THE PHYSICAL GROWTH AND DEVELOPMENT OF THE OPEN-LAND BABOON, *PAPIO DOGUERA*

by

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ABSTRACT

This study describes the physical growth and development of the open-land baboon (Papio doguera = P. cynocephalus). The sample includes representatives of three of the four major subpopulations of P. doguera: guinea, yellow and anubis. Imported and captive-born animals were measured and those of known age were measured at regular intervals during their growth.

Standard anthropometric techniques were used to measure body weight, dental eruption stage, and sixty linear body measurements at each examination. Menarchal age, oestrous cycle lengths and gestation lengths were recorded for colony-housed females and testicular growth was recorded for males. One hundred and seven sets of measurements were taken on males and 101 sets of measurements on females. The sample includes measurements of four newborns, ten adult males and eighteen adult females. The ages of the adult animals were not known but all had fully-erupted permanent dentitions. Longitudinal growth data was accumulated on known-age subjects from birth to five years of age in males and to three and a half years in females.

Simple linear regression constants of the form $Y = a + bX$ were calculated for thirty pairs of body dimensions. In most instances, trunk height (suprasternale - symphysion) was used as the independent variable. For each regression analysis, the difference in rate (b) and size (a) constants of the sexes were compared. In only one instance, total lower limb length (y) against trunk height, was a statistically significant difference in growth rate constants found.

Gestation periods averaged 181.3 days and the birth weight mean was 775 gms. Weights of adult males averaged 22.75 kgs and of females, 12.32 kgs. In both sexes, the growth in weight and in most linear measurements is rapid during the first year but slow during the second. During the third year, the rate of male growth accelerates and by 3.5 years the males are significantly larger than females. The acceleration of growth in males may be correlated with the onset of testicular maturation. Females reach menarche at an average age of 3.0 years. No clear-cut circumpuberal growth acceleration was noted in the female. Menstrual cycles average 36.4 days. A marked seasonal trend in linear growth was observed, with the higher rate occurring during the summer months.

The growth pattern of the baboon is compared with those of other primates in order to find out whether the relative growth parameters of living monkeys and apes are of value in solving some problems of primate phylogenesis. In the baboon, several features of growth may be correlated with the behavioral traits necessary for successful ecological and social adaptation to ground-living. It is concluded that, among primates in general, the growth pattern bears a significant relationship to the evolution of learned behavior.

INTRODUCTION

Studies of the growth and development of infrahuman primates are valuable for two reasons. First, such data provide normative standards for those concerned with the husbandry or experimental use of a particular species. Second, some knowledge of the pattern and tempo of postnatal growth is helpful in understanding the biology of wild populations. It is hoped that the present study will be useful from both standpoints since it describes the physical growth of the baboon, a primate important as a laboratory animal and one whose social behavior and ecology is of especial interest to zoologists and anthropologists.

Previous Work

Present knowledge of the growth and development of infrahuman primates is largely based on studies of the rhesus monkey and chimpanzee supplemented with scattered observations on other species. Prosimians are represented by a report on the gain in weight and crown-rump length of a single potto (Perodictus potto) during the first 109 days of life (Grand, Duro and Montagna 1964). No adequate growth data exist for any New World monkey. Aside from the rhesus, observations on the growth of Old World monkeys are limited to those on the proboscis monkey (Nasalis larvatus) by Schultz (1942a), and on the Java macaque (Macaca irus) by Spiegel (1929, 1950); and Harms (1956).

In 1913, Lashley and Watson described the eruption of the deciduous dentition in a rhesus monkey (Macaca mulatta). The growth of rhesus monkeys born at the Carnegie Institute colony were studied by Schultz (1933). Further studies of the growth and development of the rhesus monkey have been conducted by van Wagenen and her co-workers using as subjects the animals born in the colony maintained by the Department of Obstetrics and Gynecology at Yale University School of Medicine. These studies include a monograph on growth in body weight and sitting height (van Wagenen and Catchpole 1956), eruption times of the deciduous (Hurme and van Wagenen 1953) and permanent dentitions (Hurme and van Wagenen 1956); birth weights (van Wagenen 1954); prenatal growth (van Wagenen and Catchpole 1965); and a roentgenographic study of skeletal maturation (van Wagenen and Asling 1958). Epiphyseal closure and ossification rates of the rhesus have also been reported on by Gisler, Wilson, and Hekhuis (1960); and Haigh and Scott (1965); body weight increase from birth to 15 months is described by Hurst (1965).

Studies of the growth of living chimpanzees were initiated by Bingham (1929). Schultz (1935) recorded the dental eruption sequence in a small series of chimpanzees; Spence and Yerkes (1937) reported on body weight increase in a series of known-age animals. Notes on the growth of captive-born chimpanzees have been recorded by several authors (Jacobsen, Jacobsen and Yoshioka, 1934; Huxley 1936; Grether and Yerkes, 1949; Vanderplank 1937). A detailed study by Schultz (1940) described both chronological and relative growth changes in longitudinally-followed animals of known birth-date and was supplemented by observations on a large number of embalmed and skeletonized specimens. In 1953, Gavan published an extensive study of chimpanzee growth in which body weight increase and a number of anthropometric measurements were compared with similar data on human children of the Brush Foundation growth study (Simmons 1944). Studies limited to the dental eruption times have been published by Nissen and Riesen (1945, 1964). Gross and microscopic age changes in the bones of known-age chimpanzees have been described by Kerley (1964). A recent paper by Gavan and Swindler (1966) compares the growth of the rhesus monkey, chimpanzee and human as it is reflected in the specific growth rates of sitting height. Information on the growth on the other anthropoid apes is scanty. Schultz published monographs on the growth of the orangutan (1941, 1942b), gibbon (1944), and gorilla (1942b) in which notes on a few living animals were used to supplement data derived from larger series of preserved specimens. Grimmer (1950) collected body weight records of captive gorillas whose ages were known or could be closely estimated.

Developmental studies on living baboons of known ages are limited to observations on the eruption of the dentition (Freedman 1962a;

Reed 1965) and sexual maturation of females (Gilbert and Gillman 1960). Studies based on non-living baboon materials include descriptions of cranial growth (Zuckerman 1926; Huxley 1932; Freedman 1962b) and a paper on organ weight-body weight relationships (Snow and Vice 1965).

MATERIALS AND METHODS

SUBJECTS

The baboons used as subjects in this study represent several genetically diverse strains. Their taxonomic status is somewhat complicated by the confusion which clouds the entire genus *Papio* (Tappen 1960; Roth 1965). An eventual solution to this problem is offered in the establishment in 1963 of a "Committee on Baboon Nomenclature" composed of primatologists and taxonomists especially concerned with *Papio* taxonomy (Vagtborg 1965). An interim report of this committee (Hill 1965) suggests that the genus *Papio* should exclude drills, mandrills and the gelada and be confined to the "ordinary" baboons. The term "ordinary" includes two distinct subpopulations, *Papio hamadryas* (Somalia, West Ethiopia and Arabia) and *Papio cynocephalus* (Senegal to the Cape).

Papio cynocephalus (the savannah baboon) may be subdivided into four well-defined forms on the basis of adult morphology. The subpopulations of *Papio cynocephalus* are (1) the guinea baboon of West Africa, (2) the anubis baboon of East Africa, (3) the yellow baboon of South-Central Africa, and (4) the chacma baboon of South Africa. In the interim report cited above, differences of opinion were expressed on the rank, whether specific or subspecific, to which the *P. cynocephalus* forms were to be assigned. The decision of whether to treat *P. cynocephalus* as a superspecies composed of four distinct species or whether to consider it a species consisting of four subspecific populations was deferred by the committee until further data could be obtained. There appears to be general agreement that the common name "savannah baboon" represents the *Papio cynocephalus* group, whatever taxonomic rank this latter is ultimately assigned. In the present study "savannah baboon" will be used with the understanding that it represents four subpopulations (guinea, anubis, yellow, and chacma) which may eventually be considered as (1) separate species of a superspecies or as (2) subspecies of a single species. This taxonomic revision renders obsolete the binomial P. doguera, used in the title of the present work.

All of the baboons used as subjects in this study were savannah baboons. Three of the above described subpopulations, the guinea, the anubis, and the yellow, were represented. In addition, the sample included a fourth strain of guinea-yellow hybrids.

The yellow baboons were from a colony maintained by the Southwest Foundation for Research and Education (SFRE) at San Antonio, Texas. Its members were animals trapped in Africa and their San Antonio-born offspring. The imported animals were trapped near Darijani, Kenya, approximately 140 miles south of Nairobi. The trapping zone was a 40 square mile area near the confluence of the Athi and Kibwezi rivers (Vice and Rodriguez 1965). The animals born in San Antonio were the offspring of a single male and were thus half-siblings.

The guinea baboons of the study were from a colony established in 1940 at the Breckenridge Park Zoo in San Antonio. Originally consisting of a male and five females, it grew rapidly and by 1957 contained over eighty members. In that year a portion of the colony was acquired by SFRE for use in research. No new animals have been introduced into this colony since it was founded. Inbreeding was further intensified by the zoo-keeper's practice of eliminating young males from the colony before they attained sexual maturity so that all newborns were sired by the original male (Stark 1965). The practice of inbreeding was continued at SFRE with an offspring of the original male serving as the only sire. This extreme inbreeding is reflected in the haptoglobin and hemoglobin types of this colony which showed much less variation than was displayed among the yellow baboons at SFRE (Buettner-Janusch 1963).

In 1961, a breeding program was established at SFRE with the purpose of developing a stock of guinea-yellow hybrids. A male from the inbred guinea baboon colony was selected to serve as sire while the females were chosen from the Darijani-trapped colony of yellow baboons. A second line of guinea-yellow hybrids were developed at the colony maintained by the University of Oklahoma Department of Medicine (OUDM) at Norman, Oklahoma. The sire of this strain was an African-born guinea baboon obtained through a commercial dealer and the females were Darijani-trapped yellow baboons purchased from SFRE.

In 1963, the Department of Obstetrics and Gynecology (OUOB) of the University of Oklahoma School of Medicine established a small colony of guinea baboons. It was stocked with several females and a male from the SFRE colony. Measurements made on four animals born in this colony are included in the present study.

An infant anubis baboon was included in the present study. This animal was born on 21 July 1964 while its mother was in transit from Kenya to Oklahoma City. No information on the trapping locale of the mother is available beyond the dealer's report that she was taken "near Nairobi" and was pregnant when captured. In June, 1965, body measurements were taken on nine female adult anubis baboons of the OUDM colony. These animals were obtained from a commercial dealer, but the exact trapping locale in Kenya is not known.

The breeding histories of the above groups are shown in Figure 1. The animals of each group that were measured are listed by sex and accession number. The latter is a three digit numeral designating the animal and is prefixed by letters indicating the parent colony. To avoid overlap with SFRE accession numbers the animals of the two Oklahoma colonies have been assigned numbers beginning with 800. The SFRE prefixes, "A," "D," and "AD," designating yellow, guinea, and guinea-yellow hybrids respectively, have been retained. The anubis baboons of the series have been assigned the prefix "N."

ENVIRONMENT

The housing, diet and infant-care practices of the SFRE colony have been described elsewhere (Vice and Rodriguez 1965; Vice et al 1965).

At the OUDM colony "gang" cages were employed which provide adequate space for up to eight animals. These cages were located within a heated building and each connected to an outside run to which the animals had access in good weather. OUDM animals were maintained on a diet of Purina Monkey Chow supplemented daily with raw carrots, oranges, or

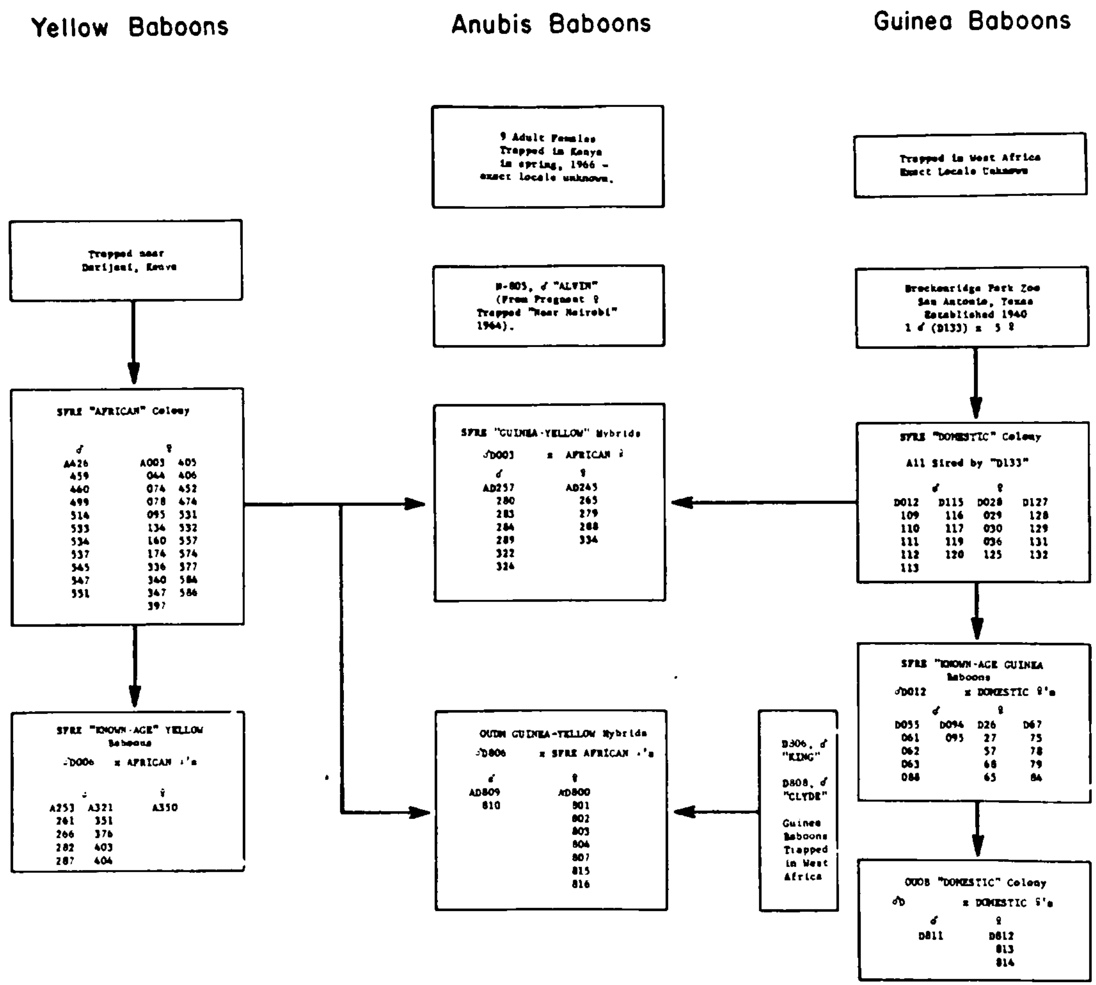

Fig. 1. Sources and Breeding Histories of Savannah Baboons used as Subjects of Present Study.

cabbage. Newborns were separated from the mother at birth and kept in a multi-unit incubator with constant humidity and temperature controls (Snow, Oviatt, and Smith 1967). Infant diet was a human infant formula modified in richness to approximate natural baboon milk (Vice et al 1965). It was supplemented with soft infant cereals until the deciduous dentition was complete. Thereafter, a gradual shift to the ordinary adult diet was accomplished.

SAMPLE STRUCTURE

In the analysis of postnatal growth and development patterns in the sections that follow, several sub-groupings of the total sample have been employed. These are:

1. Newborn: In this study, animals from 1 to 7 days old were considered "newborn." It was possible to measure only four such infants and all were females. Newborn female primates tend to be slightly smaller than the males (van Wagenen 1954; Schultz 1962; Altman and Dittmer 1963), but the differences have never been reported as statistically significant. In any case, sexual dimorphism that distinguishes the adult in the newborn baboon is probably minimal. The means and observed ranges of the various body dimensions of these newborns are given in Tables 11 through 13, Appendix B.

2. Adult: To represent the adult baboon, 10 males and 18 females were randomly selected from the SFRE and OUDM colonies. Although the exact ages of these animals were not known, all had fully erupted permanent dentition. The means, standard deviations, and observed ranges of their body measurements are presented in Tables 14 through 19, Appendix B.

One male and four females of this group displayed minimal third molar wear and are regarded as recently matured adults. One female and one male had very worn molars and showed a number of other physical signs of extreme senility. The senile male was the original sire of the San Antonio Zoo colony of guinea baboons and was therefore at least twenty-years old when measured in 1963. It is also probable, but not certain, that the senile female was one of his original consorts and may have been approximately the same age. No reliable data on the longevity of wild baboons are available. In captivity, maximum recorded ages of baboons range between 24 and 30 years (Flower 1931). Thus the sample adequately represents the age-span that baboons can attain under capive conditions.

3. Known-age Sample: Within the sample were 24 males and 14 females of known birth date. When possible, these animals were measured at 0.10 year intervals during the first year of life and at 0.20 year intervals thereafter. Data derived from these animals were used in the analysis of chronological growth (change in body dimension per unit of time). The structure of the known-age sample is shown in Figure 2. The means and observed ranges of each measurement were calculated for each age category and are given in Tables 20 through 73, Appendix B.

4. Relative Growth Sample: In addition to the animals of known-age, a number of animals of unknown age were also measured. For the analysis of relative growth (change in one body dimension per unit of change in another) it is not necessary to know the chronological age of the subjects. In this study, all available sets of measurements on dentally immature animals of both known and unknown age were used in calculating the relative growth statistics. Relative growth data are presented in Tables 74 through 83, Appendix B.

5. Supplementary Sources: In addition to the data derived from animals actually measured, supplementary data were used in calculating the statistics on birth weight, gestation period, age of female sexual maturation and menstrual cycle length. The structure of the samples used in these analyses are described in separate sections dealing with these topics.

Measurements

Measurements were taken with the animal under Sernalyn@ (phenycyclidine hydrochloride) or pentabarbital anaesthesia. The instruments used in taking linear body measurements were an anthropometer, sliding calipers, and spreading calipers (Martin 1928). Girth measurements were taken with a steel tape. Body weight was taken on a standard

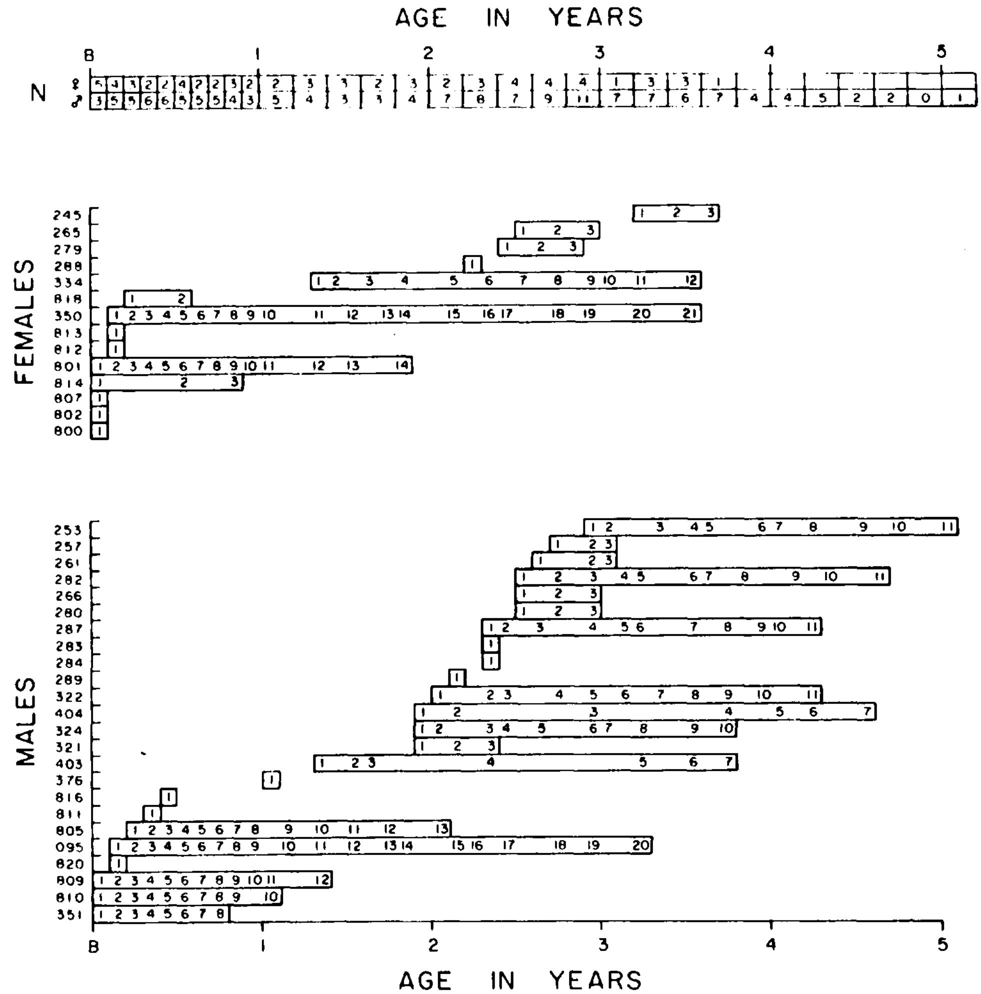

Fig. 2. Structure of the sample of known-age savannah baboons used as subjects in this study. Each bar in the body of the figure represents a single animal. Numbers within the bars are located at the ages when an animal was measured. The continuous bars at the top of the figure give the total sample size for each age group.

laboratory scale. Instruments and scale were calibrated frequently throughout the study.

Body weight was recorded to the nearest 0.01 kg and linear measurements to the nearest millimeter. All measurements and observations were made by the author and recorded by an assistant.

The dentition was examined and its state of eruption recorded. A tooth was considered erupted if any part of the crown had penetrated the gum. To refine the description of the eruption sequence, a fractional score ranging from 0.0 to 1.0 in steps of 0.25 was assigned each tooth. An unerupted tooth was given a score of 0.00; partially erupted teeth were scored as 0.25, 0.50 or 0.75 depending upon the author's subjective estimate of the degree of eruption. A fully erupted tooth was considered to be one which had reached the normal occlusal plane and was given a score of 1.0. In calculating the total dental score, the individual tooth scores were added. The final score included (1) teeth actually present, (2) all shed and replaced deciduous teeth, and (3) permanent teeth lost through disease or trauma. This method of scoring allowed the assignment of each animal's eruption stage to a continuous scale ranging from 00.00 to 52.00 (20 deciduous plus 32 permanent teeth).

Table 1 lists each measurement used in the present study together with its appropriate landmarks and the instrument with which it was usually taken. In the case of the large males it was often necessary to substitute the anthropometer for the sliding calipers for certain measurements (e.g. thigh length). In infant animals, the sliding calipers were more convenient than the anthropometer for some measurements. The last column in the table indicates the source (either Schultz 1929 or Gavan 1953) which defines the landmarks and techniques employed in taking the measurement. Those measurements used in this study which were not defined by previous authors or which differ from theirs in landmarks or technique are defined in Appendix A. All arm and leg measurements were taken on the left side.

In addition to those of Table 1, four measurements were secondarily derived from others:

TABLE 1. LANDMARKS AND INSTRUMENTS USED IN TAKING THE LINEAR BODY MEASUREMENTS EMPLOYED IN THE PRESENT STUDY.

(b = breadth, d = depth, h = height, l = length, A = anthropometer, Sl.C. = sliding caliper, Sp.C. = spreading caliper)

MEASUREMENT	LANDMARK	INSTRUMENT	DEFINED BY
I. TRUNK AND STEM			
1. sitting h.	vertex-subischiale	A	present study[1]
2. stem l.	vertex-symphysion	A	Schultz '29
3. trunk h.	suprasternale-symphysion	A	Schultz '29
4. substernale h.	substernale-symphysion	A	present study
5. biacromial b.	acromion	Sl.C.	Schultz '29
6. chest b.	level of substernale	A	present study
7. chest d.	level of substernale	A	present study
8. bicristal b.	iliocristale laterale	Sl.C.	Schultz '29
9. bitrochanteric b.	trochanterion laterale	Sl.C.	Schultz '29
10. bituberosity b.	ischiale laterale	Sl.C.	present study
11. pelvic l.	iliocristale summum-subischiale	Sl.C.	present study
II. APPENDAGES			
1. upper arm l.	acromiale-humerale	Sl.C.	Gavan '53
2. forearm l., ulnar	olecronale-stylion	Sl.C.	Gavan '53
3. forearm l., radial	radiale-stylion	Sl.C.	Schultz '29
4. hand l.	carpale-chirodactylion III	Sl.C.	present study
5. pollux l.	carpale-chirodactylion I	Sl.C.	present study
6. hand b.	metacarpale laterale-metacarpale mediale	Sl.C.	Schultz '29
7. wrist b.	bistyloid diameter	Sl.C.	present study
8. elbow b.	bicondylar diameter	Sl.C.	present study
9. thigh l.	trochanterion summum-femorale	Sl.C.	Schultz '29
10. knee h.	tibiale-plantare	Sl.C.	Schultz '29
11. tibial l.	tibiale-sphyrion	Sl.C.	Schultz '29
12. foot l.	pterion-pododactylion III	Sl.C.	Schultz '29
13. hallux l.	pterion-pododactylion I	Sl.C.	Schultz '29
14. foot b.	metatarsale laterale-metatarsale mediale	Sl.C.	Schultz '29
15. ankle b.	bimalleolar diameter	Sl.C.	present study
16. knee b.	bicondylar diameter	Sl.C.	present study
17. tail l.	caudale proximale - caudale distale	A	Schultz '29
III. HEAD			
1. total head l.	opisthocranion-prosthion	Sp.C.	present study
2. cranial l.	opisthocranion-glabella	Sp.C.	Schultz '29
3. cranial b.	maximum transverse vault	Sp.C.	Schultz '29
4. total face h.	nasion-gnathion	Sl.C.	Schultz '29
5. upper face h.	nasion-prosthion	Sl.C.	Schultz '29
6. nasal h.	nasion-subnasale	Sl.C.	Schultz '29
7. biorbital b.	ecto-orbitale	Sl.C.	present study
8. biocular b.	ectocanthion	Sl.C.	Gavan '53
9. interocular b.	endocanthion	Sl.C.	Schultz '29
10. nasal b.	bialare diameter	Sl.C.	Schultz '29
11. bizgomatic b.	zygion	Sl.C.	Schultz '29
12. bigonial b.	gonion	Sl.C.	Schultz '29
13. ear l.	superaurale-subaurale	Sl.C.	Schultz '29
14. ear b.	preaurale-postaurale	Sl.C.	Schultz '29

1. Defined in Appendix A.

1. Head-neck height: (vertex-suprasternale) The differerence between trunk height and stem length.

2. Total arm length: upper arm length + forearm length (ulnar) + hand length.

3. Total lower limb length: thigh length + leg length + foot length.

4. Thigh length + knee height: "Lower limb length" of Schultz (1929) is used here instead of total lower limb length to make certain growth comparisons with data of the latter author and Gavan (1953).

Statistical Methods

In the case of the newborn, adult, and known-age samples, arithmetic means and observed ranges are the only statistics employed. Relative growth is described by means of (a) indices, and (b) regression analysis.

Indices are simple ratios of one body dimension to another. While they offer a concise expression of proportional relationships, they have certain disadvantages when used to describe growth changes (Gavan 1952; Simpson, Roe, and Lewontin 1960). Nonetheless, in the past many anthropologists and primatologists have made extensive use of indices. Indices are used in order to compare present findings on the baboon with those of other infrahuman primates in the older literature.

As Gavan (1953) has shown, most of the relative growth relationships in the chimpanzee and human are amenable to simple linear regression analysis. In the present study, linear regression was also found applicable. In calculating regression statistics, the following procedure was employed:

1. Raw data consisted of all sets of measurements accumulated to 1 June 1965. This collection consisted of 97 sets taken on males and 83 on females. Excluded from the analysis were all animals with fully erupted permanent dentitions.

2. Class intervals based on 2 cm increments in trunk height were established and each set of measurements was assigned to the appropriate trunk height class interval. Sexes were considered separately.

3. Within each trunk height class interval the means of each measurement were computed.

4. Using these class interval means, linear regression analyses were performed using the formula,

$$Y = a + bX.$$

5. The coefficient of determination (Fisher 1950; Gavan 1953) was calculated in order to judge the fit of the equation. This statistic is equal to the square of the coefficient of correlation (r) and expresses the amount of variability in the dependent variable (Y) associated with the variability of the independent variable (X). For example, a coefficient of determination of 0.950 indicates that less than 5% of the observed variability of Y cannot be accounted for by linear regression on X and it is justified to treat the relationship as a linear one.

6. If a reasonable linearity was demonstrated for a particular pair of variables the regression constants of the males were compared with those of the females in order to determine whether statistically significant differences exist in the observed growth patterns of the sexes. (See Mather, 1965 for procedure.)

7. If neither the rate constant (b) nor size constant (a) displayed significant differences, a single regression line, using the data from both sexes, was calculated.

The pairs of measurements selected for regression analysis were those whose growth relationship are of special interest from the standpoint of phylogeny and taxonomy. Trunk height was taken as the independent variable in most instances. A number of other pairs consist of commonly studied indices and ratios (e.g. head breadth/head length). In such cases, the measurement selected as the independent variable is the one used as the denominator in calculating the index. Tables 88 through 91, Appendix B, presents the relative growth data.

Throughout the following sections it should be borne in mind that most of the statements based on derived statistics, such as indices and regression constants, refer to the mean and not the individual. The variability displayed in patterns of growth and development in the baboon are great and are as interesting to the student as are the central tendencies. However, due to time limitations and small sample size, extensive growth histories of only a few animals are yet available so that the problem of individual variability cannot be given the attention it certainly deserves. It should be clearly understood, therefore, that such statements as "at 3.00 years the male exceeds the female by 4 mm in sitting height" refer to mean values only and there may be extensive overlap in range.

NEWBORN AND ADULT

Gestation

Data on the length of the gestation period were available for a series of thirty normal births. Twenty-two of these occurred at SFRE, five at OUDM, and three at OUOB. To determine gestation length, each female was inspected at one to three day intervals and the degree of sex-skin swelling subjectively graded on a scale ranging from 0 (no swelling) to +4 ("full-bloom"). As in other cercopithecoids (Harms 1956), it was assumed that ovulation coincided with the onset of sex-skin detumescence and that conception followed within twenty-four hours. In calculating the gestation length in this series, the day of conception was counted, but not the day of birth.

The mean for 18 male births was 180.4 days and that of 12 females, 182.5 days (Fig. 3). These differences were not statistically significant and data on the sexes were combined to give a mean of 181.3 $\pm$ 10.8 days. The observed range was 157 to 202 days.

Birth Weight

Birth weights were available for sixteen baboons born in the SFRE and OUDM colonies. This series was expanded by the inclusion of the birth weights of eight infants born in the colony of savannah baboons maintained by the Bionetic Research Laboratories (Miller and Pallota 1965). The total sample of twenty-four individuals were composed of ten males and fourteen females. It did not include stillborns, Caesarian deliveries or infants that failed to survive the first day of life.

The statistics derived from the birth weight series are presented in Table 2. The average weight of newborn male baboons was 787 gms. The females averaged 21 gm lighter than the males but this difference was not statistically significant. Combining the data on both sexes yielded an overall mean of 775 gm with a standard deviation of 140 gms.

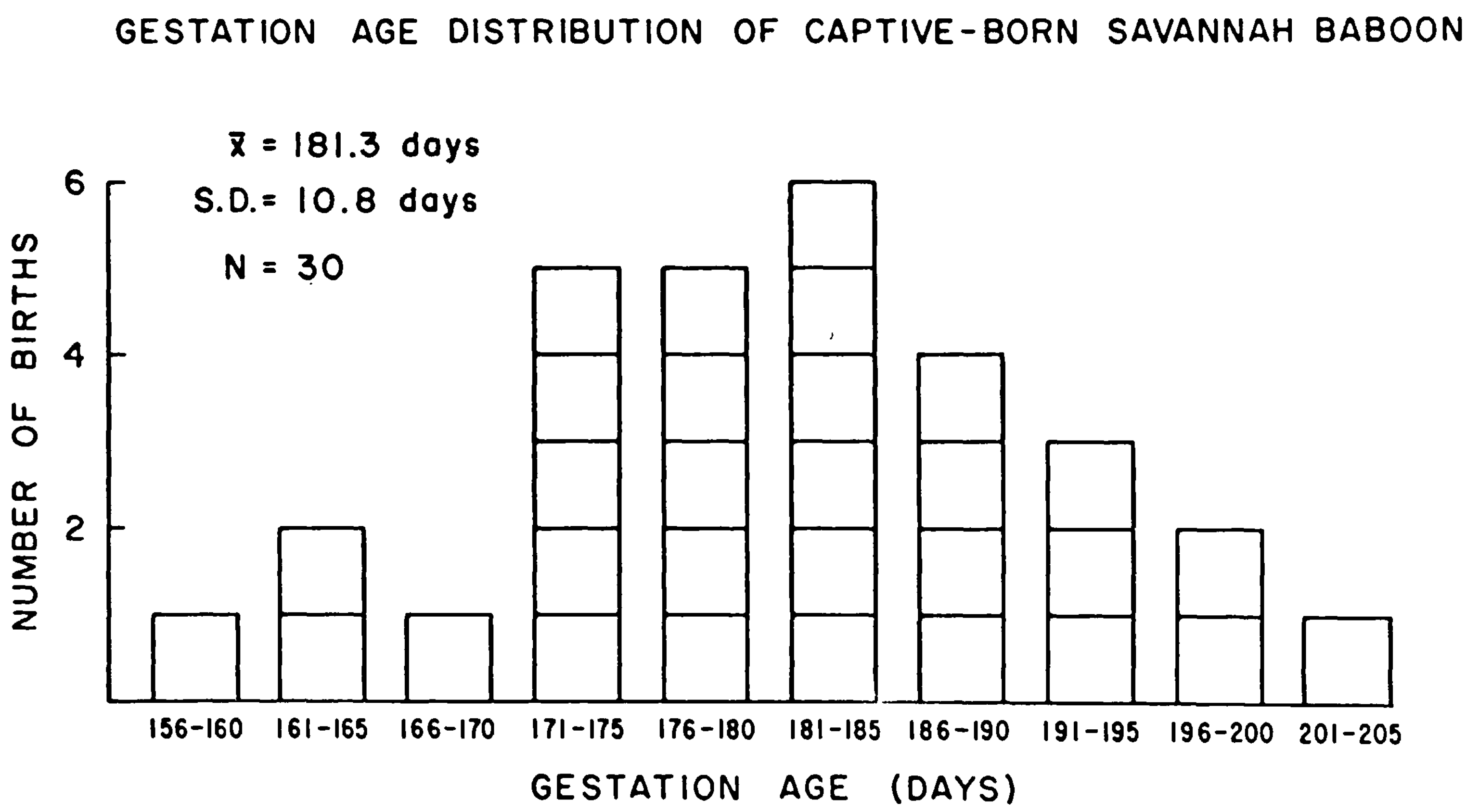

Fig. 3. Gestation age distribution of captive-born Savannah Baboons.

The median weight for the combined series was 758 gms which suggests a slight skewing toward the higher values and probably reflects a somewhat higher perinatal mortality rate among the smaller newborns. The observed range of the series was 538 gms; the smallest animal weighed 539 gms and the largest was almost twice as heavy with a weight of 1,077 gms.

TABLE 2. BIRTH WEIGHTS OF TWENTY-FOUR NORMALLY DELIVERED SAVANNAH BABOONS

Sex	N	Median	Mean	Standard Deviation	Observed Range	Coefficient of Variation
			gm.	gm.	gm.	%
Males	10	774	787	± 137	559- 955	17
Females	14	747	766	± 146	539-1077	19
Both Sexes	24	758	775	± 140	539-1077	18

Sexual Dimorphism in the Adult

The mean body weight of the ten adult males was 21.75 kgs. The average body weight of the eighteen females was 12.32 kgs or 56.6% of the weight mean of the males. The males ranged from 19.0 to 24.5 kgs and the females from 10.9 to 14.4 kgs. Although there was no overlap in this small sample, the standard deviations (2.18 kg for males, 1.16 kg for females) are large enough to suggest that an occasional female might fall within the male population range.

Although the exact ages of the adult animals were not known, relative ages could be estimated through the degree of third molar wear. When body weight was related to the age groups based on dental attrition (Table 3), a regular relationship between dental age and weight was apparent in both sexes. Adults with recently acquired third molars tended to be lighter than those displaying slight to moderate wear. Those with heavily worn third molars were lighter than those with intermediate attrition.

As Gavan (1952) points out, the cube root of body weight is preferable to body weight itself for comparing ponderal with linear attributes. When reduced to $\sqrt[3]{\text{mean body weight}}$ the female/male body weight percentage was 82.7%. If the dimorphic differences were purely a matter of size rather than shape, it would be expected that the corresponding percentages for the various linear measurements would also fall in the neighborhood of 83%. In actual fact, they ranged between 70.6% (upper face height) and 92.6% (ear breadth). This suggests that the sexual dimorphism in the baboon is manifest in proportional differences as well as absolute size.

In Figure 4, the $\frac{♀ \bar{x}}{♂ \bar{x}}$ percentages for the linear measurements are compared with the $\sqrt[3]{\bar{x} \text{ body weight}}$ relationship. A sharp distinction exists between the neurocranial and spanchnocranial portions of the skull. The cranial vault dimensions of the female approach those of the male more closely than do the facial dimensions. The female face is not only absolutely smaller but relatively smaller than the male. The female thorax is also smaller in relation to overall body size. Proportional differences in the pelvis and extremities are minimal.

