16·37	16·10	16·64	16·30	16·56
Standard Error............................	±0·2070	±0·2941	±0·2904	±0·3010	±0·3415
Standard Deviation.........................	3·2722	3·2884	3·2463	3·0101	3·4151
Coefficient of Variability.....................	19·99%	20·42%	19·51%	18·47%	20·62%
Site C.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	14·60	14·83	14·37	14·67	14·54
Standard Error............................	±0·2183	±0·2833	±0·3321	±0·3435	±0·3442
Standard Deviation.........................	3·4513	3·1667	3·7125	3·4350	3·4419
Coefficient of Variability.....................	23·64%	21·35%	25·83%	23·41%	23·67%
Site D.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	15·08	15·17	14·98	14·94	15·25
Standard Error............................	±0·2383	±0·3276	±0·3472	±0·3784	±0·3786
Standard Deviation.........................	3·7671	3·6627	3·8813	3·7841	3·7856
Coefficient of Variability.....................	24·98%	24·14%	25·91%	25·33%	24·82%
Site E.					
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	19·18	19·03	19·33	18·87	19·39
Standard Error............................	±0·1905	±0·2796	±0·2592	±0·3246	±0·2954
Standard Deviation.........................	3·0120	3·1262	2·8982	3·2463	2·9538
Coefficient of Variability.....................	15·70%	16·43%	14·99%	17·20%	15·23%

437-438b →

TABLE C *(cont.)*

Analysis of Measurements of Fibre Diameter. Right Psoas Muscle. Rabbit No. 16.
Cross-Section method (diameter calculated from Mean of Horizontal and Vertical Dimensions of Fibre).

NUMBER OF FIBRES COMPRISING EACH SELECTION.

75	75	75	50	50	50	50	50	25
18·35 ±0·4100 3·5508 19·35%	17·80 ±0·4840 4·1914 23·55%	17·69 ±0·4181 3·6204 20·46%	18·78 ±0·4645 3·2844 17·49%	17·72 ±0·5686 4·0206 22·69%	17·98 ±0·5043 3·5657 19·83%	18·48 ±0·4680 3·3089 17·90%	16·96 ±0·6094 4·3093 25·41%	18·08 ±0·6296 3·1480 17·41%
16·56 ±0·3623 3·1376 18·95%	16·17 ±0·4060 3·5159 21·74%	16·47 ±0·3692 3·1977 19·41%	15·66 ±0·4496 3·1791 20·30%	16·82 ±0·4795 3·3908 20·16%	16·66 ±0·4027 2·8472 17·09%	16·60 ±0·4824 3·4107 20·55%	16·10 ±0·4926 3·4832 21·63%	16·16 ±0·6290 3·1448 19·46%
14·48 ±0·4409 3·8180 26·37%	14·24 ±0·3786 3·2791 23·03%	14·96 ±0·3902 3·3789 22·59%	13·58 ±0·5459 3·8603 28·43%	15·40 ±0·4343 3·0706 19·94%	14·26 ±0·4168 2·9472 20·67%	15·22 ±0·4834 3·4184 22·46%	14·54 ±0·5216 3·6879 25·36%	13·24 ±0·7467 3·7336 28·20%
14·87 ±0·4720 4·0880 27·49%	15·25 ±0·4220 3·6543 23·96%	15·11 ±0·4226 3·6598 24·22%	14·86 ±0·5451 3·8545 25·94%	15·46 ±0·5453 3·8556 24·94%	14·62 ±0·5986 4·2325 28·95%	15·24 ±0·4870 3·4438 22·60%	15·20 ±0·4932 3·4876 22·94%	13·92 ±0·8122 4·0612 29·17%
18·73 ±0·3652 3·1637 16·89%	19·43 ±0·3333 2·8860 14·85%	19·32 ±0·3428 2·9690 15·37%	18·54 ±0·4808 3·3999 18·34%	18·92 ±0·3947 2·7909 14·75%	19·28 ±0·3928 2·7777 14·41%	19·64 ±0·4359 3·0822 15·69%	19·52 ±0·4172 2·9502 15·11%	19·64 ±0·6321 3·1607 16·09%

← 437-438a

437-438c →

TABLE C *(cont.)*

ibre).

TION.

25	25	25	25	25	25	25	25	25
18·36 ±0·6828 3·4142 18·59%	18·28 ±0·6097 3·0485 16·68%	18·60 ±0·8287 4·1433 22·27%	18·52 ±0·7027 3·5133 18·97%	18·32 ±0·6651 3·3257 18·15%	17·84 ±0·6263 3·1316 17·55%	17·76 ±0·9614 4·8069 27·06%	16·96 ±0·9027 4·5137 26·61%	17·12 ±0·8413 4·2063 24·57
17·12 ±0·4447 2·2233 12·99%	16·44 ±0·5449 2·7245 16·57%	16·40 ±0·7746 3·8730 23·61%	14·76 ±0·7241 3·6203 24·53%	16·08 ±0·6555 3·2777 20·38%	15·48 ±0·7396 3·6982 23·89%	16·72 ±0·7130 3·5651 21·32%	17·48 ±0·5777 2·8885 16·52%	17·04 ±0·6041 3·0205 17·72%
15·56 ±0·6610 3·3050 21·24%	14·68 ±0·7064 3·5322 24·06%	14·64 ±0·8304 4·1521 28·36%	14·16 ±0·6675 3·3377 23·57%	14·96 ±0·6096 3·0480 20·37%	15·20 ±0·5686 2·8431 18·70%	14·28 ±0·6671 3·3357 23·36%	15·00 ±0·7616 3·8079 25·39%	14·20 ±0·6596 3·2980 23·09%
15·44 ±0·8126 4·0628 26·31%	15·52 ±0·7144 3·5721 23·02%	15·24 ±0·8272 4·1360 27·14%	15·08 ±0·6974 3·4871 23·12%	15·08 ±0·7209 3·6046 23·90%	14·88 ±0·6815 3·4073 22·90%	15·32 ±0·7251 3·6254 23·66%	14·92 ±0·8163 4·0817 27·36%	15·36 ±0·7956 3·9779 25·90%
17·44 ±0·6660 3·3301 19·09%	18·72 ±0·0931 2·9653 15·84%	19·12 ±0·5302 2·6508 13·86%	19·20 ±0·5000 2·5000 13·02%	19·36 ±0·6161 3·0806 15·91%	19·68 ±0·6370 3·1849 16·18%	19·60 ±0·6083 3·0414 15·52%	19·56 ±0·5540 2·7700 14·16%	19·48 ±0·6354 3·1770 16·31%

← 437-438b

TABLE D

	250	125	125	100	100	75
Site A.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	19·12	18·65	19·59	19·18	18·86	19·25
Standard Error........................	±0·2895	±0·4096	±0·4066	±0·4267	±0·4695	±0·5339
Standard Deviation........................	4·5779	4·5795	4·5456	4·2673	4·6948	4·6239
Coefficient of Variability........................	23·94%	24·55%	23·20%	22·25%	24·89%	24·02%
Site B.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	17·53	17·81	17·25	17·20	17·75	17·13
Standard Error........................	±0·2996	±0·4236	±0·4241	±0·4461	±0·4491	±0·4777
Standard Deviation........................	4·7374	4·7361	4·7411	4·4609	4·4910	4·1373
Coefficient of Variability........................	27·02%	26·59%	27·48%	25·93%	25·30%	24·15%
Site C.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	16·09	15·91	16·28	15·61	15·84	15·59
Standard Error........................	±0·3307	±0·4542	±0·4820	±0·4859	±0·4534	±0·5433
Standard Deviation........................	5·2288	5·0784	5·3891	4·8594	4·5343	4·7051
Coefficient of Variability........................	32·48%	31·92%	33·10%	31·13%	28·62%	30·18%
Site D.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	16·78	16·71	16·85	16·32	16·98	16·55
Standard Error........................	±0·2756	±0·3642	±0·4152	±0·3939	±0·4870	±0·5555
Standard Deviation........................	4·3579	4·0716	4·6421	3·9386	4·8700	4·8107
Coefficient of Variability........................	25·97%	24·37%	27·55%	24·13%	28·68%	29·07%
Site E.						
Mean Fibre Diameter (Lanameter Scale 1 = 2μ).	19·24	19·01	19·48	19·47	18·97	19·16
Standard Error........................	±0·2762	±0·3473	±0·4300	±0·3506	±0·3773	±0·5433
Standard Deviation........................	4·3668	3·8823	4·8069	3·5064	3·7727	4·7048
Coefficient of Variability........................	22·70%	20·42%	24·65%	23·42%	19·89%	24·55%

439-440b →

TABLE D. *(cont.)*

Analysis of Measurements of Fibre Diameter. Right Psoas Muscle. Rabbit No. 16.
Hammond's Method (Diameter Measured directly across lengths of Fibre).

NUMBER OF FIBRES COMPRISING EACH SELECTION.							
75	75	50	50	50	50	50	25
18·36 ±0·5511 4·7722 25·99%	19·93 ±0·4951 4·2880 21·51%	20·08 ±0·6796 4·8058 23·93%	18·72 ±0·6478 4·5805 24·47%	18·90 ±0·6684 4·7262 25·01%	18·98 ±0·6468 4·5736 24·10%	18·92 ±0·5992 4·2371 22·39%	19·08 ±0·7915 3·9573 20·74%
17·92 ±0·5634 4·8790 27·23%	17·29 ±0·6014 5·2085 30·12%	17·08 ±0·6187 4·3745 25·61%	17·80 ±0·7882 5·5733 31·31%	17·88 ±0·6011 4·2505 23·77%	17·42 ±0·6566 4·6427 26·65%	17·46 ±0·6900 4·8790 27·94%	16·08 ±0·8224 4·1122 25·57%
16·52 ±0·5407 4·6828 28·35%	16·68 ±0·7040 6·0964 36·55	15·58 ±0·7092 5·0146 32·19	16·18 ±0·6520 4·6101 28·49%	15·50 ±0·7732 5·4670 35·27%	14·92 ±0·5763 4·0750 27·31%	18·30 ±0·8835 6·2474 34·14%	14·96 ±0·8897 4·4486 29·74%
17·36 ±0·5152 4·4620 25·70%	16·57 ±0·4662 4·0376 24·37%	16·72 ±0·5292 3·7419 22·38%	16·14 ±0·6075 4·2953 26·61%	17·58 ±0·6905 4·8827 27·77%	17·24 ±0·6771 4·7876 27·77%	16·22 ±0·5601 3·9605 24·42%	16·36 ±0·7935 3·9674 24·25%
18·99 ±0·4916 4·2569 22·42%	19·28 ±0·5263 4·5576 23·64%	19·12 ±0·6849 4·8430 25·33%	19·86 ±0·5643 3·9898 20·09%	19·10 ±0·6248 4·4182 23·13%	19·68 ±0·5824 4·1179 20·92%	18·46 ±0·6294 4·4502 24·11%	20·16 ±1·0827 5·4136 26·85%

← 439-440a

439-440c →

TABLE D (cont.)