TABLE 3. BODY WEIGHT MEANS, IN KILOGRAMS, OF ADULT BABOONS GROUPED ACCORDING TO DEGREE OF THIRD MOLAR WEAR

M3 Wear	Male		Female	
	N	Body Weight	N	Body Weight
		kg.		kg.
None	1	19.5	4	11.4
Slight	4	20.9	7	13.2
Moderate	4	23.1	6	12.0
Severe	1	22.3	1	11.7

Using the means of linear measurements, the percentage of increase from newborn to adult was calculated (Fig. 5). In all measurements the male increased most. The region that grew least was the neurocranium which increased in size by a little over 150%. Adult upper face height was almost 450% of its newborn value in males and 315% in females. The increase in breadth measurements of the face were intermediate between neurocranial and facial length gains. Thoracic and pelvic dimensions of the male increased by about 250-400% and in the females by 250-350%. In the segmental lengths of both limbs there was

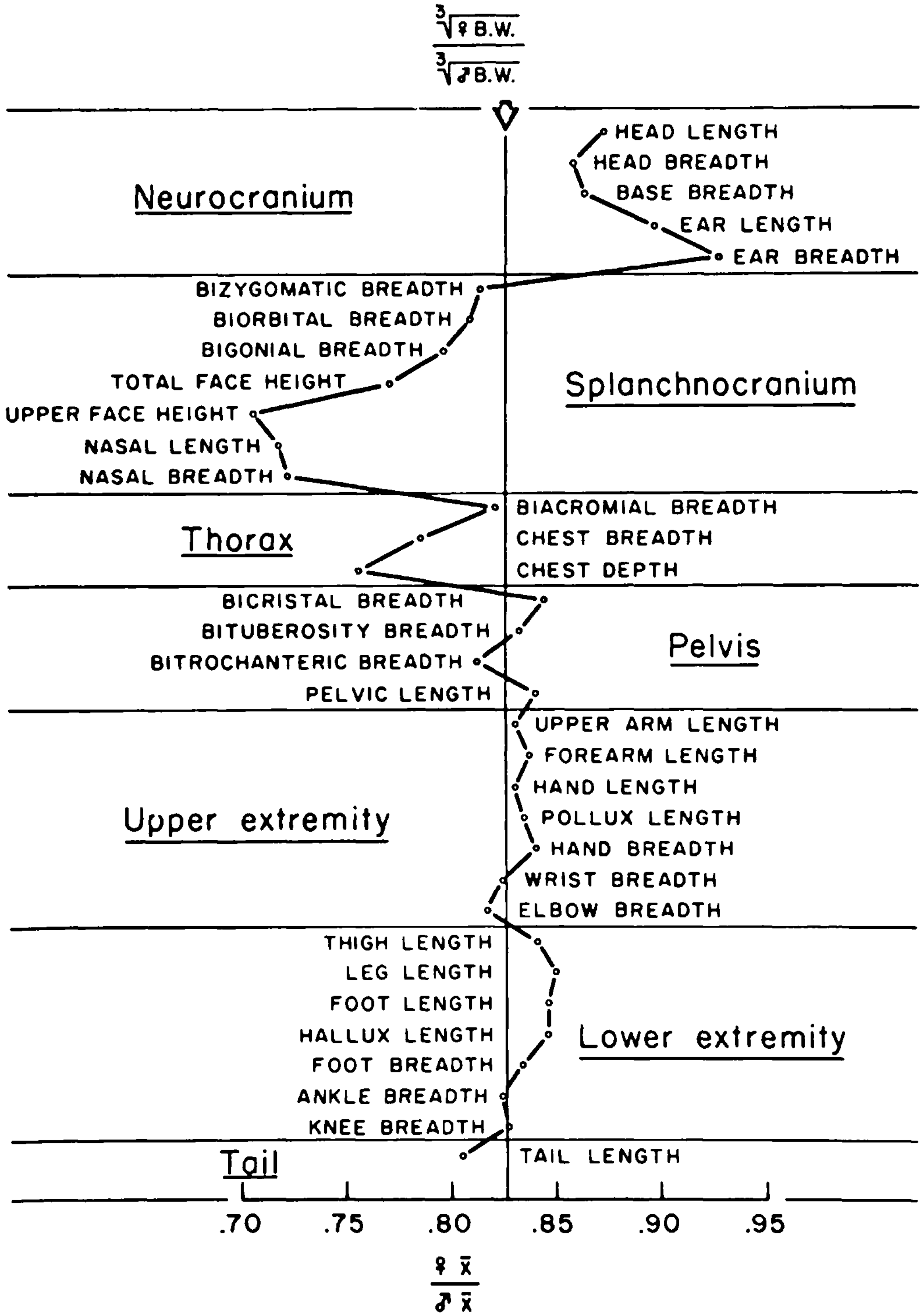

Fig. 4. Sexual Dimorphism of Linear Body Dimensions of Savannah Baboons.

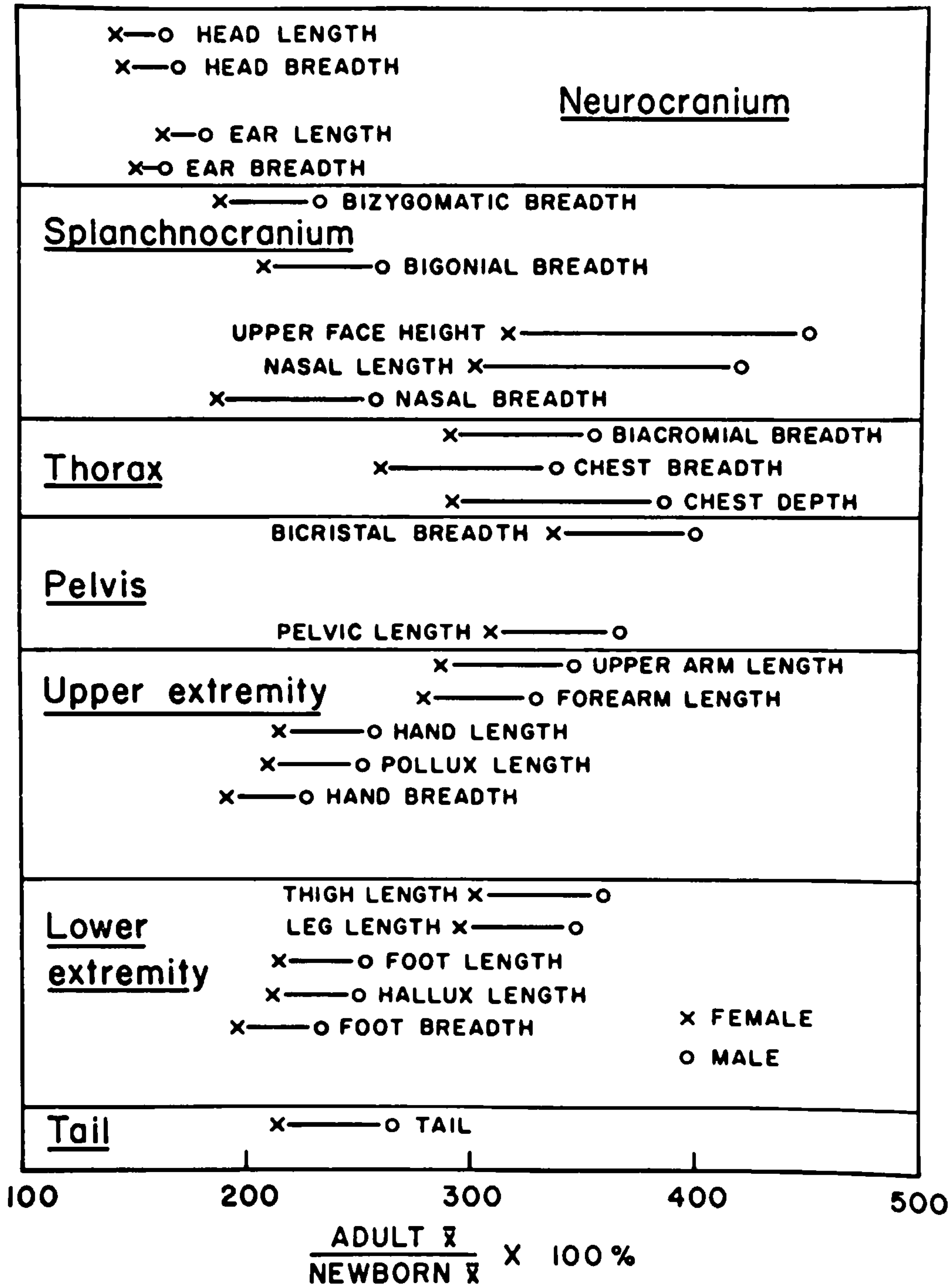

Fig. 5. Mean Linear Dimensions of Adult Savannah Baboons Expressed as Percentage of Newborn Means.

a proximal-distal gradient of upper arm > forearm > hand and thigh > leg > foot. With some exceptions, the measurements displaying the greatest degree of sexual dimorphism were those with the greatest percentage growth increments. The stick-diagrams of Figure 6 compare the overall size and proportion differences between the newborn and adult baboon.

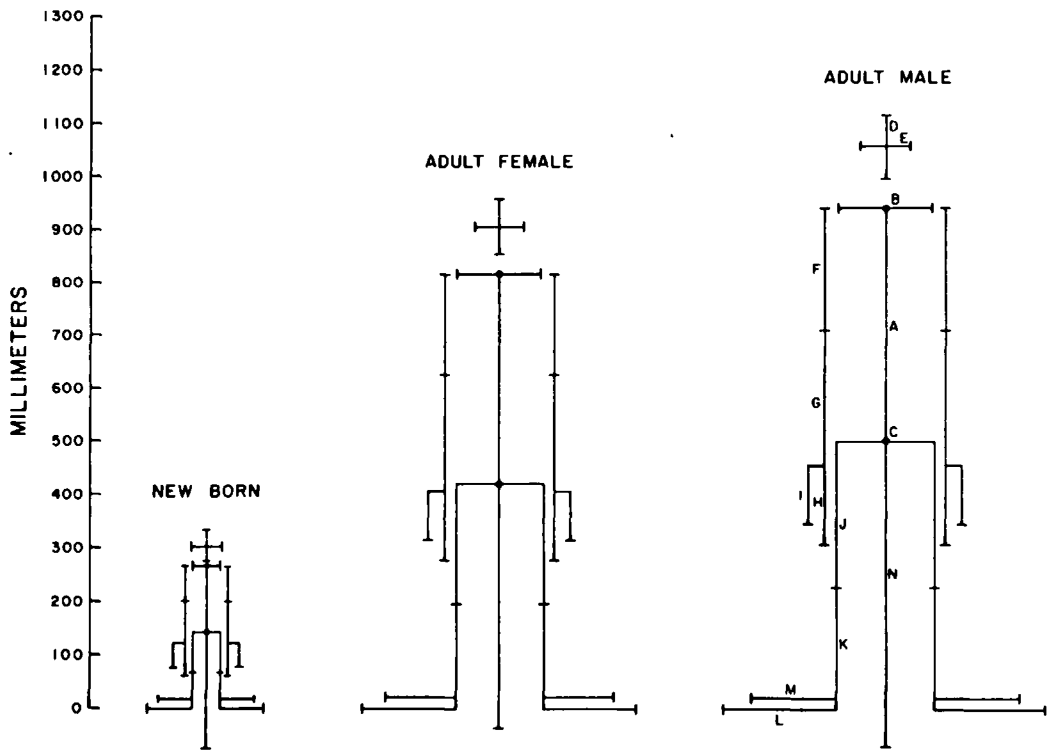

Fig. 6. Scaled Stick-Diagrams Comparing Principal Body Dimensions of the Newborn and Adult Savannah Baboons.

A = Trunk Height, B = Biacromial Breadth, C = Bitrochanteric Breadth, D = Head Length, E = Head Breadth, F = Upper Arm Length, G = Forearm Length (Ulnar), H = Hand Length, I = Thumb Length, J = Femur Length, K = Leg Length, L = Foot Length, M = Great Toe Length, N = Tail Length.

CHRONOLOGICAL GROWTH

Increase in Body Weight

In the course of postnatal growth, male baboons increased in body weight by nearly 3000% and females by 1600%. During the first year of life, male and female baboons gained weight at about the same rate. At 1.0 yr, the mean body weight for the males was 3.75 kgs and of females 3.72 kgs (Fig. 7). During the second year, males at first exceeded and later dropped below the female mean. The extremely small number of animals involved make it probable that these fluctuations were chance effects. In the rhesus monkey (van Wagenen and Catchpole 1956), the male maintained a small but uniform lead over the female throughout the first two years.

At 2.5 yrs, the males developed a lead in body weight that was maintained throughout the remainder of the postnatal growth period. At 3.5 yrs, the latest age for which female data were available, there was still some overlap of ranges: the heaviest female weighed 9.83 kgs and the smallest male, 9.44 kgs. Male preponderance in body weight was initiated by an increase in rate of gain at about 2.0 yrs. It was further accentuated by a second rate increase at about 3.2 yrs. At this time the male rate exceeded that observed during the first few months of life. At 3.7 yrs, the mean body weight of the immature males equaled that of adult females. In contrast to the male, the female weight curve decelerated gradually throughout the first three years of life. At 3.5 yrs, the female mean was 8.77 kgs or 71% of the mean body weight of the adult female.

From birth to about 0.5 yrs animals gained weight at a rate of 300-400 gm/0.1 yr (Fig. 8). In females, the rate fluctuated strongly but did not exceed the neonatal rate at any time during the first 3.5 yrs of life. In the male, the rate showed a gradual decline through the first two years. At about 2.0 yrs, the male rate began to increase, and at 2.5 yrs, exceeded the neonatal rate. Between 3.0 and 4.5 yrs, males

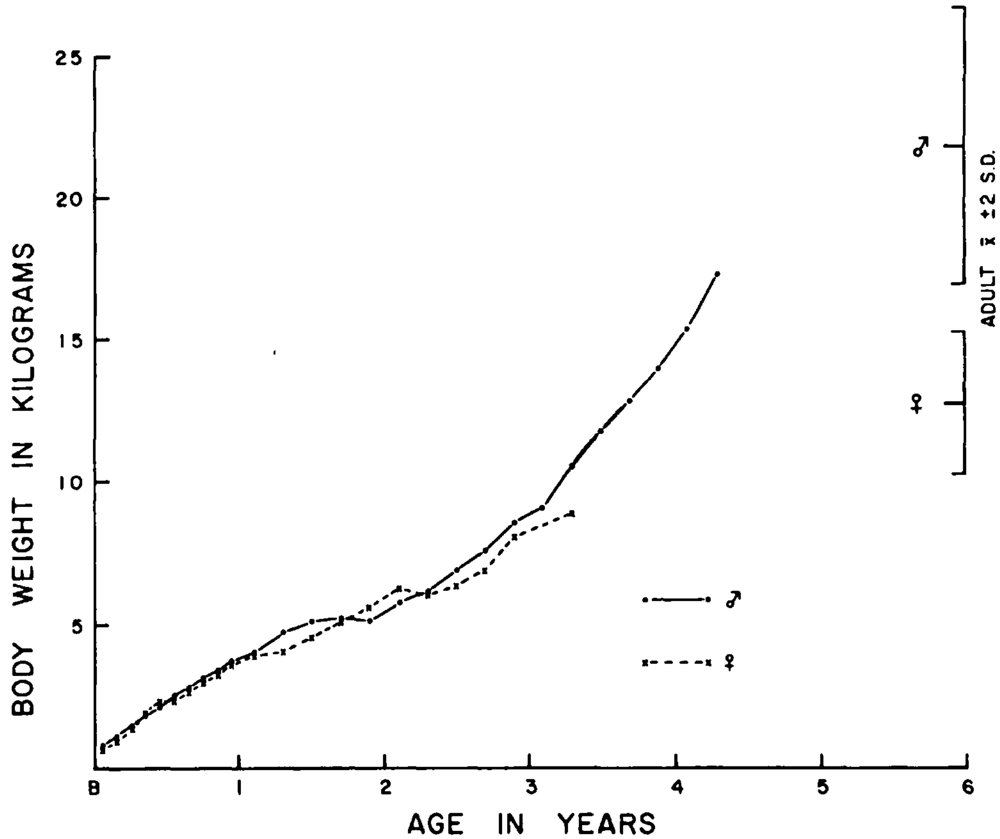

Fig. 7. Body Weight Increment Curves of Known-Age Savannah Baboons.

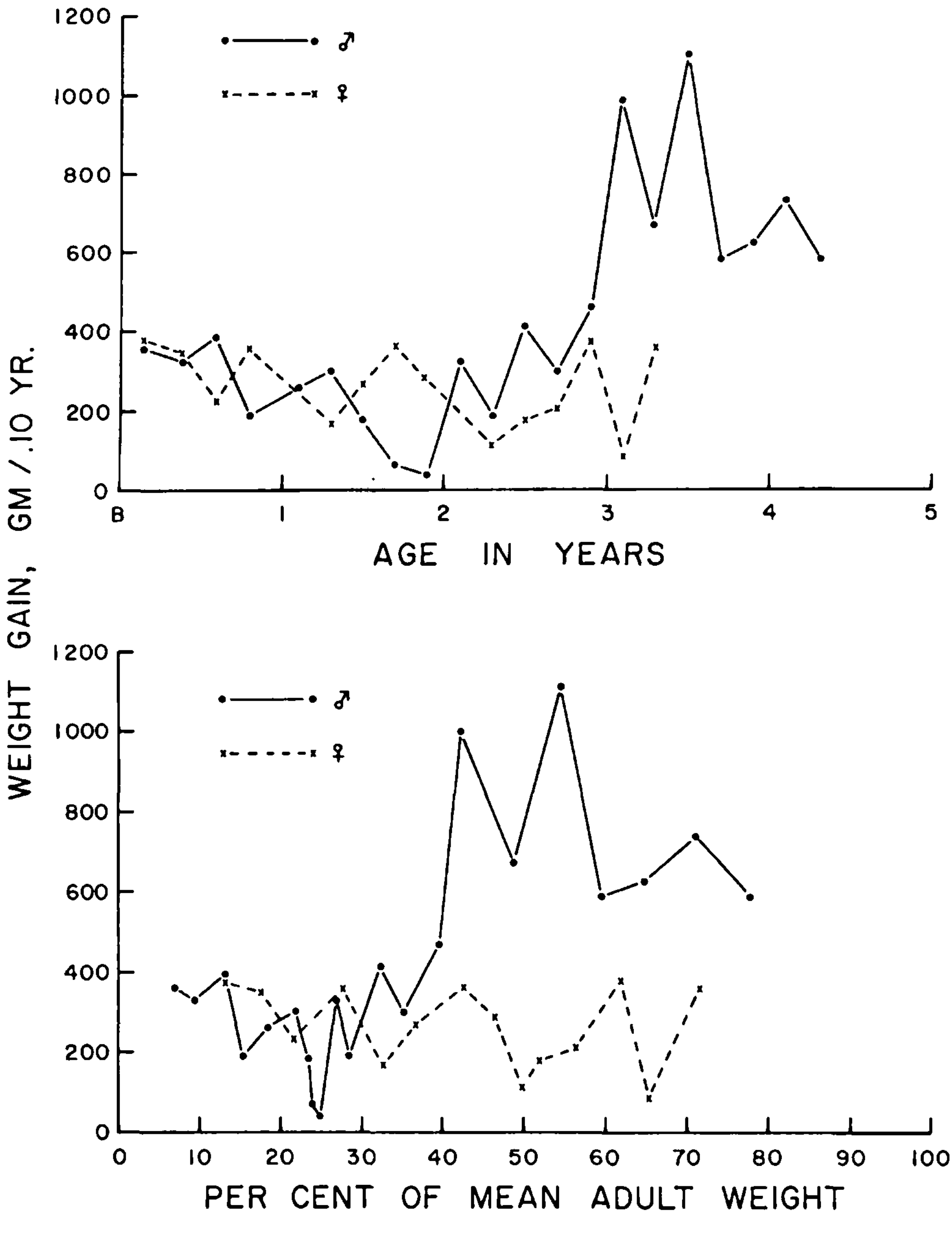

Fig. 8. Body Weight Increments of Savannah Baboons Plotted Against Age (Upper Figure) and Percent of Mean Adult Weight (Lower Figure).

gained at an average rate of about 800 gm/0.1 yr, with a peak of 1100 gm/0.1 yr at 3.5 yrs following which there occurred a decline to the neighborhood of 600-700 gm/0.1 yr. When plotted against percent of adult mean weight (Fig. 8), it is seen that the period of maximum gain in the male occurred when the animals attained 40-60% of their adult body weight. In chimpanzee and humans, the maximum gain in male occurred at 70% of the mean adult weight (Gavan 1953).

Growth in Sitting Height

The mean sitting height of the newborns was 218 mm (Fig. 9). During the first year sitting height increased to 400 mm in both sexes. In the second year, the rate decelerated and at 2.0 yrs the mean value for both sexes was 455 mm. At this age, there was some quickening of the male rate and by 3.0 yrs the growth curves began to diverge. By 3.5 yrs (the last age for which female data were available), the male mean exceeded the female by 35 mm although there was still some overlap in range. Because of the difference in final body size, the female is <u>relatively</u> more mature throughout the growth period and at 3.5 yrs the female mean was 89% of the adult female mean. Males at this age averaged 82% of the adult male mean sitting height. By 4.0 yrs, the juvenile males exceeded the mean sitting height of adult females. The mean increment curves of sitting height for the known-age animals in which growth was studied for a year or longer (Fig. 10) show gains in the neighborhood of 40-50 mm/0.1 yr during the first few weeks after birth. The rate declined rapidly and by 0.5 yr had dropped to 15-20 mm/0.1 yr. After 0.5 yr, the decline in rate slowly continued so that at 1.5 yrs the animals were growing only 3-8 mm/0.1 yr. Thereafter, the mean rate never exceeded 10 mm/0.1 yr in either sex. Unlike body weight, there was no clear-cut circumpuberal growth spurt of sitting height in the male.

Linear Growth in Other Body Regions

The growth patterns of other trunk dimensions were similar in many respects to that described for sitting height. The curves for

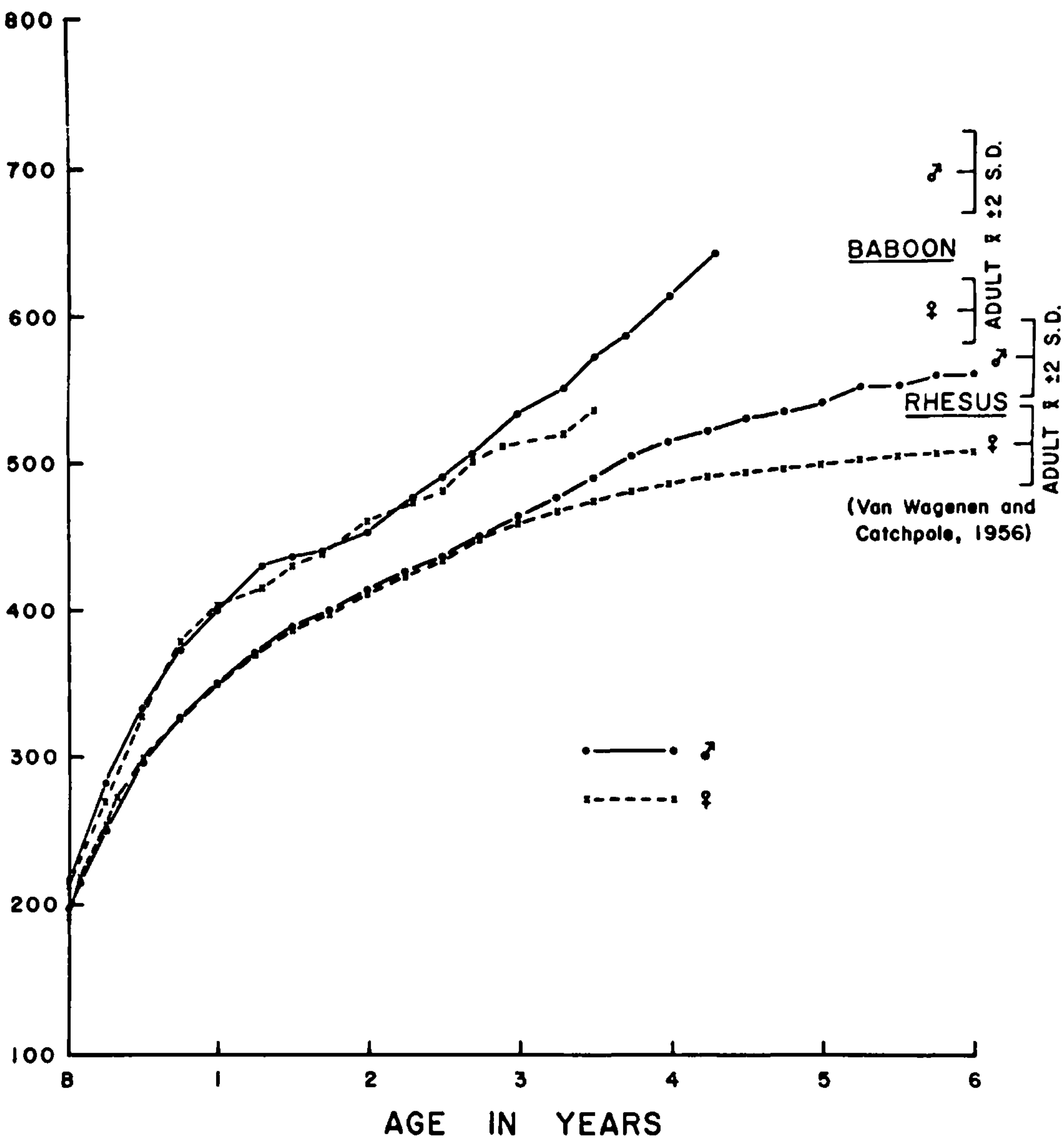

Fig. 9. Sitting Height Growth Changes of Rhesus Monkeys (van Wagenen and Catchpole 1956) and Known-Age Savannah Baboons.

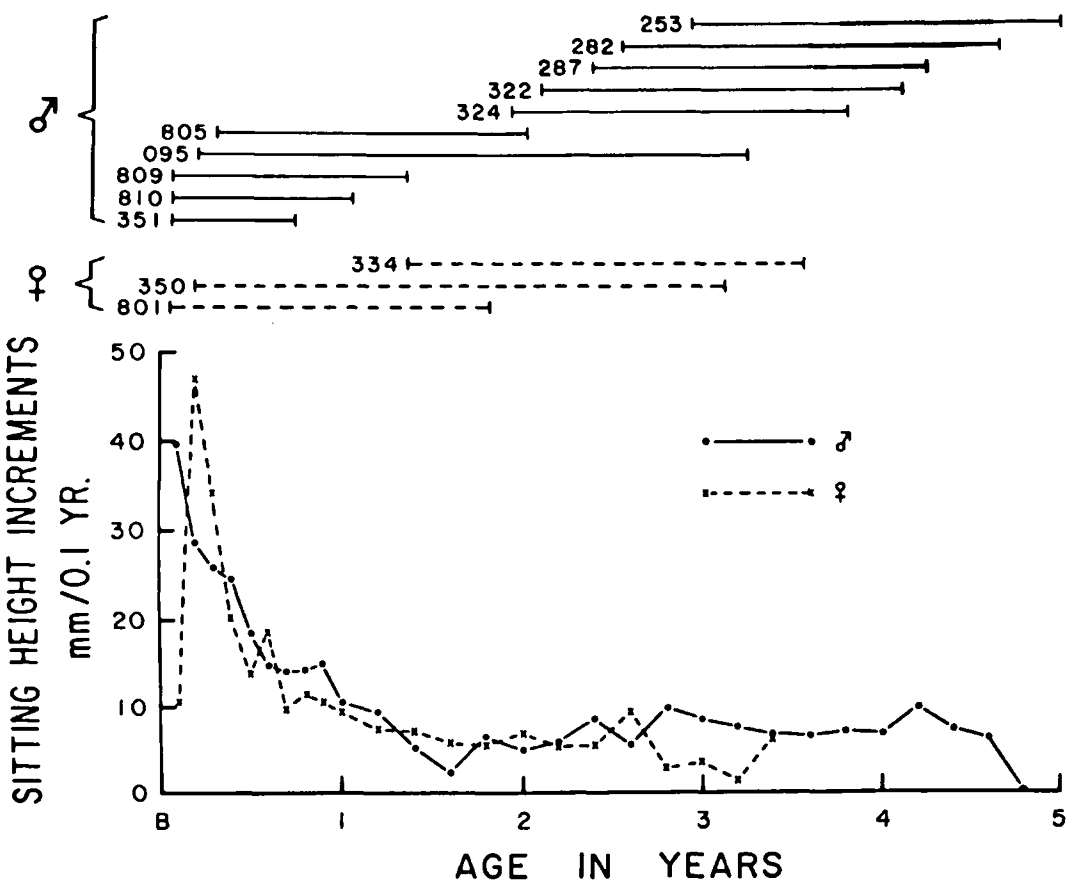

Fig. 10. Sitting Height Increment Curves of Known-Age Savannah Baboons.

chest measurements (males only) and pelvic measurements are shown in Figure 11 and that of trunk height in Figure 12. In all, there was relatively rapid growth during the first year, followed by deceleration in the second year. At the beginning of the third year of life, the male rate increased while that of the female continued its gradually decelerating course. By 4.0 yrs, the males were about equal to the average adult female in the various trunk dimensions. The same general pattern was observed in the limbs (Fig. 12) and their various segments (Figs. 13, 14, and 15).

At birth, the forearm exceeded the upper arm in absolute length and the latter segment was longer than the hand. This relationship is maintained throughout the growth period. The newborn hand segment comprised 30% of the total arm length, but only 24% in the adult.

In the lower limb, the pattern of postnatal growth is somewhat more complex. At birth, the foot was the longest of the three lower limb segments, thigh length was intermediate, and leg length the shortest. Like the hand, however, the foot increased its length more slowly than the two proximal segments. By 0.40 yrs, the foot was shorter than the thigh but was still longer than the leg. At 1.4 yrs in females and 1.8 yrs in males leg length exceeded foot length. In the newborn, foot length comprised 36% of the total lower limb length compared to 29% in the adult.

Some of the variations in regional growth patterns are more clearly shown if growth of a particular dimension is considered as a percentage of its adult size. Such percentage growth curves for several body measurements of males are shown in Figure 16. Trunk height, total lower limb length, and total arm length have very similar curves with newborn values of about 30% of the adult mean, rose to about 60% by 1.5 yrs and attained values of 85-90% at 4.0 yrs. In the upper limb, the hand of the newborn was about 40% of its adult length compared to values of 31% and 30% for the forearm and humerus respectively. During the course of postnatal growth, this gradient in relative maturity was maintained at all ages. In the lower limb, such a distal-proximal gradient was also displayed.

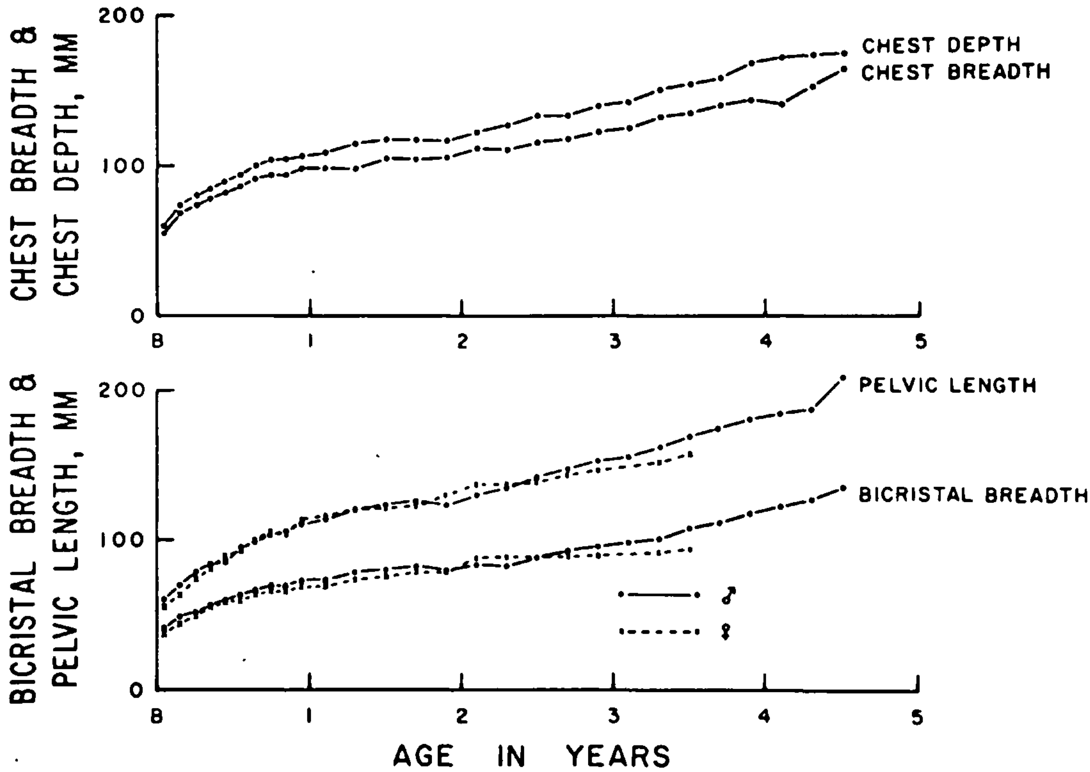

Fig. 11. Post-Natal Growth of Thorax and Pelvis of Known-Age Savannah Baboons. (Upper) Chest Depth and Breadth, Males; (Lower) Pelvic Length, Bicristal Breadth, Both Sexes.

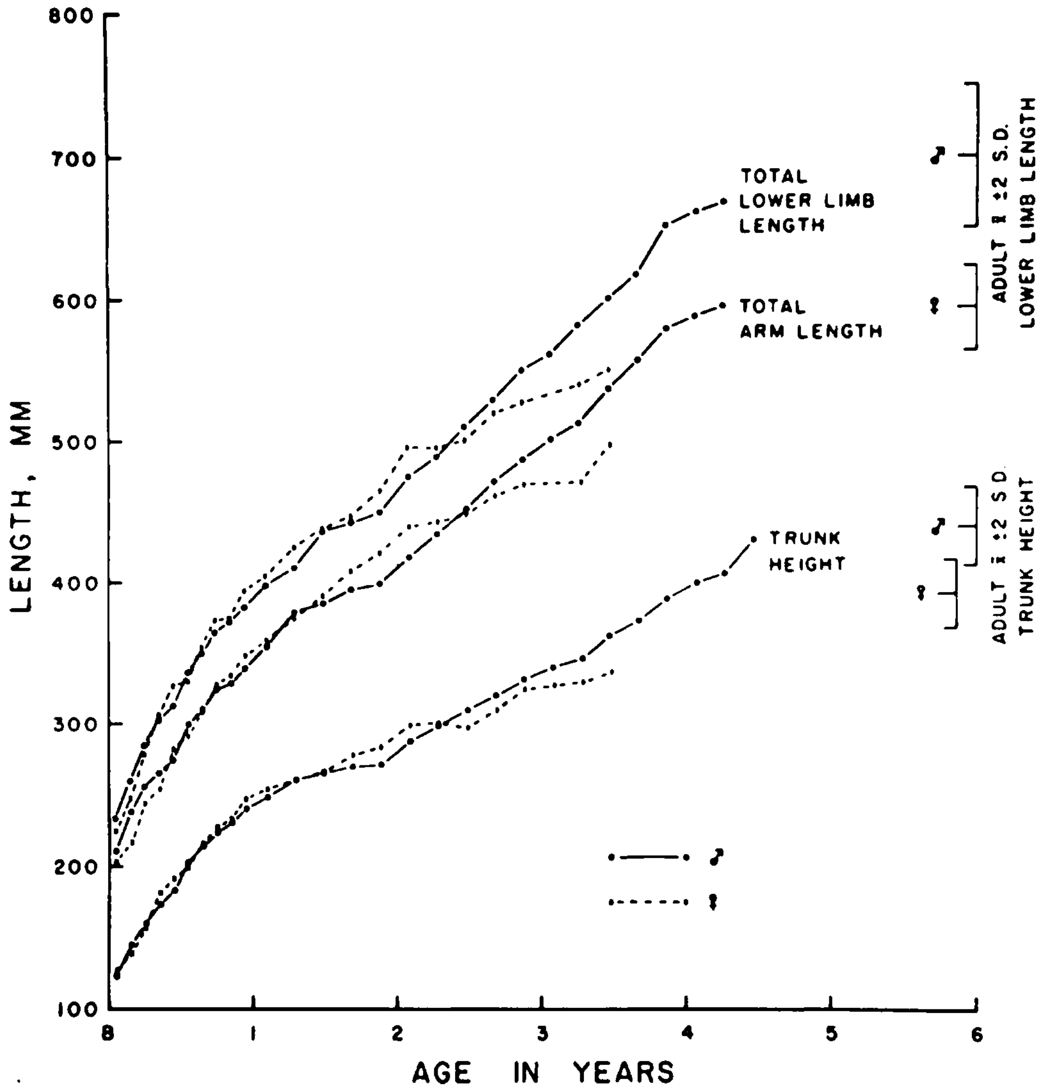

Fig. 12. Post-Natal Growth in Trunk Height, Total Arm Length, and Total Lower Limb Length of Known-Age Savannah Baboons.

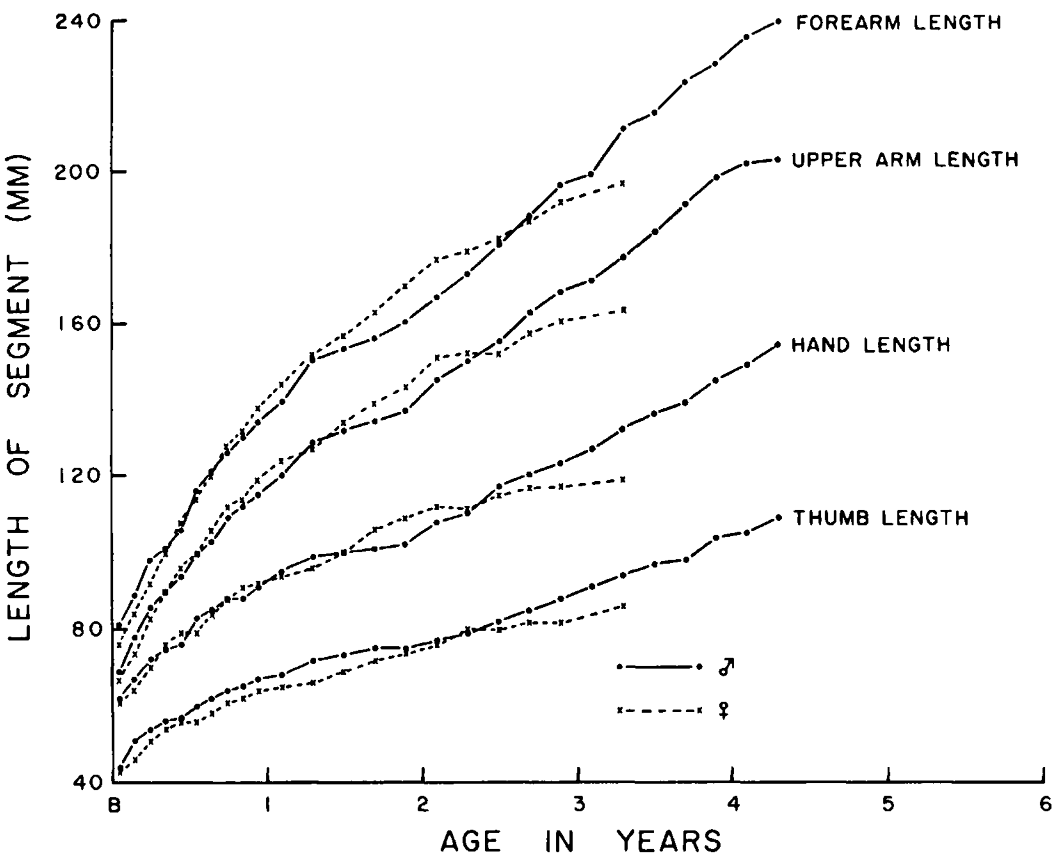

Fig. 13. Post-Natal Growth of Upper Arm, Forearm, Hand, and Pollux Lengths of Known-Age Savannah Baboons.