25	25	25	25	25	25	25	25	25
18·32 ±0·9604 4·8021 26·21%	19·48 ±0·8126 4·0632 20·86%	20·36 ±0·9998 4·9990 24·55%	18·56 ±0·0537 5·2685 28·39%	18·56 ±0·9020 4·5100 24·30%	19·84 ±0·8615 4·3077 21·71%	18·56 ±0·0134 5·0669 27·30%	20·48 ±0·9185 4·5927 22·42%	17·96 ±0·8134 4·0669 22·64%
18·20 ±0·8327 4·1633 22·87%	16·80 ±0·8104 4·0518 24·12%	17·12 ±0·8048 4·0241 23·50%	18·12 ±1·0651 5·3254 29·39%	18·24 ±0·9243 4·6213 25·34%	17·72 ±1·0701 5·3504 30·19%	18·88 ±0·9803 4·9017 25·96%	17·36 ±1·2354 6·1771 35·58%	16·76 ±0·8627 4·3135 25·74
16·20 ±1·1091 5·5453 34·23%	16·76 ±1·0153 5·0767 30·29%	15·60 ±0·8226 4·1130 26·36%	16·40 ±1·1121 5·5603 33·90%	14·60 ±1·0661 5·3307 36·51%	14·52 ±0·8409 4·2044 28·95%	15·32 ±0·7973 3·9866 26·02%	18·76 ±1·5719 7·8596 41·89%	17·84 ±0·8360 4·1801 23·43%
16·36 ±0·8142 4·0710 24·88%	15·68 ±0·8139 4·0694 25·95%	16·92 ±1·2462 6·2311 38·83%	17·44 ±0·7876 3·9379 22·58%	16·36 ±0·7068 3·5341 21·60%	16·88 ±0·7579 3·7895 22·45%	18·12 ±0·8647 4·3236 23·86%	17·16 ±0·8499 4·2493 24·76%	16·52 ±1·0167 5·0836 30·77%
19·12 ±0·7645 3·8223 19·99%	18·76 ±0·9648 4·8242 25·71%	20·36 ±0·8364 4·1821 20·54%	18·56 ±0·7507 3·7537 20·22%	20·16 ±0·5850 2·9252 14·51%	19·84 ±0·8320 4·1601 20·97%	18·00 ±0·9416 4·7082 26·16%	20·12 ±0·9150 4·7550 23·63%	17·36 ±0·8522 4·2611 24·54%

439-440b

TABLE E.

Details of Rabbits and Muscles.

Serial Number of Rabbit.	Age in Days.	Weight in Grams.	M. GASTROCNEMIUS MEDIALIS. Dimensions. Weight in Grams.	Length in Centimetres.	Width at A in Centimetres.	Width at B in Centimetres.	Width at C in Centimetres.	Width at D in Centimetres.	Width at E in Centimetres.	Depth at A in Centimetres.	Depth at B in Centimetres.	Depth at C in Centimetres.	Depth at D in Centimetres.	Depth at E in Centimetres.
Birth Group.														
93	1	74	0·039	1·0	0·21	0·34	0·35	0·32	0·24	0·10	0·18	0·17	0·13	0·12
94	1	67	0·041	1·0	0·37	0·42	0·43	0·37	0·23	0·10	0·14	0·16	0·12	0·08
95	1	77	0·043	0·9	0·24	0·34	0·34	0·27	0·20	0·12	0·14	0·14	0·13	0·09
96	1	61	0·054	1·1	0·28	0·35	0·37	0·34	0·24	0·11	0·11	0·12	0·11	0·08
97	1	80	0·051	1·0	0·29	0·40	0·38	0·32	0·24	0·10	0·12	0·12	0·12	0·09
99	2	60	0·053	0·9	0·20	0·36	0·44	0·38	0·22	0·10	0·12	0·12	0·13	0·09
100	2	65	0·046	0·9	0·24	0·39	0·42	0·40	0·22	0·10	0·10	0·12	0·13	0·08
101	2	80	0·049	1·0	0·25	0·42	0·46	0·35	0·20	0·08	0·10	0·11	0·10	0·07
102	2	61	0·045	0·9	0·30	0·36	0·36	0·32	0·22	0·09	0·09	0·11	0·09	0·06
103	2	79	0·054	1·2	0·24	0·31	0·36	0·31	0·23	0·08	0·10	0·10	0·10	0·06
Mean	1·5	70·4	0·048	0·99	0·26	0·37	0·39	0·34	0·22	0·10	0·12	0·13	0·12	0·08
100 Gm. Group.														
178	4	102	0·0565	1·0	0·35	0·44	0·45	0·37	0·23	0·15	0·17	0·17	0·13	0·10
179	4	99	0·0575	1·1	0·27	0·36	0·39	0·34	0·28	0·11	0·11	0·14	0·12	0·09
180	4	104	0·0583	1·0	0·27	0·37	0·43	0·38	0·29	0·12	0·14	0·16	0·14	0·10
182	8	102	0·0517	1·2	0·26	0·33	·033	0·30	0·17	0·12	0·15	0·14	0·10	0·06
185	4	99	0·0535	1·1	0·24	0·30	0·36	0·33	0·26	0·08	0·10	0·11	0·10	0·06
Mean	4·8	101·2	0·056	1·08	0·28	0·36	9·39	0·34	0·25	0·12	0·13	0·14	0·12	0·08
150 Gm. Group.														
181	9	149	0·1002	1·2	0·36	0·46	0·47	0·43	0·32	0·14	0·16	0·15	0·12	0·10
187	12	156	0·1246	1·4	0·31	0·51	0·54	0·47	0·38	0·13	0·17	0·18	0·14	0·09
190	11	148	0·1371	1·7	0·31	0·46	0·51	0·46	0·34	0·11	0·16	0·18	0·15	0·10
195	7	144	0·0948	1·6	0·24	0·39	0·45	0·42	0·31	0·09	0·13	0·12	0·13	0·07
204	9	153	0·1267	1·6	0·25	0·44	0·50	0·46	0·37	0·09	0·14	0·16	0·14	0·08
Mean	9·6	150·0	0·117	1·50	0·29	0·45	0·49	0·45	0·34	0·11	0·15	0·16	0·14	0·09
220 Gm. Group.														
186	12	214	0·2019	1·7	0·40	0·58	0·62	0·52	0·36	0·22	0·24	0·22	0·15	0·09
188	12	230	0·1923	1·9	0·36	0·57	0·62	0·54	0·38	0·12	0·20	0·22	0·18	0·10
191	13	210	0·1889	2·0	0·34	0·55	0·58	0·50	0·32	0·12	0·18	0·20	0·15	0·08
194	14	212	0·2502	2·2	0·40	0·60	0·62	0·54	0·33	0·14	0·18	0·20	0·14	0·09
197	17	215	0·2986	2·4	0·37	0·62	0·70	0·54	0·34	0·13	0·21	0·22	0·16	0·08
Mean	13·6	216·2	0·226	2·04	0·37	0·58	0·63	0·53	0·35	0·15	0·20	0·21	0·16	0·09
320 Gm. Group.														
183	16	316	0·3815	2·5	0·39	0·67	0·72	0·58	0·37	0·17	0·24	0·26	0·20	0·10
193	20	340	0·4309	2·4	0·54	0·76	0·81	0·66	0·42	0·18	0·26	0·24	0·20	0·10
196	17	314	0·3998	2·4	0·46	0·72	0·78	0·64	0·43	0·17	0·24	0·24	0·20	0·10
199	19	327	0·4357	2·6	0·45	0·70	0·78	0·64	0·42	0·18	0·24	0·26	0·22	0·11
201	21	324	0·4698	2·6	0·50	0·74	0·82	0·72	0·52	0·17	0·25	0·26	0·22	0·10
Mean	18·6	324·2	0·424	2·50	0·47	0·72	0·78	0·65	0·43	0·17	0·25	0·25	0·21	0·10

TABLE E (*cont.*)

M. PSOAS MAJOR.

DIMENSIONS.

Weight in Grams.	Length in Centimetres.	Width at A in Centimetres.	Width at B in Centimetres.	Width at C in Centimetres.	Width at D in Centimetres.	Width at E in Centimetres.	Depth at A in Centimetres.	Depth at B in Centimetres.	Depth at C in Centimetres.	Depth at D in Centimetres.	Depth at E in Centimetres.
0·087	2·0	0·32	0·43	0·45	0·50	0·50	0·03	0·04	0·07	0·08	0·14
0·095	2·7	0·28	0·37	0·38	0·39	0·32	0·02	0·04	0·06	0·07	0·08
0·119	2·9	0·29	0·39	0·50	0·46	0·39	0·04	0·04	0·06	0·06	0·08
0·103	2·8	0·31	0·39	0·44	0·37	0·41	0·03	0·04	0·05	0·06	0·08
0·104	2·8	0·33	0·39	0·38	0·44	0·44	0·02	0·04	0·05	0·07	0·07
0·106	2·8	0·38	0·42	0·43	0·51	0·47	0·04	0·06	0·06	0·08	0·10
0·116	2·6	0·33	0·40	0·46	0·49	0·48	0·04	0·06	0·06	0·07	0·09
0·123	2·9	0·25	0·38	0·44	0·46	0·51	0·04	0·06	0·06	0·07	0·09
0·093	2·7	0·29	0·33	0·39	0·40	0·37	0·03	0·04	0·04	0·07	0·06
0·130	3·0	0·36	0·41	0·44	0·47	0·47	0·04	0·05	0·06	0·08	0·08
0·109	2·72	0·31	0·39	0·43	0·45	0·44	0·03	0·05	0·06	0·07	0·09
0·1669	3·6	0·41	0·50	0·48	0·46	0·44	0·02	0·04	0·06	0·08	0·10
0·1796	3·6	0·41	0·48	0·56	0·53	0·46	0·04	0·05	0·07	0·07	0·10
0·1432	3·4	0·38	0·41	0·41	0·47	0·42	0·03	0·04	0·06	0·07	0·10
0·1477	3·8	0·22	0·35	0·40	0·41	0·34	0·04	0·05	0·07	0·07	0·09
0·1418	3·5	0·34	0·41	0·47	0·44	0·44	0·02	0·04	0·06	0·06	0·08
0·156	3·58	0·35	0·43	0·46	0·46	0·42	0·03	0·04	0·06	0·07	0·09
0·2924	4·4	0·50	0·52	0·58	0·58	0·56	0·04	0·06	0·09	0·10	0·11
0·2548	4·2	0·44	0·44	0·47	0·52	0·50	0·02	0·06	0·08	0·10	0·12
0·2630	4·1	0·48	0·53	0·54	0·53	0·59	0·04	0·06	0·08	0·10	0·10
0·2489	4·2	0·31	0·45	0·50	0·57	0·57	0·04	0·05	0·08	0·08	0·10
0·2799	4·6	0·41	0·46	0·55	0·62	0·69	0·02	0·06	0·06	0·08	0·10
0·268	4·30	0·43	0·48	0·53	0·56	0·58	0·03	0·06	0·08	0·09	0·11
0·3990	4·9	0·50	0·56	0·60	0·59	0·58	0·04	0·07	0·10	0·12	0·14
0·4605	5·1	0·43	0·64	0·66	0·62	0·78	0·04	0·06	0·08	0·10	0·12
0·4309	4·9	0·43	0·54	0·67	0·65	0·67	0·04	0·07	0·09	0·12	0·14
0·4126	5·1	0·50	0·63	0·63	0·72	0·59	0·04	0·06	0·08	0·10	0·11
0·4524	5·8	0·45	0·56	0·61	0·62	0·67	0·04	0·06	0·09	0·10	0·11
0·431	5·16	0·46	0·59	0·63	0·64	0·66	0·04	0·06	0·09	0·11	··12
0·8490	6·7	0·40	0·79	0·90	0·87	0·77	0·06	0·08	0·11	0·12	0·16
0·9042	6·8	0·51	0·70	0·87	0·90	0·80	0·06	0·08	0·11	0·14	0·16
0·7839	6·3	0·68	0·79	0·81	0·83	0·90	0·04	0·08	0·08	0·12	0·16
0·8891	6·8	0·65	0·78	0·80	0·81	0·78	0·06	0·08	0·10	0·12	0·18
0·9239	6·5	0·67	0·78	0·89	0·94	0·86	0·06	0·08	0·12	0·15	0·18
0·870	6·62	0·58	0·77	0·85	0·87	0·82	0·06	0·08	0·10	0·13	0·17

TABLE E—(*continued*).

Details of Rabbits and Muscles.