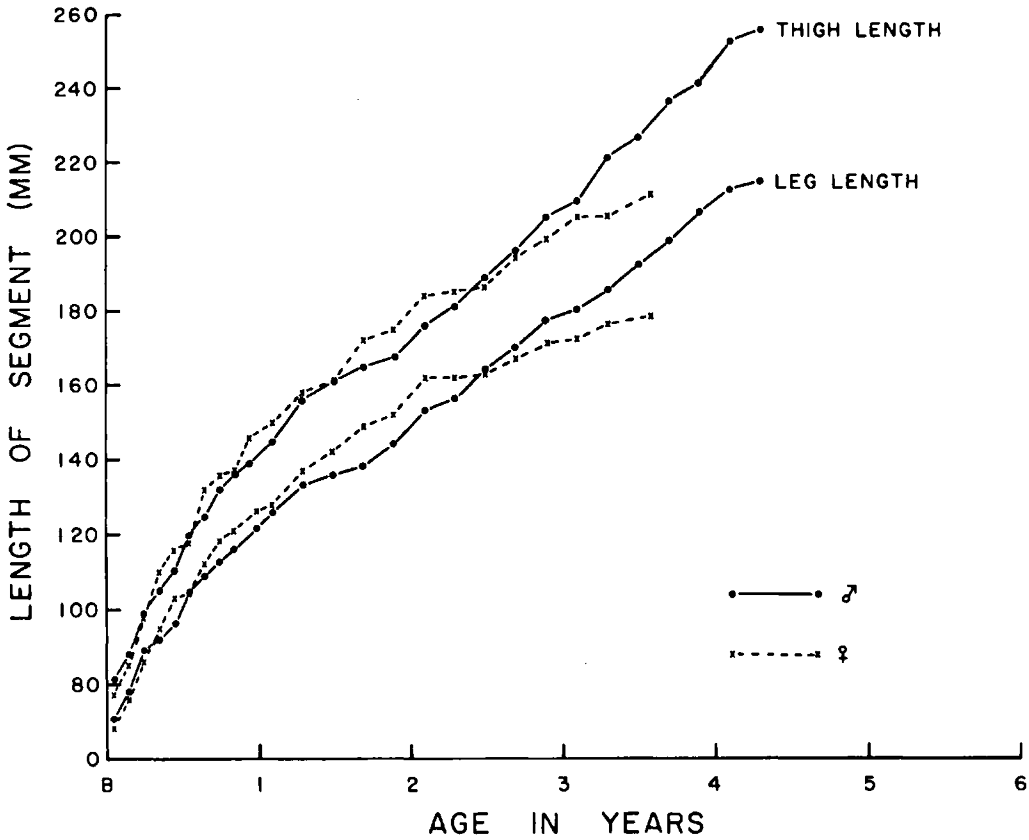

Fig. 14. Post-Natal Growth of Thigh and Leg Lengths of Known-Age Savannah Baboons.

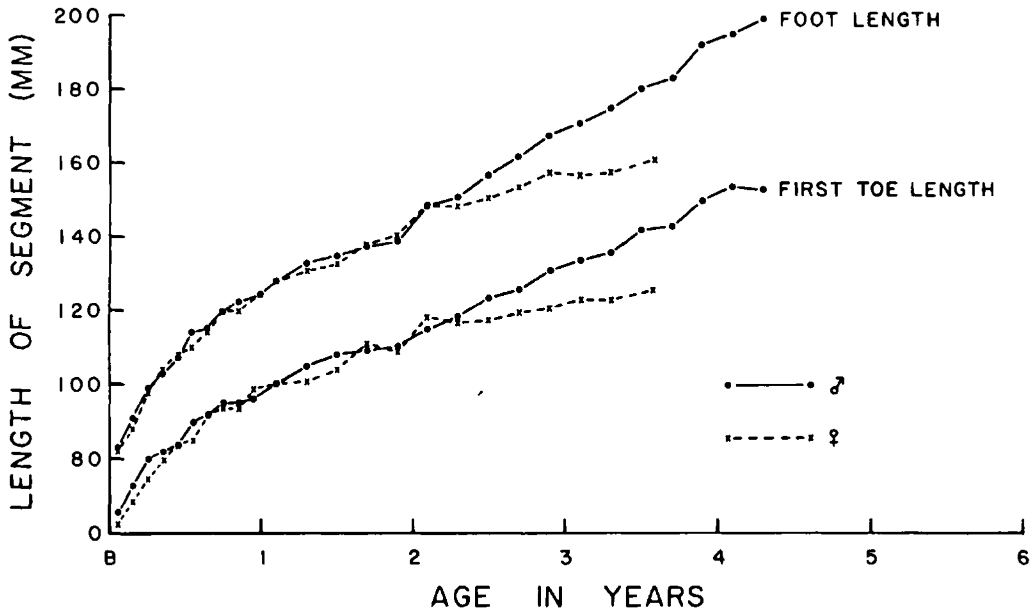

Fig. 15. Post-Natal Growth of Foot and Hallux Lengths in Known-Age Savannah Baboons.

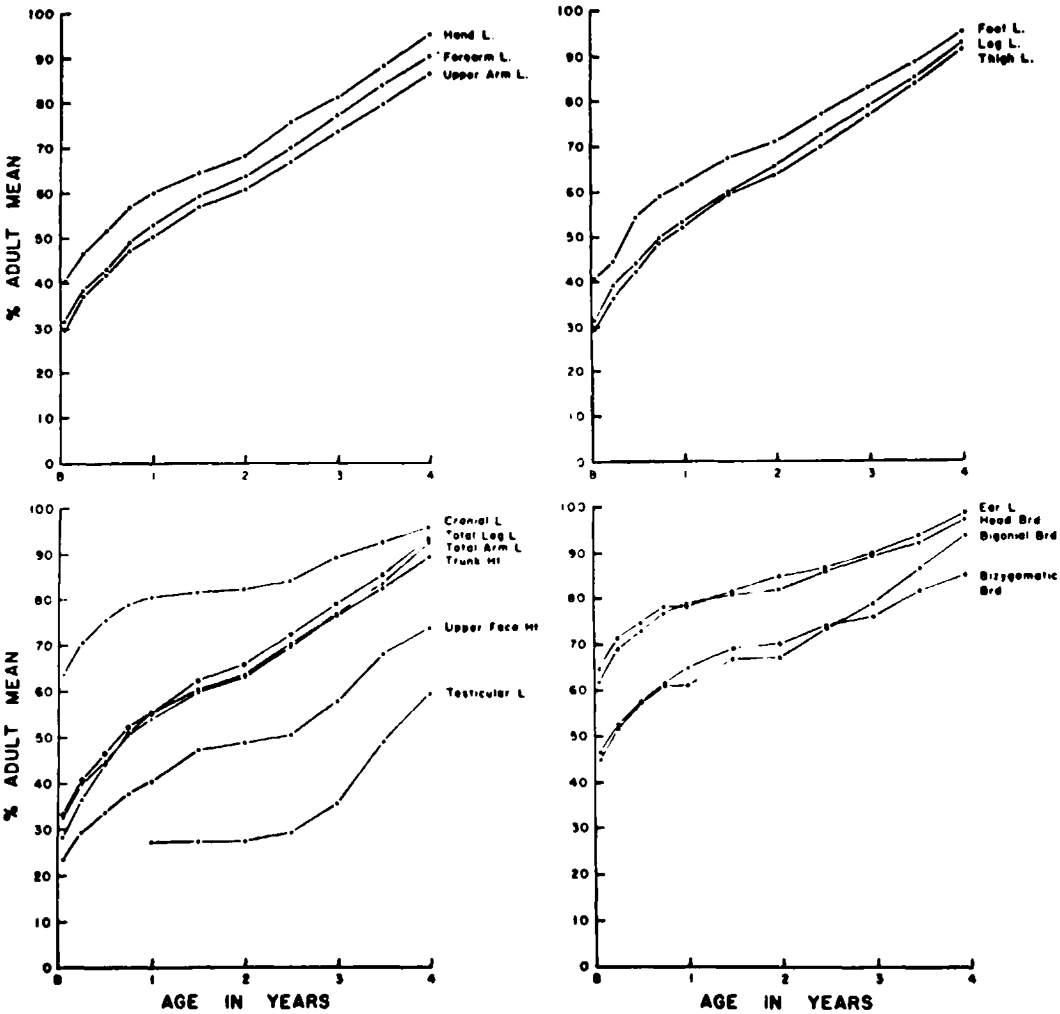

Fig. 16. Post-Natal Growth of Representative Trunk, Limb, and Head Measurements of Known-Age Male Savannah Baboons Plotted as Percentage of Adult Means.

Cranial length was about 60% of its adult value at birth, rose rapidly to 80% by the end of the first year and remained at this value until early in the third year of life when it again began to grow. At 4.0 yrs cranial length was about 92% of its adult mean. Ear length and cranial breadth followed a similar course. Upper face height, in sharp contrast to the dimensions of the neurocranial region, had only about 23% of its adult value in the newborn and at the beginning of the third year was still less than 50%. At 2.2 yrs it showed a sharp acceleration and by 4.0 yrs had risen to 75% of the adult mean. The curves of bizygomatic and bigonial breadth are intermediate between those of the neurocranial dimensions and upper face height.

Seasonal Effects

In order to study the effects of season on growth in the baboon, the individual sitting height growth increments of 13 OUDM animals were calculated. All of these animals have been maintained under nearly identical environmental conditions. The available data on these animals allowed the calculation of 145 individual growth rates distributed from birth through the first five years of life. The <u>mean growth rate</u> for each age class was calculated by averaging the increment per 0.1 yr of all animals, male and female, falling within that age class (Table 4). An <u>individual growth rate index</u> was calculated for each individual growth rate by dividing the latter by the mean growth rate of the appropriate age. For example, at 3.00 yrs, there are eight individual growth rates recorded and the mean of these is 7.0 mm/.1 yr. One of the animals in this group, ♂287, showed an individual gain of only 3.3 mm for this period. His individual growth rate index is therefore,

$\frac{3.3}{7.0} = 0.47$, indicating that, at this age, he was growing a little less than half as fast as the other individuals of his age group.

TABLE 4. MEAN AND OBSERVED RANGE OF SITTING HEIGHT GROWTH INCREMENTS OF KNOWN-AGE SAVANNAH BABOONS

(Combined data on 10♂ and 3♀)

Age in Years	N	Mean Increment mm/.1 yr	Observed Range mm/.1 yr
.10	4	32.1	10.0 - 52.5
.20	6	34.7	20.0 - 54.4
.30	7	28.0	15.7 - 49.1
.40	7	23.2	17.0 - 35.6
.50	7	16.8	10.0 - 24.0
.60	7	15.9	8.9 - 22.9
.70	7	14.2	7.8 - 21.8
.80	6	13.0	8.3 - 18.2
.90	6	13.3	8.9 - 19.6
1.00	5	9.8	7.5 - 12.7
1.20	5	7.9	5.2 - 11.9
1.40	4	5.7	3.8 - 8.5
1.60	4	5.8	1.6 - 9.0
1.80	4	5.2	2.1 - 8.5
2.00	3	6.0	4.8 - 7.6
2.20	4	6.0	5.0 - 7.9
2.40	5	7.1	3.3 - 12.9
2.60	6	6.8	3.5 - 12.0
2.80	6	7.5	2.0 - 14.3
3.00	8	7.0	2.7 - 12.5
3.20	6	6.5	1.4 - 9.3
3.40	6	6.8	4.1 - 8.2
3.60	5	6.5	4.0 - 8.5
3.80	4	7.0	4.0 - 9.5
4.00	4	6.7	2.6 - 10.0
4.20	3	9.8	1.4 - 17.5
4.40	2	7.2	3.1 - 11.3
4.60	1	6.2	——
4.80	1	0.0	——

After computation, the individual growth rate indices were categorized by the month to which they pertained. In the example cited above, ♂287 reached age 3.00 yrs in January. In this procedure, the indices were classified by month regardless of the age of the animal, thus the class for January includes indices from the entire age range of the sample. The use of the index rather than a simple deviation from the mean growth rate compensates for the greater absolute deviations observed in the infant age group.

Table 5 summarizes the results of this analysis. In January and February the mean of the individual growth rate indices fall below 1.00, indicating that growth is slower than average at this time. During the spring months of March, April, and May, the mean growth index rises to the neighborhood of 1.00 and climbs steeply in the summer.

TABLE 5. CHANGES IN MEAN INDIVIDUAL RATE INDICES FOR SITTING HEIGHT OF OUDM BABOONS COMPARED TO NORMAL MONTHLY TEMPERATURES OF THE OKLAHOMA CITY AREA

Month	Temperature			N	Mean Index	±	S.E.$\bar{x}$
	Low	High	Normal				
		°F					
January	28.1	45.9	37.0	11	0.790	±	.035
February	31.2	51.3	41.2	20	0.802	±	.025
March	37.5	59.5	48.5	7	1.037	±	.089
April	49.1	70.6	59.8	14	1.004	±	.041
May	58.6	78.1	68.3	10	1.003	±	.050
June	68.5	87.4	78.3	8	1.146	±	.140
July	72.2	92.8	82.5	16	1.279	±	.051
August	72.0	93.5	82.8	11	1.291	±	.059
September	62.9	84.7	73.8	10	0.987	±	.108
October	51.8	73.9	62.8	13	0.898	±	.038
November	38.0	58.8	48.4	13	0.973	±	.034
December	31.4	49.2	40.3	12	0.903	±	.037

By August, the mean growth rate index reaches 1.291, an increase of nearly 30% over the mean growth rate. Through the autumn months it declines and by December it is about 10% lower than the normal growth rate. An analysis of variance performed on this data indicates that month is a highly significant factor (Table 6).

The most obvious and direct factor which could account for such a seasonal variation is environmental temperature. In Figure 17, the growth index changes have been plotted against normal monthly temperatures at Oklahoma City, approximately 20 miles north of Norman. The coefficient of correlation between normal monthly temperature and the growth rate index is 0.847.

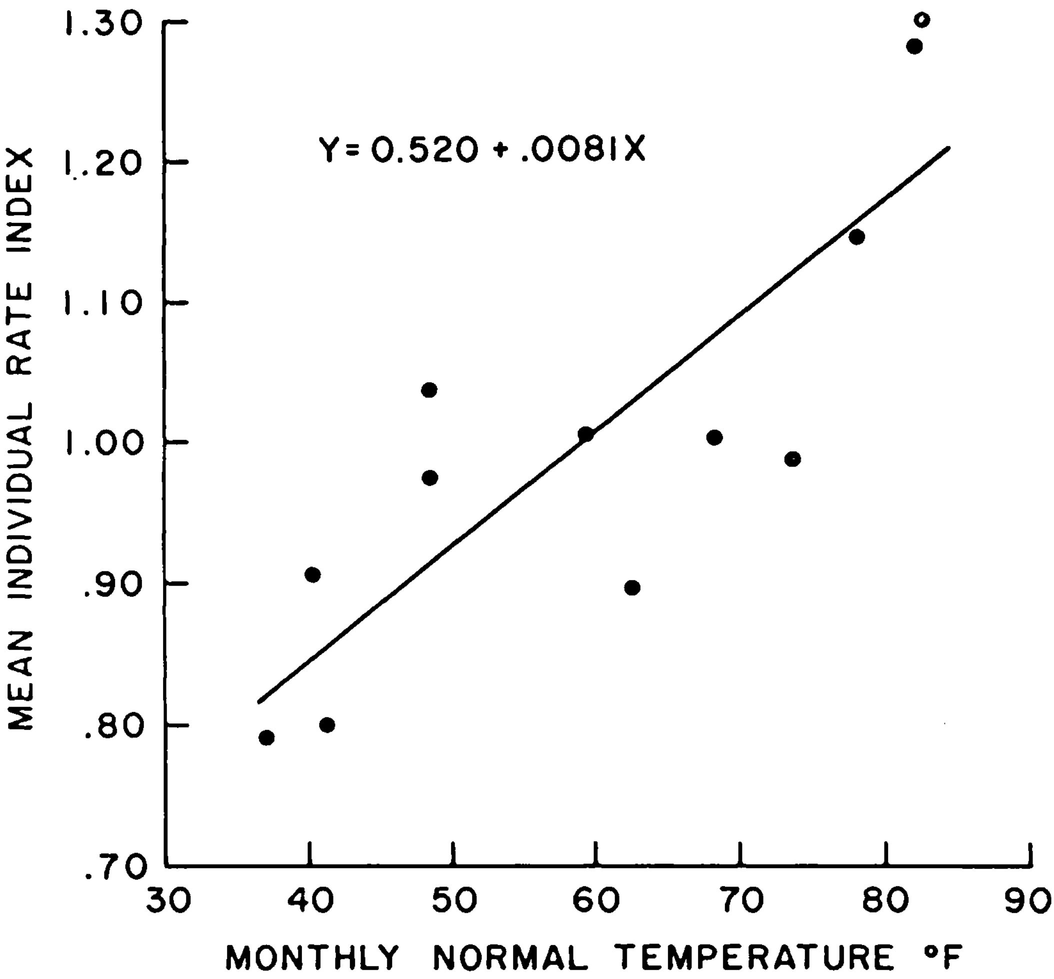

Fig. 17. Mean Individual Rate Indices of Sitting Height Plotted Against Normal Monthly Temperature.

TABLE 6. ANALYSIS OF VARIANCE FOR THE EFFECTS OF MONTH ON MEAN INDIVIDUAL RATE INDICES FOR SITTING HEIGHT OF OUDM BABOONS

"Normal monthly temperature" is computed as the 30-year mean of the daily highs and lows throughout a given month. The data used here was supplied by the Environmental Science Service Administration, Climatologist's Office, United States Weather Bureau, Oklahoma City, Oklahoma.

Source	Sum of Squares	Degrees of Freedom	Mean Square	F
Effect of Month	3.890	11	.3536	
Deviations	0.735	134	.0054	65.48 ($p<.001$)
Total	4.625	145		

Sexual Maturation

In the present study, no physical criteria for puberty were available for the male except observations on the descent and growth of the testes.

In each male examined, the testes were palpated and the length and breadth of the left testis was measured if inguinal or scrotal (Table 87, Appendix B). Throughout the first year of life, the testes remain in the abdominal cavity. In some subjects, the testes became inguinal during the second year and, in others, not until the third. Full scrotal descent did not occur until the fourth or fifth year of life. Figure 18 shows the growth of the testes of the known-age subjects as measured by <u>testicular length</u> x <u>testicular breadth</u> plotted against age.

Testes remained about constant in size until around 2.75 years. At this time, significant growth commenced and was further accelerated toward the end of the fourth year. Testicular length in the fully adult males averaged 51 mm and ranged from 35-64 mm. At 4.70 yrs, the mean testicular length of known-age males was 42 mm or 86% of the adult mean. Comparison with the weight increment curves of males (Fig. 8) shows that the onset of testicular growth coincided with the marked acceleration in body weight gain that commenced around 3.0 years. The average weight of the known-age males at the onset of testicular growth was 7.64 kg or 35% of the final adult weight mean.

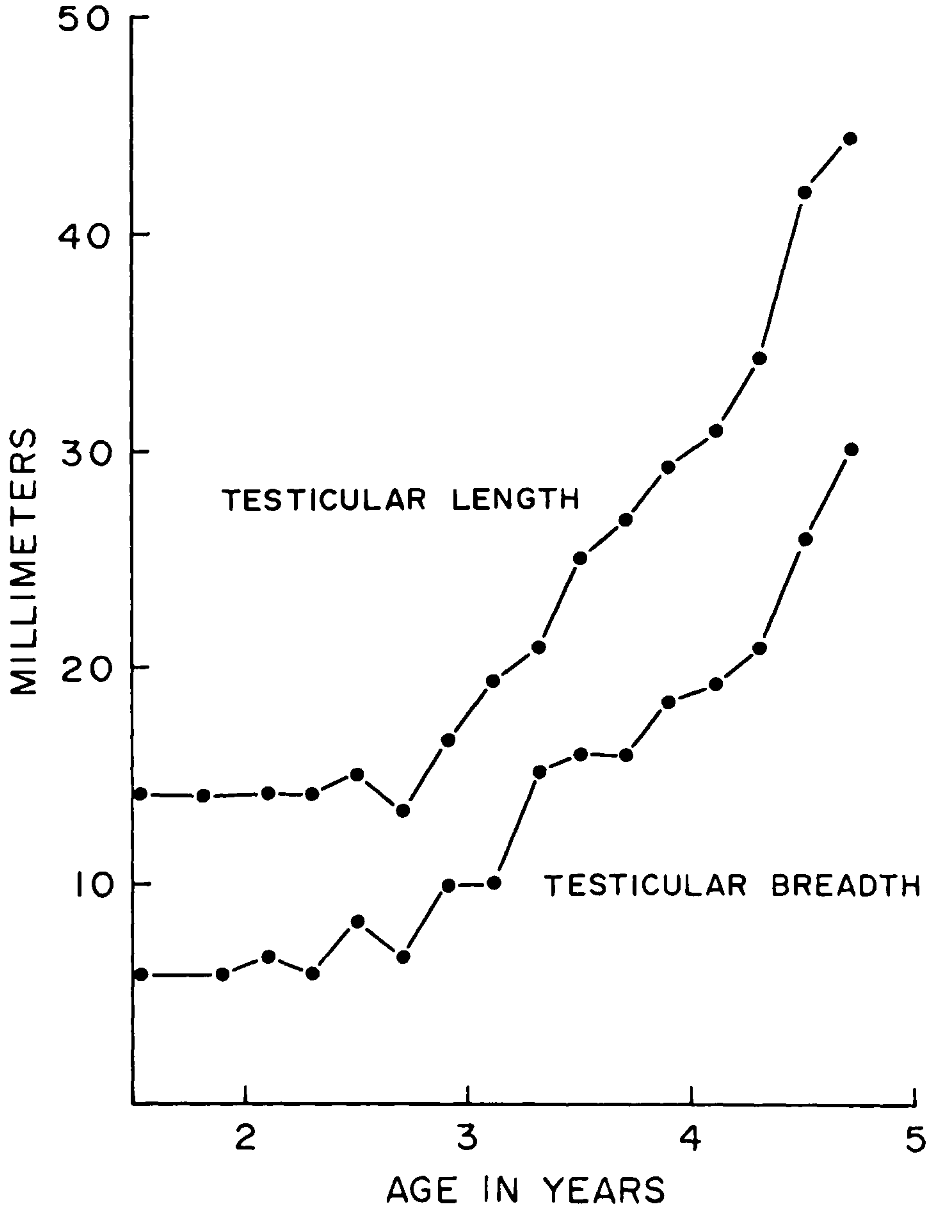

Fig. 18. Growth of Testes of Known-Age Savannah Baboons.

Data on age and body weight at time of menarche were available on 13 SFRE and 2 OUDM females (Table 7). Only 9 of these were of known chronological age. The mean at which the first oestrous cycle occurred was 3.03 yrs, which coincides closely with the onset of testicular growth in the male. The mean body weight at menarche was 8.06 kgs or about 65% of the adult mean. The standard deviation of the body weight mean was 0.75 kg compared to the age standard deviation of 0.14 yrs, which suggests that age is a better predictor of the onset of oestrous than total body size.

TABLE 7. MEANS, STANDARD DEVIATIONS AND OBSERVED RANGES IN BODY WEIGHT AND AGE OF SAVANNAH BABOONS AT TIME OF FIRST OBSERVED OESTROUS

Variable	N	Mean	Standard Deviation	Observed Range
Body Weight	15	8.06 kg	± 0.75 kg	6.36 - 9.09 kg
Age	9	3.03 yr	± 0.14 yr	2.75 - 3.35 yr

Menstrual Cycle Length

Data were collected on menstrual cycle length of 10 dentally mature OUDM females. The number of complete cycles observed in individual animals ranged from 1 to 8 and within the sample, a total of 32 complete cycles were observed. All the females had been in the colony at least six months before cycles were recorded. The mean cycle length was 36.4 days with the standard deviation of 5.7 days and an observed range of 26 to 51 days (Table 8). The distribution of cycle length shows some skewing to the left with the median length of 35 days.

A typical cycle may be divided into four subperiods based on swelling of the external sex skin. During about 25% of the cycle (8.9 days), the sex skin gradually became more swollen and deepened in color. Maximum turgescence was maintained for about 18% (6.2 days) of the cycle. On or about the fifteenth day, deturgescence occurred and the sex skin gradually returned to the normal state. During this latter period, which averaged about 17% (5.8 days) of the cycle length, the sex skin faded from the deep burgundy color typical of maximum turgescence to a lighter red or pink. A subjective impression, based on a few observed pregnancies, is that if conception occurred, the deturgescence proceeded as in the non-pregnant animal, but the burgundy coloration of the sex skin was maintained. Deturgescence was followed by a resting stage which lasted an average of 40.1% (14.1 days) of the cycle. Menstrual bleeding is scanty in the baboon and is difficult to observe when the animals are colony-caged. In the present series, it was noted in only six cycles and occurred immediately before the onset of the initial phase of increasing turgescence.

TABLE 8. MENSTRUAL CYCLE LENGTHS OF SAVANNAH BABOONS

ANIMAL NUMBER									
35	41	63	65	68	70	72	73	57	87
length of cycle in days									
29	32	32	42	43	46	35	39	34	35
37	38	32	31	35	36	36	34	41	
40	40		44		33		41		
33	30				26				
51					46				
34									
32									
34									

N = 32 $\bar{X}$ = 36.4 days S.D. = 5.7 days
O.R. = 26-51 days

Dentition: (Table 92, Appendix B)

An extensive study on the dental eruption sequence of savannah baboons (Reed 1965; Reed *in press*) is currently in progress and will be based in part, on animals used in this study. For this reason, only the overall pattern of eruption sequence will be considered here. In Figure 19, the dental scores of known-age males and females are plotted against age. The newborn baboon is usually endentulous at birth, although the deciduous incisors generally appeared within the first few weeks of life. Shortly before the end of the first year of life, the full complement of deciduous teeth was erupted giving a dental score of 20.00. The first permanent teeth to appear were the mandibular first molars at about 1.5 yrs. The maxillary first permanent molars follow

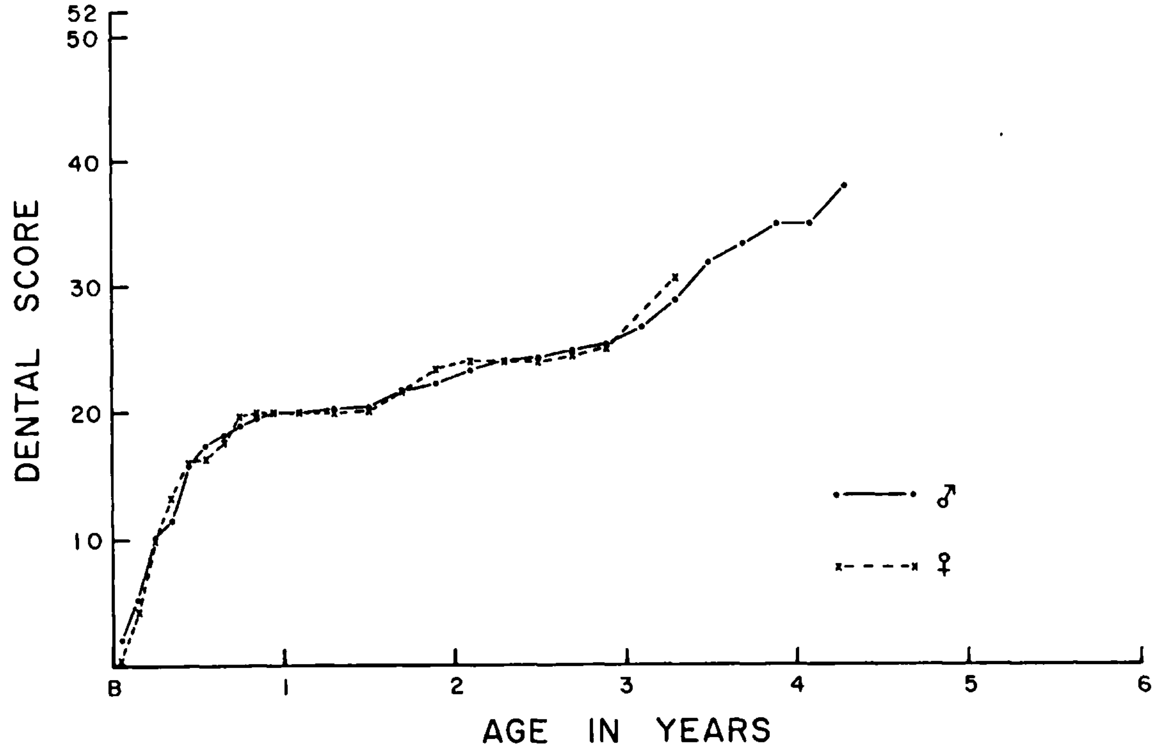

Fig. 19. Age Changes in the Dental Score of Known-Age Savannah Baboons.

rapidly so that by the end of the second year a total complement of 24 teeth was present. After attaining the first permanent molars, there is a rather distinct pause in eruption. The permanent incisors, the next teeth to appear, did not erupt until late in the third year. Following the appearance of the incisors, the premolars and second permanent molars erupted in rapid sequence. Up to 3.5 yrs of age, no significant differences between the sexes were apparent and at this age, the dental score in both was approximately 30.00.

RELATIVE GROWTH

As the body increases in size, it also changes in shape. While size increases in individual dimensions may be described as functions of age, changes in shape are products of the variations in rate and tempo of individual body parts, organs and segments, and the quantitative analysis of such relationships demands the description of two or more measurements as they simultaneously change during growth. For example, a striking feature of the male baboon is the strong development of the visceral components of the skull in relation to the neurocranium. Upper facial height (which might be more appropriately termed "muzzle length" in this extremely prognathous primate), and cranial length both average 119 mm in the adult male. In the newborn, the mean of the former measurement is 26 mm and the latter 72 mm. During postnatal growth, therefore, the cranial portion of the skull (as measured by cranial length) less than doubles in size while the visceral component increases by nearly five-fold. In terms of shape, the predominance of the neurocranial over the visceral component of the skull diminishes with age. The purpose of the present section is to describe the principal features of relative growth as they occur in the savannah baboon.

Linearity of Regression

Thirty pairs of dimensions were selected for relative growth analysis. Regression equations were calculated on each pair using the statistical techniques described previously. The regression constants for these relationships and their associated statistics are found in Tables 88 - 91, Appendix B.

The coefficients of determination ($\underline{r}^2$) of all the variable pairs exceeded 0.900 except in one instance: the regression of upper face height on cranial length in females. Although in the male, the determination coefficient for this relationship was high (0.946), it will be reserved along with that of the female for special discussion.

Among the remaining 29 variable pairs, 24 displayed coefficients of determination exceeding 0.970 in both sexes. In these, the values of the sexes were nearly identical although there was a tendency for female values to exceed those of the male slightly in trunk and upper limb measurements; while in the lower limb, the male coefficients were higher.

There were five relationships in which one sex or another displayed determination coefficients smaller than 0.970. In the regression of bituberosity breadth on trunk height, the male coefficient was 0.936 and that of the female, 0.984. Examination of the actual scattergram (not shown here) revealed that the male values were more widely dispersed around the regression line than were the female values but the dispersion was uniform. Thus, in this case, the lower value of the coefficient of determination (r^2) is attributable to a weak correlation (small r) between bituberosity breadth and trunk length in the male rather than to any marked curvilinearity in the observed data. The sexual disparity in the coefficients is difficult to account for. The landmark of bituberosity breadth (ischiale laterale) is no more difficult to locate in the male than in the female, so that the difference cannot be attributed to larger technique errors in taking the measurements on the former sex. This suggests the possibility that bituberosity breadth may be somewhat strongly correlated with some internal dimension of the pelvic outlet critical for easy childbirth. Genetic mechanisms insuring a more precise control of the relative size of the critical internal dimension would have more selective value in females than in males and would be reflected in lower variability in the female.

In two relationships, cranial length - trunk height and cranial breadth - cranial length, the male values of r^2 exceeded 0.970 but those of the female fell just above 0.900, the arbitrarily-selected limit of linearity. The scattergrams in these cases displayed rather strong tendencies for the newborn values to fall away from the regression line. Since females of this age were better represented than males, these curvilinear trends are expressed as a lower r^2 value in the former sex. Had more newborn males been represented in the sample, the male r^2 values would probably more closely approximate the female. This observation probably accounts also for the higher male value of r^2 in the case of the upper face height - trunk height relationship.

In the remaining two relationships, tail length - trunk height and chest breadth - trunk height, the values were moderately low (about 0.950) in both sexes. Examinations of the scattergrams revealed rather wide but uniform dispersion about the regression line with no pronounced curvilinearity. In the case of chest breadth, the measurement is taken at the level of the base of the xiphoid process and errors in locating this level are frequent. Such technique errors, coupled with those introduced through respiratory excursion, probably explain the low r^2 values. Individual variation in tail length is high in most cercopithecoids (Schultz 1956); caudale proximale is rather difficult to locate; and, often, the tail may be shortened by an old accidental amputation which, unless extensive, may not be apparent to the measurer. All the foregoing factors probably account for the low r^2 values in this relationship.

Sexual Differences in Relative Growth Relationships

For the 29 relative growth relationships in which a reasonable linearity ($r^2 > 0.900$) was displayed, linear regression equations were calculated for each sex. The male and female constants of each sex were then compared to determine whether their differences were statistically significant. The rate constant (b), showed no significant differences ($p < .05$) in 28 of the relationships. In the regression of thigh length + knee height on trunk height, the rate constant of the male was significantly larger than that of the female ($p = 0.04$) indicating that the male lower limb grows at a somewhat higher relative rate than does the female. The difference between the rate constants for the total lower limb - trunk height relationship also approached the significant level ($p = 0.08$). In addition, borderline values ($0.1 > p > 0.05$) were observed in several upper limb relationships (Table 89).

Significance tests comparing the male and female values of the size (a) constants were performed for the 28 relative growth relationships which displayed no significant differences in the rate constant. In all of these, the differences were not significant and in only one, pelvic length - trunk height, was a borderline value observed. Lack of any significant difference in both rate and size constants indicates that a single regression line serves to describe the variability in both sexes. Accordingly, in these cases, the male and female data were combined and common regression equations were calculated (final columns of Tables 88 - 91).

Development of Trunk and Tail

In Figure 20, the combined regression lines of several trunk breadth measurements on trunk height are shown. Relative growth rates (b constants) varied between 0.293 (chest breadth) and 0.383 (biacromial breadth). Thus, these trunk dimensions increased by roughly 1/3 cm with each 1 cm increase in trunk height. The more cephalad measurements had higher rate constants, the strongest exception being chest breadth which was exceeded in rate by both bicristal and bituberosity breadth. A similar pattern was displayed in the size constants.

Throughout the postnatal growth period, the thorax increased more rapidly in its anterior-posterior diameter than transversely. The extent of this difference is shown in the rate constant of 1.253 for the chest depth/chest breadth regression. In the newborn baboon, the two dimensions were approximately equal. In the adult, chest depth exceeded chest breadth by about 15-20%. This configuration of the adult is typical of most monkeys (and other quadrupeds) and contrasts strongly with the anterior-posterior flattening of the chest seen in man and the great apes.

In general, shape of the pelvis is expressed by the relation of its breadth to its length. In the newborn baboon the index of bicristal breadth/pelvic length was 0.66—compared to a value for this index of 0.71 in adult males and 0.72 in females. During the course of

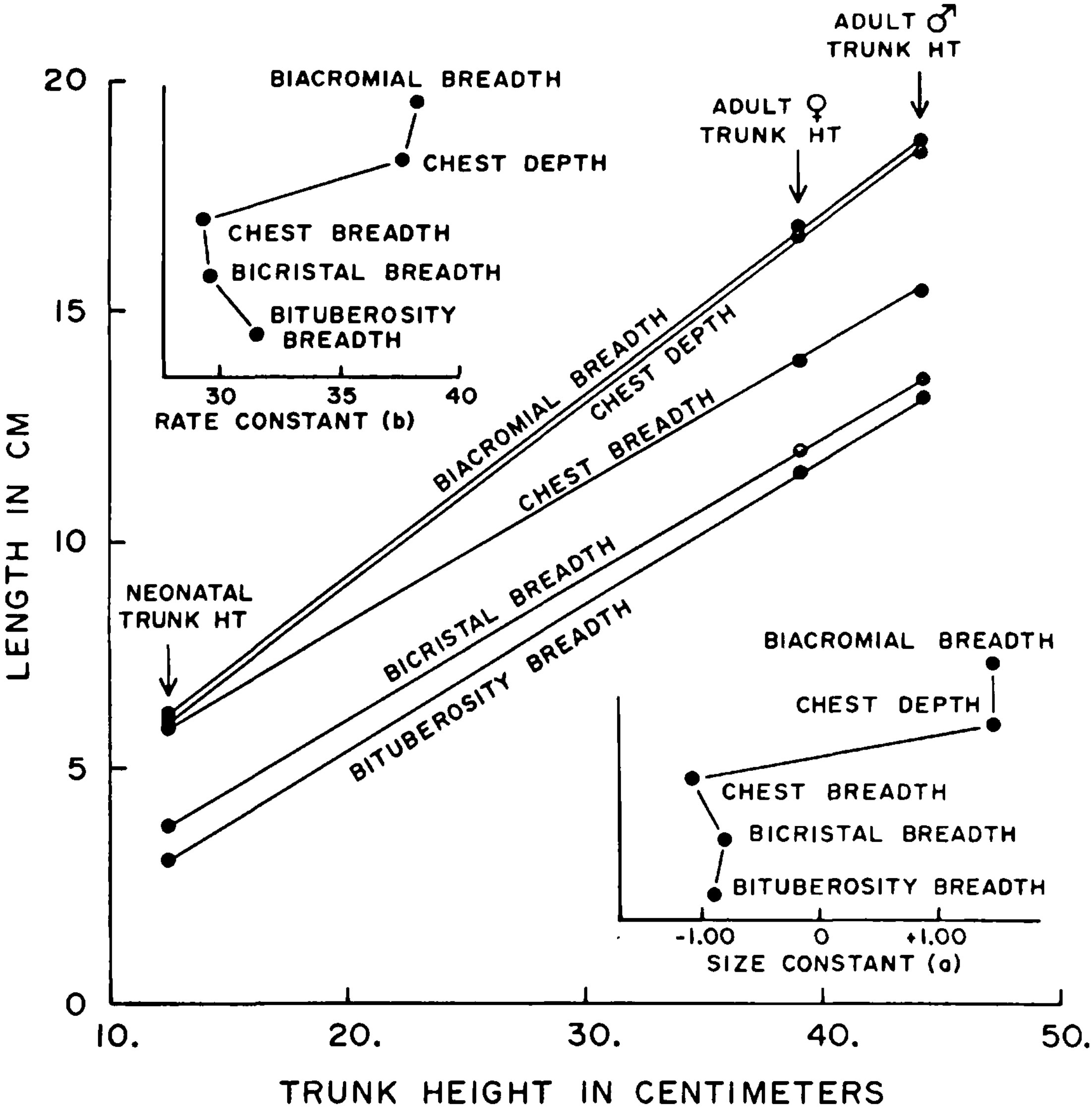

Fig. 20. Regression of Trunk Dimensions on Trunk Height in Savannah Baboons.

postnatal growth, bicristal breadth increased about 0.66 cm for each 1 cm gain in pelvic length.