Serial Number of Rabbit.	Age in Days.	Weight in Grams.	M. GASTROCNEMIUS MEDIALIS. Dimensions. Weight in Grams.	Length in Centimetres.	Width at A in Centimetres.	Width at B in Centimetres.	Width at C in Centimetres.	Width at D in Centimetres.	Width at E in Centimetres.	Depth at A in Centimetres.	Depth at B in Centimetres.	Depth at C in Centimetres.	Depth at D in Centimetres.	Depth at E in Centimetres.
480 Gm. Group.														
192	20	470	0·6066	2·7	0·54	0·86	0·92	0·80	0·52	0·21	0·30	0·31	0·26	0·14
198	23	481	0·7568	3·2	0·61	0·87	0·99	0·84	0·63	0·22	0·28	0·28	0·26	0·14
200	26	484	0·7930	3·0	0·55	0·94	1·05	0·88	0·58	0·24	0·36	0·35	0·28	0·16
202	29	489	0·6781	2·9	0·54	0·85	0·96	0·87	0·64	0·18	0·30	0·30	0·30	0·17
203	27	500	0·8985	3·2	0·66	1·02	1·11	0·96	0·67	0·27	0·32	0·34	0·30	0·16
Mean	25·0	484·8	0·747	3·00	0·58	0·91	1·01	0·87	0·61	0·22	0·31	0·32	0·28	0·15
600 Gm. Group.														
74	34	615	1·01	3·2	0·78	1·15	1·26	1·13	0·81	0·36	0·39	0·35	0·36	0·22
76	38	647	1·02	3·4	0·77	1·16	1·22	1·08	0·80	0·35	0·35	0·36	0·36	0·18
77	38	655	0·94	3·1	0·82	1·17	1·22	0·98	0·68	0·32	0·32	0·32	0·30	0·20
78	38	633	0·94	3·2	0·80	1·17	1·24	1·02	0·74	0·33	0·33	0·31	0·31	0·16
79	40	622	0·91	3·2	0·78	1·18	1·26	1·01	0·70	0·34	0·38	0·36	0·34	0·22
80	40	620	0·97	3·2	0·69	1·17	1·34	1·08	0·74	0·29	0·34	0·31	0·30	0·18
81	41	648	0·98	3·3	0·68	1·12	1·16	1·02	0·72	0·30	0·38	0·34	0·33	0·21
82	33	617	1·10	3·5	0·82	1·08	1·16	0·98	0·74	0·34	0·34	0·34	0·32	0·18
83	34	636	1·06	3·4	0·82	1·19	1·28	1·12	0·80	0·30	0·31	0·32	0·31	0·19
85	38	640	1·10	3·2	0·75	1·10	1·20	1·10	0·86	0·29	0·34	0·33	0·34	0·24
Mean	37·4	633·3	1·00	3·27	0·77	1·15	1·23	1·05	0·76	0·32	0·35	0·33	0·33	0·20
1200 Gm. Group.														
62	60	1,225	2·01	4·0	1·00	1·62	1·75	1·54	1·09	0·44	0·44	0·39	0·37	0·24
63	60	1,250	1·89	3·8	0·86	1·55	1·69	1·53	1·08	0·38	0·39	0·36	0·36	0·23
64	63	1,230	1·73	4·0	0·90	1·43	1·58	1·45	1·09	·034	0·38	0·32	0·32	0·22
65	63	1,200	1·97	4·2	0·99	1·55	1·66	1·45	1·00	0·34	0·34	0·36	0·33	0·22
68	73	1,215	1·73	4·1	1·00	1·46	1·47	1·38	1·08	0·38	0·35	0·36	0·35	0·23
69	83	1,270	1·78	4·2	1·00	1·48	1·52	1·40	0·98	0·38	0·32	0·35	0·35	0·26
87	55	1,212	1·96	4·2	1·12	1·56	1·64	1·38	0·95	0·40	0·40	0·39	0·38	0·26
88	56	1,228	1·91	4·1	1·01	1·49	1·57	1·40	1·04	0·40	0·40	0·38	0·38	0·24
89	61	1,236	1·89	4·2	1·01	1·48	1·56	1·32	0·92	0·42	0·38	0·39	0·40	0·20
90	59	1,213	2·11	4·4	1·04	1·51	1·47	1·26	0·81	0·43	0·42	0·41	0·40	0·21
Mean	63·3	1,227·9	1·90	4·12	0·99	1·51	1·59	1·41	1·00	0·39	0·38	0·37	0·36	0·23
1,800 Gm. Group.														
43	83	1,775	2·77	4·4	1·24	1·82	1·96	1·78	1·44	0·50	0·50	0·52	0·47	0·35
44	86	1,865	3·19	4·7	1·26	1·81	1·88	1·81	1·32	0·46	0·46	0·48	0·45	0·34
48	77	1,807	2·88	4·9	1·20	1·77	1·91	1·83	1·44	0·42	0·40	0·44	0·44	0·31
50	99	1,785	3·04	5·0	0·98	1·72	1·92	1·74	1·27	0·39	0·42	0·44	0·42	0·26
51	98	1,805	3·06	5·2	1·12	1·79	2·04	1·76	1·26	0·40	0·40	0·43	0·42	0·28
52	106	1,792	3·07	5·2	1·11	1·85	1·95	1·72	1·26	0·40	0·46	0·45	0·42	0·26
53	120	1,845	2·91	5·2	1·30	1·81	1·80	1·62	1·14	0·43	0·38	0·41	0·39	0·24
54	120	1,815	3·04	5·3	1·23	1·82	1·98	1·76	1·28	0·39	0·41	0·42	0·40	0·27
55	120	1,865	2·63	5·1	1·06	1·82	1·78	1·54	0·95	0·39	0·39	0·38	0·36	0·22
58	126	1,825	2·91	5·0	1·13	1·71	1·88	1·70	1·17	0·38	0·40	0·44	0·42	0·30
Mean	103·5	1,817·9	2·95	5·0	1·16	1·79	1·91	1·73	1·25	0·42	0·42	0·44	0·42	0·28

TABLE E (*cont.*)

M. PSOAS MAJOR.

DIMENSIONS.

Weight in Grams.	Length in Centimetres.	Width at A in Centimetres.	Width at B in Centimetres.	Width at C in Centimetres.	Width at D in Centimetres.	Width at E in Centimetres.	Depth at A in Centimetres.	Depth at B in Centimetres.	Depth at C in Centimetres.	Depth at D in Centimetres.	Depth at E in Centimetres.
1·2772	6·9	0·70	0·86	0·99	1·00	0·98	0·08	0·10	0·15	0·19	0·22
1·4196	8·0	0·75	0·77	0·94	0·91	0·98	0·06	0·10	0·12	0·14	0·20
1·6189	8·2	0·92	0·84	0·98	0·98	0·94	0·08	0·12	0·16	0·18	0·22
1·6108	8·4	0·81	0·86	0·98	1·01	1·08	0·08	0·10	0·14	0·18	0·21
1·8914	8·7	0·87	1·02	1·20	1·22	1·12	0·07	0·11	0·15	0·20	0·22
1·564	8·04	0·81	0·87	1·02	1·02	1·02	0·07	0·11	0·14	0·18	0·21
2·12	8·2	0·96	1·03	1·14	1·23	1·22	0·10	0·16	0·19	0·22	0·24
1·99	9·1	0·74	1·00	1·04	1·00	1·08	0·10	0·14	0·16	0·20	0·21
1·76	9·0	0·99	1·02	1·02	1·08	1·02	0·08	0·12	0·14	0·16	0·18
1·76	8·6	0·91	0·90	0·98	1·06	1·05	0·08	0·11	0·17	0·18	0·21
1·72	9·0	1·06	0·94	1·10	1·06	1·06	0·08	0·11	0·14	0·16	0·18
1·87	8·4	0·84	0·91	1·04	1·02	1·17	0·08	0·11	0·12	0·16	0·19
1·76	8·6	0·81	0·94	1·02	1·14	1·10	0·07	0·10	0·14	0·14	0·17
2·17	9·2	0·75	0·86	0·94	0·94	1·00	0·10	0·13	0·18	0·19	0·25
2·28	9·2	0·86	0·95	1·06	1·08	1·02	0·10	0·12	0·16	0·20	0·23
2·07	9·2	0·64	0·89	0·92	0·93	0·94	0·09	0·12	0·16	0·17	0·22
1·95	8·85	0·86	0·94	1·03	1·05	1·07	0·09	0·12	0·16	0·18	0·21
4·35	7·8	1·74	1·78	2·08	2·24	1·98	0·17	0·20	0·29	0·32	0·41
4·80	8·5	2·06	2·18	2·32	2·11	1·99	0·19	0·26	0·30	0·35	0·43
4·13	7·4	1·08	1·45	1·69	1·60	1·58	0·22	0·24	0·28	0·33	0·38
4·61	11·1	1·31	1·78	1·86	1·78	1·78	0·14	0·19	0·24	0·28	0·34
4·56	9·4	0·95	1·33	1·36	1·34	1·45	0·14	0·16	0·24	0·26	0·30
4·93	10·6	1·26	1·62	1·64	1·65	1·60	0·16	0·20	0·26	0·29	0·35
4·64	11·4	1·05	1·39	1·46	1·51	1·40	0·12	0·16	0·20	0·23	0·29
4·22	11·8	1·06	1·22	1·31	1·32	1·35	0·11	0·16	0·19	0·21	0·26
4·72	11·7	1·40	1·36	1·40	1·44	1·29	0·12	0·20	0·24	0·22	0·28
5·06	12·0	1·06	1·34	1·61	1·50	1·50	0·12	0·16	0·20	0·21	0·26
4·60	10·17	1·30	1·55	1·67	1·65	1·59	0·15	0·19	0·24	0·27	0·33
7·23	10·6	1·83	1·71	1·72	1·96	1·56	0·17	0·23	0·28	0·30	0·34
8·08	11·0	1·56	1·79	2·04	2·22	1·76	0·17	0·19	0·25	0·28	0·38
10·40	12·5	1·76	2·14	2·24	2·34	2·42	0·22	0·28	0·34	0·40	0·46
8·58	13·4	1·86	2·04	2·22	2·32	1·72	0·17	0·24	0·30	0·33	0·41
9·26	13·6	1·66	1·95	2·28	2·10	1·96	0·20	0·24	0·30	0·33	0·38
9·03	11·8	1·74	2·16	2·19	2·28	2·24	0·19	0·35	0·39	0·44	0·48
9·30	11·8	1·71	2·07	2·22	2·39	2·15	0·18	0·23	0·29	0·32	0·37
8·59	13·4	1·52	1·78	2·04	2·02	1·71	0·20	0·27	0·36	0·38	0·42
7·51	13·5	1·56	2·10	2·17	2·22	2·00	0·18	0·26	0·28	0·33	0·41
8·05	12·8	1·49	1·60	1·70	1·93	1·75	0·17	0·22	0·28	0·32	0·39
8·60	12·44	1·67	1·93	2·08	2·18	1·93	0·19	0·25	0·31	0·34	0·40

TABLE E—(*continued*).

Details of Rabbits and Muscles.

Serial Number of Rabbit.	Age in Days.	Weight in Grams.	M. GASTROCNEMIUS MEDIALIS.											
			Dimensions.											
			Weight in Grams.	Length in Centimetres.	Width at A in Centimetres.	Width at B in Centimetres.	Width at C in Centimetres.	Width at D in Centimetres.	Width at E in Centimetres.	Depth at A in Centimetres.	Depth at B in Centimetres.	Depth at C in Centimetres.	Depth at D in Centimetres.	Depth at E in Centimetres.
2,400 Gm. Group.														
38	186	2,400	2·99	4·6	1·24	1·77	1·82	1·84	1·36	0·42	0·41	0·43	0·42	0·30
40	121	2,395	4·17	5·6	1·34	1·98	2·11	1·88	1·30	0·48	0·52	0·53	0·52	0·33
41	121	2,490	4·18	5·6	1·23	1·90	2·00	1·83	1·22	0·46	0·48	0·52	0·52	0·30
42	193	2,490	3·59	5·8	1·18	1·83	1·89	1·79	1·30	0·42	0·43	0·46	0·44	0·29
47	113	2,460	4·03	5·6	1·31	2·01	2·20	2·02	1·31	0·48	0·47	0·48	0·43	0·27
49	138	2,435	3·92	5·6	1·34	1·90	2·04	1·78	1·14	0·46	0·46	0·48	0·44	0·25
60	137	2,455	3·44	5·0	1·22	1·90	2·00	1·92	1·54	0·38	0·40	0·44	0·46	0·34
61	148	2,471	3·44	5·7	1·25	1·82	1·88	1·68	1·14	0·40	0·46	0·48	0·44	0·26
75	135	2,432	3·75	5·6	1·12	1·79	1·96	1·78	1·50	0·46	0·45	0·44	0·44	0·33
86	192	2,395	3·56	5·7	1·09	1·75	1·88	1·76	1·23	0·42	0·42	0·46	0·45	0·35
Mean	148·4	2,442·3	3·71	5·48	1·23	1·87	1·98	1·83	1·30	0·44	0·45	0·47	0·46	0·30
3,000 Gm. Group.														
39	172	3,025	5·13	6·0	1·46	2·09	2·26	2·12	1·34	0·52	0·48	0·52	0·52	0·32
59	216	3,032	4·84	5·9	1·17	2·15	2·42	2·23	1·61	0·45	0·50	0·48	0·50	0·38
66	206	2,987	4·23	5·8	1·40	2·18	2·22	2·04	1·54	0·44	0·41	0·40	0·41	0·32
109	158	3,051	4·99	5·8	1·30	1·98	2·09	2·06	1·51	0·48	0·44	0·44	0·52	0·36
112	198	3,043	4·32	6·0	1·32	1·94	2·16	1·94	1·32	0·47	0·42	0·45	0·46	0·30
150	224	3,027	4·60	6·0	1·34	2·04	2·06	1·88	1·30	0·46	0·48	0·58	0·56	0·28
157	255	2,965	4·64	6·0	1·31	2·04	2·23	2·02	1·20	0·40	0·42	0·47	0·48	0·29
170	204	3,016	4·49	5·8	1·31	1·91	2·09	1·83	1·19	0·43	0·46	0·48	0·47	0·41
172	225	2,990	4·41	6·2	1·25	1·92	1·97	1·81	1·20	0·41	0·37	0·46	0·48	0·33
176	243	2,980	4·76	5·8	1·38	1·08	2·26	2·09	1·28	0·40	0·44	0·47	0·49	0·45
Mean	210·1	3,010·6	4·64	5·93	1·32	2·03	2·18	2·00	1·35	0·45	0·44	0·48	0·49	0·34
Mature Group.														
108	433	3,070	4·22	5·7	1·42	2·03	2·19	2·06	1·26	0·42	0·40	0·44	0·41	0·31
110	598	2,975	4·43	6·0	1·38	2·04	2·20	2·12	1·42	0·41	0·37	0·40	0·42	0·28
111	430	3,037	4·14	6·0	1·38	1·98	2·05	2·00	1·30	0·45	0·40	0·44	0·44	0·30
158	409	3,058	4·58	6·1	1·50	2·10	2·14	1·93	1·30	0·44	0·43	0·46	0·48	0·42
159	414	3,097	4·67	5·9	1·47	2·12	2·26	2·07	1·52	0·40	0·42	0·46	0·51	0·34
168	381	3,143	5·28	6·6	1·43	2·18	2·32	2·20	1·49	0·49	0·44	0·49	0·50	0·32
171	417	3,019	4·93	6·2	1·27	2·13	2·26	2·08	1·40	0·37	0·41	0·48	0·50	0·37
173	354	3,215	4·67	6·1	1·32	2·00	2·25	2·06	1·34	0·39	0·39	0·47	0·48	0·41
174	359	3,145	5·19	6·3	1·31	2·06	2·35	2·24	1·43	0·38	0·40	0·46	0·49	0·38
175	365	2,963	5·07	6·6	1·16	1·92	2·08	2·04	1·42	0·42	0·38	0·41	0·44	0·36
Mean	416·0	3,072·2	4·72	6·15	1·36	2·06	2·21	2·08	1·39	0·42	0·40	0·45	0·47	0·35

TABLE E (cont.)

M. PSOAS MAJOR.

DIMENSIONS.

Weight in Grams.	Length in Centimetres.	Width at A in Centimetres.	Width at B in Centimetres.	Width at C in Centimetres.	Width at D in Centimetres.	Width at E in Centimetres.	Depth at A in Centimetres.	Depth at B in Centimetres.	Depth at C in Centimetres.	Depth at D in Centimetres.	Depth at E in Centimetres.
11·34	14·4	1·60	1·99	2·21	2·28	1·98	0·18	0·25	0·35	0·37	0·44
10·16	14·6	1·72	1·81	2·05	2·18	1·88	0·20	0·28	0·32	0·42	0·46
11·80	15·8	1·78	2·07	2·34	2·12	2·03	0·16	0·25	0·29	0·37	0·43
11·29	13·3	1·87	2·31	2·58	2·26	1·88	0·22	0·26	0·36	0·46	0·50
11·29	14·2	2·10	2·36	2·52	2·49	2·12	0·19	0·30	0·39	0·46	0·55
11·06	12·1	1·91	2·29	2·38	2·44	2·48	0·24	0·32	0·36	0·41	0·51
12·27	14·4	1·64	1·98	2·31	2·53	2·09	0·21	0·26	0·32	0·38	0·46
10·45	15·0	1·68	2·00	2·36	2·20	2·12	0·16	0·20	0·26	0·32	0·38
13·94	15·2	1·70	2·13	2·24	2·42	2·28	0·23	0·29	0·38	0·42	0·46
11·92	16·0	1·42	1·75	2·02	2·04	1·84	0·20	0·24	0·32	0·35	0·49
11·55	14·50	1·74	2·07	2·30	2·30	2·07	0·20	0·27	0·34	0·40	0·47
13·95	16·2	1·74	2·15	2·51	2·44	2·01	0·23	0·28	0·33	0·42	0·47
17·29	15·9	2·06	2·34	2·68	2·84	2·61	0·20	0·30	0·39	0·40	0·57
13·67	16·2	1·73	2·12	2·21	2·42	2·24	0·20	0·26	0·33	0·37	0·44
12·28	15·1	1·75	2·02	2·37	2·33	2·22	0·20	0·25	0·29	0·32	0·42
15·76	15·6	1·76	2·23	2·54	2·76	2·25	0·23	0·34	0·40	0·45	0·55
16·24	16·1	2·01	2·34	2·60	2·58	2·29	0·27	0·32	0·38	0·45	0·54
12·95	15·4	1·78	2·01	2·31	2·41	2·36	0·18	0·26	0·32	0·38	0·42
15·37	15·9	1·94	2·29	2·57	2·48	2·51	0·24	0·26	0·31	0·42	0·50
15·75	15·6	1·76	2·31	2·56	2·76	2·59	0·22	0·28	0·38	0·40	0·50
14·65	16·2	1·72	2·08	2·30	2·44	2·48	0·19	0·25	0·31	0·34	0·42
14·79	15·82	1·83	2·19	2·47	2·55	2·36	0·22	0·28	0·34	0·40	0·48
16·71	15·2	2·08	2·36	2·60	2·90	2·50	0·26	0·32	0·36	0·44	0·51
16·57	16·6	1·87	2·26	2·38	2·47	2·18	0·25	0·30	0·38	0·43	0·52
13·47	15·2	1·80	2·13	2·36	2·37	2·14	0·21	0·26	0·35	0·45	0·50
15·93	16·0	1·64	2·27	2·48	2·62	2·83	0·20	0·30	0·40	0·42	0·51
17·79	16·2	1·99	2·47	2·73	2·83	2·69	0·25	0·31	0·39	0·44	0·54
16·10	15·6	1·97	2·32	2·66	2·72	2·65	0·22	0·28	0·37	0·40	0·48
15·17	15·6	1·58	2·10	2·26	2·60	2·45	0·24	0·31	0·41	0·42	0·50
15·30	16·0	1·78	2·13	2·31	2·38	2·42	0·21	0·28	0·34	0·38	0·50
19·83	16·1	1·87	2·28	2·76	3·14	2·90	0·30	0·33	0·40	0·46	0·52
14·43	17·1	1·54	1·93	2·22	2·39	2·50	0·21	0·24	0·28	0·32	0·39
16·13	15·96	1·81	2·23	2·47	2·64	2·53	0·24	0·29	0·37	0·42	0·50

Table F.

Details of muscle bundles and muscle fibres.

Serial No. of Rabbit.	M. Gastrocnemius Medialis.											Area of Bundle in Cross-section (Sq. mm.).
	La.	Lb.	Lc.	Ld.	Le.	No. of Fibres in Bundle.	Fa.	Fb.	Fc.	Fd.	Fe.	
Birth Group.												
93	—	—	—	—	—	57	13·57	11·85	12·41	11·54	12·11	0·005,703,5
94	—	—	—	—	—	43	11·25	10·96	10·74	10·77	10·67	0·005,299,4
95	—	—	—	—	—	49	10·60	10·24	10·88	10·22	9·78	0·003,610,8
96	—	—	—	—	—	43	12·37	10·99	10·00	10·38	11·67	0·004,724,6
97	—	—	—	—	—	45	12·03	11·09	9·89	12·21	13·30	0·004,623,1
99	—	—	—	—	—	46	12·42	10·52	9·38	9·77	11·02	0·003,986,1
100	—	—	—	—	—	49	11·65	10·82	9·95	10·06	11·73	0·004,245,3
101	—	—	—	—	—	46	13·39	12·51	12·68	12·20	12·16	0·006,100,1
102	—	—	—	—	—	53	12·72	11·61	10·96	10·95	10·55	0·004,662,4
103	—	—	—	—	—	48	13·03	12·67	11·44	11·00	11·09	0·005,845,3
Mean	—	—	—	—	—	48	12·30	11·33	10·83	10·91	11·41	0·004,880,1
220 Gm. Group.												
186	0·56	0·67	0·73	0·71	0·67	—	—	—	—	—	—	—
188	0·60	0·65	0·66	0·66	0·65	—	—	—	—	—	—	—
191	0·64	0·65	0·69	0·71	0·73	—	—	—	—	—	—	—
194	0·78	0·81	0·82	0·82	0·85	—	—	—	—	—	—	—
197	0·83	0·83	0·86	0·88	0·90	—	—	—	—	—	—	—
Mean	0·68	0·72	0·75	0·76	0·76	—	—	—	—	—	—	—

Abbreviations as follows :— La, Lb., etc.................. Length of bundle in centimetres at A, at B, etc.
Fa, Fb, etc.................. Fibre Diameter in microns at A, at B, etc.

TABLE F. (*continued* 2).

Details of muscle bundles and muscle fibres.