The rate constant for the regression of tail length on trunk height was 1.041 indicating that both these segments of the body axis grow at approximately the same rate.

Development of the Upper Limb

Table 89, Appendix B, gives the linear regression constants for the various upper limb relationships of the baboon. In all cases, the coefficients of determination exceeded 0.980, suggesting that the relationships were well satisfied by linear regression.

During the postnatal growth, the arm increases its length by 1.39 cm for each 1.00 cm increase in trunk height. Despite this higher rate of growth, it fails to keep pace with the trunk and the upper limb of the newborn baboon is relatively longer than that of the adult. The total arm length/trunk height index is 1.62 in the newborn but only 1.45 in the adult males and 1.37 in adult females.

The growth of the arm is a product of the growth of its composite segments: the upper arm, forearm, and hand. Each of these components is characterized by a distinct pattern of relative growth (Fig. 20). The upper arm increased its length by 0.52 cm for each 1.00 cm increase in trunk height. The forearm grew more rapidly than the upper arm (0.57 cm/1.00 cm trunk height) and the hand more slowly than the two proximal segments (0.29 cm/1.00 cm trunk height). The size constants (a) of the trunk height regression equations of the three segments also displayed a distal-proximal gradient: upper arm $<$ forearm $<$ hand. The interpretation of such a gradient in size constants is difficult since mathematically they signify the size of the dependent variable if the independent variable is zero, —an obviously impossible condition in organic growth. This observation serves to emphasize that the regression equations apply only to the postnatal segment of the total growth process and cannot be extrapolated beyond the observed data to include prenatal growth relationships.

Development of the Lower Limb

Total lower limb length (thigh + leg + foot lengths) increased by 1.51 cm for 1.00 cm growth in trunk height, slightly faster than total arm length (1.39 cm). As in the case of the upper limb, the lower extremity was relatively longer in newborns than the adult. The total lower limb length/trunk height index was 1.78 in the newborn. The value of this index in the adult female was 1.51 and in the male, 1.59.

The regression lines of thigh, leg, and foot length against trunk height for the baboon are shown in Figure 21. In the rate constants, there is a distal-proximal gradient with thigh > leg > foot. Relative to trunk height, the thigh grows faster than the upper arm and the foot faster than the hand. The baboon forearm, however, exceeds the leg in its relative growth rate. The size constants of the lower limb segments show a gradient pattern similar to that of the upper limb.

In the baboon the lower limb exceeds the upper limb by about 10% in total length. In the newborn, the total arm length/total lower limb length index was 0.91 and identical values were found in both male and female adults.

Development of the Head

The head of the newborn baboon, as in other primates, is large in relation to total body size. The maximum length of the head, as measured from opisthocranion to prosthion, averaged 85 mm in the newborn animals or 67% of trunk height. During postnatal growth, the head as a whole lags behind general somatic development and the above percentage is reduced to 48% in adult males and 41% in adult females. However, as was noted in the discussion of chronological growth, the neurocranium is relatively large at birth but grows slowly in contrast to the splanchnocranium, which is small at birth, but is characterized by a very rapid rate of growth. Cranial length averaged 57% of trunk height in the newborn. In the adult of both sexes, cranial length is only 26% as long as trunk height. Stated otherwise, the cranium is less than half as large, in proportion to total body size in the adult as in the newborn. In contrast, upper face height was 21% of total trunk height

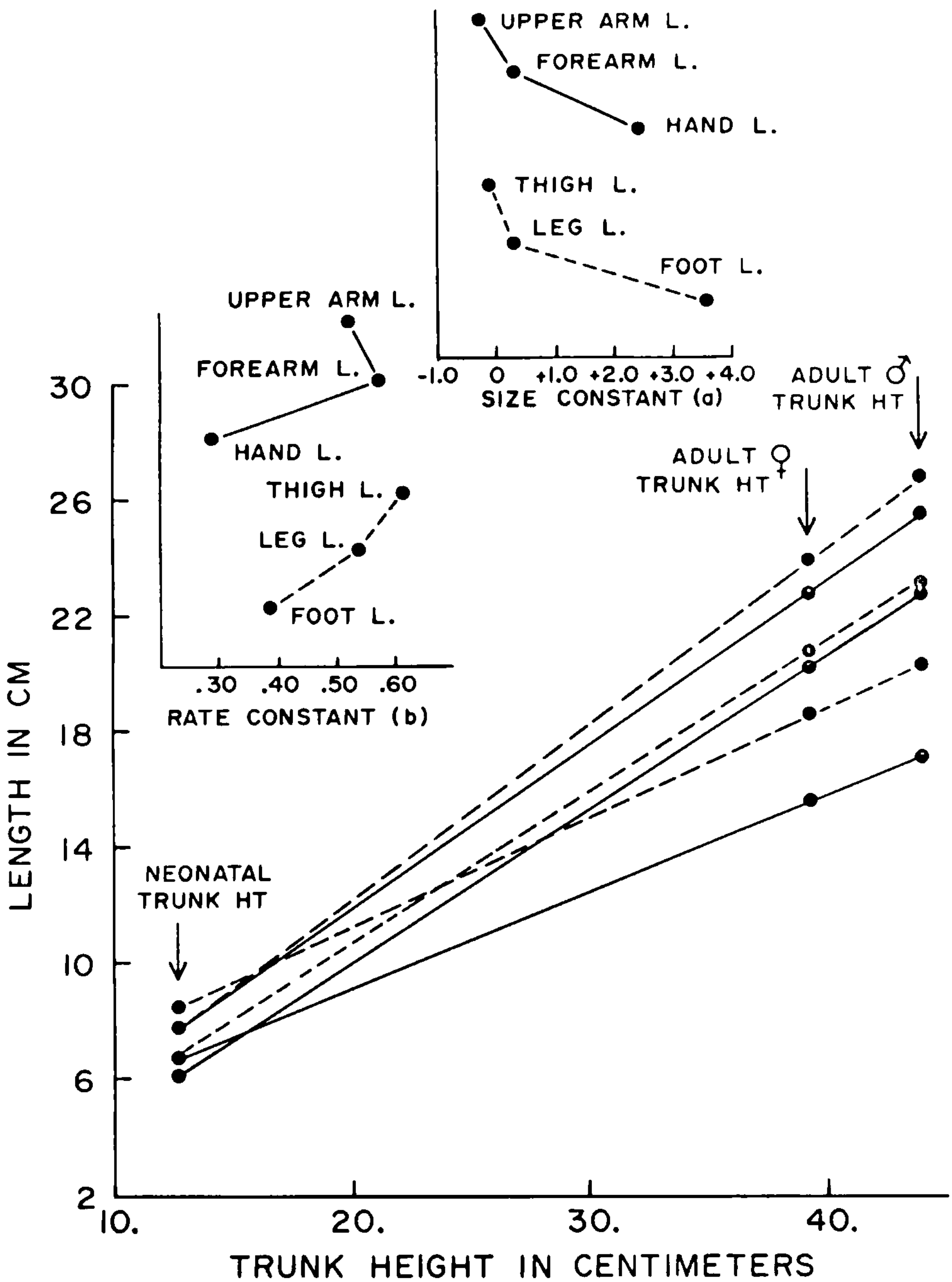

Fig. 21. Regression of Limb Segments on Trunk Height in Savannah Baboons.

at birth but, in females, maintained pace with body growth as a whole so that in the adult female it was still 21% as long as the trunk. In the male, the face grew even faster than the trunk and upper face height was 26% of the adult male trunk height. Thus, the face is proportionately larger in the adult male than in the infant.

The cephalic index (cranial breadth/cranial length) increases from 0.74 in the newborn to 0.81 in the adult baboon. This increase is in large part due to the growth of the temporalis muscle during post-natal growth. In the young baboon, the temporalis is very small and its superior border lies below the cranial points used in measuring head breadth. As the masticatory apparatus develops, the temporalis grows in proportion and its cranial margin advances superiorly and medialward over the cranial vault and adds its thickness to the externally measured head breadth. Schultz (1962) found that in Macaca and Cercopitheus skulls there was a postnatal decrease in the cranial index and it is probable that this observation holds also for the baboon. In the living baboon the head breadth grows at about the same rate as head length ($b = 0.989$).

The more rapid growth of the facial, relative to the cranial, portion of the skull is also reflected in the comparison of bizygomatic with head breadth. The regression analysis indicates that face breadth increased by about 1.6 cm for each 1.00 cm increase in head breadth (Table 91, Appendix B). This high growth rate results in a proportionately broader face relative to cranial breadth in the adult. In the newborn, the bizygomatic breadth/head breadth index is 0.88; it increases postnatally to 0.93 in adult females and 1.00 in adult males. Relative to facial length, however, the face narrows during postnatal growth so that the bizygomatic breadth/upper face height is reduced from 1.93 in the newborn to 1.15 and 1.00 in adult females and males, respectively.

The only relative growth relationship found to be strongly non-linear was the regression of upper face height on cranial length. The values of these dimensions in the baboon are plotted in Figure 22. The available data indicates a slow growth rate in the facial length relative to cranial length until the latter dimension attains a value of

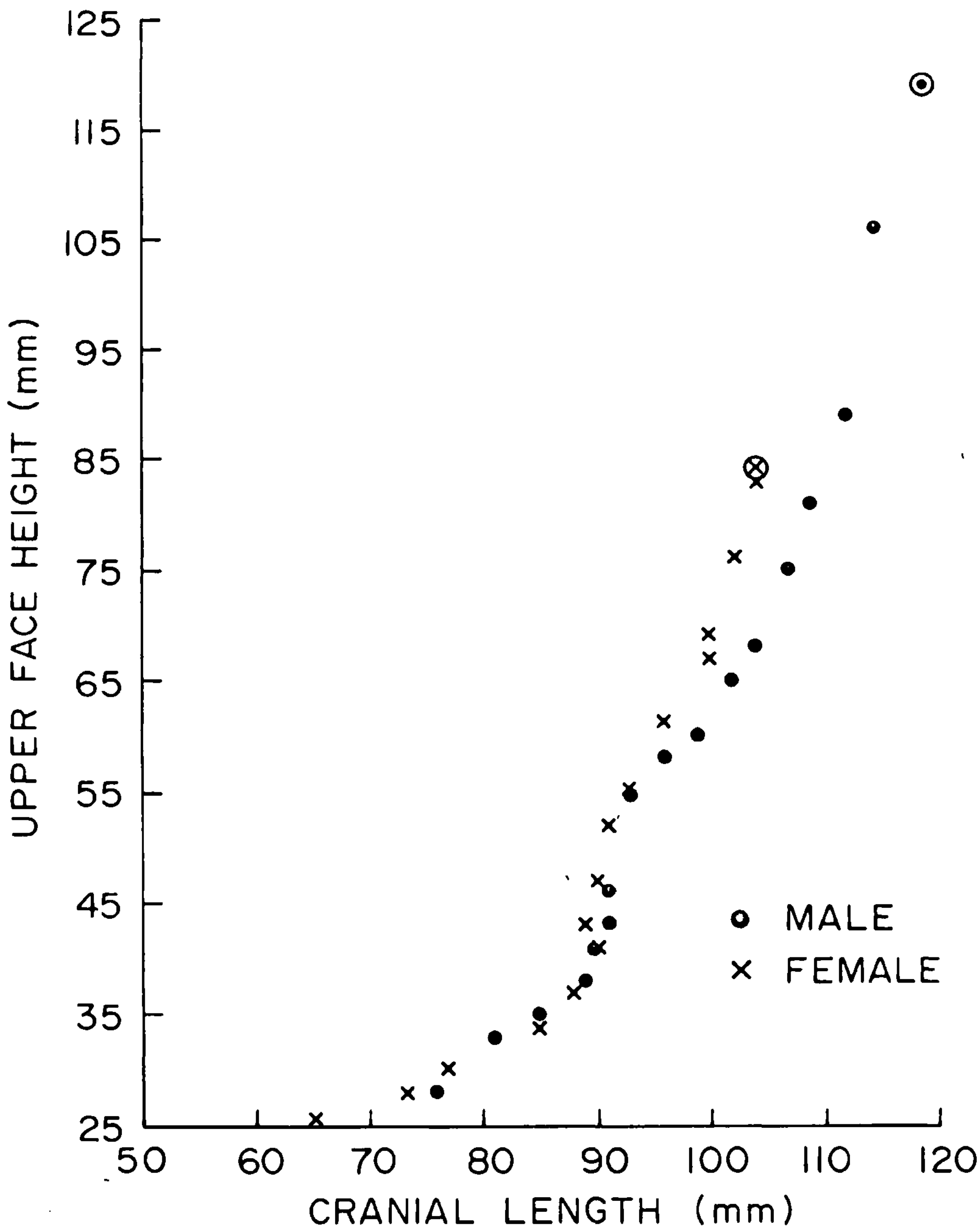

Fig. 22. Upper Face Height of Savannah Baboons Plotted Against Cranial Length.

approximately 90 mm. At this stage, the cranial length decelerates markedly and the increased rate of facial growth is maintained throughout the remainder of the growth period. In the male, the facial length averaged about 35 mm at the onset of cranial length deceleration or, roughly, it is about 50% as long as the cranium at this time. In the adult male, both dimensions average 119 mm so that while the face has increased its length by 85 mm, the cranium grows only about 30 mm.

Weight-Body Length Relationships

The relationship between the weight and length of the body is an index of its linearity. In human studies, it is most often expressed as a simple ratio of weight to height, the ponderal index. Van Wagenen and Catchpole (1956) calculated the ponderal index of the rhesus monkey with sitting height as the length dimension. Their data are compared with that of the baboon in Table 9. In both species, the males were generally stockier than the females. In the baboon, however, the mean ponderal index of the females exceeded that of the males at 2.00 yrs. In the chimpanzee and human, males were also found to be stockier than females except between the age of 5 to 7 yrs in the chimpanzee and 6 to 7 yrs in human (Gavan 1953). Throughout the first four years of life and in the adult, rhesus of both sexes are more linear in body build than baboons.

TABLE 9. PONDERAL INDEX $\frac{[\text{Wt. (kg.) x 100}]}{[\text{Sitting Ht.(cm)}]}$ OF RHESUS MONKEYS (van Wagenen and Catchpole 1956) AND KNOWN-AGE BABOONS

AGE	BABOON		RHESUS	
	MALE	FEMALE	MALE	FEMALE
(yrs)				
Birth	3.62	3.53	2.50	2.39
.50	7.06	6.82	4.85	4.75
1.00	9.62	9.50	6.27	6.24
2.00	12.05	12.72	8.35	8.26
3.00	16.55	15.44	11.40	10.52
4.00	24.16	-	14.60	12.27
5.00	-	-	16.10	13.35
6.00	-	-	17.80	14.40
Adult	31.29	20.46	19.30	15.63

COMPARATIVE SUMMARY

Gestation Age

The mean gestation of 181.3 days was ten days higher than that of a series of five Papio hamadryas births reported by Zuckerman and Parkes (1932). As in the present study, these authors counted conception from the climax of oestrous swelling. The mean gestation age of a series of 225 viable rhesus monkey births (van Wagenen and Catchpole 1965) was 168.9 $\pm$ 6.85 days, counted from the day of mating. This agrees closely with the mean of 167 days from time of mating of 17 Java macaques (Harms 1956), and 171 days from the peak of oestrous swelling for the pig-tailed macaque (Zuckerman 1931).

Among the Pongidae extensive data on gestation age exists only for the chimpanzee. Eighty-five chimpanzees born in the Yerkes colony (Gavan 1953) had a mean gestation length of 227.2 $\pm$ 11.8 days. Oglivie (1923 cited in Schultz 1956) reported a gestation age of 210 days for gibbons. Orangutans had a gestation period of approximately 273 days (Schultz 1942). Schaller (1963) reported three gorilla pregnancies for which accurate conception dates are known. In two, the gestation length was 252 days and in the third it was 289 days, giving a mean of 264 days. Conception age for humans is 263.7 days (Gavan 1953, Taback 1951).

In summary, it would appear that in macaques and baboons gestation periods range from 24-26 weeks. The anthropoid apes have gestation periods ranging from 30 weeks for gibbons to 39 weeks in orangutans. As emphasized by Schultz (1956) this difference between monkeys and apes is not merely a function of larger body size since, for example, the gibbon is much smaller than the baboon.

Maternal-Newborn Weight Relationship

Maternal weights for births reported in this series were not available but, using the mean of 12.32 kg recorded for eighteen fully adult females, we may calculate that the average newborn baboon weighs approximately 6.3% as much as its mother. Among placental non-primate species for which data are available, the birth weight means vary from about 2 to 10% of the average weight of adult females. Corresponding percentages for 13 representative infrahuman primates fall within the general mammalian range and vary from 2.1% in gorillas (Schultz 1956) to 10.3% in Macaca irus (Harms 1956). When these percentages are plotted against the absolute weight means of adult females, an inverse relationship is revealed (Fig. 23); the larger species have proportionately smaller young. Humans among whom the young weigh about 5.5% of mean maternal weight (Schultz 1956) form a notable exception to this general primate trend.

Neonatal Weight Gain

Time required for an infant to double its birth weight is useful in judging its nutritional status. Infant baboons of the present study attained a weight mean of 1550 gm at 101 days of age (Table 10). Infant rhesus monkeys doubled their birth weights of 474 gm at 91 days (van Wagenen and Catchpole 1956). Data on the chimpanzee (Gavan 1953) indicate that about 90 days is required to double the birth weight mean of 1800 gms. Human infants require about 150 days to double birth weight (Watson and Lowrey 1962). The absolute rate of gain varies from 5.27 gm/day in the rhesus monkey to 22.7 gm/day in humans. In Figure 24, the logarithm of weight is plotted against that of age for these four primates. All four regression lines are nearly parallel. This finding suggests that the disparity in absolute gain is largely a function of overall body size.

In humans (Stoudt, Damon and McFarland 1964; Pett and Ogilvie 1956), chimpanzee (Gavan 1953) and macaques (van Wagenen and Catchpole 1956; Harms 1956), body weight continues to increase for some time after full linear growth is attained. In old age, humans apparently decline in body weight Stoudt, et al 1965), but until now no data has existed documenting senile weight loss in apes or monkeys. Although age could only be assessed through dental wear, adult baboons appear

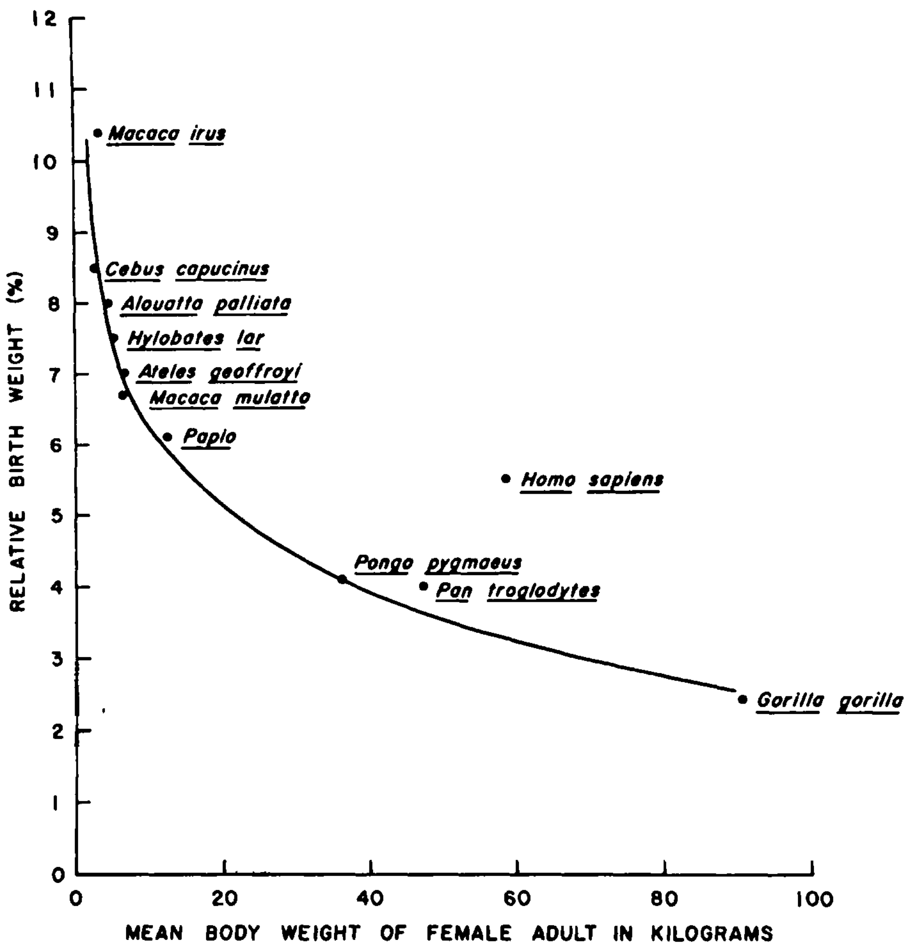

Fig. 23. Relative Birth Weight Plotted Against Mean Adult Body Weight of Representative Primate Species.

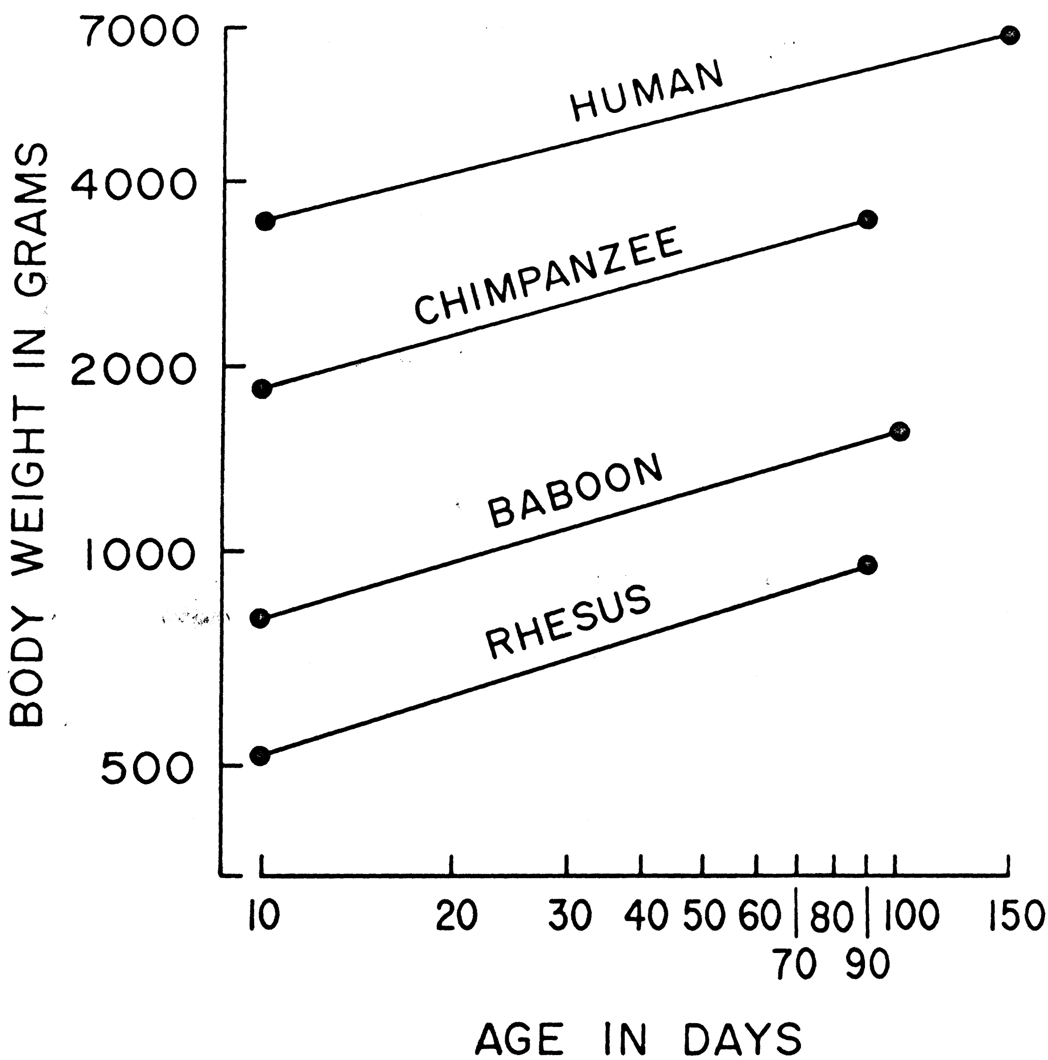

Fig. 24. Logarithms of Body Weight Plotted Against Logarithm of Time Required to Double Birthweight in Rhesus Monkeys, Baboon, Chimpanzee and Human.

to gain weight through the earlier period of maturity and to lose weight in later years.

There is little sexual difference in body size and shape in the neonate, although in the baboon, as in most primates (van Wagenen 1954; Schultz 1962, 1963; Altmann and Ditmer 1963), the male tends to be slightly larger at birth. Adult baboons, however, are characterized by a strong difference in body size with males almost twice the size of females. Such size dimorphism is the rule among higher primates although much variability is encountered. In Siamangs (*Hylobates moloch*), females averaged about 95% of the male mean body weight. In the orangutan, gorilla, and proboscis monkey (*Nasalis larvatus*), the females weigh only about 50% as much as the male (Schultz 1956).

TABLE 10. NEONATAL WEIGHT GAIN IN BABOONS, RHESUS MONKEYS, CHIMPANZEES AND HUMANS

	N	Mean Birthweight	Time to Double Birthweight	Mean Gain
		gm	days	gm/day
Baboon	24	774 ± 140	101	7.67
Rhesus*	208	474 ± 64	91	5.27
Chimpanzee**	42	1800	90	20.00
Human***	-	3400	150	22.66

*van Wagenen and Catchpole 1956
**Gavan 1953
***Watson and Lowrey 1962

Body Weight-Length Relationships

Comparisons of the ponderal index show that the baboon is generally stockier in body build than the macaques. Males of both species were stockier than females. Gavan (1952) has shown that, in some respects, it is more informative to relate the length dimensions to the cube root of body weight rather than to body weight *per se*. This procedure results in a linear relationship that is amenable to simple regression analysis. In Figure 25, Gavan's (1953) regression lines of $\sqrt[3]{\text{body weight}}/\text{trunk height}$ for the chimpanzee and human are shown along with the scattergram values for baboons of the present study. Gavan found no statistically significant differences between the regression

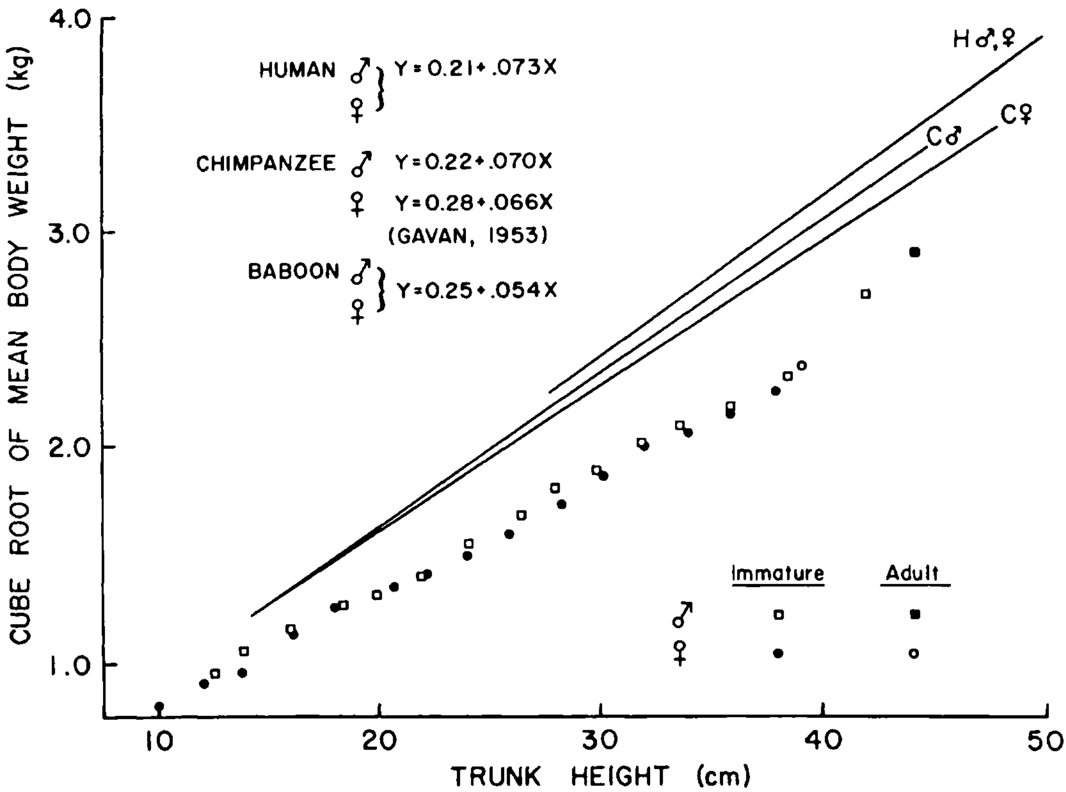

Fig. 25. Cube Root of Mean Body Weight Plotted Against Trunk Height of Savannah Baboons, Chimpanzee, and Human.

constants of human males and females. In the chimpanzee, the male rate was significantly higher than that of the female. No significant sexual differences were demonstrated for the baboon. As indicated by the slope of the regression lines, the human is somewhat more compact (in terms of weight per unit of body length) than the chimpanzee and baboon throughout the period of postnatal growth. The chimpanzee and human resemble each other more closely in this respect than either do the baboon. This resemblance may be partly due to the relative shortening of the trunk, through reduction in number and relative height of the vertebrae (Schultz and Straus 1945), that characterizes both the anthropoid apes and man, and partly to the proportionately more massive human legs and chimpanzee arms.

Growth in Sitting Height

The sitting height growth curves for rhesus monkeys (van Wagenen and Catchpole 1956) are compared with those of the baboon in Figure 9. At birth, the baboon is slightly larger than the rhesus and this initial difference increases slowly throughout the course of postnatal growth. The absolute differences obscure similarities in the growth curves of the two species. Some of these similarities are revealed when growth is considered as a percentage of its newborn value (Fig. 26). Until about 2.5 yrs, both the baboon and the rhesus grew at the same relative rate. At this age, both sexes of the baboon and rhesus had increased in sitting height by approximately 225%. Late in the third year of life the males began to exceed the females in both species. Also at about 2.5 yrs, the male baboon began to outstrip the male rhesus in relative length, so that at 4.00 yrs, the male baboon has attained a sitting height about 275% of its newborn mean compared to the 250% increase in the rhesus monkey.

Linear Growth

The dimorphic size differences that distinguish adult baboons so strongly are not apparent through the first two years of growth. The known-age males and females of the present study grew at much the

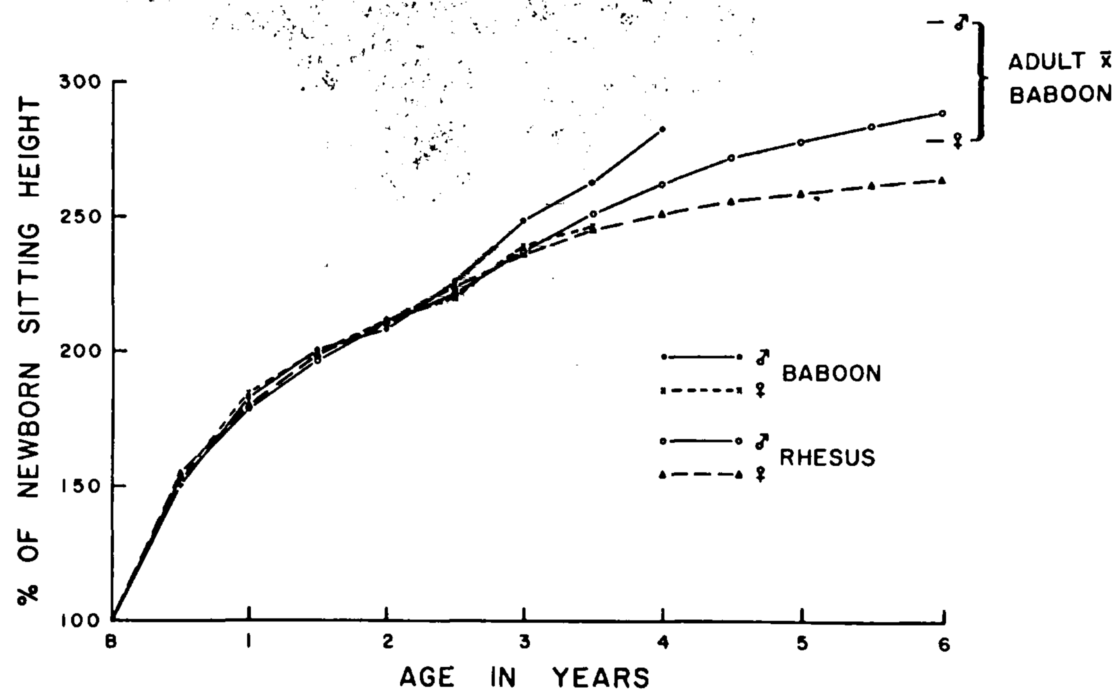

Fig. 26. Post-Natal Growth Curves of Rhesus Monkey (van Wagenen and Catchpole 1956) and Known-Age Savannah Baboons Plotted as Percentage of Newborn Means.

same rate throughout the first two years of life. Shortly after their second birthday, the males begin a growth acceleration and by the end of the third year, have exceeded the females in most dimensions. Between the third and fourth years, the immature males equal or exceed the adult female mean values for most dimensions. Because of the nearly identical size of male and female at birth and the adult disparity in body size, females are relatively more mature than males throughout the postnatal growth period. This same observation would apply, of course, to other primates (including man) characterized by an appreciable degree of sexual dimorphism in body size.

The various body segments and regions are characterized by distinct growth curves that may be best compared by reducing them to a common scale. This was done (Fig. 16) for the male by plotting the immature values as percentages of the adult mean. Most measurements of the trunk and appendages follow a very similar pattern with birth values averaging 30-40% of the adult mean, rising rapidly to about 50-60% during the first year of life. During the second year, growth is slowest. Near the beginning of the third year, the previously mentioned acceleration occurs and is continued so that, by 4.0 yrs, values are about 80-90% of the adult. These percentage curves show a gradient in both limbs such that the more distal segments (hand and foot) are relatively more mature than the intermediate segments (forearm and leg). The latter are, in turn, more mature than the proximal segments (upper arm and thigh). A similar maturity gradient has been demonstrated in growth of the upper and lower limbs of human children (Tanner 1962).

The growth of the head is characterized by two disparate growth patterns. The neurocranium and its associated structures have already attained about 60% of its adult size at birth. It grows very rapidly through the first year of life by which time it is about 80% as large as the adult head. Throughout the second, and most of the third year of life, growth in this region practically ceases. At about 2.50 yrs the rate of neurocranial growth quickens perceptibly and by 4.0 yrs it has reached 90% of the adult size. In contrast, most measurements of the splanchnocranium are relatively small at birth but grow at a more rapid rate than the neurocranium as a whole.

Sexual Maturation

The mean age at menarche of nine known-age baboons was 3.03 yrs. Gilbert and Gillman (1960) report a mean menarchal age of 3.21 yrs in chacma baboons. In rhesus monkeys, menarche occurs at about 2.0 yrs (van Wagenen 1952). The onset of menarche also occurs relatively earlier in the female rhesus since these animals weigh only about 45% as much as the mean adult female at this time while the female baboon, at menarche, averages about 65% of the adult mean. However, it is interesting to note that female of both species average about one-third (rhesus 32%, baboon 36%) the body weight of the adult male at menarche. This similarity is due to the greater degree of sexual dimorphism in body weight of the baboon. In the latter species, females weigh about 56% as much as the male compared to 69% in the rhesus (Schultz 1956). This finding suggests that the menarchal female/adult male ratio in body size may be a factor in determining the age of sexual maturation in females.

The testes of the male baboon begins a strong acceleration in growth rate at about 2.8 yrs of age. At this time, the males weigh about 35% of the adult mean. In the male rhesus monkey, the onset of testicular growth occurs at about 2.5 yrs and, at this age, the animals weigh about 36% as much as the adult (van Wagenen 1954). Thus the relative difference in age of sexual maturation between the females of the two forms do not appear to exist in the males. Van Wagenen (1954) found that fully mature spermatozoa are formed at about 3.0 yrs in the rhesus but the earliest fertile impregnation observed was about 3.35 yrs. Although OUDM colony males as young as 4.0 yrs have been observed to copulate with mature females, the earliest recorded impregnation occurred when the male was 5.40 yrs of age.