Serial No. of Rabbit.	M. GASTROCNEMIUS MEDIALIS.											Area of Bundle in Cross-section (Sq. mm.).
	La.	Lb.	Lc.	Ld.	Le.	No. of Fibres in Bundle.	Fa.	Fb.	Fc.	Fd.	Fe.	
320 Gm. Group.												
183	0·92	0·96	0·99	1·03	1·03	—	—	—	—	—	—	—
193	0·95	0·94	0·97	1·00	1·00	—	—	—	—	—	—	—
196	0·87	0·84	0·88	0·90	0·93	—	—	—	—	—	—	—
199	0·92	0·92	0·96	0·98	1·02	—	—	—	—	—	—	—
201	0·89	0·91	0·93	0·94	0·98	—	—	—	—	—	—	—
Mean	0·91	0·91	0·95	0·97	0·99	—	—	—	—	—	—	—
480 Gm. Group.												
192	0·94	0·93	0·94	0·97	0·97	—	—	—	—	—	—	—
198	0·97	0·99	1·03	1·05	1·09	—	—	—	—	—	—	—
200	1·03	0·99	0·99	1·02	1·07	—	—	—	—	—	—	—
202	0·91	0·97	0·99	1·00	1·00	—	—	—	—	—	—	—
203	1·05	1·03	1·04	1·06	1·12	—	—	—	—	—	—	—
Mean	0·98	0·98	1·00	1·02	1·05	—	—	—	—	—	—	—
600 Gm. Group.												
74	0·98	0·86	0·91	0·93	0·97	52	36·76	35·82	40·74	42·46	39·68	0·062,406
76	0·78	0·79	0·84	0·88	0·95	49	36·20	35·08	37·20	40·10	35·34	0·052,061
77	0·81	0·75	0·80	0·91	0·98	56	33·26	33·38	35·62	34·86	35·42	0·052,380
78	0·88	0·85	0·88	0·94	0·98	49	35·94	36·60	37·80	39·76	37·58	0·054,235
79	0·92	0·85	0·92	1·00	0·98	50	34·24	36·96	37·44	42·28	36·30	0·055,047
80	0·80	0·80	0·83	0·84	0·88	51	34·34	36·68	39·78	40·56	38·68	0·057,870
81	1·02	1·05	1·06	1·10	1·06	47	32·06	34·82	35·42	38·42	37·20	0·046,731
82	1·05	1·08	1·09	1·09	1·13	51	31·48	35·18	37·44	41·52	37·56	0·053,774
83	0·91	0·91	0·96	0·99	0·99	50	32·82	30·92	33·68	38·12	35·46	0·045,932
85	0·91	0·90	0·94	0·89	0·99	52	31·58	31·98	32·76	37·66	38·00	0·048,329
Mean	0·91	0·88	0·92	0·96	0·99	51	33·87	34·74	36·79	39·57	37·12	0·052,877

Abbreviations as follows :— La, Lb., etc. .... Length of bundle in centimetres at A, at B, etc.
Fa, Fb, etc. .... Fibre Diameter in microns at A, at B, etc.

TABLE F. (*continued* 3).

Details of muscle bundles and muscle fibres.

Serial No. of Rabbit.	M. Gastrocnemius Medialis.											Area of Bundle in Cross-section (Sq. mm.).
	La.	Lb.	Lc.	Ld.	Le.	No. of Fibres in Bundle.	Fa.	Fb.	Fc.	Fd.	Fe.	
1,200 Gm. Group.												
62	0·93	0·79	0·93	0·93	0·92	46	39·48	42·34	47·72	49·34	43·96	0·071,769
63	0·90	0·75	0·82	0·86	0·88	59	41·08	45·92	50·76	52·52	47·04	0·104,376
64	0·89	0·77	0·74	0·78	0·81	53	44·02	48·22	46·84	47·62	47·86	0·091,601
65	0·91	0·76	0·82	0·88	0·91	53	42·76	50·06	54·18	56·02	52·04	0·108,312
68	0·77	0·70	0·80	0·84	0·94	51	44·68	46·82	43·64	48·44	49·40	0·806,983
69	0·84	0·87	0·78	0·84	0·95	55	38·46	40·18	47·88	54·88	49·60	0·092,201
87	0·88	0·86	0·92	1·02	1·09	51	47·94	49·30	52·62	53·38	51·42	0·103,898
88	0·97	0·89	0·83	0·84	0·95	50	34·26	37·76	40·18	45·84	45·90	0·065,338
89	0·86	1·10	0·93	1·01	1·07	52	44·38	47·48	52·76	50·96	42·16	0·092,341
90	1·12	0·91	1·07	1·11	1·20	48	45·20	45·38	51·94	52·80	53·02	0·093,008
Mean	0·91	0·84	0·86	0·91	0·97	52	42·23	45·35	48·85	51·18	48·24	0·090,983
1,800 Gm. Group.												
43	0·93	0·86	0·92	0·94	0·94	67	57·08	58·84	61·60	62·64	59·72	0·189,312
44	0·92	0·94	0·96	1·06	1·11	60	55·32	57·56	62·88	64·16	66·80	0·177,309
48	1·01	1·03	1·08	1·11	1·18	53	58·32	59·32	61·40	70·88	72·64	0·173,229
50	1·09	0·93	0·95	1·01	1·11	62	53·48	56·80	64·04	69·16	64·04	0·184,176
51	1·05	0·92	0·91	0·95	0·98	64	50·72	55·44	59·96	71·52	70·52	0·190,922
52	0·98	0·93	0·99	1·09	1·11	59	53·00	56·88	60·20	67·80	63·52	0·168,380
53	0·92	0·87	0·94	1·01	1·05	59	59·68	62·92	68·12	75·60	76·64	0·218,004
54	1·02	1·01	1·05	1·14	1·16	58	50·20	55·24	57·80	58·52	58·40	0·143,008
55	1·00	0·83	0·91	0·99	1·18	63	59·08	64·16	65·04	67·00	62·04	0·199,265
58	0·93	0·98	1·00	1·03	1·04	54	55·28	58·36	62·00	70·52	67·96	0·167,371
Mean	0·99	0·93	0·97	1·03	1·09	60	55·22	58·55	62·30	67·78	66·23	0·181,098

Abbreviations as follows :—

La, Lb, etc. .... Length of bundle in centimetres at A, at B, etc.
Fa, Fb, etc. .... Fibre diameter in microns at A, at B, etc.

TABLE F. (*continued* 4).

Details of muscle bundles and muscle fibres.

Serial No. of Rabbit.	M. Gastrocnemius Medialis.											Area of Bundle in Cross-section (Sq. mm.).
	La.	Lb.	Lc.	Ld.	Le.	No. of Fibres in Bundle.	Fa.	Fb.	Fc.	Fd.	Fe.	
2,400 Gm. Group.												
38	0·78	0·70	0·74	0·82	0·85	47	64·96	67·92	70·56	80·40	78·88	0·194,242
40	1·00	1·00	1·01	1·09	1·12	53	63·00	66·12	69·84	78·68	75·32	0·207,421
41	1·00	0·94	0·98	1·05	1·13	57	59·04	67·24	66·92	70·32	73·56	0·203,490
42	1·06	1·02	1·01	1·02	1·02	50	56·40	60·64	67·12	75·32	74·36	0·175,075
47	1·16	1·12	1·07	1·11	1·15	61	57·76	67·76	70·92	74·56	76·44	0·231,348
49	0·87	0·88	0·90	1·01	1·07	58	65·64	69·12	66·72	74·80	71·84	0·220,794
60	0·86	0·85	0·87	0·91	0·97	53	58·80	65·72	70·96	74·04	79·72	0·203,095
61	1·02	0·92	0·95	1·04	1·17	62	58·80	62·96	63·36	70·00	68·68	0·204,219
75	1·08	0·90	0·95	1·06	1·14	49	57·96	67·12	70·76	80·20	79·64	0·194,767
86	0·94	0·91	0·94	1·07	1·13	50	56·96	61·52	63·40	66·04	70·00	0·158,746
Mean	0·98	0·92	0·94	1·02	1·08	54	59·93	65·61	68·06	74·44	74·84	0·199,320
3,000 Gm. Group.												
39	0·90	0·82	0·85	0·94	0·94	48	72·40	80·48	82·92	87·32	95·64	0·264,425
59	1·07	0·90	0·89	0·91	0·93	48	71·32	78·08	81·16	88·32	92·16	0·254,789
66	1·00	0·91	0·91	0·92	0·97	47	60·64	67·44	71·44	77·60	77·36	0·185,559
109	1·05	0·87	0·90	0·97	1·00	53	72·76	77·00	82·52	82·72	82·40	0·262,956
112	0·96	0·92	1·05	1·08	1·06	53	57·16	61·48	68·32	74·88	76·32	0·190,391
150	1·05	0·85	0·97	1·07	1·12	51	54·88	63·08	70·56	77·60	72·20	0·183,369
157	1·01	0·85	0·94	1·02	1·04	53	62·88	71·92	74·96	79·64	72·88	0·218,556
170	0·98	0·85	0·89	1·01	0·84	50	63·24	76·96	80·56	86·68	86·28	0·243,474
172	0·99	0·87	0·98	1·02	1·06	49	61·12	73·84	71·12	80·04	79·44	0·205,703
176	0·77	0·74	0·81	0·82	0·81	46	67·56	70·36	71·28	80·72	83·52	0·201,546
Mean	0·98	0·86	0·92	0·98	0·98	50	64·40	72·06	75·48	81·55	81·82	0·221,077

Abbreviations as follows :—

La, Lb, etc. .... Length of bundle in centimetres at A, at B, etc.
Fa, Fb, etc. .... Fibre diameter in microns at A, at B, etc.

TABLE F. (*continued* 5).

(*Details of muscle bundles and muscle fibres.*)

Serial No. of Rabbit.	M. Gastrocnemius Medialis.											Area of Bundle in Cross-section (Sq. mm.).
	La.	Lb.	Lc.	Ld.	Le.	No. of Fibres in Bundle.	Fa.	Fb.	Fc.	Fd.	Fe.	
Mature Group.												
108	0·78	0·75	0·76	0·78	0·82	45	72·72	83·00	86·68	106·48	107·80	0·294,867
110	0·88	0·78	0·80	0·88	0·99	62	63·28	73·24	75·68	87·72	90·00	0·296,107
111	1·04	0·98	1·00	1·03	1·06	53	66·68	70·60	72·36	79·28	90·80	0·240,054
158	1·02	0·94	0·96	1·03	1·05	44	63·36	70·16	74·04	87·16	81·12	0·195,269
159	0·82	0·81	0·86	0·90	0·93	51	76·44	86·76	93·20	93·28	98·12	0·321,284
168	1·11	1·05	1·13	1·17	1·21	51	58·08	66·96	67·04	72·60	67·44	0·176,709
171	1·21	1·02	1·04	1·13	1·18	57	70·12	79·60	81·36	90·40	93·68	0·308,628
173	0·97	0·92	1·00	1·09	1·03	51	63·96	72·44	73·36	79·16	80·44	0·218,573
174	0·89	0·79	0·85	0·90	0·96	42	69·04	80·16	78·16	82·84	83·24	0·204,258
175	0·99	1·01	1·10	1·12	1·19	49	66·76	70·00	72·44	77·52	81·12	0·208,300
Mean	0·97	0·91	0·95	1·00	1·04	51	67·04	75·29	77·43	85·64	87·38	0·246,405

Abbreviations as follows :—

La, Lb, etc. .... Length of bundle in centimetres at A, at B, etc.
Fa, Fb, etc. .... Fibre diameter in microns at A, at B, etc.

TABLE G.

Details of muscle bundles and muscle fibres.