A characteristic feature of the human growth curve is the circumpuberal growth spurt. Its occurrence in the chimpanzee (Gavan 1953; Gavan and Swindler 1966) has also been documented. In both forms, the

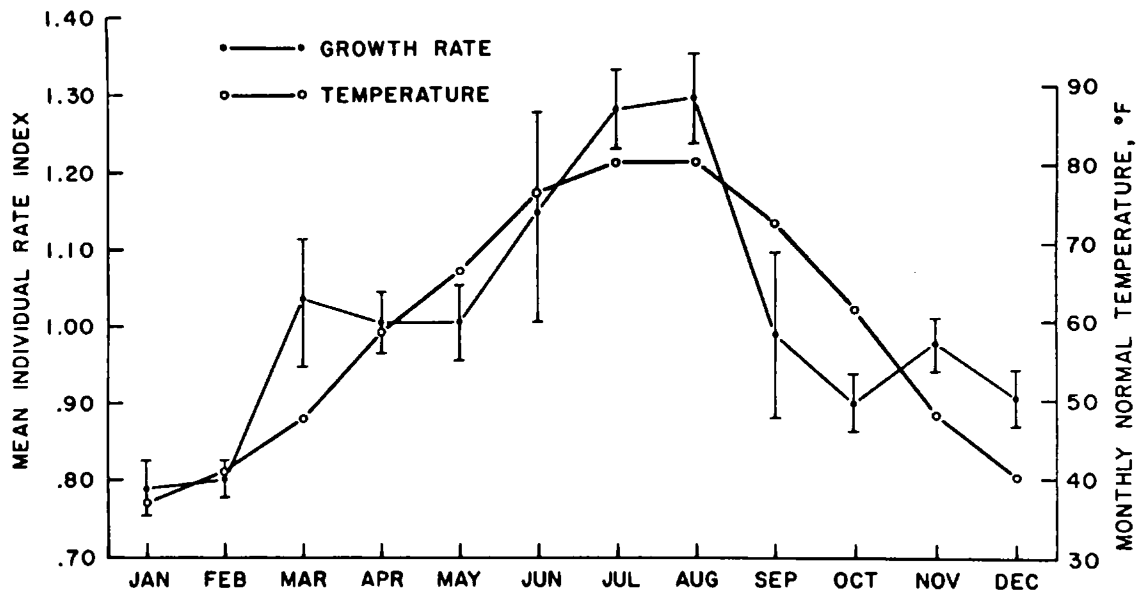

Fig. 27. Mean Individual Rate Indices of Sitting Height Plotted Against Normal Monthly Temperature.

magnitude of the spurt in males exceeds that of females. In females, the acceleration in growth is thought to be a product of the androgenic hormones of the adrenals which first appear in quantity at about this time. The larger male growth spurt is attributable to the synergistic action of the androgenic hormones and testosterone secreted by the testes (Tanner 1962).

In the male baboon, a very pronounced acceleration in body weight commences at about 2.8 yrs and is coincident with onset of testicular development. By 3.2 yrs, the males are gaining at about 1000 gms per month, a rate about 2.5 times faster than that observed in the early months of life. Of course, this greater absolute rate of growth in the adolescent male represents a very small relative gain. A 10 kg male that grows at the rate of 1000 gm/0.1 yr is increasing his total body weight by 10%. Infants weighing about 1000 gms are increasing their body weight by about 35% per 0.1 yr.

Effects of Season

The effects of season on growth have been demonstrated in a number of organisms, including man (Thompson 1942; Harrison 1964). German military cadets, for example, showed consistently greater statural increments during the summer (Daffner 1902, cited in Thompson 1942); British and Scandinavian school children show their greatest height gains from March to May (Nylin 1929; Orr and Clark 1930; Bransby 1945) while among the Japanese such increases have been noted from May to July (Takahashi 1966). In the OUDM baboon, seasonal growth acceleration in sitting height also occurred. The greatest growth, however, occurs in the months of maximum temperature rather than in the spring as is apparently the case in humans (Fig. 27). The strong correlation that exists between normal monthly temperatures and the increases in sitting height growth rate may be spurious since as yet unassessed factors such as amount of daylight, increased activity or increased dietary intake (the OUDM diet was qualitatively constant through the year) may be involved. Nonetheless, temperature is the most obvious and direct factor which could account for such a seasonal variation in growth rate.

Relative Growth Patterns

In Gavan's (1953) analysis of the relative growth relationships of children and chimpanzees, a number of small but statistically significant differences were found between regression constants of males and those of females. In all but one of the corresponding relationships in the baboon no significant sexual differences were found. The single exception was the regression of knee height + leg length on trunk height in which the rate constant of baboon males was higher than the female. This general lack of sexual differences might be more closely related to the structure of the samples involved than to biological reality. In both the normative group of Yerkes chimpanzees and the Brush Foundation Human Growth Study (Simmons 1944), the populations from which Gavan derived his data, most of the subjects were followed for a number of years and the overall samples were predominately <u>longitudinal</u> (Tanner 1951). The baboon sample consisted of a large number of single observations on individual animals plus repeated observations on a few. In addition, the total number of observations upon which both the chimpanzee and human regression analyses were based was larger than that available for the baboon. Thus, the greater homogeniety and larger sample sizes of the human and chimpanzee series would be more likely to reveal slight, but significant, differences between the sexes than the small and predominately <u>cross-sectional</u> (Tanner 1951) baboon sample. Until data from an equivalently-structured sample are available on the baboon, it would probably be unjustified to draw any conclusions based on the lack of sexual differences in relative growth patterns.

In Figures 28 through 38, a number of relative growth relationships of the baboon are compared with those of the chimpanzee and human. Data on the latter two species are taken from Gavan (1953). In the case of the baboon, the grouped means of the various body dimensions are plotted against trunk height. The chimpanzee and human are represented by regression lines. In instances in which significant sexual differences in regression constants occurred, separate regression constants are shown for males and females. The scattergrams for the baboon cover a trunk height range from 10 cm to about 45 cm which is roughly the span observed during postnatal growth. The chimpanzee lines also cover the postnatal growth range (about 15-50 cm). The human regression lines range from about 20 (Thompson 1951) to 50 cm. Postnatal human trunk heights actually range from about 23 cm at birth to 56 cm in adult males (Snow and Snyder 1966). Relative growth data on the human, however, were available to Gavan from only the 30th postnatal month, the age at which Brush Foundation subjects entered the study (Simmons 1944). In the figures, the human regression lines have been extended only to 50 cm for technical reasons. In the discussion that follows, the term relative, when used in reference to growth rates or proportions, always refers to the size of a body segment or dimension relative to trunk height. The indices discussed are also ratios of each particular segment to the corresponding trunk height value. Unless otherwise noted, the indices refer to those of the adult male calculated from the regression equation. Such derived indices may differ slightly from the actual mean indices as measured directly since there is a tendency (as may be noted in the scattergrams of the baboon) for adult values to fall slightly below the main trend of regression. In calculating the adult male indices from regression equations, trunk height (X) values of 44 cm, 50 cm, and 56 cm have been used for the baboon, chimpanzee and human, respectively.

The figures allow the comparison of the relative growth patterns of representatives of the three principal families of living catarrhine primates: the cercopithecid (baboon), pongid (chimpanzee), and hominid (*H. sapiens*). Each is characterized by a multitude of morphological, physiological and behavioral differences. Among these are the differences in general body proportions. Most cercopithecoids, for example, tend to have arms and legs of about equal length (Schultz 1956). Pongids are characterized by relatively long upper limbs which reflect their adaptation to a brachiating mode of progression; bipedal humans, in contrast, have relatively long lower limbs. Compared to humans, neurocranial dimensions of the two infrahuman groups are small relative to total body size. Yet, as Schultz (1956) has emphasized, many of the differences in body proportions that characterize the adult are developed during postnatal growth.

The chimpanzee is typical of the pongids in its relatively long arms in relation to trunk height. The index for this relationship is about 1.8 in Pan and among anthropoid apes ranges from 1.7 in the gorilla to 2.4 in the gibbon (Schultz 1956). In adult humans, it averages about 1.48 and in the baboon, 1.44. However, these adult proportions are products of the very dissimilar relative growth rates which characterize each species. At birth, the baboon and chimpanzee have nearly identical upper limb proportions. In the chimpanzee, the arm grows about 1.9 cm for each 1 cm increase in trunk height; in the baboon the rate is only 1.4 cm per 1 cm of trunk height (Fig. 28). This disparity in relative rates results in the rapid development of size differences between the baboon and chimpanzee arms. By the time postnatal growth is complete, the arm of the chimpanzee far exceeds that of the baboon in its absolute and relative dimensions. The human arm, at birth, is shorter than those of baboons and chimpanzee of equal trunk height. The human arm grows at a rate intermediate between the baboon and chimpanzee, increasing its length by 1.7 cm for each 1 cm increase in trunk height. As a result, the initial size advantage of the baboon is gradually overcome during postnatal growth, the regression lines cross and the arm length/trunk height index of adult humans slightly exceeds that of the baboon.

The growth of the arm as a whole is the product of the individual growth patterns of its three component segments (Figs. 29 - 31): the upper arm, forearm, and hand. The upper arm/trunk height index is 0.51 in the baboon, 0.67 in the chimpanzee and 0.61 in humans. The newborn chimpanzee and young baboon are practically identical in the absolute and relative dimensions of the upper arm. Again, however, the postnatal relative growth rate of the chimpanzee exceeds that of the baboon so that, by the time that adult size is attained, the chimpanzee has a relatively longer upper arm. The newborn human has a short upper arm when compared to the other two forms. Its postnatal growth rate is, however, the highest of the three forms. This higher rate results in a

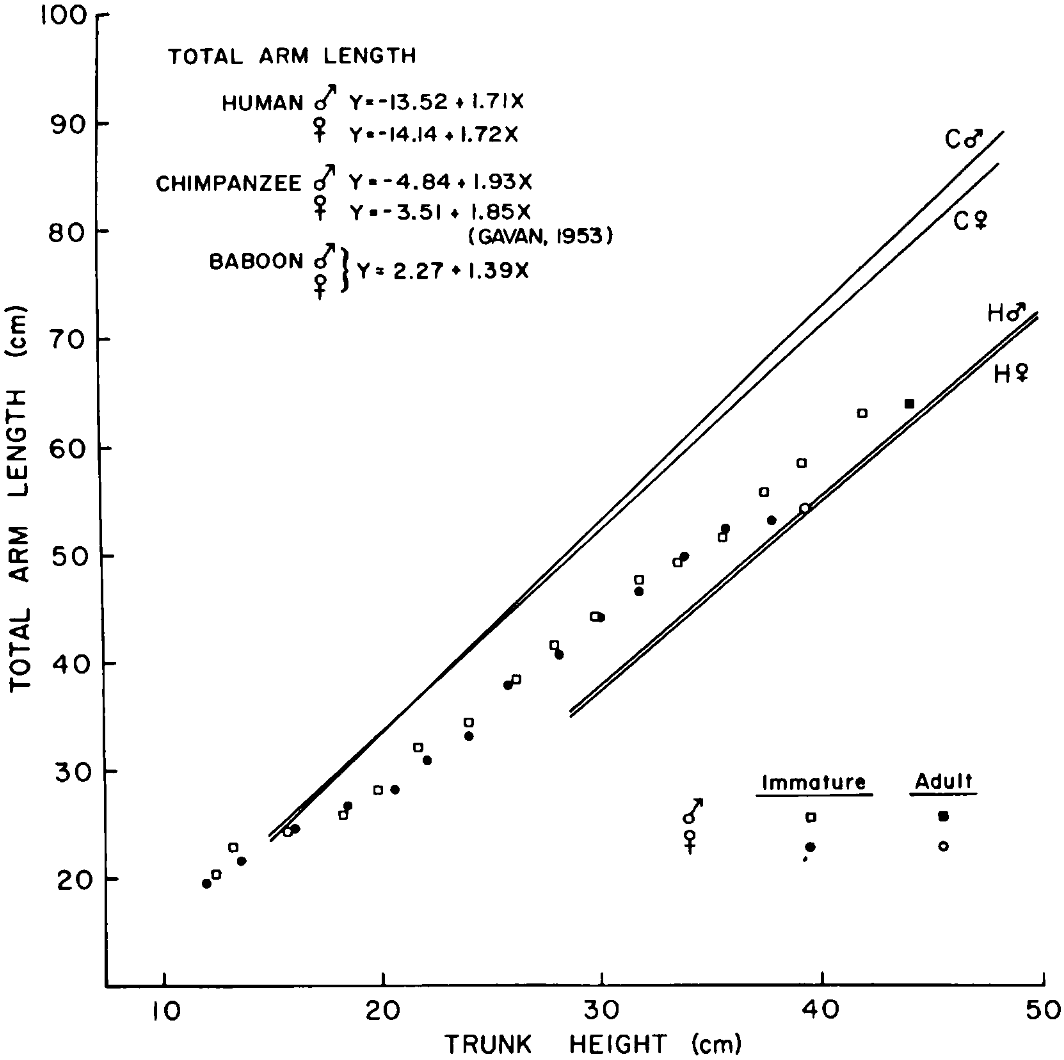

Fig. 28. Regression of Total Arm Length on Trunk Height in Baboons, Chimpanzee and Human.

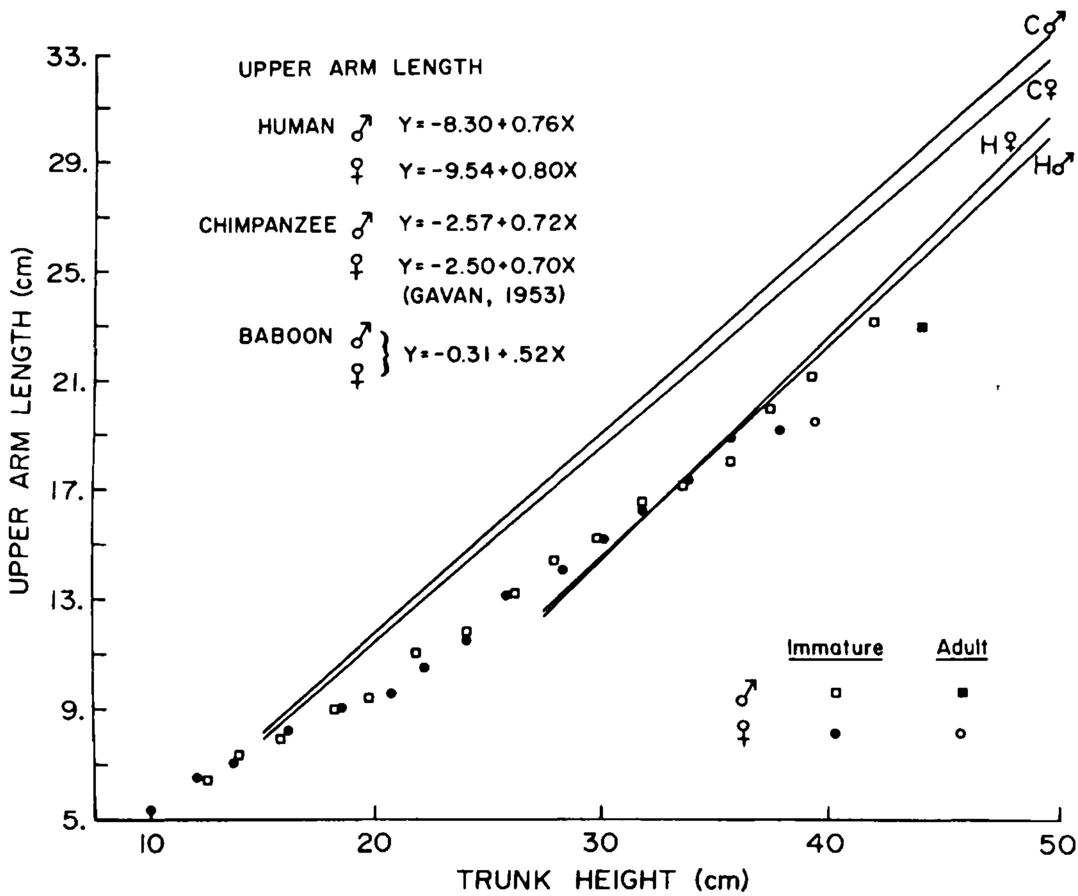

Fig. 29. Regression of Upper Arm Length on Trunk Height in Baboons, Chimpanzee and Human.

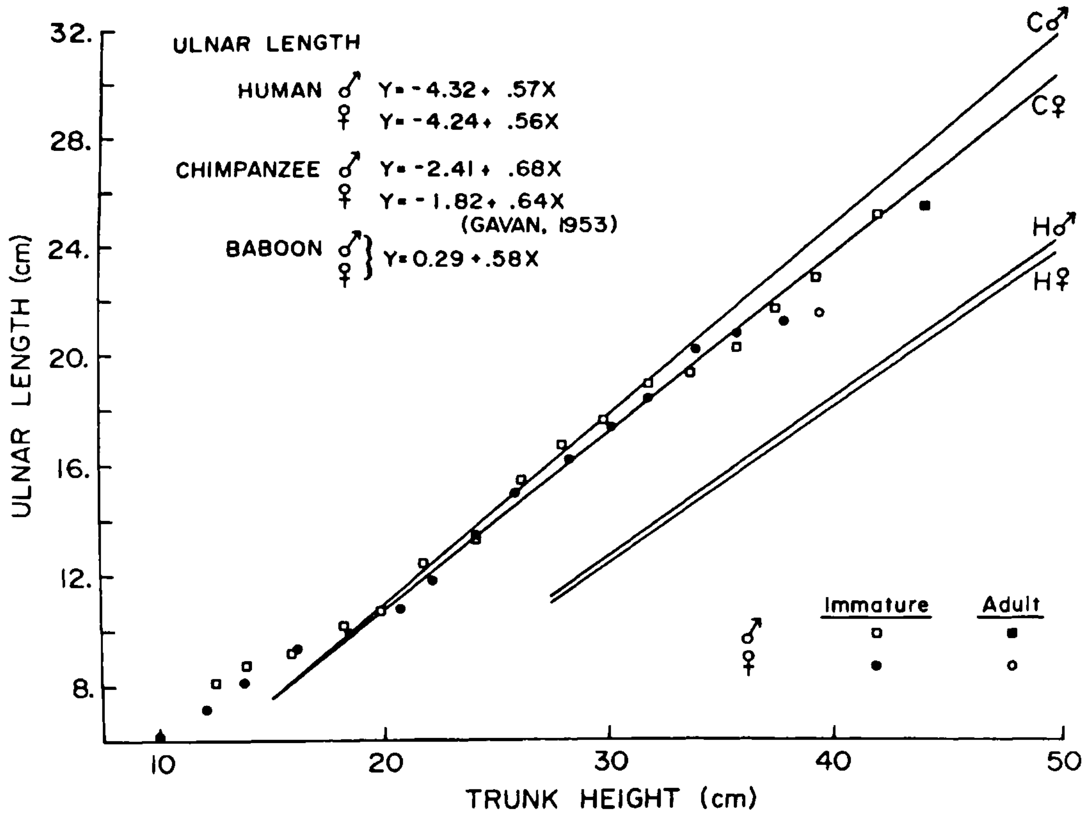

Fig. 30. Regression of Forearm Length on Trunk Height in Baboons, Chimpanzee and Human.

crossing of the baboon regression line so that the index of the adult human exceeds that of the baboon. The more rapid rate is not sufficient to overcome the initial size advantage of the chimpanzee and the arm of the latter form is still relatively longer than the human in adulthood.

The forearm segment shows little disparity in growth rates in the three species. The chimpanzee rate is the highest, the forearm increasing its length by 0.68 cm for each 1 cm increase in trunk height. The baboon and human have nearly identical postnatal growth rates in this segment, that of the former being 0.57, and the latter, 0.58 cm for each 1 cm of trunk height growth. Despite the similarity in rates, the human forearm is much smaller in relation to trunk length than those of the other two forms. While the human, chimpanzee, and baboon regression lines are nearly parallel, the initial size differences are more or less maintained throughout postnatal growth. Because of this, the chimpanzee and baboon have nearly identical indices in adulthood but both strongly exceed the human index.

At birth, the chimpanzee hand (Fig. 31) is absolutely and relatively longer than that of the baboon and, as in the case of the more proximal segments, grows at a higher relative rate ($\underline{b}$ = 0.54). The human infant has a smaller hand than the baboon, but a slightly higher relative rate ($\underline{b}$ = 0.38) than the latter animal ($\underline{b}$ = 0.29). The hand length/trunk height index is 0.34 in the adult baboon and 0.37 in humans. Both are strongly exceeded in this index by the chimpanzee with its adult value of 0.54.

Since the foot length was not available for human children of the Brush Foundation Study, Gavan (1953) used thigh length + knee height as a measure of lower extremity growth (Fig. 32). In the baboon, the rate constant ($\underline{b}$) for the total length of these two segments against trunk height was 1.18. In humans, no significant sexual differences were found in the regression constants; in chimpanzees and baboons, the male rate was significantly higher than that of the female. The relative rate of the chimpanzee (1.40) is somewhat higher than that of the baboon (1.18) but both are greatly exceeded by that of humans in which 2.32 cm gain was recorded for each 1 cm increase in trunk height.

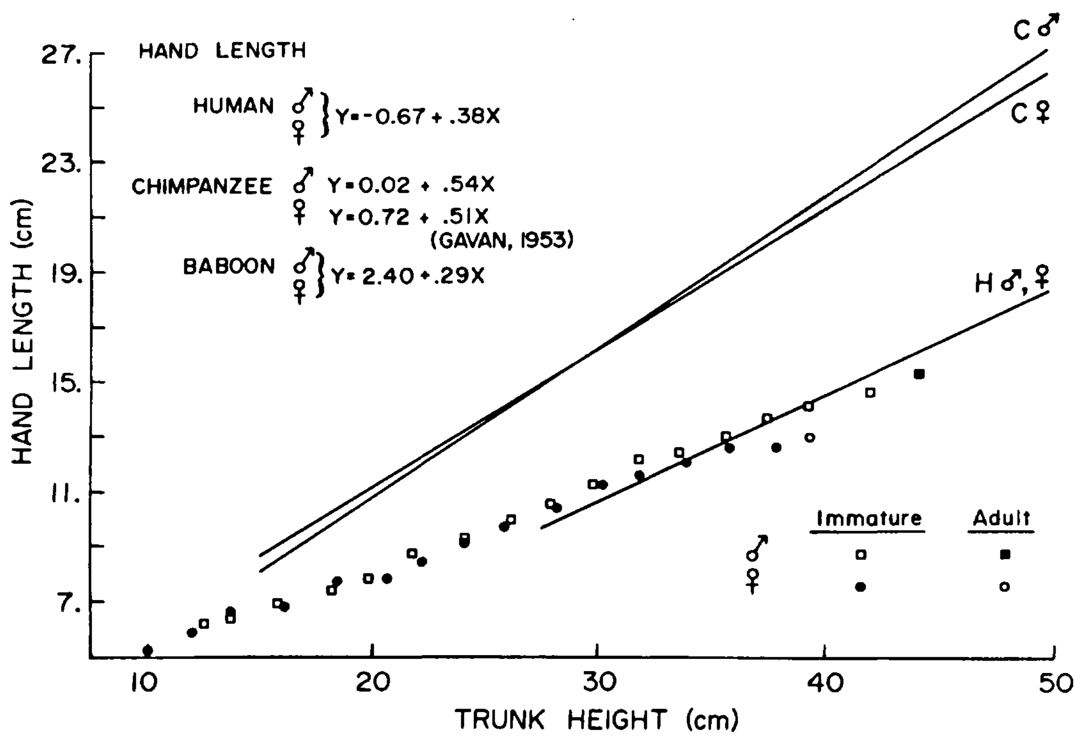

Fig. 31. Regression of Hand Length on Trunk Height in Baboons, Chimpanzee and Human.

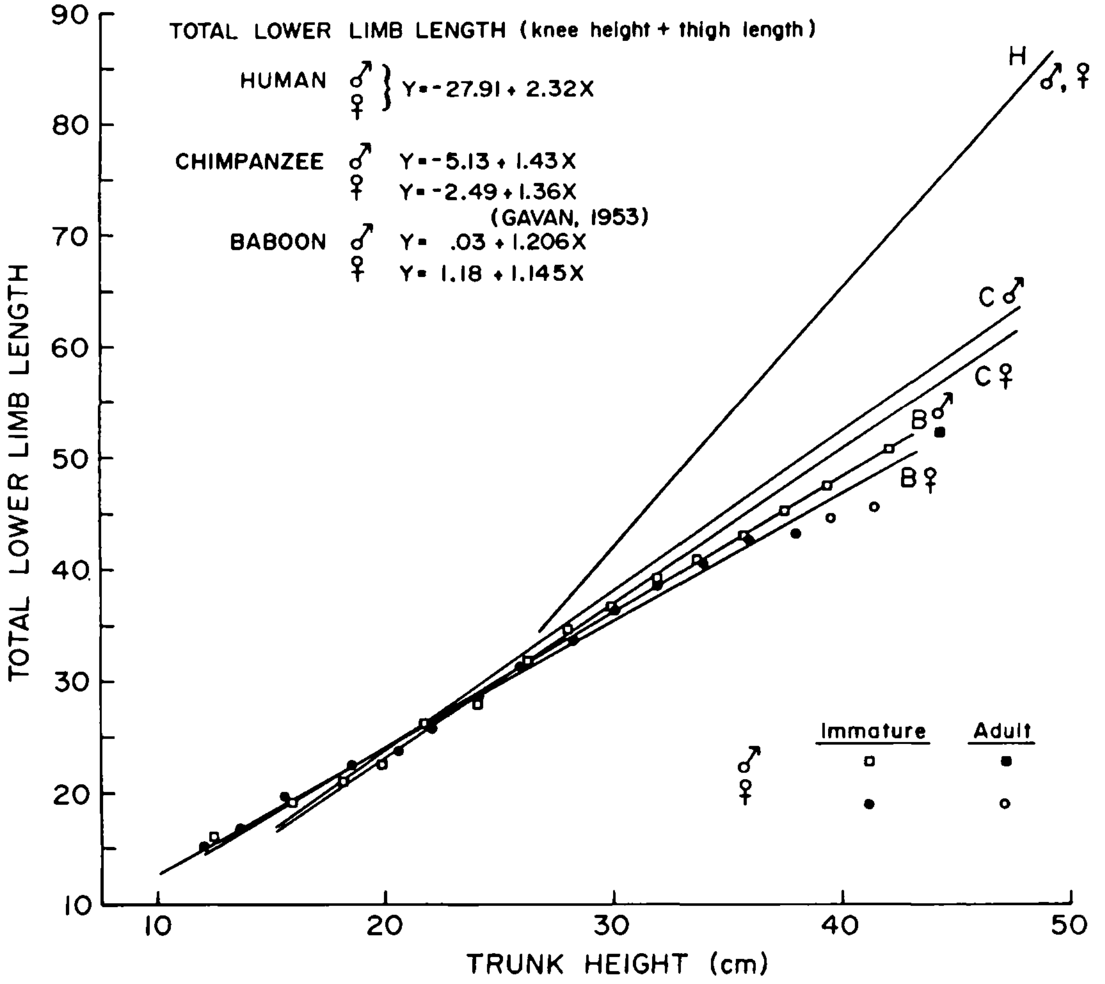

Fig. 32. Regression of Lower Limb (Thigh Length + Knee Height) Length on Trunk Height in Baboons, Chimpanzee and Human.

The much more rapid human rate is also displayed in the thigh and leg length regressions on trunk height (Figs. 33, 34). In both segments the chimpanzee and baboon are quite similar although the chimpanzee rate constants are slightly higher. The chimpanzee foot (Fig. 35) grows faster than that of the baboon, although, as in the two proximal segments, the resemblance in growth pattern is strong.

Regression for bitrochanteric breadth on trunk height are shown in Figure 36. The rate constants for the female human were significantly higher than the male. In the chimpanzee, as in the baboon, the regression constants of females were not significantly different from those of males. Of the three forms, humans increased most rapidly in bitrochanteric breadth relative to trunk height, and chimpanzees were intermediate. The baboon rate was the lowest, increasing 0.43 cm per 1.00 cm growth in trunk height.

The regression of head length and breadth on trunk height are shown in Figures 37 and 38. At birth, the chimpanzee head is relatively larger than that of baboons of equal trunk height. The chimpanzee also has a higher relative growth rate so that the initial difference becomes more pronounced as growth proceeds. An enormous difference in size exists between the newborn human head and those of the other two forms, but the postnatal relative growth rates ($\underline{b}$ = 0.12) of both lower primates are about double the human rate ($\underline{b}$ = 0.06).

Since hominids and pongids are generally supposed to have had a cercopithecoid ancestor, it is interesting to compare the overall growth patterns of the two higher forms with that of the baboon. This has been done in Figure 39 which shows human and chimpanzee linear regression constants of the several body dimensions on trunk height plotted as deviations from those of the baboon.

In general, the chimpanzee deviations are smaller than the human in the case of the size constant ($\underline{a}$). With the exception of the two cranial measurements and bitrochanteric breadth, the baboon size constants are larger than those of the other two forms. The rate constants ($\underline{b}$) for the head dimensions of all three forms are similar, again emphasizing the fact that the human head is relatively large due to size

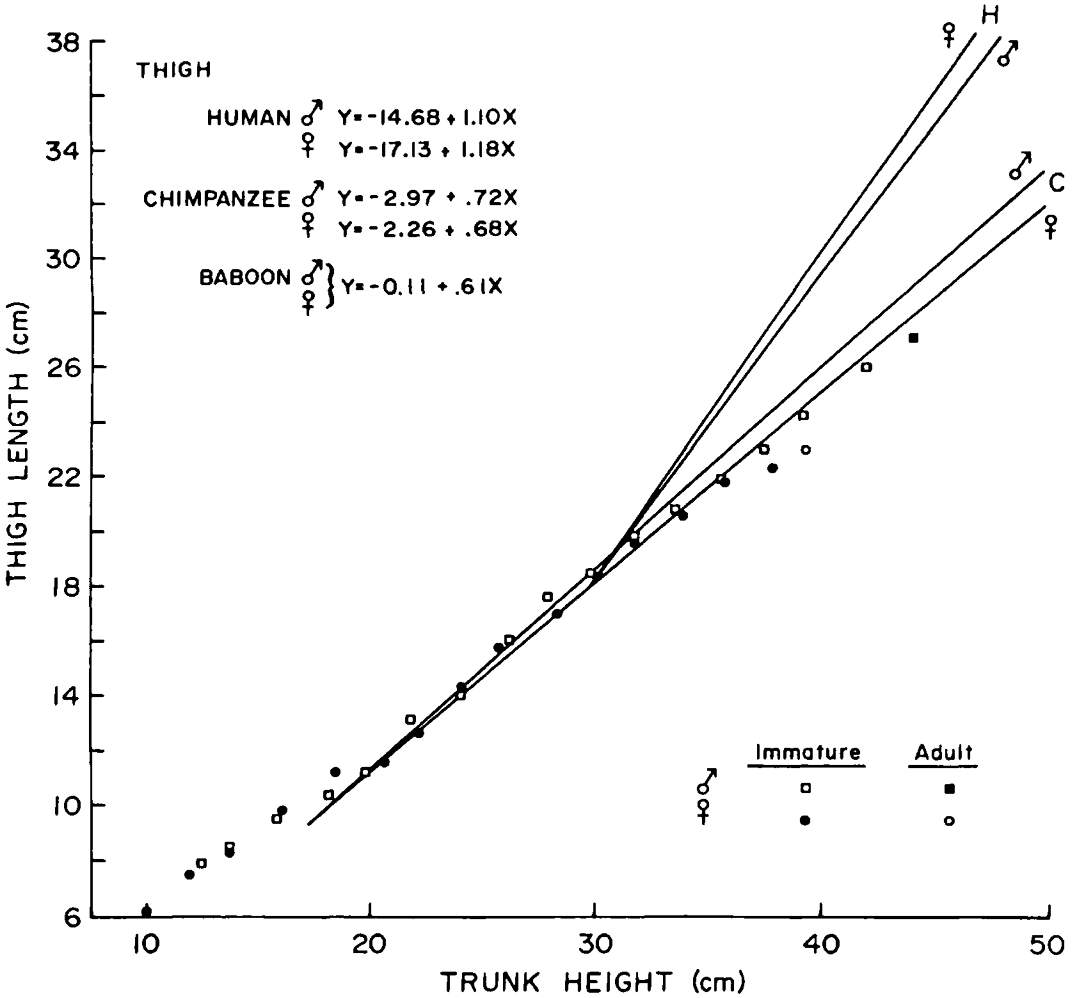

Fig. 33. Regression of Thigh Length on Trunk Height in Baboons, Chimpanzee and Human.

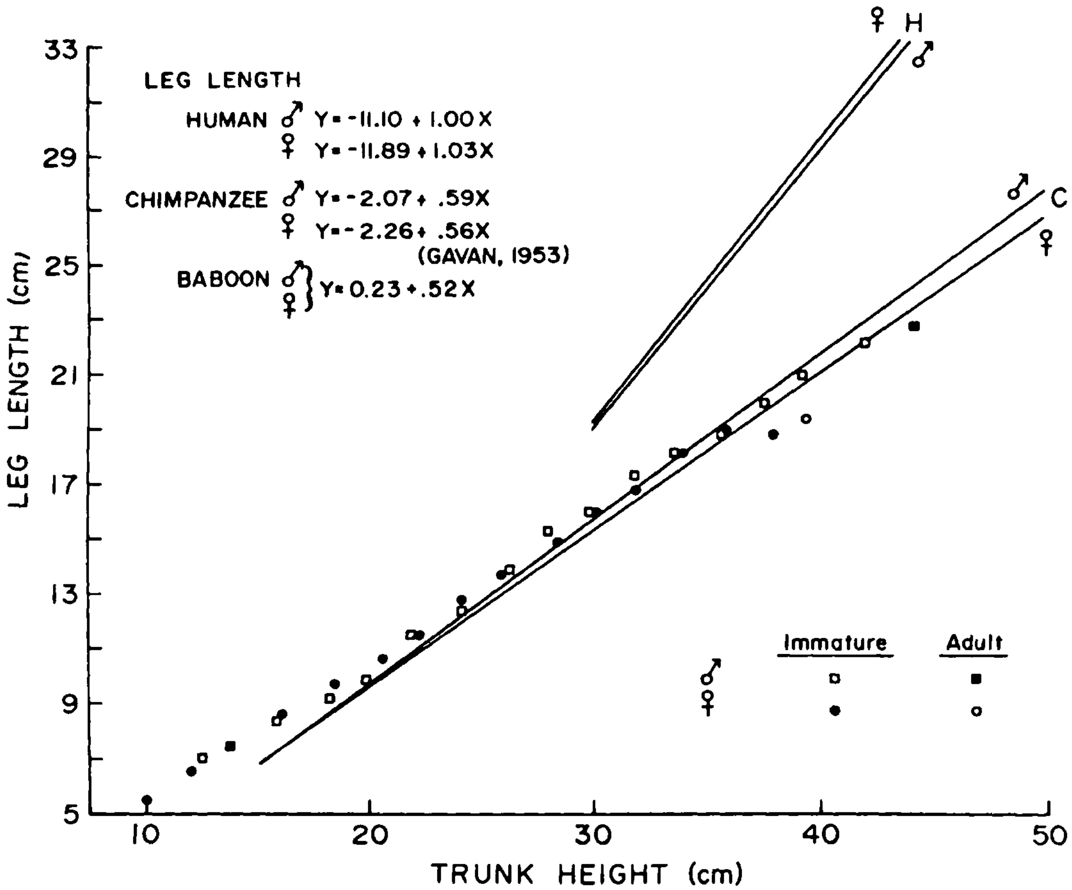

Fig. 34. Regression of Leg Length on Trunk Height in Baboons, Chimpanzee and Human.

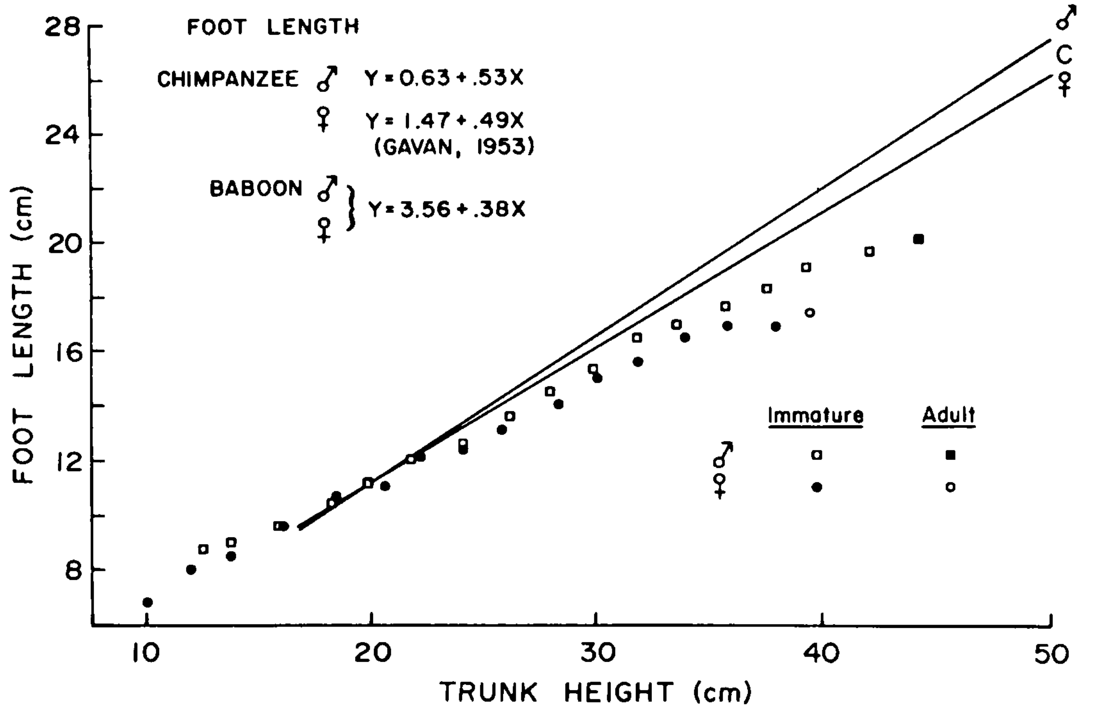

Fig. 35. Regression of Foot Length on Trunk Height in Savannah Baboons and Chimpanzee.

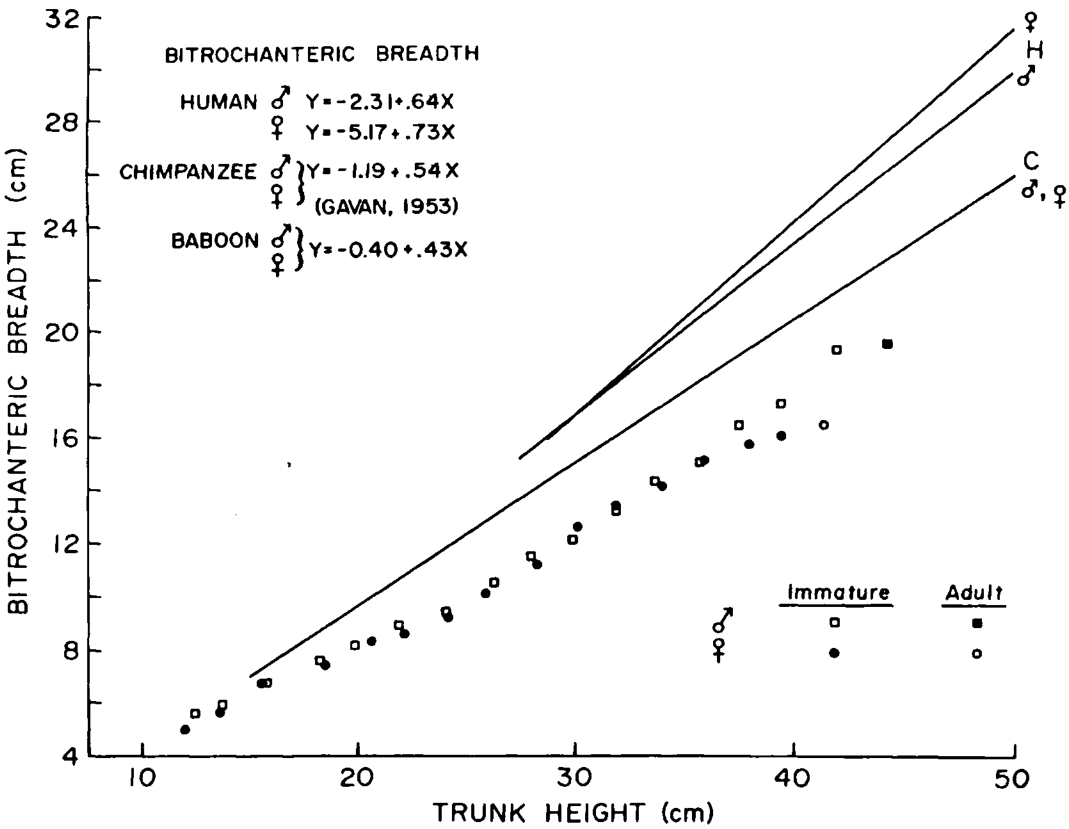

Fig. 36. Regression of Bitrochanteric Breadth Plotted on Trunk Height in Savannah Baboons, Chimpanzee and Human.

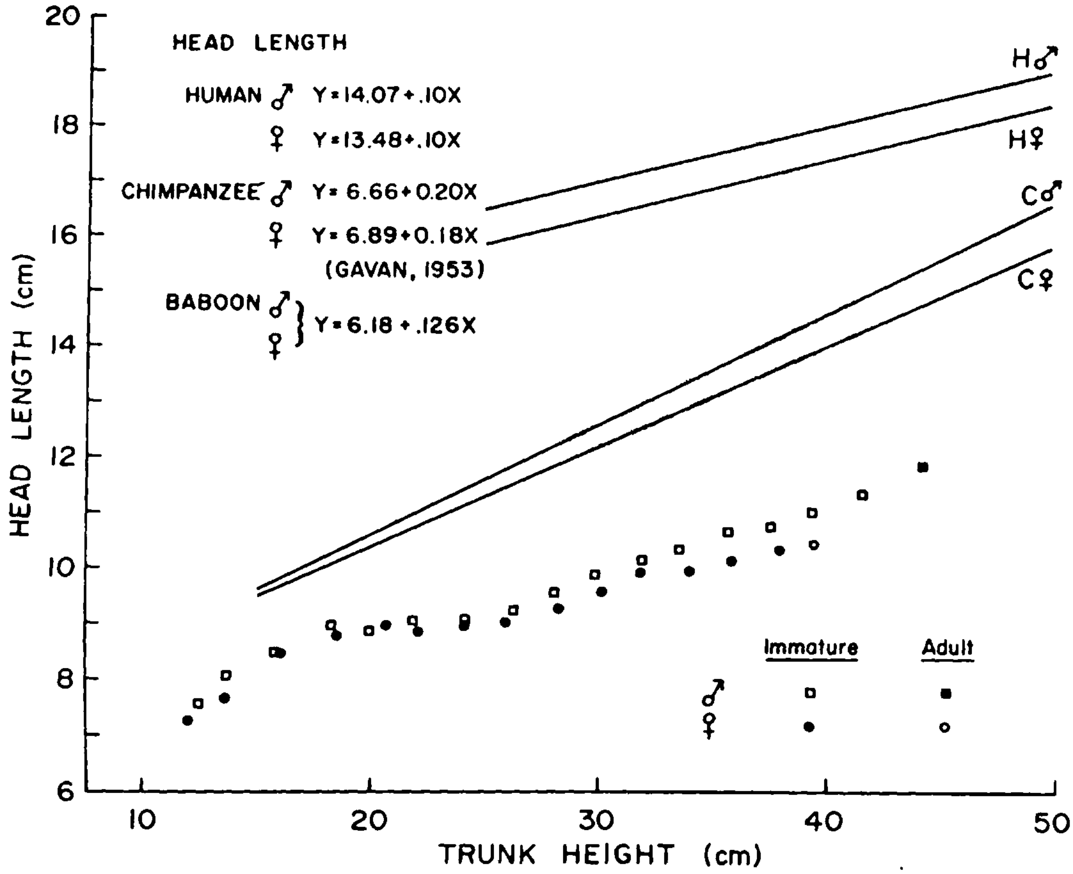

Fig. 37. Regression of Cranial Length on Trunk Height in Savannah Baboons, Chimpanzee and Human.

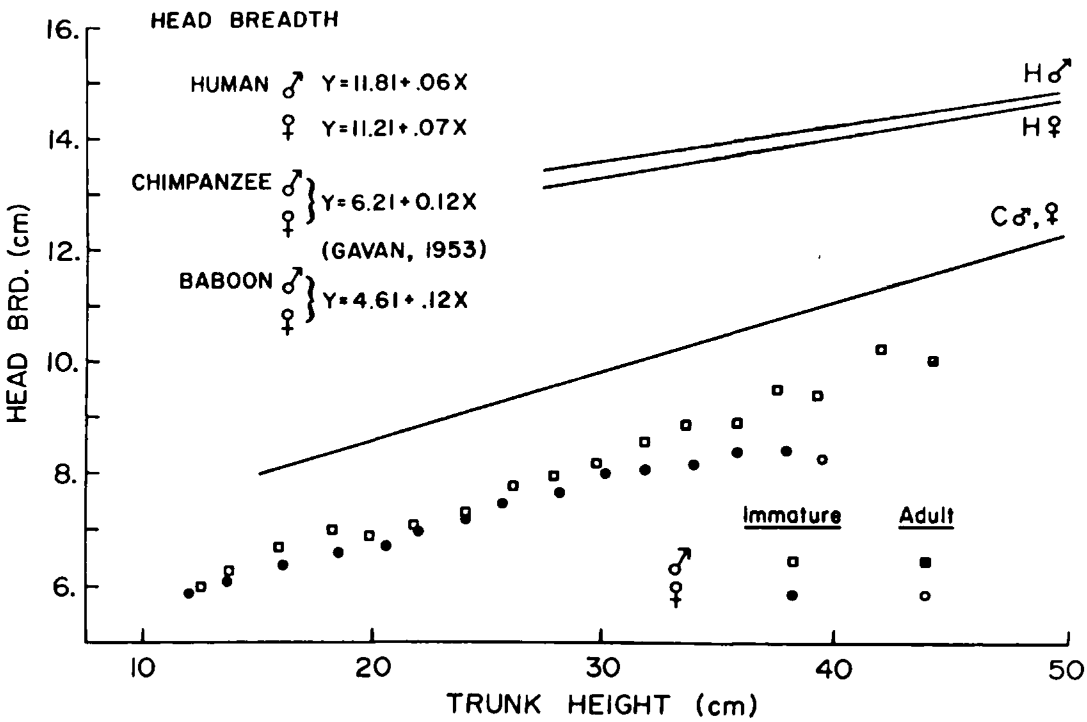

Fig. 38. Regression of Cranial Breadth on Trunk Height in Savannah Baboons, Chimpanzee and Human.

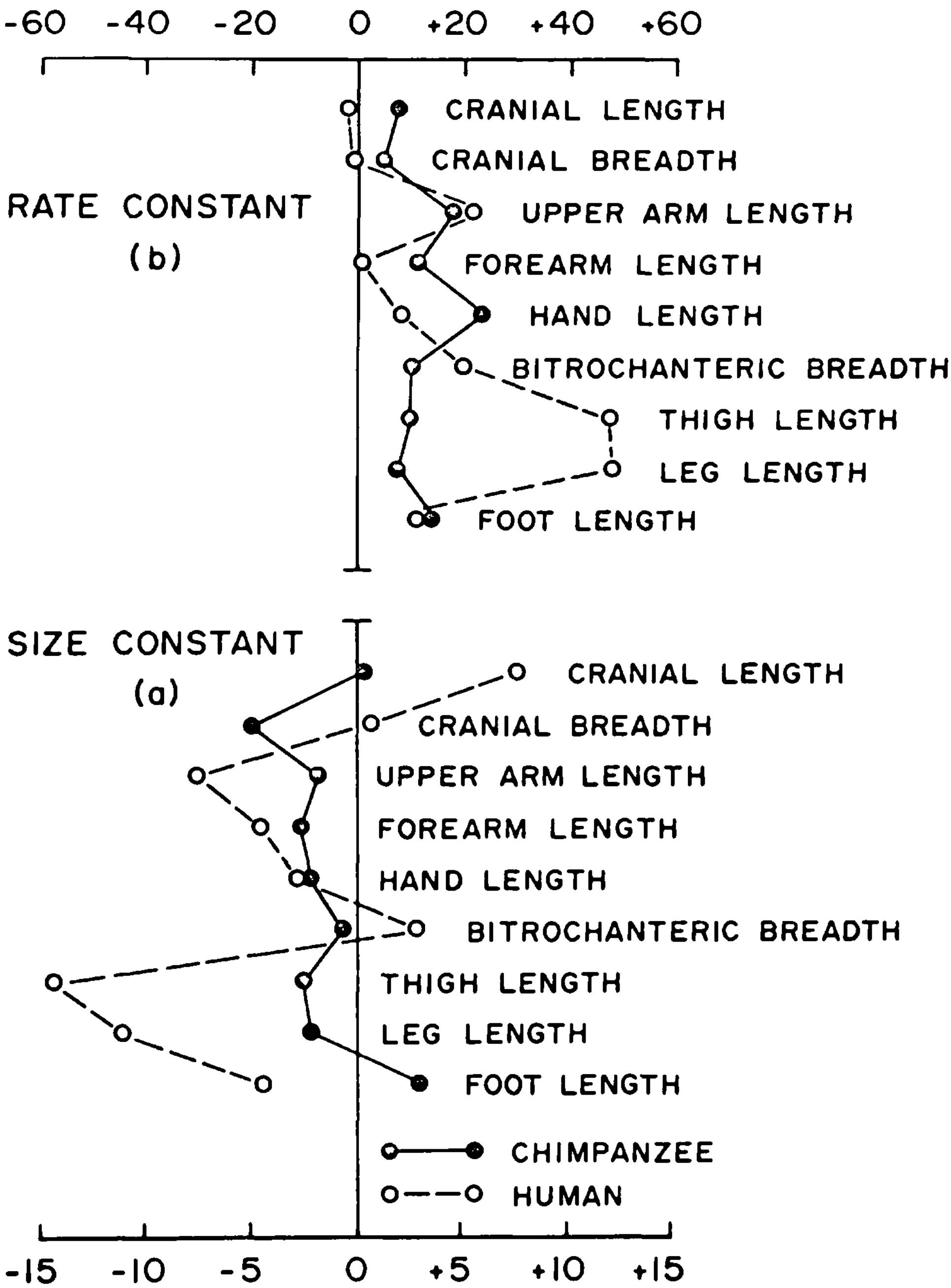

Fig. 39. Linear Regression Constants of Principal Body Dimensions on Trunk Height of Human and Chimpanzee Males Plotted as Deviations from those of the Male Baboon.

attained at birth rather than to any faster rate of postnatal growth. The upper arm constants of human and chimpanzee are nearly identical but the human rate constants for the forearm and hand deviate very little from that of the baboon. The chimpanzee arm is relatively longer because of the more rapid postnatal rate in all three segments. The relatively long human leg is a product of very high postnatal growth rate in the two proximal segments.

In terms of rate constants, both human and chimpanzee heads grow like those of monkeys; the human upper arm grows like that of an ape, and his forearm and hand like that of a monkey; the chimpanzee lower limb grows like that of a monkey.

CONCLUSIONS

Although physical anthropologists have traditionally included the study of human growth and development as one of the focal points of their discipline, they have paid little attention to the growth of man's "poor relations," the infrahuman primates. This neglect is especially deplorable when one considers the potentially valuable role of such studies in helping to solve some of the still perplexing problems of primate phylogeny and taxonomy. As Schultz (1956) points out: "With the realization that the specific characters of adults are merely temporary results of the preceding, inherited, ontogenetic processes, all evolutionary innovations must be regarded as primarily due to some alteration in at least one of the great many details of development and growth."

Schultz (1961) has emphasized the enormous prolongation of the growth period in humans when compared to that of the anthropoid ape and monkey. Physical growth in the rhesus and baboon is complete in 6-8 yrs, and in smaller species probably less. Chimpanzees attain adult size in about 12 yrs; in man, physical growth is not complete until about 20-25 yrs.

Not only is the growth period prolonged in man and ape but puberty occurs relatively later than it does in monkeys. The extension of the postnatal growth and delayed puberty are of enormous significance in human evolution. The vulnerable young are protected by the vigilance and better defensive capabilities of an organized troop. At the same time, the young have a longer period in which to learn, through imitation, any protocultural repertoire which the troop might possess. To survive and reproduce, a primate must thus be socially as well as biologically fit. A primate social organization, be it a baboon troop or human tribe, requires the adaptation of the individual to a pattern of behavior which requires constant and sometimes subtle readjustments in its relationship to other members of the group. In this respect, both the terms "individual" and "group" take on a widened and more profound significance among primates than among many other mammals.

Lower mammals display social behavior in the sense that they mutually interact with other members of their group in predictable patterns which may generally be shown to have some survival value for the species as a whole. For nearly any mammalian species studied, the total inventory of social behavior is impressive. Yet, compared to some lower mammals, the social behavior of the higher primate is so incomparably rich and far-ranging that the difference appears to represent a quantum progression rather than an extension in scale. The demands of such a broadened inventory are met to a large extent through learning as opposed to the innate, stereotyped and generally inflexible kinds of behavior which are included under the rubric "instinct." The increased role of learned as opposed to innate behavior has two results. First, learning itself is a response to external environmental cues and the variation in the presentation of such cues results in a corresponding variability in the behavior that is learned.

Variations in learned behavior are, in a sense, as subject to selection as are morphological or physiological variations. An animal that accidentally learns to do something in a way that is better than the way that it is generally done may be increasing the chances of his survival and reproduction. In the case of an advantageous gene mutation, the animal can pass it along only to his immediate offspring. If the learning "mutation" happens to be one transmitted by imitation or observation by the young individual of his elders, it may be passed along to all the youngsters of the group (Etkin 1964). The effectiveness of such a mechanism depends largely on having a sizable group of learning youngsters which the successful elders can "teach." For example, if displayed in the small isolated, consorts-plus-young grouping that characterize many carnivores, it would have little advantage over a genetically mediated mutation. Thus primate sociality, to whatever factors it owes its fundamental cohesiveness, is certainly reinforced by the advantages of such a mechanism. Behavior patterns contributing to troop stability also have selective value. Along with the selective reinforcement of sociality, there would have to be a concurrent selection for intelligence, for once a premium was placed on learning the animals genetically endowed with greater learning abilities would also be more apt to survive.

A troop of baboons is thus something quite apart from a simple aggregation or herd. As the repository of a learned and extra-genetically transmitted body of behavior, it acts as a vehicle for evolutionary change. The individual animal of a troop becomes more than a single integer adding strength to the group by its simple presence. Each individual is a potential source of innovation. Exceptional intelligence in a bison can do little except enhance the individual's chance of survival. An exceptionally intelligent monkey, ape or man may contribute to the survival of the less well-endowed members of his troop or tribe.

Tertiary fossil beds are littered with the bones of lower mammalian species that became extinct through sheer inability to adapt to changing environments. In contrast, the gradually emerging record of catarrhine evolution presents a picture of phyletic speciation with improved populations replacing their forebearers. In only two instances, Oreopithecus and Gigantopithecus is there clear-cut evidence of fossil lines reaching evolutionary dead-ends. The intertroop variability displayed by wild baboons in food-getting behavior (Hall 1963) and similar observations of Japanese macaque, Macaca irus, (Itani 1965) suggests that these animals, if faced with sudden ecological changes affecting diet would simply learn to eat something else. Among savannah baboons, much variation in social unit size and organization has been observed (Washburn and DeVore 1961; Hall 1962; Maxim and Buettner-Janusch 1963) and the evidence strongly indicates that these were ecological adaptations mediated through learned rather than innate behavioral patterns.

Learning ability is to some extent a function of age. Younger primates are ready learners but most primates become notoriously hard to train after sexual maturity is attained. Within monkey populations (van Wagenen 1956), as in human populations (Tanner 1962), there are late- and early-maturing individuals. Although the precise mechanism of the genetic control of maturation rates are as yet poorly understood, it is reasonable to assume that selection in non-human primates would also act in favor of late-maturing individuals. Thus, the prolongation of the growth period observed among the higher primates would also be a result of the increased reliance on learned behavior.

Turning to other implications of the present study, there is the question of applicability of growth and developmental data on the baboon to the morphological problems of primate phylogeny. Let us use the example of the fossil cercopithecoid Mesopithecus. This creature was originally recovered from the Lower Miocene beds at Pikermi, Greece (Hill 1966) and further remains from East Africa have been tentatively assigned to this genus (Clark and Leakey 1951). The permanent molars of Mesopithecus display a full development of the bilophodont cusp pattern typical of the modern cercopithecoids (Clark 1959). The molar wear pattern and other dental features indicate that Mesopithecus was adapted to a diet similar to the present-day leaf-eating Semnopithecinae. Thus, it appears that this fossil represents a late stage of cercopithecoid evolution and one in which the basic morphological features characterizing the taxa had already been attained.

Piveteau (1961) presents a brief analysis of the sizable collection of Mesopithecus fossils recovered from the Pikermi bed. Disparity in canine size and overall robustness of the mandibles suggest that sexual dimorphism was well developed. Although anatomical details of the limbs indicate that they spent more time on the ground than in the trees, the toes of Mesopithecus are long and inconvenient for walking and from this Piveteau infers that they were limited in range. The large concentration of fossils recovered from a limited area implies that they lived in troops. From this, it would appear that the salient features of the cercopithecoid pattern of living were developed by the Lower Miocene and that little change has occurred since then. If this is so, the biological and behavioral attributes of the less specialized species of Old World monkeys, such as the macaque and baboon, can be extrapolated backward in time with some confidence.

In the case of hominoids, the situation is far different. Even the most primitive present-day human groups possess rich and intricate social and cultural inventories. Inferences on the social behavior and organization of early man, based on the study of such groups can not with confidence be projected farther backward than the Middle Paleolithic. Studies of the social behavior of anthropoid apes (Carpenter 1940; Goodall 1962, 1963; Schaller 1963) are of immense value but must be applied with caution since the morphological specializations of the anthropoids may be paralleled by social and behavioral specializations to an as yet unknown degree. With the exception of the gorilla, modern apes are adept aborealists specialized for brachiation. The gorilla is secondarily adapted to a ground-dwelling (Morton 1935) existence but displays the morphological traits of its arboreal heritage. Unfortunately, most of the fossil pongids are represented by teeth and jaws only and post-cranial remains are fragmented and scarce. A humerus, attributed to Dryopithecus (Piveteau 1961), has a well-developed supinator crest indicative of a powerful brachioradialis and indicates that by Middle Miocene times these ancestral pongids were brachiating. The limb bone proportions of the Lower Miocene pongids, Limnopithecus and Proconsul, suggests they were not brachiators but quadrupedal climbers (Clark and Leakey 1951) and the latter form may have led a largely ground-living existence. If, as Leakey (1967) claims, hominid origins are pushed back to Lower, or Early Middle, Miocene by the recently-found Ramapithecus africanus remains, the ancestral hominoid representing a common hominid-pongid stem appears to have been at most, only an incipient brachiator. The implications are that the earliest hominoids were essentially cercopithecoid in morphology and, probably, behaviorally as well. If man and ape parted company at such a cercopithecoidal stage, parallelism must be given greater credit than it usually is in accounting for the morphological similarities of the two forms. Since a brachiating, arboreal pattern of life may have influenced social behavior as profoundly as morphology, inferences on hominid social evolution based on the observations of living anthropoid apes must be reviewed with new caution. If on the other hand, as

Piveteau suggests, the cercopithecoid life pattern has remained stable since Early Miocene times then behavorial and ecological studies of wild populations of Old World monkeys become more relevant to our understanding of hominid beginnings.

In the baboon the relationship between growth pattern and behavior is manifested, for example, in the growth of the hands and feet. In the newborn baboon, hands and feet are relatively long, making up about one-third of total extremity length, compared to only one-fourth in the adult. Female baboons (and other cercopithecoid monkeys) do not carry their young as do apes and humans. Instead, the infant itself, from birth, clings tightly to the fur of the maternal underbelly (DeVore 1963a). While the mother may occasionally offer support to the infant during periods of resting or quiet feeding, during rapid bursts of locomotion the infant alone is largely responsible for maintaining its attachment to its mother. Relatively large and well-developed hands and feet at birth are obviously of some selective value.

In body size the ground-dwelling members of the genus *Papio* and *Mandrillus* exceed most of the more arboreal cercopithecoid species. Life in the open-lands entails greater exposure to predation and larger body size would provide some additional protection in this respect. However, such an increase would be more apt to occur if the species relied more strongly on fight than flight. The patas monkey (*Erythocebus patas*) is as confirmed a terrestrialite as the savannah baboon but of only about one-half the body weight of the latter. According to Hall (1965):

> The baboon group, according to report and as evidenced by their behavior toward dogs and other predatory animals, relies on the simultaneous arousal of aggressive defense by the males to ensure the group's survival. The patas group, as judged by all the circumstantial evidence, survives predation by its evolved technique of moving its home range to different areas nightly, and by individual dispersal which presumably allows for the occasional loss of an individual while the group itself continues.

This general wariness of the patas and its tendency toward group dispersal is most probably a behavior pattern engendered as a protection from leopards against which these small monkeys are relatively defenseless. The individuals most likely to become victims would be those less adept at stealth and concealment. The necessity for frequent dispersal would tend to select for those animals with low drives toward the development and maintenance of social bonds. In contrast, while as an individual baboon is certainly no match for a leopard, the several adult males of a typical troop present such a formidable array that direct attack upon a troop seldom, if ever, occurs. Baboon victims are likely to be sick or wounded animals unable to keep up with the troop (DeVore 1963b) or peripheral males who have withdrawn or have been forced from the troop (Hall 1965). Thus a single selective agent (the leopard) may have had entirely different evolutionary end-results on the two species. In the patas monkey, larger adult body size would offer no particular advantage and, indeed, might prove a handicap to its stealth and elusiveness. In baboons larger size, along with increased aggressiveness, would enhance the defensive capabilities of the troop. A defendable troop, inhabiting the open lands would gain strength through additional numbers whereas in a species depending on concealment and dispersion for survival would be handicapped by large social units. Patas monkey groups seldom exceed 15 individuals whereas baboon troops are generally at least twice as large (Hall 1965). Since the modal size of the breeding unit is an important factor of genetic change, micro-evolutionary dynamics of the two species might be quite different with the patas population more subject to gene frequency shifts due to drift. On the other hand, its lesser aggressiveness coupled with frequent dispersion might be expected to result in more frequent shifts of individuals from one group to another in the patas thereby facilitating gene flow between individual breeding units. Such shifts occur seldom among baboons (Maxim and Buettner-Janusch 1963) and the troops represent strongly endogamous units. Thus, adult body size, the most obvious ultimate product of the postnatal growth pattern may have influenced individual behavior, social organization and, to some extent, the evolutionary history of the two species.

Another interesting feature of the baboon's growth pattern is the strong dimorphism in body size that develops during the circumpuberal growth spurt. DeVore (1963b) points out that sexual dimorphism among infrahuman primates tends to be more strongly developed among the ground-dwelling forms (e.g. Papio, Mandrillus, Gorilla) and suggests that it also represents an adaptive response to predation pressure. Larger males would be able to protect the troop from direct attack by predators. They would also be in a better position to maintain the rigid intra-troop discipline and control which, indirectly, serves to protect the troop from attack in an open environment.

Since the male shoulders the primary role in troop defense, selection for dimorphic size differences would be ecologically efficient since a baboon troop of given biomass would have greater reproductive capacity than it would if the females were as large as males (DeVore 1963b). Thus ground-living would select not only for greater over-all species body size but for genes favoring dimorphic size differences as well.

Although males are slightly larger than females at birth and probably maintain this advantage through the first few years of life, the very strong differences that separate the adults appear only during the circumpuberal growth spurt. In Old World monkeys and the gibbons, (in contrast to the great apes) the birth canal dimensions of the female and the fetal head diameters are closely matched (Schultz 1949) so that any strong increase in average size at birth unaccompanied by increase in adult female body size would lead to difficulties in partuition. It is not surprising therefore that the greater male body size is a product of postnatal development.

The circumpuberal growth spurt appears to be a characteristic unique to the higher primates. At least it has not been observed in any non-primate mammalian species so far studied (Harrison et al 1964). Its occurrence in platyrrhine monkeys and prosimians has not been documented. As was noted previously, the characteristic feature of the primate life-pattern is the strong orientation toward a well-developed group structure based, in part at least, on learned and socially conditioned behavior. As zoo-keepers (and human parents) will testify, higher primates, especially males, become increasingly intractable with the onset of sexual maturation. The relatively quiescent period of growth during the second and third years of life results in a juvenile male that is both tempermentally and physically incapable of challenging the adult. This prolonged juvenile period assures the individual of a period during which, through play and imitation, the learned elements of social behavior vital to the troop's survival can be absorbed.

The continuance of the troop as a social unit is also based largely upon social and sexual bonds that develop between adult animals. Structural solidarity of the group is reinforced if these bonds are inter-generational. The somewhat earlier sexual maturation of the female baboon makes it probable that she will develop consort relationships with the older males rather than with animals of her sibling generation. Such ties are adaptive in that they contribute to the temporal stability of the troop.

Along with its larger body size, the adult male baboon is characterized by enormously elongated muzzle which, in relation to total head size, is relatively as well as absolutely larger than that of the female. That this preponderance is due primarily to the extremely large canines of the male rather than to a uniform enlargement of the dentition is shown by the fact that the length of the maxillary post-canine tooth row of adult females averaged 92% that of the males (Snow, unpublished data). Thus that part of the dental apparatus concerned with mastication is proportionately no larger in the male than in the female and the higher relative growth rate of the male muzzle is, like size dimorphism, an adaptive response to the agonistic role of the male in troop defense.

Often, when we consider problems of population adaptation, we tend to think of selective pressures acting on the adult alone. We tend to forget that the immature animal must continually and successfully adapt to an environment that changes as rapidly as he grows. The difference between the physical, biological, and social environments of a newborn and yearling baboon are enormous yet, to survive, each must be as nicely adapted to its environment as is the fully grown animal to his. To a leopard, a canine-less juvenile baboon is just as tempting and tasty a morsel as the more formidable adult male and, physically, the juvenile is much more vulnerable. A baby chimpanzee is no less subject to the law of gravity than its parents and a fall from a tree can be just as disasterous to the infant as to the adult. Selective pressures begin to operate on the individual at conception and the laws of nature neither offer immunity to the juvenile offender nor protect the rights of minors. Thus, it is apparent that a full understanding of the mechanisms by which a population adjusts to its environment cannot be had without some knowledge of how its individual members pass from infancy to adults.

Summary

Postnatal growth and development have been adequately documented in only two Old World infrahuman primates, the rhesus monkey (M. mulatta) and the chimpanzee. The present study presents the principal growth features of a third form, the savannah baboon (Papio cynocephalus). The major findings are as follows:

1. The gestation age of captive-born savannah baboons is approximately 6 calendar months (181.3 days).

2. Birth weights average 775 gm or approximately 6% of mean maternal weight. Birth weight is doubled by about the 100th postnatal day.

3. Body weight of adult males averaged 21.75 kg; adult females averaged 12.32 kg, or about 55% of the male. The male newborn increases its weight by about 30 times and the female by about 16 times during postnatal growth.

4. Sitting height averages 218 mm in the newborn and increases by 320% in males and 275% in females.

5. The overall growth rate declines until about 2.0 years. During the first 0.5 years body weight increases by 300% of birth weight. At 1.0 yrs it is 500% and at 2.0 yrs it is 750% of birth weight.

Throughout the first two years of life, males and females are about equal in size.

6. During the third year of life, males begin to exceed females in size and by 4.5 years immature males equal or exceed the average adult female in body size.

7. The size advantage of the male is the result of an acceleration in growth rate which begins at about 2.5 years. This acceleration is coincident with the onset of testicular enlargement in the male.

8. Menarche in females occurs at about 3.0 years of age. At this time the female baboon weighs about 8.00 kg or 65% of final adult body weight. The menstrual cycle averages 35.4 days (a non-pregnant animal would have about 10 cycles a year). The present data did not demonstrate a clear-cut circumpuberal growth acceleration in the female.

9. The newborn is generally endentulous. The deciduous dentition is complete by about 0.6 years. The first permanent molars appear at about 1.5 years and are completely erupted by about 2.0 years. The permanent incisors begin to erupt at about 2.5 - 3.0 years. Up until about 3.5 years, no dimorphism in the overall eruption sequence (as measured by dental score) was noted.

10. A seasonal growth rhythm in sitting height was demonstrated. During the summer months growth rates are higher than in the winter.

11. In this study, no direct data were available on the age at which linear growth is completed in the baboon. By 4.0 years, the males had attained about 85-95% of their total growth in most linear body dimensions. An indirect estimation, based on comparison with the rhesus monkey, indicates that male baboons attain adult body size in linear dimensions at about 6.5 to 7.5 years and females mature slightly earlier than males. Both sexes are sexually fertile before full physical growth is attained.

12. When considered as percentages of adult size, the various body regions of the newborn display a wide variation in relative maturity. The strongest disparities occur in the head: in males, growth of the neurocranium is about 60% complete at birth, but upper

face height is only 25% complete. Most trunk and limb measurements have attained 30-40% of adult size at birth. In the upper limb of the newborn, the hand is closer to its adult size than the forearm and the forearm closer than the upper arm. The gradient is maintained throughout the postnatal growth period. A similar distal-proximal gradient occurs in the lower limb.

13. In general, the baboon follows a course of postnatal growth which strongly resembles that of the rhesus macaque. The principal growth differences between the two forms appear to be related to differences in final adult body size. The baboon appears also to have a slightly longer period of postnatal growth (about 7-7.5 yrs) than the rhesus (6-6.5 yrs). The similarity of the two forms in overall growth would indicate that it might characterize the growth patterns of other Old World monkeys, or at least members of the subfamily Cercopithecinae. Such a cercopithecoid pattern; if shown to exist, would display strong similarity in the relative timing of most key events of postnatal development but variations in the total duration of growth with the smaller species maturing earlier than the larger.

14. Linear regression analysis was used to describe the relative growth of thirty pairs of linear dimensions. (In most pairs, trunk height was taken as the independent variable). The male lower limb increases its length at a higher relative rate than the female. In all other relationships, no significant sex difference in rate or size constants were found.

15. The relative growth patterns (using trunk height as the independent variable) of the chimpanzee and human (Gavan 1955) were compared with those of the baboons. The rate constants of the regression of cranial dimensions of the human were similar to those of the baboon and both were exceeded by those of the chimpanzee. Upper arm rate constants of the chimpanzee and human were similar while in the case of the forearm the human and baboon values were identical. In the lower limb segments, the chimpanzee rate constants were slightly higher than those of the baboon while those of the human thigh and leg greatly exceeded the infrahuman values.

16. The rapidly accumulating information on the ecology and behavior of primates in the wild make it increasingly apparent that many of the features of the postnatal growth pattern that characterize a species serve to adapt either the growing animal or the adult to its biological and social environment. In the baboon, overall species size, sexual dimorphism, the relatively large hands and feet of the newborns, the circumpuberal growth spurt and the relative timing of sexual maturity are seen as mechanisms enabling the species to adapt to ground-living.

APPENDIX A: DEFINITIONS OF SPECIAL MEASUREMENTS

I. Several measurements used in this study (Table 1, page 12) differ slightly from those employed by Schultz (1929) or Gavan (1953). These are:

a. Substernale height, chest breadth, chest depth: In these, substernale is located at the base of the xiphoid process rather than at its tip.

b. Hand length: Carpale is measured from the most proximal point on the pisiform bone.

c. Pollux length: From carpale as defined above.

d. Sitting height: The measurement is the same as that of Schultz but the term subischiale is introduced to denote the most distal point on the left ischial callosity.

II. The following measurements are entirely new:

a. Bituberosity breadth: The transverse distance between the lateral-most points of the ischial tuberosities (ischiale laterale).

b. Pelvic length: From the most superior point of the iliac crest (iliocristale summum) to the most distal point of the callosity (ischiale).

III. The breadths of wrist, elbow, knee and ankle, while not employed by the previously mentioned authors, are commonly used in human growth studies. Each is taken transversely at the broadest part of the joint.

IV. Total head length: Commonly taken by mammalogists. This measurement is from the posterior-most point of the cranium (opisthocranion) to prosthion.

V. Girth measurements were taken as follows:

a. Cranial circumference: The horizontal circumference of the head measured with the tape passing over glabella and opisthocranion.

b. Neck circumference: Horizontal circumference of the neck.

c. Chest circumference: The horizontal circumference of the thorax with the tape passing over substernale and held in a plane at right angles to the longitudinal body axis.

d. Abdominal circumference: The horizontal circumference of the abdomen with the tape passing over the umbilicus and held in a plane at right angles to the longitudinal body axis.

e. Upper arm circumference: The horizontal circumference of the upper arm taken midway between acromion and radiale. The arm is extended at the elbow. This measurement is taken with the tape at the midpoint of the humeral segment.

f. Forearm circumference: With the arm extended at the elbow, this measurement is taken at the midpoint of the distance between the proximal tip of the olecranon process and the ulnar stylion.

g. Wrist circumference: The girth of the wrist immediately proximal to the ulnar and radial stylion.

h. Thigh circumference: With the thigh and leg flexed at right angles, girth of the thigh at a point midway between trochanterion summum and femorale.

i. Calf circumference: The girth of the leg at the point of maximum circumference.

j. Ankle circumference: The circumference of the leg immediately proximal to the malleoli.