Serial No. of Rabbit.	M. PSOAS MAJOR.							
	L.	No. of Fibres in Bundle.	Fa.	Fb.	Fc.	Fd.	Fe.	Area of Bundles in Cross-section (Sq. mm.).
Birth Group.								
93........	2·1	88	9·22	9·51	9·48	9·45	9·99	0·006,277,1
94........	2·4	83	9·26	8·34	8·48	8·35	8·81	0·004,877,5
95........	2·6	98	8·84	8·20	8·19	9·62	9·24	0·005,987,6
96........	2·6	85	7·45	7·43	7·59	7·01	7·70	0·003,695,4
97........	2·5	103	8·30	7·80	8·23	7·57	7·75	0·005,087,2
98........	2·9	92	9·28	8·86	8·92	8·05	8·21	0·005,418,9
100........	2·6	87	8·42	9·06	7·98	8·71	9·85	0·005,291,5
101........	2·8	98	8·77	8·11	8·09	8·05	8·24	0·005,238,7
102........	2·4	86	8·73	7·61	8·02	7·90	7·97	0·004,377,1
103........	2·4	95	9·10	8·99	8·79	8·52	8·96	0·005,870,3
Mean.....	2·53	92	8·74	8·39	8·38	8·32	8·67	0·005,212,1

Serial No. of Rabbit.	L.	Serial No. of Rabbit.	L.	Serial No. of Rabbit.	L.
100 Gm. Group.		150 Gm. Group.		220 Gm. Group.	
178...........	3·30	181..........	4·10	186..........	4·63
179...........	3·24	187..........	4·01	188..........	4·66
180...........	3·11	190..........	3·95	191..........	4·47
182...........	3·48	195..........	3·86	194..........	4·67
185...........	3·10	204..........	4·10	197..........	5·46
Mean........	3·25	Mean.......	4·00	Mean.......	4·78

Serial No. of Rabbit.	L.	Serial No. of Rabbit.	L.
320 Gm. Group.		480 Gm. Group.	
183.........................	5·94	192.........................	6·63
193.........................	6·30	198.........................	7·30
196.........................	6·03	200.........................	7·72
199.........................	6·18	202.........................	7·64
201.........................	5·93	203.........................	7·77
Mean....................	6·08	Mean....................	7·41

Abbreviations as follows :—

L.................... Length of bundles in centimetres.
Fa, Fb, etc........... Fibre diameter in microns at A, at B, etc.

TABLE G. (*continued*).

Serial No. of Rabbit.	M. Psoas Major.							
	L.	No. of Fibres in Bundle.	Fa.	Fb.	Fc.	Fd.	Fe.	Area of Bundles in Cross-section (Sq. m.m.).
600 Gm. Group.								
74........	7·4	88	19·68	20·06	20·18	19·46	19·92	0·027,260
76........	8·3	85	19·38	17·74	18·28	19·08	17·72	0·022,700
77........	8·5	85	17·58	16·86	17·22	16·80	19·74	0·020,773
78........	7·9	78	20·40	19·06	19·20	18·26	19·30	0·022,678
79........	8·1	90	20·64	19·38	18·38	19·78	18·10	0·026,221
80........	8·2	101	18·46	18·36	17·48	18·42	18·08	0·026,160
81........	7·8	99	19·70	20·24	21·40	20·62	19·84	0·032,232
82........	8·1	85	23·10	20·66	20·48	19·62	20·04	0·028,827
83........	8·4	88	22·52	20·58	20·16	19·38	20·52	0·029,415
85........	8·5	110	21·38	21·08	20·60	20·18	20·40	0·037,126
Mean.....	8·1	91	20·28	19·40	19·34	19·16	19·37	0·027,339
1,200 Gm. Group.								
62........	7·3	79	33·32	30·62	29·32	30·48	28·52	0·057,530
63........	8·1	92	32·70	29·14	28·02	28·12	32·94	0·065,814
64........	10·4	105	29·62	27·72	28·02	25·78	26·80	0·062,775
65........	9·3	95	34·80	30·72	31·16	27·60	28·10	0·069,318
68........	10·1	81	31·12	28·50	27·84	27·58	28·36	0·052,328
69........	10·3	87	30·32	28·18	27·00	26·62	27·92	0·053,609
87........	11·0	80	36·38	30·80	31·02	29·84	32·84	0·065,066
88........	11·4	96	29·70	26·54	24·96	25·24	27·14	0·053,831
89........	7·3	84	26·94	24·46	27·00	26·78	27·90	0·046,751
90........	9·9	72	29·32	30·00	28·66	28·82	29·74	0·048,580
Mean.....	9·5	87	31·42	28·67	28·30	27·69	29·03	0·057,560
1,800 Gm. Group.								
43........	11·7	75	34·50	34·94	32·22	33·24	32·72	0·066,185
44........	12·4	93	37·86	40·32	34·78	33·06	35·10	0·095,823
48........	11·3	76	38·08	37·92	34·96	38·50	38·96	0·084,747
50........	11·0	98	36·94	38·78	38·90	38·68	40·50	0·115,634
51........	11·9	110	41·22	40·04	40·08	36·78	41·90	0·138,230
52........	9·2	105	39·38	36·96	36·48	36·24	37·72	0·115,105
53........	11·4	94	45·74	43·64	44·58	41·86	41·72	0·139,765
54........	10·9	87	41·00	36·02	35·62	37·90	42·60	0·101,967
55........	9·8	116	38·92	38·24	35·86	36·44	47·48	0·127,368
58........	11·7	93	41·38	35·06	33·50	37·72	36·82	0·099,455
Mean.....	11·1	95	39·50	38·19	36·70	37·04	38·55	0·108,428

Abbreviations as follows :—

L.................... Length of bundle in centimetres.
Fa, Fb, etc........... Fibre diameter in microns at A, at B, etc.

TABLE G. (*continued*).

Serial No. of Rabbit.	M. PSOAS MAJOR.							
	L.	No. of Fibres in Bundle.	Fa.	Fb.	Fc.	Fd.	Fe.	Area of Bundle in Cross-section (Sq. mm.).
2,400 Gm. Group.								
38........	12·5	103	46·38	43·54	42·50	38·72	44·46	0·150,413
40........	13·0	92	43·58	41·06	40·26	39·64	39·70	0·120,577
41........	13·9	88	44·36	41·40	37·60	37·18	43·36	0·114,939
42........	11·1	91	48·90	42·82	42·70	46·02	48·24	0·149,529
47........	10·4	80	45·40	39·56	42·00	41·44	40·46	0·109,625
49........	12·4	86	42·32	45·22	39·30	41·12	43·38	0·120,685
60........	12·7	100	47·60	41·88	43·42	43·90	46·80	0·157,071
61........	13·8	84	44·44	41·06	39·78	41·40	45·30	0·118,605
75........	14·5	92	42·22	43·42	42·20	43·60	44·36	0·134,599
86........	13·2	91	44·74	44·52	45·92	49·52	49·16	0·156,339
Mean.....	12·8	91	44·99	42·45	41·57	42·25	44·52	0·133,238
3,000 Gm. Group.								
39........	13·5	87	54·62	46·56	45·94	42·36	50·14	0·156,908
59........	14·1	93	50·58	45·78	46·40	46·26	49·28	0·165,914
66........	14·4	109	48·54	46·20	44·12	48·54	47·36	0·188,707
109........	13·6	87	41·90	37·34	39·28	41·46	41·78	0·111,249
112........	13·7	109	51·36	43·62	40·56	44·18	47·80	0·177,231
150........	14·6	90	43·58	41·50	42·54	43·98	49·54	0·138,283
157........	12·6	94	44·26	40·04	44·60	45·38	47·64	0·145,410
170........	14·2	84	43·98	45·86	46·66	46·08	48·52	0·140,939
172........	13·1	103	47·04	49·16	44·26	46·74	48·80	0·180,224
176........	14·5	86	43·14	39·76	40·90	42·66	44·76	0·120,514
Mean.....	13·8	94	46·90	43·58	43·53	44·76	47·56	0·152,538
Mature Group.								
108........	13·2	89	49·76	45·88	46·66	43·62	54·74	0·161,925
110........	15·3	86	51·04	47·44	46·98	51·60	52·86	0·168,726
111........	13·0	98	45·68	43·40	41·38	45·72	46·70	0·152,967
158........	13·6	82	54·52	46·52	44·70	48·20	47·86	0·150,618
159........	13·8	79	51·20	50·54	48·28	48·38	49·94	0·153,076
168........	13·4	84	44·02	45·92	45·92	43·50	48·60	0·137,123
171........	13·7	80	51·34	46·96	50·44	49·06	56·12	0·162,019
173........	13·7	88	45·94	44·46	42·86	42·20	44·38	0·133,625
174........	13·7	100	46·68	46·02	48·12	45·98	52·82	0·180,354
175........	15·1	88	46·62	44·98	44·30	42·94	45·46	0·139,089
Mean.....	13·9	87	48·68	46·21	45·96	46·12	49·95	0·153,952

Abbreviations as follows :—

L.................... Length of bundle in centimetres.
Fa, Fb, etc........... Fibre diameter in microns at A, at B, etc.

CHAPTER VIII.—RELATIVE GROWTH.

In an attempt to derive a bio-mathematical concept of the growth phenomena, Mr. van der Reyden, Section of Statistics, has made a considerable study of the wealth of data accumulated during the experiment. His findings will be presented at some future date, but many interesting points have already been brought out by his researches.

As it would be undesirable not to mention this aspect, Mr. van der Reyden has kindly consented to summarise certain findings for inclusion in this work. For convenience, his discussion is treated in a separate section. This addition enhances the value of the study and may be of service to other workers in this field.

Relative Growth.

By D. VAN DER REYDEN, Section of Statistics,
Onderstepoort.

In this chapter the quantitative methods used in evaluating the observed data are discussed shortly. The scope and significance of the law of simple allometry will be emphasised. Statements about the inter-relation of weight and form will lead to the question of what constitutes appropriate measurements in muscle growth.

PART I.—The Law of simple Allometry.

(*a*) *Mathematical formulation.*

Proposed by Julian S. Huxley in 1924, the law of simple allometry, in the sense of heterauxesis as well as allomorphosis (Huxley, Needham, and Lerner, 1941), has been extensively used to relate the measurement of the part to the measurement of the whole or standard. It is written

$$y = bx^a \quad \text{.......} \quad (1)$$

where—

y = measurement of part,

x = measurement of whole,

b = growth index, the value of y when $x = 1$,

a = equilibrium constant.

The important parameter is a, which can be written

$$a = \frac{\text{relative rate of increase of } y}{\text{relative rate of increase of } x} \quad \text{.......} \quad (2)$$

which, on integration, yields expression (1). Differentiating the expression we find the instantaneous rate of change to be

$$\frac{dy}{dx} = \frac{ay}{x} \quad \text{.......} \quad (3)$$

Expressing the allometric equation in logarithms the linear form is obtained,

$$\log. y = \log b + a \log. x \quad \text{.......} \quad (4)$$

(*b*) *Statistical formulation.*

(1) *The estimation problem.*—It is the task of statistics to investigate the possibility of bridging the gap between the mathematical formulation and the observed data. Most data to which the allometric equation is fitted can be expressed symbolically in either of the two forms presented below.

TABLE 35.

Observational data.

Time Classification.			Classification in Terms of Whole.	
Time Point.	Measurement of Part.	Measurement of Whole.	Measurement of Whole.	Measurement of Part.
1	Y(1, 1) Y(1, 2) . . Y(1, k)	X(1, 1) X(1, 2) . . X(1, k)	X_1	Y(1, 1) Y(1, 2) . . Y(1, k)
2	Y(2, 1) Y(2, 2) . . Y(2, k)	X(2, 1) X(2, 2) . . X(2, k)	X_2	Y(2, 1) Y (2, 2) . . Y(2, k)
. . . .	. . . .	. . . .	. . . .	. . . .
n	Y(n, 1) Y(n, 2) . . Y(n, k)	X(n, 1) X(n, 2) . . X(n, k)	X_n	Y(n, 1) Y(n, 2) . . Y(n, k)

The first symbol in the bracket refers to the classification point, while the second refers to the animal in each subgroup of k animals. Excluding the case in which the same individual can be measured consecutively, arithmetical averages of each subgroup are taken, thus:—

TABLE 36.

Average Figures.

Whole.	Part.	Estimated Part.
x_1	y_1	$\hat{y}_1$
x_2	y_2	$\hat{y}_2$
.	.	.
.	.	.
x_n	y_n	$\hat{y}_n$

It is now assumed that the allometric formulation is applicable and the statistical theory of estimation [Fisher, 1938; 1941] brought into play to obtain estimates of the parameters b and α. Attention must also be drawn to a publication by Kavanagh and Richards (1942) in which various methods of curve fitting are discussed. Utilising the obtained estimates of the parameters the third column in Table 36 can be calculated.