APPENDIX B: TABLES

TABLE 11. MEANS AND OBSERVED RANGES OF SOME LINEAR MEASUREMENTS OF THE TRUNK OF NEWBORN SAVANNAH BABOONS (N = 4♀)

Measurement	Mean	Observed Range
	mm.	mm.
Sitting Height	218	204-226
Trunk Height	126	120-130
Biacromial Breadth	54.0	49- 59
Chest Breadth	52.8	48- 56
Chest Depth	54.8	50- 61
Bicristal Breadth	36.8	34- 42
Pelvic Length	56.2	52- 59
Tail Length	215	196-239

TABLE 12. MEANS AND OBSERVED RANGES OF SOME LINEAR MEASUREMENTS OF THE APPENDAGES OF NEWBORN SAVANNAH BABOONS (N = 4♀)

Measurement	Mean	Observed Range
	mm.	mm.
Humerus Length	66.8	65- 70
Ulnar Length	77.8	74- 81
Hand Length	60.1	58- 64
Pollux Length	43.5	42- 44
Hand Breadth	22.0	20- 23
Total Arm Length	205	198-211
Femur Length	75.8	74- 78
Tibial Length	65.5	61- 69
Foot Length	80.5	77- 83
Hallux Length	62.5	59- 66
Foot Breadth	21.0	19- 22
Total Leg Length	224	219-229

TABLE 13. MEANS AND OBSERVED RANGES OF SOME LINEAR MEASUREMENTS OF THE CRANIUM AND FACE OF NEWBORN SAVANNAH BABOONS (N = 4♀)

Measurement	Mean	Observed Range
	mm.	mm.
Cranium Length	72.2	70-73
Cranium Breadth	58.2	56-60
Bizygomatic Breadth	51.2	48-53
Bigonial Breadth	28.5	27-31
Upper Face Height	26.5	26-27
Nasal Length	26.2	24-28
Nasal Breadth	14.0	12-18
Ear Length	32.5	31-34
Ear Breadth	25.0	24-26

TABLE 14. MEANS, STANDARD DEVIATIONS AND OBSERVED RANGES OF BODY WEIGHT AND GENERAL BODY MEASUREMENTS OF ADULT SAVANNAH BABOONS WITH FULLY-ERUPTED PERMANENT DENTITION

Measurement	Male				Female			
	N	$\bar{X}$	S.D.	O.R.	N	$\bar{X}$	S.D.	O.R.
			(kg)				(kg)	
Body Weight	10	21.75	2.18	19.0-24.5	18	12.32	1.16	10.9-14.4
			(cm)				(cm)	
Trunk Height	10	44.1	1.4	42.0-47.3	18	39.3	1.2	37.4-41.9
Sitting Height	10	69.5	1.9	67.0-72.7	18	60.2	1.1	58.5-61.5
Stem Length	10	61.0	1.7	58.7-64.6	11	53.2	1.2	51.0-54.7
Total Head Height	10	17.4	1.4	15.4-20.3	12	14.2	0.8	11.9-15.0
Substernale Height	10	30.0	2.2	27.9-34.1	14	27.9	1.5	25.9-29.9
Tail Length	7	56.9	1.7	49.8-59.7	7	45.8	2.2	43.1-49.4

TABLE 15. MEANS, STANDARD DEVIATIONS AND OBSERVED RANGES OF MEASUREMENTS OF THE THORACIC AND PELVIC REGIONS OF ADULT SAVANNAH BABOONS WITH FULLY-ERUPTED PERMANENT DENTITION

Measurement	Male				Female			
	N	$\bar{X}$	S.D.	O.R.	N	$\bar{X}$	S.D.	O.R.
			(cm)				(cm)	
Biacromial Breadth	10	19.1	0.8	17.9-20.2	11	15.7	0.7	14.6-16.7
Chest Breadth	10	17.8	1.6	15.1-20.2	17	14.0	1.1	12.1-15.8
Chest Depth	10	21.1	1.1	19.8-22.6	18	16.0	0.8	14.6-17.5
Bithelion Diameter	9	6.3	1.0	5.0- 7.8	8	4.7	0.8	3.6- 6.1
Bicristal Breadth	10	14.7	0.8	13.1-16.0	18	12.4	0.7	11.1-13.9
Bituberosity Breadth	10	14.7	0.4	14.0-15.4	18	12.2	0.8	10.8-13.4
Bitrochanteric Breadth	10	19.4	0.8	18.2-21.2	18	15.8	0.6	14.4-16.8
Pelvic Length	10	20.6	0.8	19.6-21.8	18	17.3	0.5	16.5-18.0

TABLE 16. MEANS, STANDARD DEVIATIONS AND OBSERVED RANGES OF UPPER LIMB MEASUREMENTS OF ADULT SAVANNAH BABOONS WITH FULLY-ERUPTED PERMANENT DENTITION

Measurement	Male				Female			
	N	$\bar{X}$	S.D.	O.R.	N	$\bar{X}$	S.D.	O.R.
			(mm)				(mm)	
Upper Arm Length	10	231	11	214-244	17	192	7	184-211
Forearm Length	10	256	12	230-271	17	217	7	207-230
Hand Length	10	154	7	141-164	18	128	4	121-134
Total Arm Length	10	641	27	585-728	17	538	13	518-567
Thumb Length	10	109	3.9	104-116	15	91	3.3	85-96
Hand Breadth	10	50	2.5	47-55	14	42	2.2	36-44
Wrist Breadth	10	40	1.9	38-44	14	33	2.4	31-37
Elbow Breadth	10	44	2.6	41-50	14	36	1.6	33-39

TABLE 17. MEANS, STANDARD DEVIATIONS AND OBSERVED RANGES OF LOWER LIMB MEASUREMENTS OF ADULT SAVANNAH BABOONS WITH FULLY-ERUPTED PERMANENT DENTITION

Measurement	Male				Female			
	N	$\bar{X}$	S.D.	O.R.	N	$\bar{X}$	S.D.	O.R.
			(mm)				(mm)	
Thigh Length	10	271	8	257-284	18	228	9	214-252
Knee Height	10	254	11	232-267	17	216	8	206-237
Leg Length	10	227	11	205-242	17	193	6	182-205
Foot Length	10	203	10	187-215	17	172	5	163-180
Total Lower Limb Length	10	701	26	649-733	16	594	15	573-629
Hallux Length	10	156	9.3	139-167	14	132	3.2	128-140
Foot Breadth	10	49	1.6	45-50	13	41	1.3	38-42
Ankle Breadth	10	39	2.2	36-43	14	32	1.6	30-36
Knee Breadth	10	45	1.2	43-47	14	37	1.5	34-40

TABLE 18. MEANS, STANDARD DEVIATIONS AND OBSERVED RANGES OF CRANIAL AND FACIAL MEASUREMENTS OF ADULT SAVANNAH BABOONS WITH FULLY-ERUPTED PERMANENT DENTITION

Measurement	Male				Female			
	N	$\bar{X}$	S.D.	O.R.	N	$\bar{X}$	S.D.	O.R.
			(mm)				(mm)	
Maximum Length	10	206	7.0	195-217	17	160	8.0	149-176
Cranial Length	10	119	5.6	111-130	18	104	3.4	99-113
Base Length	10	116	5.5	109-127	9	102	2.7	99-107
Cranial Breadth	10	99	5.5	90-105	18	85	3.5	78-91
Base Breadth	10	95	6.1	87-105	9	82	2.7	79-87
Cranial Height	10	52	2.7	48-56	9	47	3.6	40-51
Total Face Height	10	131	6.5	122-140	16	101	6.8	91-122
Upper Face Height	10	119	5.9	112-132	16	84	7.9	74-105
Bizygomatic Breadth	10	119	5.7	110-130	18	97	4.4	84-105
Bigonial Breadth	10	74	6.9	62-85	18	59	3.6	52-67
Ecto-Orbital Breadth	10	95	8.5	85-113	17	77	2.2	73-81
Bi-Ocular Breadth	10	65	3.7	61-69	14	57	2.2	53-61
Inter-Ocular Breadth	10	18	0.9	17-19	13	14	1.5	11-16
Nasal Length	10	110	6.3	101-122	11	79	7.5	72-96
Nasal Breadth	10	36	2.9	31-40	11	26	1.8	23-28
Ear Length	10	59	3.2	53-65	13	53	2.2	50-57
Ear Breadth	10	41	2.2	38-44	13	38	2.1	34-40

TABLE 19. MEANS, STANDARD DEVIATIONS AND OBSERVED RANGES OF BODY GIRTH MEASUREMENTS OF ADULT SAVANNAH BABOONS WITH FULLY-ERUPTED PERMANENT DENTITION

Measurement	Male			Female		
	N	$\bar{X}$	O.R.	N	$\bar{X}$	O.R.
Cranial Circumference	5	389	371-400	4	320	317-324
Neck Circumference	5	319	296-341	6	238	220-251
Chest Circumference	7	601	560-642	6	478	450-500
Abdominal Circumference	7	527	504-564	6	437	364-536
Upper Arm Circumference	7	221	197-262	6	186	166-210
Forearm Circumference	7	148	136-165	6	127	115-135
Wrist Circumference	7	107	102-118	6	87	83-90
Thigh Circumference	7	302	270-334	6	253	235-267
Calf Circumference	7	204	182-227	6	185	164-180
Ankle Circumference	7	123	114-131	6	96	90-99

TABLE 20. POSTNATAL GROWTH: BODY WEIGHT

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(kg.)	(kg.)		(kg.)	(kg.)
0.00 - .10	3	.79	0.74 - 0.87	6	0.70	0.63 - 0.78
.11 - .20	5	1.19	0.98 - 1.42	4	0.97	0.89 - 1.05
.21 - .30	6	1.50	1.24 - 2.06	3	1.54	1.33 - 1.77
.31 - .40	5	1.85	1.44 - 2.38	2	1.94	1.89 - 2.00
.41 - .50	6	2.10	1.58 - 2.72	2	2.21	2.01 - 2.40
.51 - .60	5	2.59	2.31 - 2.95	4	2.33	2.16 - 2.58
.61 - .70	5	2.88	2.60 - 3.37	2	2.70	2.53 - 2.88
.71 - .80	5	3.20	3.00 - 3.60	2	3.02	2.74 - 3.29
.81 - .90	4	3.38	3.15 - 3.59	3	3.23	2.83 - 3.43
.91 - 1.00	3	3.75	3.64 - 3.96	2	3.72	3.64 - 3.81
1.01 - .20	5	4.04	3.27 - 4.76	2	4.01	3.86 - 4.16
.21 - .40	4	4.68	4.45 - 4.94	3	4.04	3.16 - 4.81
.41 - .60	3	5.09	4.90 - 5.24	3	4.53	3.64 - 5.41
.61 - .80	3	5.22	5.16 - 5.29	2	5.20	4.49 - 5.91
.81 - 2.00	4	5.13	4.65 - 5.56	3	5.47	5.02 - 6.28
2.01 - .20	7	5.81	4.88 - 6.49	2	6.32	6.00 - 6.65
.21 - .40	8	6.23	5.82 - 6.71	3	6.14	4.99 - 7.08
.41 - .60	7	6.97	6.24 - 7.55	4	6.40	4.76 - 7.54
.61 - .80	9	7.64	6.73 - 8.88	4	6.90	5.80 - 7.61
.81 - 3.00	11	8.55	7.45 - 9.77	4	7.58	6.84 - 8.11
3.01 - .20	7	9.13	7.88 - 10.35	1	8.42	——
.21 - .40	7	10.27	8.18 - 11.25	4	8.06	7.03 - 9.00
.41 - .60	6	11.77	9.44 - 12.88	2	8.77	7.71 - 9.83
.61 - .80	7	12.88	10.55 - 13.98			
.81 - 4.00	5	14.28	13.64 - 15.40			
4.01 - .20	4	15.38	14.30 - 16.14			
.21 - .40	4	16.83	15.55 - 19.52			
.41 - .60	2	19.67	16.76 - 22.56			
.61 - .80	2	20.60	17.33 - 23.81			

TABLE 21. POST-NATAL GROWTH: SITTING HEIGHT

AGE (yrs.)	MALE No.	MALE Mean (mm.)	MALE Observed Range (mm.)	FEMALE No.	FEMALE Mean (mm.)	FEMALE Observed Range (mm.)
0.00 - .10	3	223	217 - 229	6	216	204 - 226
.11 - .20	5	259	236 - 281	4	234	228 - 244
.21 - .30	6	283	250 - 328	3	270	267 - 277
.31 - .40	5	304	273 - 343	2	310	298 - 321
.41 - .50	6	321	294 - 363	2	328	318 - 339
.51 - .60	5	346	328 - 380	4	338	319 - 360
.61 - .70	5	359	342 - 388	2	364	351 - 376
.71 - .80	5	373	358 - 401	2	379	375 - 383
.81 - .90	4	380	363 - 394	3	380	361 - 391
.91 - 1.00	3	395	385 - 408	2	399	394 - 404
1.01 - .20	5	411	398 - 431	2	408	400 - 416
.21 - .40	4	430	419 - 439	3	415	392 - 439
.41 - .60	3	437	425 - 451	3	431	411 - 456
.61 - .80	3	440	435 - 447	2	440	429 - 459
.81 - 2.00	4	443	430 - 450	3	451	444 - 462
2.01 - .20	7	465	442 - 482	2	475	462 - 488
.21 - .40	8	476	464 - 487	3	474	458 - 494
.41 - .60	7	490	472 - 521	4	480	454 - 500
.61 - .80	9	507	483 - 540	4	501	470 - 520
.81 - 3.00	11	526	491 - 570	4	512	487 - 521
3.01 - .20	7	542	530 - 560	1	524	——
.21 - .40	7	550	515 - 586	3	519	502 - 534
.41 - .60	6	572	545 - 601	2	536	526 - 547
.61 - .80	7	586	556 - 615			
.81 - 4.00	5	608	571 - 636			
4.01 - .20	4	619	577 - 648			
.21 - .40	3	642	619 - 675			
.41 - .60	2	678	647 - 709			
.61 - .80	2	681	641 - 722			

TABLE 22. POST-NATAL GROWTH: STEM LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	205	203 - 206	6	201	188 - 208
.11 - .20	5	228	213 - 244	3	220	217 - 225
.21 - .30	6	255	230 - 294	3	244	242 - 246
.31 - .40	5	276	235 - 309	2	272	263 - 281
.41 - .50	6	281	253 - 320	2	293	277 - 309
.51 - .60	5	302	284 - 334	4	300	291 - 321
.61 - .70	5	317	303 - 343	2	320	312 - 328
.71 - .80	5	330	316 - 354	2	336	329 - 342
.81 - .90	4	340	326 - 346	3	342	324 - 354
.91 - 1.00	3	351	344 - 360	2	357	350 - 364
1.01 - .20	5	360	352 - 378	2	364	353 - 374
.21 - .40	4	378	362 - 385	3	373	348 - 399
.41 - .60	3	384	372 - 397	3	381	365 - 405
.61 - .80	3	388	379 - 398	2	401	393 - 409
.81 - 2.00	4	388	382 - 392	3	404	398 - 413
2.01 - .20	7	409	386 - 428	2	422	413 - 432
.21 - .40	8	422	410 - 433	3	421	403 - 438
.41 - .60	7	434	417 - 469	4	424	399 - 444
.61 - .80	9	448	428 - 482	4	445	416 - 461
.81 - 3.00	11	465	446 - 503	4	456	434 - 466
3.01 - .20	7	479	457 - 503	1	463	——
.21 - .40	7	480	449 - 516	4	464	449 - 478
.41 - .60	6	500	487 - 530	2	474	467 - 480
.61 - .80	7	514	488 - 544			
.81 - 4.00	5	538	513 - 562			
4.01 - .20	4	546	521 - 572			
.21 - .40	3	556	528 - 589			
.41 - .60	2	577	562 - 592			
.61 - .80						

TABLE 23. POST-NATAL GROWTH: TRUNK HEIGHT

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	125	121 - 131	6	127	120 - 135
.11 - .20	5	147	135 - 159	4	140	133 - 149
.21 - .30	6	162	144 - 192	3	160	153 - 170
.31 - .40	5	175	160 - 201	2	184	180 - 187
.41 - .50	6	184	164 - 208	2	194	189 - 199
.51 - .60	5	204	191 - 221	4	202	196 - 216
.61 - .70	5	215	203 - 231	2	218	210 - 225
.71 - .80	5	225	212 - 242	2	228	225 - 231
.81 - .90	4	232	227 - 240	3	235	224 - 242
.91 - 1.00	3	242	235 - 251	2	248	246 - 250
1.01 - .20	5	248	240 - 259	2	256	249 - 262
.21 - .40	4	262	251 - 269	3	261	244 - 278
.41 - .60	3	266	254 - 277	3	267	246 - 284
.61 - .80	3	271	259 - 283	2	280	271 - 289
.81 - 2.00	4	272	265 - 276	3	285	280 - 293
2.01 - .20	7	288	272 - 303	2	300	290 - 310
.21 - .40	8	299	286 - 312	3	302	295 - 315
.41 - .60	7	310	290 - 336	4	298	267 - 321
.61 - .80	9	320	302 - 344	4	311	277 - 331
.81 - 3.00	11	332	316 - 358	4	325	309 - 333
3.01 - .20	7	341	326 - 358	1	328	——
.21 - .40	7	347	325 - 374	4	330	326 - 335
.41 - .60	6	363	352 - 385	2	339	337 - 341
.61 - .80	7	373	355 - 395			
.81 - 4.00	5	388	368 - 405			
4.01 - .20	4	399	374 - 414			
.21 - .40	3	407	386 - 427			
.41 - .60	2	430	406 - 453			
.61 - .80	2	430	414 - 447			

TABLE 24. POST-NATAL GROWTH: SUBSTERNALE HEIGHT

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	80	80 - 81	3	88	87 - 92
.11 - .20	5	90	81 - 99	3	91	87 - 95
.21 - .30	6	104	92 - 112	3	101	93 - 110
.31 - .40	5	112	103 - 122	2	114	112 - 116
.41 - .50	6	123	111 - 137	2	128	119 - 136
.51 - .60	5	134	121 - 155	4	134	122 - 141
.61 - .70	5	139	131 - 148	2	144	136 - 151
.71 - .80	5	156	145 - 161	2	153	151 - 155
.81 - .90	4	167	161 - 175	3	155	147 - 167
.91 - 1.00	3	172	168 - 175	2	172	170 - 174
1.01 - .20	5	176	164 - 184	2	175	170 - 180
.21 - .40	4	188	177 - 192	3	185	175 - 200
.41 - .60	3	190	179 - 205	3	187	181 - 198
.61 - .80	3	188	184 - 191	2	193	184 - 203
.81 - 2.00	4	187	180 - 197	3	198	189 - 204
2.01 - .20	7	198	183 - 211	2	210	206 - 214
.21 - .40	8	207	190 - 226	3	211	205 - 220
.41 - .60	7	215	195 - 248	4	217	191 - 234
.61 - .80	9	219	200 - 245	4	222	205 - 230
.81 - 3.00	11	228	214 - 242	4	227	219 - 236
3.01 - .20	7	236	224 - 262	—	—	—
.21 - .40	7	235	225 - 257	4	230	223 - 234
.41 - .60	6	245	237 - 266	2	239	237 - 241
.61 - .80	7	255	243 - 282			
.81 - 4.00	5	262	246 - 279			
4.01 - .20	4	278	250 - 295			
.21 - .40	3	282	269 - 304			
.41 - .60	2	300	283 - 317			
.61 - .80						

TABLE 25. POST-NATAL GROWTH: BIACROMIAL BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	60	58 - 62	6	57	49 - 61
.11 - .20	5	72	64 - 78	4	61	56 - 64
.21 - .30	6	78	65 - 96	3	76	74 - 78
.31 - .40	5	86	75 - 102	2	80	74 - 89
.41 - .50	6	89	71 - 106	2	94	93 - 95
.51 - .60	5	96	88 - 109	4	93	84 - 102
.61 - .70	5	101	92 - 111	2	102	100 - 104
.71 - .80	5	110	98 - 120	2	108	106 - 110
.81 - .90	4	113	103 - 122	2	102	91 - 113
.91 - 1.00	3	115	110 - 124	1	112	—
1.01 - .20	5	113	106 - 120	2	114	112 - 117
.21 - .40	4	122	116 - 128	3	114	100 - 125
.41 - .60	3	123	117 - 128	3	111	102 - 116
.61 - .80	3	128	127 - 130	2	128	123 - 133
.81 - 2.00	4	120	111 - 133	3	127	124 - 130
2.01 - .20	7	128	117 - 139	2	135	128 - 142
.21 - .40	8	131	115 - 144	3	133	119 - 146
.41 - .60	7	133	121 - 142	4	132	113 - 150
.61 - .80	9	137	130 - 145	4	141	123 - 162
.81 - 3.00	11	148	135 - 161	4	141	133 - 150
3.01 - .20	7	153	148 - 161	0	—	—
.21 - .40	7	159	146 - 171	4	145	136 - 154
.41 - .60	6	165	148 - 177	2	152	151 - 152
.61 - .80	7	170	161 - 183			
.81 - 4.00	5	174	162 - 181			
4.01 - .20	4	170	163 - 183			
.21 - .40	4	181	170 - 194			
.41 - .60	2	192	182 - 205			
.61 - .80	2	188	181 - 195			

TABLE 26. POST-NATAL GROWTH: CHEST BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	57	55 - 59	6	55	48 - 63
.11 - .20	5	69	61 - 76	4	62	56 - 68
.21 - .30	6	74	66 - 86	3	77	76 - 78
.31 - .40	5	78	70 - 91	2	78	75 - 80
.41 - .50	6	82	77 - 94	2	85	83 - 87
.51 - .60	5	87	81 - 94	4	87	83 - 91
.61 - .70	5	91	90 - 95	2	98	97 - 98
.71 - .80	5	93	89 - 97	2	104	100 - 107
.81 - .90	4	94	91 - 97	3	98	89 - 104
.91 - 1.00	3	99	95 - 102	2	105	104 - 106
1.01 - .20	5	99	85 - 108	2	108	107 - 108
.21 - .40	4	99	94 - 103	3	102	88 - 114
.41 - .60	3	105	101 - 110	3	104	90 - 115
.61 - .80	3	105	98 - 110	2	108	102 - 115
.81 - 2.00	4	105	97 - 113	3	109	103 - 115
2.01 - .20	7	112	100 - 124	2	118	116 - 119
.21 - .40	8	111	103 - 122	3	112	101 - 120
.41 - .60	7	115	105 - 133	4	111	101 - 121
.61 - .80	9	119	110 - 137	4	108	104 - 112
.81 - 3.00	11	123	111 - 140	4	112	102 - 126
3.01 - .20	7	125	112 - 139	1	115	—
.21 - .40	7	133	125 - 146	4	114	106 - 123
.41 - .60	6	136	125 - 146	2	116	104 - 127
.61 - .80	7	141	133 - 149			
.81 - 4.00	5	144	135 - 152			
4.01 - .20	4	142	137 - 145			
.21 - .40	4	154	144 - 165			
.41 - .60	2	165	161 - 169			
.61 - .80	2	167	162 - 172			

TABLE 27. POST-NATAL GROWTH: CHEST DEPTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	60	56 - 65	6	55	50 - 61
.11 - .20	5	74	65 - 78	4	64	61 - 67
.21 - .30	6	80	70 - 88	3	81	76 - 84
.31 - .40	5	84	78 - 93	2	86	85 - 86
.41 - .50	6	89	82 - 102	2	88	87 - 88
.51 - .60	5	93	84 - 103	4	92	87 - 96
.61 - .70	5	100	96 - 107	2	97	95 - 99
.71 - .80	4	103	94 - 106	2	102	101 - 103
.81 - .90	4	104	102 - 105	3	104	102 - 107
.91 - 1.00	3	106	104 - 107	2	107	105 - 109
1.01 - .20	5	108	93 - 113	2	110	108 - 111
.21 - .40	4	115	108 - 121	3	111	106 - 118
.41 - .60	3	118	110 - 127	3	115	111 - 122
.61 - .80	3	117	107 - 128	2	121	116 - 126
.81 - 2.00	4	117	113 - 125	3	123	113 - 129
2.01 - .20	7	123	112 - 134	2	129	127 - 131
.21 - .40	8	127	118 - 132	3	127	122 - 131
.41 - .60	6	134	124 - 143	4	124	108 - 131
.61 - .80	9	134	125 - 144	4	128	116 - 139
.81 - 3.00	11	140	129 - 154	4	133	125 - 142
3.01 - .20	7	143	133 - 155	1	136	——
.21 - .40	7	151	139 - 165	4	136	129 - 144
.41 - .60	6	156	141 - 169	2	139	129 - 149
.61 - .80	7	159	142 - 170			
.81 - 4.00	5	168	160 - 177			
4.01 - .20	4	172	170 - 180			
.21 - .40	3	174	167 - 191			
.41 - .60	2	175	165 - 185			
.61 - .80	2	186	181 - 190			

TABLE 28. POST-NATAL GROWTH: PELVIS LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	60	60 - 60	6	57	52 - 62
.11 - .20	2	70	66 - 73	3	64	60 - 67
.21 - .30	4	78	75 - 82	2	75	74 - 76
.31 - .40	3	84	79 - 88	1	83	——
.41 - .50	4	86	80 - 92	1	90	——
.51 - .60	3	95	92 - 98	3	89	87 - 93
.61 - .70	3	99	96 - 101	1	100	——
.71 - .80	3	103	100 - 105	1	106	——
.81 - .90	3	106	105 - 107	2	104	97 - 111
.91 - 1.00	2	110	109 - 112	2	114	112 - 115
1.01 - .20	4	113	106 - 119	2	116	114 - 119
.21 - .40	2	120	119 - 122	3	121	109 - 131
.41 - .60	2	124	123 - 126	3	123	112 - 135
.61 - .80	2	126	125 - 126	2	123	109 - 137
.81 - 2.00	3	123	120 - 127	3	131	124 - 139
2.01 - .20	5	131	128 - 138	2	138	130 - 146
.21 - .40	8	135	131 - 145	3	138	130 - 150
.41 - .60	7	142	133 - 152	4	140	132 - 153
.61 - .80	9	148	140 - 157	4	144	136 - 156
.81 - 3.00	11	153	143 - 164	4	148	141 - 160
3.01 - .20	7	157	146 - 166	0	—	——
.21 - .40	6	164	153 - 171	4	154	145 - 165
.41 - .60	6	170	160 - 175	2	158	154 - 159
.61 - .80	7	176	165 - 184			
.81 - 4.00	4	182	177 - 190			
4.01 - .20	4	186	180 - 191			
.21 - .40	3	189	183 - 199			
.41 - .60	1	210	——			
.61 - .80	1	212	——			

TABLE 29. POST-NATAL GROWTH: BICRISTAL BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	42	39 - 44	6	38	34 - 42
.11 - .20	5	48	44 - 52	4	44	42 - 45
.21 - .30	6	52	47 - 60	3	51	49 - 52
.31 - .40	5	57	50 - 64	2	56	54 - 59
.41 - .50	6	60	55 - 66	2	60	57 - 63
.51 - .60	5	64	61 - 69	4	60	56 - 64
.61 - .70	5	67	62 - 72	2	64	62 - 67
.71 - .80	5	69	66 - 73	2	67	65 - 69
.81 - .90	4	70	64 - 75	3	66	62 - 71
.91 - 1.00	3	74	71 - 78	2	69	68 - 70
1.01 - .20	5	74	67 - 83	2	70	69 - 70
.21 - .40	4	79	76 - 84	3	74	69 - 80
.41 - .60	3	82	80 - 86	3	77	72 - 83
.61 - .80	3	83	81 - 88	2	80	76 - 85
.81 - 2.00	4	80	76 - 84	3	80	75 - 86
2.01 - .20	7	84	77 - 92	2	88	85 - 92
.21 - .40	8	84	79 - 92	3	89	86 - 94
.41 - .60	6	89	82 - 98	4	89	83 - 95
.61 - .80	9	93	84 - 101	4	91	86 - 97
.81 - 3.00	11	97	88 - 107	4	92	83 - 100
3.01 - .20	7	99	94 - 105	0	—	——
.21 - .40	7	102	96 - 108	4	94	86 - 102
.41 - .60	6	108	101 - 114	2	96	90 - 103
.61 - .80	7	112	103 - 119			
.81 - 4.00	5	118	106 - 128			
4.01 - .20	4	123	120 - 127			
.21 - .40	3	128	124 - 135			
.41 - .60	2	137	129 - 145			
.61 - .80	2	135	128 - 143			

TABLE 30. POST-NATAL GROWTH: BITROCHANTERIC BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	55	53 - 56	6	52	48 - 56
.11 - .20	5	62	54 - 67	4	59	55 - 61
.21 - .30	6	67	63 - 78	3	67	64 - 69
.31 - .40	5	73	68 - 82	2	74	74 - 75
.41 - .50	6	75	69 - 85	2	82	81 - 83
.51 - .60	5	84	81 - 87	4	81	77 - 86
.61 - .70	5	88	84 - 91	2	89	87 - 91
.71 - .80	5	91	87 - 96	2	95	94 - 96
.81 - .90	4	93	91 - 97	3	94	86 - 99
.91 - 1.00	3	97	95 - 101	2	100	99 - 102
1.01 - .20	5	99	91 - 106	2	102	100 - 104
.21 - .40	4	106	103 - 108	3	100	85 - 112
.41 - .60	3	107	103 - 112	3	108	95 - 117
.61 - .80	3	110	109 - 112	2	112	104 - 120
.81 - 2.00	4	110	102 - 117	3	116	109 - 123
2.01 - .20	7	117	106 - 124	2	124	118 - 130
.21 - .40	8	120	112 - 124	3	124	117 - 132
.41 - .60	6	125	116 - 138	4	126	114 - 135
.61 - .80	9	130	124 - 142	4	130	120 - 140
.81 - 3.00	11	136	127 - 149	4	134	126 - 145
3.01 - .20	7	140	129 - 148	1	137	——
.21 - .40	7	148	133 - 154	4	137	123 - 159
.41 - .60	6	155	144 - 164	2	139	136 - 142
.61 - .80	7	160	146 - 170			
.81 - 4.00	5	167	159 - 174			
4.01 - .20	4	170	161 - 181			
.21 - .40	3	175	170 - 179			
.41 - .60	2	190	189 - 191			
.61 - .80	1	193	——			

TABLE 31. POST-NATAL GROWTH: BITUBEROSITY BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	35	32 - 38	6	36	32 - 38
.11 - .20	3	40	37 - 43	3	40	38 - 42
.21 - .30	4	46	42 - 52	1	45	——
.31 - .40	3	50	46 - 56	0	——	——
.41 - .50	4	50	45 - 58	1	55	——
.51 - .60	2	54	50 - 59	3	55	53 - 57
.61 - .70	4	58	52 - 60	1	60	——
.71 - .80	5	58	55 - 62	1	62	——
.81 - .90	4	59	56 - 64	3	61	60 - 63
.91 - 1.00	3	62	59 - 67	2	64	63 - 66
1.01 - .20	5	65	61 - 72	2	67	66 - 68
.21 - .40	3	69	66 - 72	3	69	61 - 76
.41 - .60	2	72	70 - 73	3	73	66 - 80
.61 - .80	3	71	69 - 76	2	78	73 - 82
.81 - 2.00	3	67	65 - 69	3	79	73 - 84
2.01 - .20	6	75	66 - 81	2	84	81 - 87
.21 - .40	8	74	70 - 79	3	84	76 - 91
.41 - .60	6	79	74 - 87	4	85	76 - 95
.61 - .80	9	82	75 - 92	4	88	80 - 95
.81 - 3.00	11	87	80 - 98	4	92	84 - 100
3.01 - .20	7	89	83 - 93	0	——	——
.21 - .40	7	92	85 - 97	4	96	85 - 105
.41 - .60	6	97	88 - 101	2	100	92 - 107
.61 - .80	7	102	93 - 111			
.81 - 4.00	5	107	100 - 117			
4.01 - .20	4	114	105 - 118			
.21 - .40	3	118	108 - 127			
.41 - .60	2	128	122 - 133			
.61 - .80	2	129	123 - 135			

TABLE 32. POST-NATAL GROWTH: TOTAL ARM LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	212	208 - 215	6	204	196 - 211
.11 - .20	5	238	228 - 253	4	218	214 - 234
.21 - .30	6	256	231 - 276	3	245	239 - 250
.31 - .40	5	266	244 - 286	2	266	264 - 269
.41 - .50	6	276	260 - 301	2	284	-284-
.51 - .60	5	300	276 - 322	3	293	286 - 298
.61 - .70	5	311	293 - 336	2	310	310 - 311
.71 - .80	5	326	309 - 355	2	328	325 - 330
.81 - .90	4	330	324 - 335	2	337	-337-
.91 - 1.00	3	341	334 - 350	2	350	346 - 353
1.01 - .20	5	355	344 - 370	2	361	355 - 367
.21 - .40	4	378	372 - 386	3	376	364 - 390
.41 - .60	3	385	377 - 392	3	391	377 - 410
.61 - .80	3	395	382 - 412	2	408	399 - 417
.81 - 2.00	4	399	386 - 412	2	422	-422-
2.01 - .20	7	418	390 - 440	2	440	436 - 444
.21 - .40	8	434	408 - 461	3	443	425 - 455
.41 - .60	7	452	420 - 490	4	449	425 - 469
.61 - .80	9	471	439 - 504	4	461	439 - 480
.81 - 3.00	11	487	450 - 521	4	470	454 - 484
3.01 - .20	7	498	465 - 520	1	491	——
.21 - .40	7	511	460 - 538	4	472	454 - 490
.41 - .60	6	535	498 - 554	2	498	476 - 521
.61 - .80	7	554	457 - 579			
.81 - 4.00	5	577	563 - 604			
4.01 - .20	4	586	571 - 598			
.21 - .40	4	593	583 - 611			
.41 - .60	2	622	620 - 624			
.61 - .80	2	624	618 - 630			

TABLE 33. POST-NATAL GROWTH: UPPER ARM LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	69	67 - 72	6	67	63 - 72
.11 - .20	4	78	78 - 86	4	74	71 - 78
.21 - .30	6	86	78 - 92	3	83	81 - 85
.31 - .40	5	90	84 - 97	2	90	90 - 91
.41 - .50	6	94	90 - 102	2	96	96 - 97
.51 - .60	5	100	94 - 108	4	104	97 - 115
.61 - .70	5	103	100 - 115	2	106	105 - 107
.71 - .80	5	109	106 - 124	2	112	-112-
.81 - .90	4	112	112 - 114	3	113	113 - 115
.91 - 1.00	3	115	115 - 117	2	119	118 - 120
1.01 - .20	4	120	117 - 123	2	124	121 - 127
.21 - .40	3	129	127 - 131	3	127	122 - 134
.41 - .60	3	132	131 - 132	3	134	129 - 140
.61 - .80	3	132	131 - 133	2	139	134 - 143
.81 - 2.00	4	137	132 - 142	3	142	140 - 145
2.01 - .20	6	145	133 - 154	2	151	149 - 153
.21 - .40	8	150	141 - 160	3	152	149 - 156
.41 - .60	7	155	144 - 165	4	152	145 - 159
.61 - .80	9	163	152 - 176	4	157	148 - 166
.81 - 3.00	11	168	156 - 180	4	160	153 - 169
3.01 - .20	7	171	159 - 184	1	166	——
.21 - .40	6	177	164 - 189	4	165	155 - 172
.41 - .60	6	184	173 - 193	2	170	162 - 178
.61 - .80	7	191	179 - 198			
.81 - 4.00	4	198	193 - 207			
4.01 - .20	4	202	196 - 210			
.21 - .40	4	205	199 - 209			
.41 - .60	2	213	-213-			
.61 - .80	2	212	208 - 216			

TABLE 34. POST-NATAL GROWTH: FOREARM LENGTH (ULNAR)

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	81	78 - 82	6	76	70 - 81
.11 - .20	4	89	84 - 93	4	84	79 - 90
.21 - .30	6	98	88 - 106	3	92	89 - 95
.31 - .40	5	101	92 - 109	2	100	-100-
.41 - .50	6	106	98 - 117	2	108	107 - 108
.51 - .60	5	116	104 - 123	4	112	109 - 116
.61 - .70	5	121	111 - 127	2	120	-120-
.71 - .80	5	126	116 - 133	2	128	112 - 129
.81 - .90	4	130	123 - 135	3	125	109 - 133
.91 - 1.00	3	134	128 - 139	2	138	-138-
1.01 - .20	4	139	132 - 149	2	144	143 - 144
.21 - .40	3	150	142 - 156	3	152	147 - 157
.41 - .60	3	153	147 - 158	3	157	149 - 165
.61 - .80	3	156	150 - 161	2	163	160 - 163
.81 - 2.00	4	160	154 - 169	3	166	158 - 173
2.01 - .20	6	167	156 - 176	2	177	175 - 179
.21 - .40	8	173	158 - 186	3	179	170 - 185
.41 - .60	7	180	162 - 197	4	182	168 - 194
.61 - .80	9	188	172 - 203	4	187	177 - 197
.81 - 3.00	11	196	177 - 217	4	192	186 - 198
3.01 - .20	7	199	189 - 207	1	200	——
.21 - .40	6	211	206 - 224	4	195	184 - 210
.41 - .60	6	215	200 - 228	2	206	199 - 212
.61 - .80	7	223	210 - 241			
.81 - 4.00	5	332	222 - 250			
4.01 - .20	4	235	224 - 245			
.21 - .40	3	239	231 - 249			
.41 - .60	2	256	255 - 256			
.61 - .80	2	254	248 - 261			

TABLE 35. POST-NATAL GROWTH: FOREARM LENGTH (RADIUS)

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	75	74 - 76	6	68	62 - 74
.11 - .20	4	82	80 - 83	3	77	76 - 79
.21 - .30	6	89	81 - 96	3	86	86 - 87
.31 - .40	5	92	84 - 100	2	92	92 - 93
.41 - .50	6	98	91 - 107	2	99	97 - 101
.51 - .60	5	106	100 - 114	4	102	96 - 108
.61 - .70	5	109	105 - 115	2	112	110 - 114
.71 - .80	5	114	111 - 120	2	118	114 - 121
.81 - .90	4	118	115 - 117	2	116	108 - 123
.91 - 1.00	3	119	117 - 121	1	128	——
1.01 - .20	4	126	121 - 133	2	130	129 - 132
.21 - .40	3	136	128 - 146	3	137	131 - 142
.41 - .60	3	138	131 - 149	3	143	138 - 147
.61 - .80	3	143	136 - 152	2	146	144 - 150
.81 - 2.00	4	145	138 - 156	3	152	150 - 153
2.01 - .20	6	154	142 - 166	2	161	160 - 162
.21 - .40	8	159	146 - 171	3	163	157 - 166
.41 - .60	7	163	150 - 179	4	165	158 - 173
.61 - .80	9	170	156 - 182	4	172	164 - 179
.81 - 3.00	11	178	160 - 194	4	175	168 - 179
3.01 - .20	7	182	169 - 192	1	181	——
.21 - .40	6	190	176 - 202	4	181	172 - 188
.41 - .60	6	197	181 - 214	1	182	——
.61 - .80	7	203	186 - 219			
.81 - 4.00	5	212	201 - 232			
4.01 - .20	4	216	204 - 228			
.21 - .40	3	225	218 - 231			
.41 - .60	1	231	——			
.61 - .80	1	238	——			

TABLE 36. POST-NATAL GROWTH: HAND LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	62	61 - 63	6	61	58 - 64
.11 - .20	4	67	63 - 70	4	64	63 - 65
.21 - .30	6	72	65 - 78	3	70	69 - 70
.31 - .40	5	75	68 - 80	2	76	74 - 78
.41 - .50	6	76	71 - 82	2	79	-79-
.51 - .60	5	83	78 - 93	4	78	75 - 80
.61 - .70	5	85	80 - 94	2	84	83 - 86
.71 - .80	5	88	83 - 98	2	88	86 - 89
.81 - .90	4	88	85 - 90	3	88	83 - 93
.91 - 1.00	3	91	88 - 94	2	92	90 - 95
1.01 - .20	4	95	92 - 98	2	94	91 - 96
.21 - .40	3	99	98 - 100	3	96	92 - 101
.41 - .60	3	100	98 - 103	3	100	96 - 105
.61 - .80	3	101	99 - 106	2	106	105 - 108
.81 - 2.00	4	102	98 - 109	3	106	101 - 110
2.01 - .20	6	108	101 - 112	2	112	-112-
.21 - .40	8	110	105 - 118	3	111	106 - 114
.41 - .60	7	117	109 - 126	4	115	112 - 118
.61 - .80	9	120	112 - 129	4	117	114 - 120
.81 - 3.00	11	123	115 - 133	4	117	113 - 122
3.01 - .20	7	127	117 - 133	1	125	——
.21 - .40	6	132	119 - 136	4	119	115 - 126
.41 - .60	6	136	125 - 139	2	123	115 - 131
.61 - .80	7	139	131 - 143			
.81 - 4.00	5	145	141 - 147			
4.01 - .20	4	149	143 - 156			
.21 - .40	3	154	149 - 159			
.41 - .60	2	154	151 - 156			
.61 - .80	2	158	153 - 162			