(2) *Confidence intervals and applicability of allometric law.*—Very closely allied with the process of estimation is the question of goodness of fit of the equation. Statistical literature abounds with different methods, ranging from the χ^2-test first proposed in 1900 to the Theory of Runs (Mood, 1940). Most of these have as starting point the assumption that the differences between the observed and estimated values of y are due to chance. While not stating that the reasoning involved in any one of these methods is of a *petitio principii* nature, the need for a method independent from the estimated values is evident. This requirement is partly met by the theory of *confidence intervals* (Neyman, 1941, where an extensive bibliography is given) or, for that matter, by Fisher's *fiducial theory* (1936, 1942).

As applied to the test for allometry, the reasoning is shortly as follows:–

From a statistical point of view the allometric equation, if appropriate, will hold between the "true" values of y and x. In how far can $\hat{y}$ be regarded as a "true" value of y? That is, how big a deviation can be allowed between y and $\hat{y}$? As the y-values are averages, calculated on k replicates at each measuring point of the whole, it is possible to determine limits between which the unknown "true" value at each point almost certainly lies.

Consider the k replicates, $Y_1, Y_2, \ldots\ldots, Y_k$, at any point as independent variables, varying normally about η, the "true" value, with an unknown standard error σ. Then confidence interval for η is given by

$$y - s_y t_\beta(k) \leq \eta \leq y + s_y t_\beta(k) \ldots\ldots\ldots\ldots \quad (5)$$

where $y = \frac{1}{k} \Sigma Y$, $s^2_y = \frac{1}{k(k-1)} \Sigma(Y - y)^2$, and $t_\beta(k)$ is Fisher's t corresponding to the number of degrees of freedom $(k - 1)$ and to chosen confidence coefficient β.

In other words, if the true value lies within the confidence interval determined by the data and the significance test (5), that value is not contradicted by the data at the level of significance chosen. By calculating at each point a confidence interval for the arithmetic mean of the part, and by connecting the end-points of consecutive intervals a *confidence region* for the experiment is obtained. If now the allometirc formulation is *not* applicable, its curve will intersect the boundary lines of the confidence region at one or more points. It must be emphasised that if the allometric curve lies within the confidence region, it does not necessarily follow that it is "true". In conformity with modern scientific methodology, statistics cannot prove a statement correct; it can only reject an incorrect statement.

It is not intended to assess the varous biological interpretations existing especially about the exponent α in the allometric formulation. Emphasis is rather laid upon the methodological aspect. Two basic requirements must first be satisfied before it is attempted to assign a biological meaning to the so-called equilibrium constant. The first is that the measurement performed on the part or whole must *in itself* be capable of biological explanation. Secondly a valid criterion must be available to control the acceptance, on the basis of the observed data, of the allometric formulation. These two requirements have not yet received the attention they merit.

PART 2.—Body Weight as Standard.

Let y be the measurement of the part and x that of the whole, in this experiment the weight of the rabbit. For computational purposes expression (1) was formulated as

$$\hat{Y} = B + AX \quad \text{.......... (6)}$$

where—

$\hat{Y}$ = best estimate of Y = log. y,

X = log. x,

B = log. b,

A = best estimate of a.

As graphical analysis showed that some of the measurements did not obey (6), it was decided as a preliminary step to fit to all measurements a logarithmic parabola as first empirical extension of the allometric fomula, thus

$$\hat{Y} = B + AX + CX^2 \quad \text{.......... (7)}$$

as equivalent of

$$\hat{y} = bx^a 10^{c \log.^2 x} \quad \text{.......... (8)}$$

$$\text{or } \hat{y} = bx^{a + c \log. x} \quad \text{.......... (9)}$$

Curve fitting was done by the mthod of least squares. As the same set of body weights was used throughout the experiment, Fisher's technique (1941) was used to avoid the simultaneous equations afres hon each occasion. Further simplification became possible by introducing Waugh's method of solving the equations (1935). After obtaining the numerical values of the constants B, A and C, last-mentioned was tested for significance. If insignificant, the last term in (7) was omitted and the necessary corrections applied to A and B. For instance, the weight of M. Psoas before correction was expressed as

$$\hat{Y} = -3\cdot715 + 1\cdot535X - 0\cdot0361X^2.$$

After correction it became

$$\hat{Y} = -3\cdot459 + 1\cdot338X.$$

Finally the confidence regions were calculated. Control was established at the 1 per cent. level of significance.

Instantaneous rates of increase relative to body weight were obtained by mathematical differentiation of the allometric formula or expression (7). The formulae became respectively

$$\frac{dy}{dx} = A\frac{\hat{y}}{x} \quad \text{.......... (10)}$$

and

$$\frac{dy}{dx} = (A + 2CX)\frac{\hat{y}}{x} \quad \text{.......... (11)}$$

TABLE 37.

Estimates of relative growth parameters.

Characteristic.	M. Gastrocnemius.					M. Psoas.				
	B.	b.	A = a.	C.	I.*	B.	b.	A = a.	C.	I.*
Weight	−5·5016	·000,003	2·71	−0·269	D	−3·4592	0·003,474	1·34	—	O.
Length	−1·7474	0·017,890	2·16	−0·9366	Q	−0·9366	0·115,720	0·91	−0·086	O.
Width A.	−1·5141	0·030,612	0·48	—	D	−1·4647	0·034,301	05·0	—	O.
B.	−1·3879	0·040,935	0·50	—	D	−1·3604	0·043,611	0·49	—	O.
C.	−1·3443	0·045,259	0·49	—	D	−1·3262	0·047,185	0·49	—	O.
D.	−1·4483	0·035,621	0·51	—	D	−1·3183	0·048,051	0·50	—	D.
E.	−1·6047	0·024,848	0·51	—	D	−1·2928	0·050,956	0·48	—	O.
Depth A.	−1·8322	0·014,716	0·44	—	D	−2·7363	0·001,835	0·60	—	O.
B.	−2·8803	0·001,317	1·38	−0·189	O	−2·4071	0·003,917	0·54	—	O.
C.	−2·4677	0·003,407	1·08	−0·133	O	−2·2343	0·005,830	0·52	—	O.
D.	−1·7184	0·019,125	0·41	—	D	−2·1237	0·007,521	0·50	—	O.
E.	−1·9866	0·010,314	0·43	—	D	−2·0208	0·009,532	0·49	—	O.
Bundle length	—	—	—	—	—	−1·0908	0·081,133	1·01	−0·108	O.
Bundle size	−4·2112	0·000,061	1·04	—	O	−4·0359	0·000,092	0·92	—	O.
Fibre Diameter A.	0·2710	1·8664	0·44	—	O	0·0666	1·1657	0·46	—	O.
B.	0·1417	1·3858	0·50	—	O	0·0571	1·1405	0·46	—	O.
C.	0·0913	1·2340	0·52	—	O	0·0632	1·1566	0·45	—	O.
D.	0·0579	1·1426	0·54	—	O	0·0433	1·1049	0·46	—	O.
E.	0·0754	1·1896	0·53	—	O	0·0404	1·0975	0·47	—	O.

* Abreviation :—I = Intersects.

Results :—

In Table 37 the results of the curve fittings are shown. Under column headings A and C only those values which showed significance by the t-test are shown. To test agreement between the ordinary significance tests and the confidence region, it was arbitrarily decided to employ two or more intersections of the fitted curve with the boundaries of the confidence region as a criterion of " badness " of fit. This is symbolically represented by " D " in the table, while " O " stands for no or one slight intersection.

A study of the results reveals :—

(1) With the exception of muscle and bundle length M. Psoas grows heterauxetically in all its measurements; M. Gastrocnemius does so only in the measurements of its lesser constituents, size of bundle and fibre diameter.

(2) This fact makes an inter-muscle comparison of the equilibrium constants very difficult.

(3) On the basis of the available measurements no evidence can be presented for the existence of growth centres and gradients within the muscle, excepting fibre diameter of M. Gastrocnemius and muscle thickness (depth) of M. Psoas.

(4) Intra-muscularly it seems that the equilibrium constants of muscle width and fibre diameter are related.

Figures 24-30.

These figures are presented as a matter of interest. They illustrate that a linear relationship in logs can be established for many measurements by the method of least squares, control being established at the 5 per cent. level of significance. However, when the confidence regions are calculated, intersection of the fitted line with the boundaries of the confidence region indicates a " badness " of fit for many of these measurements (two examples demonstrated in Figures 32 and 33).

The rapidly growing literature contains numerous similar examples of curve-fitting. Either the least squares method is employed to establish a linear relationship in logs, or the data may even be fitted by eye from a scatter diagram. By rejecting certain proposed curves the confidence region criterion assists in testing agreement with the ordinary significance tests, as well as eliminating a possible degree of wishful thinking.

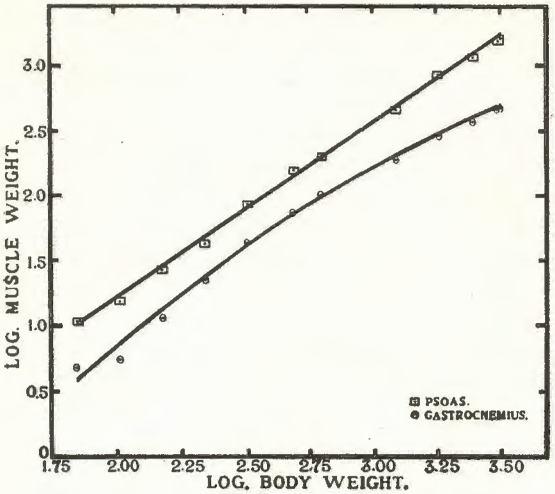

Fig. 24.—Weight of Muscle.

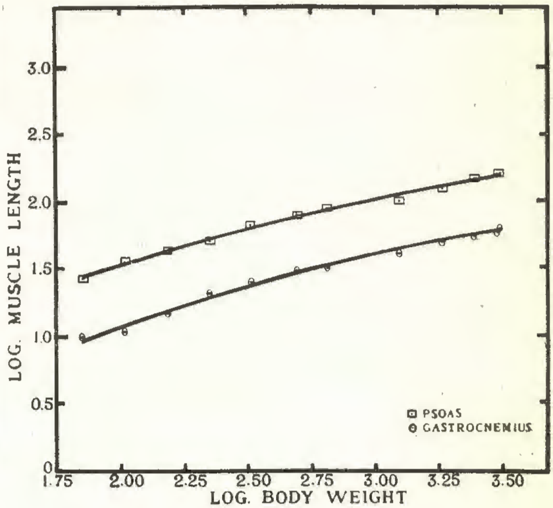

Fig. 25.—Length of Muscle.

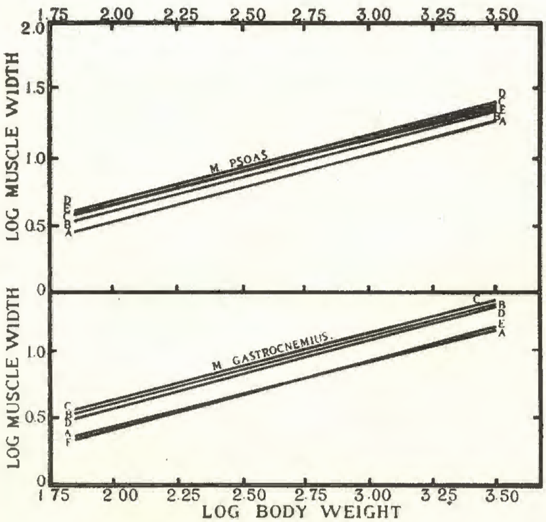

Fig. 26.—Width of Muscle.

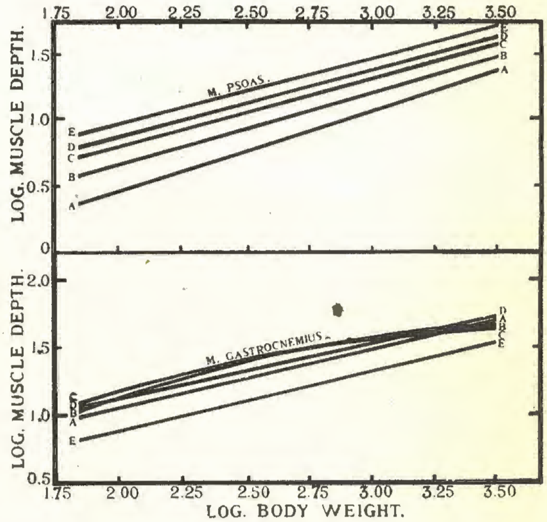

Fig. 27.—Depth of Muscle.

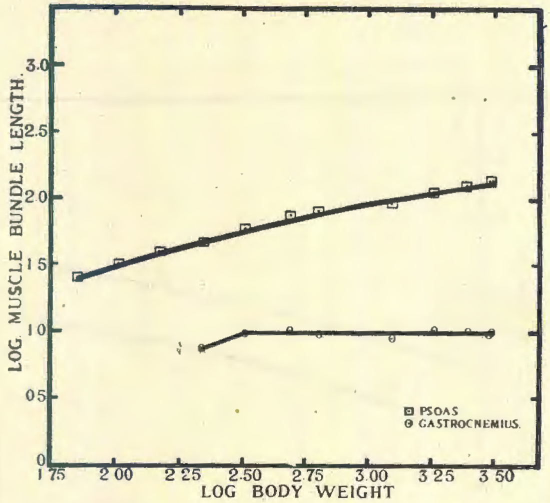

Fig. 28.—Length of Muscle Bundle.

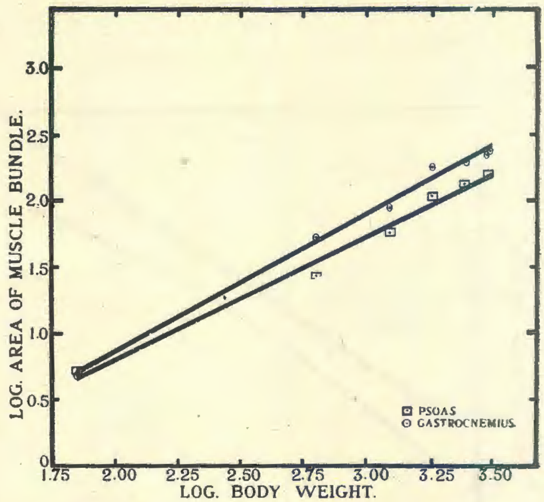

Fig. 29.—Thickness of Muscle Bundle.

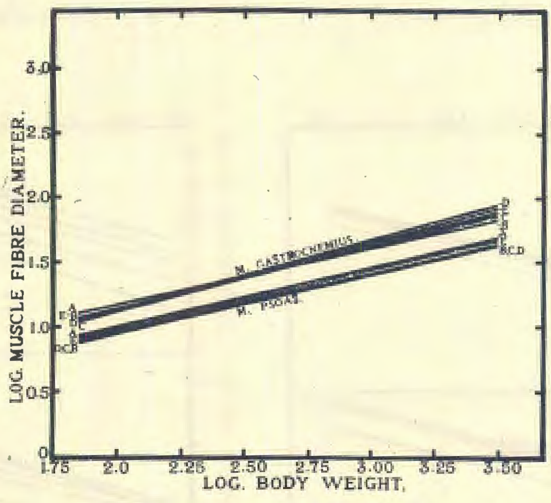

Fig. 30.—Diameter of Muscle Fibre.

Figures 31-33.

In Figure 31 the confidence region criterion supports the straight-line relationship in logs., established by the least squares method. In Figures 32 and 33 the fitted line intersects the boundary of the confidence region, indicating the " badness " of fit for width and depth of the Gastrocnemius muscle at site A.

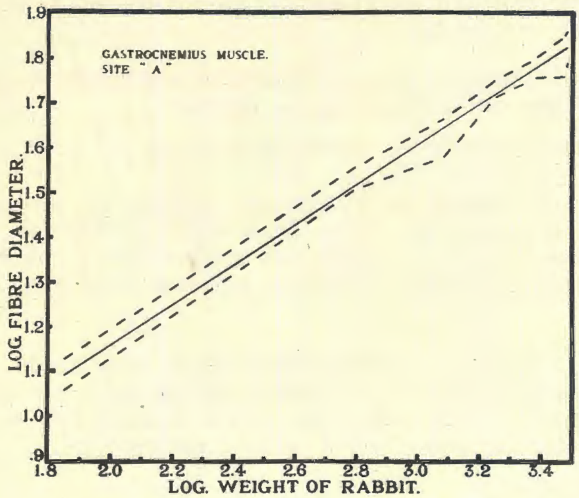

Fig. 31.—Fibre Diameter—M. Gastrocnemius, Site A.

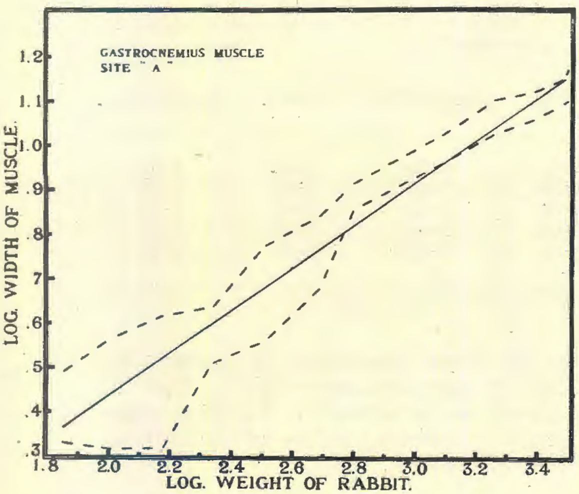

Fig. 32.—Width—M. Gastrocnemius, Site A.

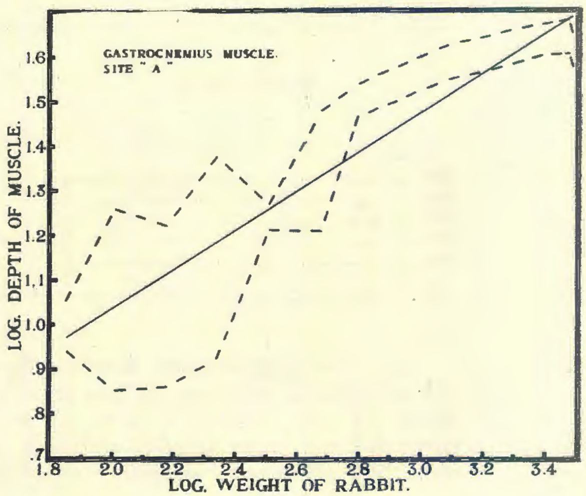

Fig. 33.—Depth—M. Gastrocnemius, Site A.

PART 3.—*Muscle Weight in Terms of Linear Measurement.*

In how far, if at all, is it possible to express weight growth in terms of increase of linear measurements, length, width, and depth? Before attempting to answer this question, it must first be investigated whether the weight at any development-point can be approximated by some combination of length, width and depth.

Assuming that for our purposes weight is equivalent to mass, a relationship between weight and volume can be written

$$(\text{volume}) = (\text{mass}) \times (\text{density})^{-1} \quad \text{.......................(12)}$$

The next step would be to express volume in terms of the linear measurements. As length was taken from origin to insertion, *extra animalis*, and the widths and depths perpendicular to this line, a cuboid form suggests itself as a first approximation. In fact, enforces itself due to the method of measurement.

As practical density determinations were only made on five weight groups, it was deemed advisable to restrict all attempts at "muscle-building" to these. In Table 38 is shown the actual density figures as well as the hypothetical ones, calculated on a cuboid assumption.

TABLE 38.

Density Calculations.

Weight Group.	Gastrocnemius.		Psoas.	
	Actual.	Hypothetical.	Actual.	Hypothetical.
Gm.				
100	1·05	1·31	1·06	1·69
150	1·06	1·46	1·05	1·71
220	1·06	1·41	1·06	1·74
320	1·06	1·39	1·06	1·53
480	1·06	1·21	1·06	1·46

As the hypothetical density figures are much too large, it means that the calculated volumes are too small. This in turn can only signify that the shape of the muscle cannot be represented as a cuboid. Various other formulations were tried: addition of smaller cuboids, solids of revolution, etc., but all these methods yielded values still worse.

It can only be concluded that the volume or shape of the muscle cannot be approximated by an arbitrary system of linear measurements perpendicular to one another. Only when a fixed reference system can be found, inside or outside the muscle, and measurements, linear or non-linear, appropriate to the shape of the muscle performed, will this morpho-metrical problem be capable of solution.

It must be pointed out that it is possible interpolationarily to express muscle weight in terms of any of the linear measurements. By utilising the results from Table 37 we have symbolically

$$\left.\begin{aligned} W &= f_1(x) \\ L &= f_2(x) \\ B &= f_3(x) \\ D &= f_4(x) \end{aligned}\right\} \qquad \text{(13)}$$

where—

x = body weight,
W = muscle weight,
L = length,
B = width,
D = depth.

By mathematically eliminating body weight between any two of the above equation the following permutations could easily be obtained.

$$\left.\begin{aligned} W &= F_1(L) \\ W &= F_2(B) \\ W &= F_3(D) \end{aligned}\right\} \qquad \text{(14)}$$

It might be thought that by differentiating W with respect to L, then to B and finally to D, and comparing the three sets of relative increases an answer might be given to the question whether increase in muscle weight is mainly " caused " by increase of any one of the three linear measurements. This supposition is quite wrong for the question itself has no meaning. Growth of muscle is a three-dimensional affair, and the increase in weight is due to the *simultaneous* increase in three dimensions, as has been clearly shown in preceding chapters. A practical illustration might be of interest, however. It is possible to write the instantaneous rates of increase of weight of M. Psoas, say, relative to the linear measurement as

$$\left.\begin{aligned} \frac{dW}{dL} &= \frac{dW}{dx}\Big/\frac{dL}{dx} = \frac{A_W}{A_1 + 2c \log. x} \cdot \frac{W}{L} \\ \frac{dW}{dB} &= \frac{dW}{dx}\Big/\frac{dB}{dx} = \frac{A_W}{A_B} \cdot \frac{W}{B} \\ \frac{dW}{dD} &= \frac{dW}{dx}\Big/\frac{dD}{dx} = \frac{A_W}{A_D} \cdot \frac{W}{D} \end{aligned}\right\} \qquad \text{(15)}$$

where A is the practical equilibrium constant.

It has already been stressed that the system of linear measurement utilised in this experiment only allows a cuboid reconstruction of the muscle. That is, we are entitled to write

$$W = \rho LBD \qquad \text{(16)}$$

or some such expression.

If this is substituted for W in the above expressions, it can be seen at once that the rate of increase of W with respect to either L or B or D depends on the magnitudes of *both* the remaining two at the *same* time.

It might be useful to point out that if $L > B > D$ then $\frac{dW}{dL} < \frac{dW}{dB} < \frac{dW}{dD}$.

Summing up, it can be stated however useful length, width, or depth might be considered *separately*, they are of little or no use in evaluating the weight of the muscle. Taking a mechanical analogy, one might investigate the utilitarian value of the length, width, and depth of an electrical dynamo relative to its efficiency.

Conclusion.

In the introduction to Chapter 1 it was stated "Definition of the quantitative character of muscle, in terms of measurable biological entities such as muscle bundle and muscle fibre, constitutes a primary requisite for such investigation."

Translated into statistical language it may be stated that the measurements performed for the purpose of throwing light upon muscle growth must be of such a nature as to satisfy the following requirement:

Measurement of individual muscle = measurement of lesser muscle unit X number of lesser units.

As this statement opens up vast fields of investigation, details will be omitted. Suffice it to state that powerful statistical procedures are available for simplification, so as to allow an unambiguous interpretation of data based on biological fact.

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