TABLE 37. POST-NATAL GROWTH: POLLUX LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	44	43 - 45	6	44	39 - 45
.11 - .20	3	51	47 - 58	3	46	44 - 50
.21 - .30	5	54	50 - 60	3	51	49 - 52
.31 - .40	5	56	54 - 61	2	54	52 - 56
.41 - .50	6	57	53 - 62	2	56	54 - 58
.51 - .60	5	60	56 - 64	4	56	55 - 59
.61 - .70	5	62	58 - 66	2	58	57 - 60
.71 - .80	5	64	60 - 67	2	61	60 - 62
.81 - .90	4	65	62 - 68	3	61	58 - 65
.91 - 1.00	3	67	63 - 70	2	64	60 - 67
1.01 - .20	4	68	65 - 70	2	65	62 - 68
.21 - .40	3	72	71 - 74	3	66	65 - 68
.41 - .60	3	73	72 - 75	3	69	67 - 73
.61 - .80	3	75	73 - 77	2	72	71 - 73
.81 - 2.00	4	75	74 - 76	2	72	70 - 74
2.01 - .20	6	77	74 - 82	2	76	76 - 77
.21 - .40	8	79	76 - 84	3	80	75 - 85
.41 - .60	7	82	78 - 86	4	80	78 - 83
.61 - .80	9	85	80 - 89	4	82	80 - 85
.81 - 3.00	11	88	82 - 94	4	82	81 - 84
3.01 - .20	7	91	85 - 95	1	85	——
.21 - .40	6	94	86 - 98	4	85	84 - 87
.41 - .60	6	97	92 - 100	2	86	85 - 88
.61 - .80	7	98	92 - 101			
.81 - 4.00	5	104	99 - 108			
4.01 - .20	4	105	100 - 111			
.21 - .40	3	109	105 - 112			
.41 - .60	2	106	102 - 110			
.61 - .80	2	110	105 - 115			

TABLE 38. POST-NATAL GROWTH: ELBOW BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	18	17 - 20	6	17	16 - 18
.11 - .20	3	20	19 - 21	3	19	18 - 20
.21 - .30	5	22	20 - 23	3	20	20 - 21
.31 - .40	5	24	22 - 26	2	22	22 - 23
.41 - .50	6	25	23 - 27	2	24	23 - 24
.51 - .60	5	26	25 - 28	4	24	23 - 25
.61 - .70	5	27	25 - 29	2	25	24 - 26
.71 - .80	5	28	26 - 29	2	26	25 - 26
.81 - .90	4	28	26 - 30	3	27	26 - 27
.91 - 1.00	3	30	28 - 31	2	28	27 - 28
1.01 - .20	4	30	28 - 32	2	28	27 - 28
.21 - .40	3	31	30 - 32	3	28	27 - 29
.41 - .60	3	32	31 - 33	3	29	28 - 30
.61 - .80	3	32	31 - 34	2	32	31 - 32
.81 - 2.00	4	32	30 - 33	3	31	30 - 33
2.01 - .20	6	33	30 - 35	2	32	32 - 33
.21 - .40	8	34	33 - 37	3	33	32 - 34
.41 - .60	7	35	33 - 37	4	32	31 - 34
.61 - .80	9	37	34 - 39	4	33	32 - 34
.81 - 3.00	11	38	35 - 41	4	33	32 - 34
3.01 - .20	7	38	36 - 42	1	34	——
.21 - .40	6	40	37 - 44	4	35	33 - 36
.41 - .60	6	41	38 - 45	2	36	-36-
.61 - .80	7	42	38 - 46			
.81 - 4.00	5	43	42 - 46			
4.01 - .20	4	44	41 - 47			
.21 - .40	3	43	41 - 45			
.41 - .60	2	45	44 - 46			
.61 - .80	1	45	——			

TABLE 39. POST-NATAL GROWTH: WRIST BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	18	17 - 18	6	18	16 - 18
.11 - .20	3	20	19 - 21	3	19	18 - 21
.21 - .30	5	21	20 - 22	3	20	19 - 21
.31 - .40	5	22	21 - 24	2	21	20 - 22
.41 - .50	6	23	20 - 25	2	22	21 - 23
.51 - .60	5	25	23 - 26	4	24	22 - 25
.61 - .70	5	25	23 - 27	2	25	24 - 26
.71 - .80	5	26	24 - 28	2	25	24 - 26
.81 - .90	4	26	24 - 29	3	25	23 - 26
.91 - 1.00	3	28	26 - 30	2	26	-26-
1.01 - .20	4	28	25 - 30	2	26	25 - 27
.21 - .40	3	29	28 - 30	3	25	23 - 27
.41 - .60	3	30	29 - 30	3	27	25 - 29
.61 - .80	3	31	30 - 31	2	29	28 - 30
.81 - 2.00	4	29	28 - 31	3	29	28 - 30
2.01 - .20	6	30	28 - 32	2	31	30 - 32
.21 - .40	8	31	30 - 33	3	31	29 - 32
.41 - .60	7	33	30 - 36	4	30	28 - 32
.61 - .80	9	33	31 - 35	4	31	30 - 32
.81 - 3.00	11	34	32 - 37	4	32	31 - 33
3.01 - .20	7	35	33 - 36	1	32	——
.21 - .40	6	36	35 - 37	4	32	31 - 35
.41 - .60	6	38	36 - 40	2	31	-31-
.61 - .80	7	39	37 - 40			
.81 - 4.00	5	40	38 - 41			
4.01 - .20	4	41	39 - 43			
.21 - .40	3	41	41 - 41			
.41 - .60	2	42	41 - 42			
.61 - .80	1	40	——			

TABLE 40. POST-NATAL GROWTH: HAND BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	23	22 - 25	6	22	20 - 23
.11 - .20	4	25	23 - 27	4	23	20 - 24
.21 - .30	6	26	24 - 28	3	25	24 - 27
.31 - .40	5	27	25 - 28	2	28	27 - 28
.41 - .50	6	28	26 - 29	2	28	-28-
.51 - .60	5	29	28 - 30	4	28	26 - 29
.61 - .70	5	30	29 - 31	2	30	-30-
.71 - .80	5	31	29 - 34	2	30	30 - 31
.81 - .90	4	32	30 - 34	3	30	28 - 32
.91 - 1.00	3	32	30 - 34	2	32	-32-
1.01 - .20	4	33	31 - 35	2	32	-32-
.21 - .40	3	35	34 - 35	3	34	32 - 35
.41 - .60	3	35	35 - 36	3	34	33 - 34
.61 - .80	3	36	35 - 36	2	34	33 - 35
.81 - 2.00	4	36	34 - 36	3	34	33 - 36
2.01 - .20	6	37	36 - 38	2	35	34 - 36
.21 - .40	8	37	36 - 39	3	36	35 - 37
.41 - .60	7	38	37 - 41	4	36	34 - 38
.61 - .80	9	40	38 - 42	4	36	36 - 37
.81 - 3.00	11	41	37 - 43	4	38	37 - 38
3.01 - .20	7	41	40 - 43	1	38	——
.21 - .40	6	42	40 - 46	4	38	37 - 40
.41 - .60	6	43	42 - 44	2	39	-39-
.61 - .80	7	44	42 - 46			
.81 - 4.00	5	46	43 - 48			
4.01 - .20	4	46	43 - 49			
.21 - .40	3	47	45 - 50			
.41 - .60	2	49	48 - 50			
.61 - .80	2	48	46 - 49			

TABLE 41. POST-NATAL GROWTH: TOTAL LOWER LIMB LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	234	225 - 239	6	227	222 - 245
.11 - .20	5	261	243 - 278	4	249	244 - 260
.21 - .30	6	286	262 - 312	3	280	277 - 282
.31 - .40	5	304	279 - 345	2	308	300 - 317
.41 - .50	6	313	296 - 345	2	328	321 - 334
.51 - .60	5	338	326 - 356	4	332	318 - 354
.61 - .70	5	351	335 - 375	2	356	352 - 361
.71 - .80	5	366	356 - 387	2	375	367 - 383
.81 - .90	4	373	371 - 374	3	377	360 - 395
.91 - 1.00	3	383	379 - 389	2	396	387 - 406
1.01 - .20	5	399	392 - 409	2	407	397 - 417
.21 - .40	4	421	416 - 429	3	426	419 - 451
.41 - .60	3	437	425 - 447	3	439	422 - 461
.61 - .80	3	442	432 - 460	2	459	442 - 476
.81 - 2.00	4	450	429 - 465	3	467	451 - 484
2.01 - .20	7	475	445 - 497	2	496	486 - 505
.21 - .40	8	488	463 - 511	3	495	475 - 514
.41 - .60	7	509	471 - 564	4	499	476 - 524
.61 - .80	9	528	482 - 578	4	519	490 - 559
.81 - 3.00	11	549	494 - 604	4	527	503 - 555
3.01 - .20	7	559	502 - 575	1	553	—
.21 - .40	7	580	544 - 605	4	538	514 - 560
.41 - .60	6	598	592 - 624	2	549	538 - 560
.61 - .80	7	617	555 - 649			
.81 - 4.00	5	650	634 - 686			
4.01 - .20	4	660	644 - 677			
.21 - .40	4	667	653 - 688			
.41 - .60	2	709	699 - 719			
.61 - .80	2	717	715 - 719			

TABLE 42. POST-NATAL GROWTH: THIGH LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	80	77 - 82	6	77	71 - 84
.11 - .20	4	88	83 - 93	4	85	82 - 88
.21 - .30	6	98	90 - 106	3	98	97 - 99
.31 - .40	5	105	96 - 114	2	110	107 - 113
.41 - .50	6	110	104 - 121	2	116	115 - 117
.51 - .60	5	120	114 - 125	4	118	112 - 124
.61 - .70	5	125	117 - 133	2	132	130 - 134
.71 - .80	5	132	128 - 140	2	136	-136-
.81 - .90	4	136	135 - 138	3	137	130 - 142
.91 - 1.00	3	139	138 - 141	2	146	142 - 149
1.01 - .20	4	145	143 - 149	2	150	145 - 156
.21 - .40	3	156	153 - 159	3	158	150 - 166
.41 - .60	3	161	158 - 164	3	161	155 - 174
.61 - .80	3	165	161 - 172	2	172	164 - 179
.81 - 2.00	4	167	158 - 174	3	175	171 - 182
2.01 - .20	6	176	164 - 186	2	184	182 - 187
.21 - .40	8	181	174 - 191	3	185	176 - 192
.41 - .60	7	189	175 - 208	4	186	175 - 197
.61 - .80	9	196	182 - 213	4	194	182 - 205
.81 - 3.00	11	205	188 - 223	4	199	188 - 211
3.01 - .20	7	209	192 - 218	1	205	——
.21 - .40	6	221	199 - 239	4	205	192 - 217
.41 - .60	6	226	205 - 240	2	211	204 - 218
.61 - .80	7	236	213 - 253			
.81 - 4.00	4	241	240 - 242			
4.01 - .20	4	252	244 - 269			
.21 - .40	4	255	249 - 262			
.41 - .60	2	278	277 - 278			
.61 - .80	2	275	267 - 283			

TABLE 43. POST-NATAL GROWTH: KNEE HEIGHT

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	81	78 - 83	6	78	71 - 84
.11 - .20	4	90	86 - 96	4	86	84 - 88
.21 - .30	6	100	90 - 108	3	99	97 - 101
.31 - .40	5	105	98 - 113	2	108	106 - 111
.41 - .50	6	111	103 - 122	2	118	114 - 121
.51 - .60	5	119	111 - 126	4	120	114 - 127
.61 - .70	5	125	118 - 132	2	130	127 - 134
.71 - .80	5	129	124 - 136	2	137	134 - 140
.81 - .90	4	133	131 - 134	2	135	124 - 143
.91 - 1.00	3	137	134 - 140	2	144	140 - 149
1.01 - .20	4	143	140 - 150	2	149	143 - 155
.21 - .40	3	153	149 - 159	3	156	150 - 166
.41 - .60	3	156	151 - 161	3	162	156 - 172
.61 - .80	3	157	154 - 164	2	168	160 - 177
.81 - 2.00	4	163	157 - 170	3	172	166 - 181
2.01 - .20	6	171	160 - 180	2	182	178 - 186
.21 - .40	8	177	164 - 188	3	184	173 - 198
.41 - .60	7	186	169 - 206	4	182	174 - 191
.61 - .80	9	192	176 - 210	4	188	180 - 198
.81 - 3.00	11	198	181 - 218	4	193	186 - 205
3.01 - .20	7	202	184 - 212	1	198	——
.21 - .40	6	209	191 - 215	4	197	189 - 208
.41 - .60	6	217	200 - 229	2	200	194 - 206
.61 - .80	7	225	204 - 240			
.81 - 4.00	4	230	227 - 235			
4.01 - .20	4	238	234 - 246			
.21 - .40	4	242	234 - 247			
.41 - .60	2	254	253 - 254			
.61 - .80	2	260	259 - 260			

TABLE 44. POST-NATAL GROWTH: LEG LENGTH

AGE (yrs.)	MALE No.	MALE Mean (mm.)	MALE Observed Range (mm.)	FEMALE No.	FEMALE Mean (mm.)	FEMALE Observed Range (mm.)
0.00 - .10	3	71	69 - 74	6	68	61 - 77
.11 - .20	4	78	73 - 82	4	76	72 - 80
.21 - .30	6	89	78 - 97	3	86	85 - 87
.31 - .40	5	92	86 - 99	2	95	93 - 97
.41 - .50	6	96	91 - 107	2	103	100 - 106
.51 - .60	5	105	99 - 111	4	104	99 - 113
.61 - .70	5	109	104 - 116	2	112	108 - 115
.71 - .80	5	113	108 - 120	2	118	113 - 124
.81 - .90	4	116	114 - 117	3	121	114 - 128
.91 - 1.00	3	119	117 - 122	2	126	124 - 129
1.01 - .20	4	126	123 - 128	2	128	126 - 130
.21 - .40	3	133	130 - 138	3	137	131 - 146
.41 - .60	3	136	131 - 144	3	142	137 - 151
.61 - .80	3	138	134 - 147	2	149	142 - 156
.81 - 2.00	4	144	137 - 151	3	152	145 - 160
2.01 - .20	6	153	143 - 159	2	162	158 - 167
.21 - .40	8	156	146 - 164	3	162	155 - 170
.41 - .60	7	164	151 - 185	4	163	155 - 173
.61 - .80	9	170	156 - 188	4	167	158 - 177
.81 - 3.00	11	177	162 - 193	4	171	162 - 183
3.01 - .20	7	180	162 - 188	1	172	——
.21 - .40	6	185	170 - 193	4	176	168 - 184
.41 - .60	6	192	179 - 202	2	178	174 - 181
.61 - .80	7	198	181 - 209			
.81 - 4.00	4	206	203 - 211			
4.01 - .20	4	212	207 - 218			
.21 - .40	4	214	210 - 220			
.41 - .60	2	230	228 - 233			
.61 - .80	2	237	227 - 248			

TABLE 45. POST-NATAL GROWTH: FOOT LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	83	79 - 88	6	81	77 - 84
.11 - .20	4	91	86 - 96	4	88	85 - 92
.21 - .30	6	99	94 - 110	3	95	95 - 96
.31 - .40	5	103	97 - 113	2	104	100 - 107
.41 - .50	6	107	100 - 117	2	108	106 - 111
.51 - .60	5	114	109 - 120	4	110	107 - 117
.61 - .70	5	117	112 - 126	2	116	114 - 119
.71 - .80	5	120	116 - 127	2	120	118 - 123
.81 - .90	4	122	119 - 124	3	120	116 - 125
.91 - 1.00	3	124	121 - 126	2	124	121 - 128
1.01 - .20	4	127	124 - 132	2	128	126 - 131
.21 - .40	3	133	132 - 133	3	131	126 - 139
.41 - .60	3	137	135 - 139	3	133	130 - 139
.61 - .80	3	137	134 - 141	2	138	136 - 141
.81 - 2.00	4	138	133 - 142	3	140	133 - 144
2.01 - .20	6	148	138 - 152	2	148	146 - 151
.21 - .40	8	150	143 - 159	3	148	144 - 152
.41 - .60	7	156	144 - 171	4	150	146 - 154
.61 - .80	9	161	144 - 177	4	153	150 - 156
.81 - 3.00	11	167	146 - 188	4	157	153 - 161
3.01 - .20	7	170	148 - 176	1	156	—
.21 - .40	6	174	162 - 183	4	157	154 - 159
.41 - .60	6	179	165 - 186	2	160	160 - 161
.61 - .80	7	182	161 - 190			
.81 - 4.00	4	191	188 - 194			
4.01 - .20	4	194	190 - 197			
.21 - .40	4	198	191 - 206			
.41 - .60	2	201	194 - 208			
.61 - .80	2	204	200 - 209			

TABLE 46. POST-NATAL GROWTH: HALLUX LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	66	64 - 67	6	63	59 - 66
.11 - .20	3	73	69 - 76	3	69	66 - 71
.21 - .30	5	80	76 - 88	3	75	75 - 76
.31 - .40	5	82	78 - 91	2	80	77 - 84
.41 - .50	6	84	78 - 94	2	84	79 - 86
.51 - .60	5	90	86 - 99	4	85	82 - 93
.61 - .70	5	92	87 - 102	2	92	88 - 95
.71 - .80	5	95	91 - 103	2	94	92 - 97
.81 - .90	4	95	92 - 97	3	94	89 - 102
.91 - 1.00	3	96	94 - 97	2	99	96 - 102
1.01 - .20	4	100	98 - 106	2	100	98 - 103
.21 - .40	3	105	104 - 106	3	101	97 - 108
.41 - .60	3	108	106 - 110	3	104	98 - 112
.61 - .80	3	109	107 - 113	2	111	110 - 112
.81 - 2.00	4	110	104 - 113	3	109	105 - 112
2.01 - .20	6	115	108 - 121	2	118	116 - 119
.21 - .40	8	118	112 - 127	3	117	114 - 120
.41 - .60	7	123	115 - 131	4	117	110 - 122
.61 - .80	9	125	115 - 136	4	119	114 - 123
.81 - 3.00	11	130	119 - 145	4	120	118 - 122
3.01 - .20	7	133	121 - 139	1	123	——
.21 - .40	6	135	124 - 141	4	122	119 - 126
.41 - .60	6	141	137 - 144	2	125	122 - 128
.61 - .80	7	142	131 - 147			
.81 - 4.00	4	149	141 - 152			
4.01 - .20	4	153	150 - 155			
.21 - .40	4	152	144 - 155			
.41 - .60	2	156	152 - 161			
.61 - .80	2	158	157 - 159			

TABLE 47. POST-NATAL GROWTH: KNEE BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	18	18 - 19	6	17	16 - 18
.11 - .20	4	20	19 - 22	2	20	19 - 21
.21 - .30	5	23	21 - 26	3	21	20 - 22
.31 - .40	5	25	23 - 26	1	24	——
.41 - .50	6	26	24 - 27	2	25	24 - 26
.51 - .60	3	27	26 - 28	4	26	25 - 27
.61 - .70	5	28	27 - 29	2	26	26 - 27
.71 - .80	5	29	28 - 30	2	28	27 - 28
.81 - .90	4	30	29 - 30	3	28	27 - 29
.91 - 1.00	3	30	29 - 31	2	29	28 - 30
1.01 - .20	4	31	30 - 33	2	30	28 - 31
.21 - .40	3	33	21 - 34	3	29	27 - 33
.41 - .60	3	33	32 - 35	3	31	28 - 33
.61 - .80	2	34	33 - 34	2	32	31 - 34
.81 - 2.00	4	34	31 - 35	3	32	30 - 34
2.01 - .20	6	35	32 - 36	2	34	32 - 35
.21 - .40	8	36	34 - 38	3	34	32 - 35
.41 - .60	7	37	34 - 39	4	34	32 - 35
.61 - .80	9	38	35 - 40	4	34	32 - 36
.81 - 3.00	11	39	36 - 42	4	35	33 - 38
3.01 - .20	7	39	37 - 42	1	36	——
.21 - .40	6	40	38 - 44	4	36	35 - 38
.41 - .60	6	42	40 - 45	2	36	36 - 37
.61 - .80	7	42	40 - 46			
.81 - 4.00	4	43	41 - 47			
4.01 - .20	4	45	42 - 48			
.21 - .40	4	44	43 - 48			
.41 - .60	2	45	44 - 46			
.61 - .80	1	44	——			

TABLE 48. POST-NATAL GROWTH: ANKLE BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	13	11 - 15	6	15	14 - 16
.11 - .20	3	18	14 - 20	3	18	16 - 19
.21 - .30	5	20	18 - 22	3	19	18 - 20
.31 - .40	5	21	20 - 23	2	21	20 - 22
.41 - .50	6	22	20 - 24	2	22	21 - 23
.51 - .60	5	24	23 - 25	4	22	21 - 24
.61 - .70	5	24	23 - 26	2	24	23 - 25
.71 - .80	5	25	23 - 26	2	25	24 - 26
.81 - .90	4	25	23 - 25	3	24	21 - 27
.91 - 1.00	3	25	24 - 26	2	27	26 - 28
1.01 - .20	4	26	24 - 29	2	27	26 - 28
.21 - .40	3	28	26 - 29	3	26	23 - 30
.41 - .60	3	29	27 - 30	3	27	26 - 29
.61 - .80	2	30	30 - 30	2	27	25 - 29
.81 - 2.00	4	29	26 - 31	3	29	27 - 30
2.01 - .20	6	30	26 - 32	2	30	29 - 31
.21 - .40	8	31	28 - 32	3	29	28 - 31
.41 - .60	7	31	30 - 34	4	30	28 - 31
.61 - .80	9	32	30 - 34	4	30	28 - 32
.81 - 3.00	11	33	30 - 35	4	30	29 - 31
3.01 - .20	7	33	30 - 37	1	31	——
.21 - .40	6	35	32 - 37	4	31	30 - 32
.41 - .60	6	35	35 - 41	2	30	29 - 32
.61 - .80	7	36	33 - 38			
.81 - 4.00	4	37	35 - 39			
4.01 - .20	4	38	37 - 40			
.21 - .40	4	36	36 - 37			
.41 - .60	2	39	-39-			
.61 - .80	1	38	——			

TABLE 49. POST-NATAL GROWTH: FOOT BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	21	21 - 22	6	21	19 - 22
.11 - .20	4	24	22 - 25	4	22	20 - 25
.21 - .30	6	25	24 - 28	3	24	23 - 24
.31 - .40	5	27	25 - 29	2	26	25 - 27
.41 - .50	6	26	23 - 29	2	26	26 - 27
.51 - .60	5	28	27 - 30	4	27	27 - 28
.61 - .70	5	29	27 - 30	2	28	28 - 29
.71 - .80	5	30	28 - 32	2	30	29 - 31
.81 - .90	4	31	28 - 33	3	30	28 - 31
.91 - 1.00	3	32	30 - 34	2	31	30 - 32
1.01 - .20	4	32	31 - 34	2	32	30 - 33
.21 - .40	3	33	31 - 34	3	31	28 - 34
.41 - .60	3	35	34 - 35	3	32	29 - 36
.61 - .80	3	34	34 - 35	2	34	34 - 35
.81 - 2.00	4	34	31 - 35	3	33	32 - 34
2.01 - .20	6	36	31 - 37	2	36	35 - 36
.21 - .40	8	36	31 - 38	3	36	35 - 37
.41 - .60	7	36	34 - 38	4	36	34 - 39
.61 - .80	9	38	34 - 40	4	37	36 - 38
.81 - 3.00	11	39	36 - 41	4	37	36 - 38
3.01 - .20	7	40	38 - 42	1	38	—
.21 - .40	6	41	38 - 44	4	37	36 - 40
.41 - .60	6	43	42 - 44	2	37	36 - 38
.61 - .80	7	43	40 - 46			
.81 - 4.00	4	44	44 - 45			
4.01 - .20	4	45	44 - 46			
.21 - .40	4	45	44 - 47			
.41 - .60	2	46	45 - 48			
.61 - .80	2	46	46 - 47			

TABLE 50. POST-NATAL GROWTH: TOTAL HEAD LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	89	87 - 91	6	85	82 - 90
.11 - .20	4	92	91 - 92	4	91	90 - 92
.21 - .30	6	97	95 - 102	2	97	93 - 101
.31 - .40	5	100	97 - 106	1	102	——
.41 - .50	6	102	98 - 110	1	103	——
.51 - .60	5	105	103 - 116	4	103	99 - 105
.61 - .70	5	108	105 - 120	2	107	106 - 108
.71 - .80	5	112	108 - 122	2	110	109 - 112
.81 - .90	4	115	111 - 124	3	111	108 - 114
.91 - 1.00	3	118	114 - 126	2	116	114 - 118
1.01 - .20	4	121	118 - 128	2	120	117 - 122
.21 - .40	3	126	123 - 130	3	118	111 - 122
.41 - .60	3	126	122 - 133	3	119	113 - 122
.61 - .80	3	128	123 - 138	2	120	112 - 128
.81 - 2.00	4	119	114 - 124	3	126	119 - 132
2.01 - .20	6	128	118 - 134	2	130	124 - 136
.21 - .40	8	130	124 - 136	3	130	126 - 135
.41 - .60	7	134	128 - 139	4	129	123 - 135
.61 - .80	9	136	132 - 144	4	133	127 - 142
.81 - 3.00	11	141	135 - 151	4	136	131 - 143
3.01 - .20	7	143	137 - 150	1	141	——
.21 - .40	6	150	141 - 164	4	142	137 - 148
.41 - .60	6	156	146 - 173	2	144	143 - 146
.61 - .80	7	162	154 - 180			
.81 - 4.00	4	165	161 - 169			
4.01 - .20	4	170	165 - 173			
.21 - .40	4	175	169 - 181			
.41 - .60	2	186	184 - 189			
.61 - .80	2	186	180 - 192			

TABLE 51. POST-NATAL GROWTH: CRANIAL LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	76	76 - 76	4	73	70 - 76
.11 - .20	4	81	79 - 82	4	75	71 - 79
.21 - .30	6	84	80 - 88	3	83	81 - 85
.31 - .40	5	88	85 - 93	2	87	86 - 88
.41 - .50	6	89	84 - 95	2	88	87 - 90
.51 - .60	5	91	88 - 97	3	88	85 - 91
.61 - .70	5	92	90 - 98	2	91	90 - 92
.71 - .80	5	94	91 - 99	2	92	91 - 92
.81 - .90	4	95	93 - 99	2	91	88 - 94
.91 - 1.00	3	96	94 - 100	2	94	92 - 95
1.01 - .20	4	96	94 - 99	2	94	92 - 96
.21 - .40	3	96	92 - 100	3	92	86 - 97
.41 - .60	3	97	93 - 101	3	92	87 - 96
.61 - .80	3	98	94 - 103	2	94	89 - 98
.81 - 2.00	4	95	90 - 99	3	95	91 - 99
2.01 - .20	6	98	93 - 100	2	97	94 - 100
.21 - .40	8	99	96 - 101	3	97	94 - 100
.41 - .60	7	100	97 - 104	4	96	94 - 101
.61 - .80	9	103	99 - 106	4	97	96 - 101
.81 - 3.00	11	105	101 - 109	4	99	97 - 103
3.01 - .20	7	106	101 - 110	1	100	——
.21 - .40	6	108	103 - 111	4	101	100 - 103
.41 - .60	6	110	104 - 112	2	101	100 - 102
.61 - .80	7	111	106 - 115			
.81 - 4.00	4	114	112 - 116			
4.01 - .20	4	115	113 - 117			
.21 - .40	3	118	116 - 121			
.41 - .60	2	118	113 - 122			
.61 - .80	2	122	120 - 124			

TABLE 52. POST-NATAL GROWTH: TOTAL FACE HEIGHT

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	41	39 - 42	7	40	37 - 45
.11 - .20	4	47	44 - 49	4	46	43 - 47
.21 - .30	6	52	51 - 54	3	49	47 - 50
.31 - .40	5	54	53 - 56	2	52	52 - 52
.41 - .50	6	56	53 - 60	2	58	55 - 59
.51 - .60	5	60	58 - 62	4	58	57 - 60
.61 - .70	5	62	60 - 65	2	62	61 - 62
.71 - .80	5	64	62 - 66	2	64	64 - 64
.81 - .90	4	66	64 - 68	3	63	59 - 66
.91 - 1.00	3	67	64 - 70	2	66	66 - 66
1.01 - .20	4	68	65 - 74	2	67	66 - 68
.21 - .40	3	74	70 - 76	3	70	65 - 74
.41 - .60	3	75	70 - 78	3	73	69 - 76
.61 - .80	3	77	72 - 80	2	74	71 - 76
.81 - 2.00	4	74	73 - 77	3	76	75 - 78
2.01 - .20	6	78	74 - 81	2	81	80 - 82
.21 - .40	8	81	79 - 85	3	81	77 - 83
.41 - .60	7	83	79 - 90	4	83	79 - 88
.61 - .80	9	87	82 - 93	4	84	80 - 89
.81 - 3.00	11	90	86 - 98	4	85	81 - 90
3.01 - .20	7	92	89 - 98	1	92	——
.21 - .40	6	99	92 - 105	4	89	86 - 93
.41 - .60	6	102	99 - 116	2	92	88 - 97
.61 - .80	7	108	101 - 121			
.81 - 4.00	5	113	106 - 125			
4.01 - .20	4	114	108 - 120			
.21 - .40	3	118	112 - 121			
.41 - .60	2	126	125 - 127			
.61 - .80	1	131	——			

TABLE 53. POST-NATAL GROWTH: UPPER FACE HEIGHT

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	28	26 - 30	7	28	26 - 32
.11 - .20	4	32	29 - 34	4	31	30 - 33
.21 - .30	6	35	32 - 38	3	34	34 - 35
.31 - .40	5	37	34 - 40	2	36	36 - 37
.41 - .50	6	38	32 - 42	2	40	38 - 41
.51 - .60	5	41	38 - 43	4	41	37 - 43
.61 - .70	5	43	40 - 46	2	43	42 - 44
.71 - .80	5	45	42 - 48	2	44	44 - 45
.81 - .90	4	46	44 - 50	3	44	39 - 48
.91 - 1.00	3	47	44 - 52	2	46	44 - 49
1.01 - .20	4	48	45 - 54	2	48	45 - 50
.21 - .40	3	54	49 - 58	3	51	50 - 53
.41 - .60	3	56	50 - 60	3	55	51 - 57
.61 - .80	3	57	51 - 61	2	56	54 - 57
.81 - 2.00	4	55	52 - 58	3	57	56 - 58
2.01 - .20	6	58	54 - 62	2	62	60 - 64
.21 - .40	8	60	55 - 67	3	61	58 - 65
.41 - .60	7	60	56 - 69	4	61	57 - 66
.61 - .80	9	64	60 - 71	4	64	58 - 71
.81 - 3.00	11	68	64 - 75	4	65	59 - 72
3.01 - .20	7	70	67 - 73	1	70	——
.21 - .40	6	76	69 - 86	4	71	67 - 74
.41 - .60	6	81	75 - 96	2	75	71 - 79
.61 - .80	7	85	80 - 99			
.81 - 4.00	5	88	81 - 101			
4.01 - .20	4	89	83 - 94			
.21 - .40	3	93	90 - 95			
.41 - .60	2	100	98 - 103			
.61 - .80	2	101	98 - 104			

TABLE 54. POST-NATAL GROWTH: NASAL LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	29	27 - 31	6	27	26 - 29
.11 - .20	4	32	29 - 34	4	29	28 - 30
.21 - .30	6	34	32 - 36	3	33	32 - 34
.31 - .40	5	35	33 - 38	2	35	34 - 36
.41 - .50	6	38	35 - 39	2	41	38 - 44
.51 - .60	5	41	40 - 43	4	41	38 - 45
.61 - .70	5	44	42 - 45	2	42	40 - 45
.71 - .80	5	46	44 - 49	2	44	42 - 46
.81 - .90	4	47	45 - 50	2	41	38 - 46
.91 - 1.00	3	47	45 - 49	2	45	44 - 46
1.01 - .20	4	48	44 - 54	2	46	45 - 47
.21 - .40	3	52	47 - 55	3	50	47 - 52
.41 - .60	3	53	48 - 56	3	51	48 - 54
.61 - .80	3	55	50 - 58	2	52	49 - 55
.81 - 2.00	4	53	52 - 57	3	55	53 - 57
2.01 - .20	6	56	51 - 61	2	58	57 - 60
.21 - .40	8	58	55 - 64	3	59	55 - 63
.41 - .60	7	62	58 - 66	4	60	55 - 66
.61 - .80	9	63	59 - 68	4	60	56 - 66
.81 - 3.00	11	65	61 - 71	4	62	56 - 70
3.01 - .20	7	66	62 - 70	-	-	—
.21 - .40	6	74	71 - 81	4	65	60 - 71
.41 - .60	6	76	73 - 84	2	70	64 - 75
.61 - .80	7	80	74 - 90			
.81 - 4.00	4	81	77 - 85			
4.01 - .20	4	84	78 - 91			
.21 - .40	3	92	89 - 95			
.41 - .60	2	94	91 - 97			
.61 - .80	1	100	—			

TABLE 55. POST-NATAL GROWTH: CRANIAL BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	61	60 - 62	6	59	56 - 60
.11 - .20	4	65	63 - 68	4	59	57 - 62
.21 - .30	6	68	64 - 72	3	64	64 - 65
.31 - .40	5	71	68 - 75	2	66	65 - 66
.41 - .50	6	71	68 - 77	2	66	66 - 67
.51 - .60	5	74	70 - 79	4	68	68 - 69
.61 - .70	5	75	70 - 80	2	70	70 - 71
.71 - .80	5	76	72 - 79	2	72	71 - 73
.81 - .90	4	78	74 - 80	3	72	70 - 74
.91 - 1.00	3	77	74 - 81	2	74	73 - 74
1.01 - .20	4	78	74 - 83	2	74	74 - 75
.21 - .40	3	80	77 - 83	3	75	73 - 77
.41 - .60	3	80	77 - 84	3	77	75 - 79
.61 - .80	3	82	78 - 86	2	76	76 - 77
.81 - 2.00	4	80	79 - 81	3	78	76 - 79
2.01 - .20	6	81	79 - 83	2	79	78 - 80
.21 - .40	8	82	80 - 84	3	78	77 - 79
.41 - .60	7	85	81 - 96	4	80	78 - 81
.61 - .80	9	86	83 - 92	4	80	79 - 81
.81 - 3.00	11	88	82 - 90	4	81	80 - 82
3.01 - .20	7	88	84 - 91	1	83	——
.21 - .40	6	89	86 - 92	4	82	81 - 84
.41 - .60	6	91	87 - 94	2	82	81 - 83
.61 - .80	7	92	88 - 94			
.81 - 4.00	4	95	93 - 99			
4.01 - .20	4	96	90 - 99			
.21 - .40	3	96	92 - 99			
.41 - .60	2	95	94 - 95			
.61 - .80	2	97	96 - 98			

TABLE 56. POST-NATAL GROWTH: BIZYGOMATIC BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	55	54 - 57	6	52	48 - 55
.11 - .20	4	57	55 - 58	4	56	50 - 58
.21 - .30	6	62	60 - 63	3	59	55 - 61
.31 - .40	5	63	61 - 67	2	62	61 - 63
.41 - .50	6	66	64 - 69	2	64	63 - 66
.51 - .60	5	69	66 - 72	4	67	64 - 69
.61 - .70	5	68	68 - 74	2	68	66 - 71
.71 - .80	5	73	69 - 76	2	70	68 - 73
.81 - .90	4	75	73 - 77	3	71	69 - 73
.91 - 1.00	3	77	75 - 79	2	72	70 - 74
1.01 - .20	4	78	74 - 81	2	74	72 - 75
.21 - .40	3	80	79 - 82	3	74	68 - 78
.41 - .60	3	82	80 - 84	3	75	70 - 79
.61 - .80	3	82	81 - 84	2	74	73 - 76
.81 - 2.00	4	80	77 - 83	3	78	75 - 82
2.01 - .20	6	83	79 - 86	2	78	76 - 80
.21 - .40	8	85	81 - 88	3	80	77 - 82
.41 - .60	7	88	84 - 95	4	80	79 - 81
.61 - .80	9	89	84 - 93	4	82	80 - 83
.81 - 3.00	11	90	87 - 94	4	83	82 - 84
3.01 - .20	7	91	88 - 96	1	84	——
.21 - .40	6	94	90 - 98	4	86	85 - 86
.41 - .60	6	97	93 - 102	2	86	86 - 87
.61 - .80	7	99	95 - 104			
.81 - 4.00	4	100	98 - 104			
4.01 - .20	4	102	99 - 105			
.21 - .40	3	103	102 - 106			
.41 - .60	2	106	106 - 107			
.61 - .80	2	108	-108-			

TABLE 57. POST-NATAL GROWTH: ECTO-ORBITAL BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	47	45 - 49	7	45	42 - 48
.11 - .20	4	50	48 - 50	4	48	46 - 49
.21 - .30	6	53	52 - 54	3	52	51 - 55
.31 - .40	5	55	53 - 58	2	55	54 - 56
.41 - .50	6	56	53 - 59	2	56	55 - 57
.51 - .60	5	57	53 - 59	4	56	54 - 60
.61 - .70	5	58	55 - 60	2	58	57 - 60
.71 - .80	5	60	58 - 62	2	59	58 - 60
.81 - .90	4	62	59 - 63	3	59	56 - 60
.91 - 1.00	3	62	59 - 64	2	60	60 - 66
1.01 - .20	4	62	60 - 63	2	60	60 - 66
.21 - .40	3	63	61 - 64	3	61	60 - 63
.41 - .60	3	64	62 - 65	3	62	61 - 64
.61 - .80	3	65	62 - 66	2	64	63 - 64
.81 - 2.00	4	64	63 - 65	3	64	62 - 65
2.01 - .20	6	66	64 - 69	2	68	67 - 68
.21 - .40	8	68	64 - 72	3	67	65 - 68
.41 - .60	7	69	65 - 72	4	66	62 - 69
.61 - .80	9	70	66 - 76	4	66	63 - 69
.81 - 3.00	11	71	65 - 74	4	68	64 - 70
3.01 - .20	7	73	70 - 76	1	71	——
.21 - .40	6	76	71 - 78	4	69	68 - 71
.41 - .60	6	78	74 - 81	2	70	69 - 72
.61 - .80	7	79	74 - 82			
.81 - 4.00	4	82	79 - 84			
4.01 - .20	4	83	81 - 86			
.21 - .40	4	85	82 - 88			
.41 - .60	2	84	81 - 88			
.61 - .80	2	89	87 - 91			

TABLE 58. POST-NATAL GROWTH: BIORBITAL BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	37	36 - 38	6	35	34 - 36
.11 - .20	4	39	38 - 40	4	38	35 - 40
.21 - .30	6	41	40 - 42	3	40	39 - 41
.31 - .40	5	43	41 - 44	2	41	40 - 42
.41 - .50	6	44	42 - 45	2	42	41 - 42
.51 - .60	5	45	43 - 47	4	42	40 - 44
.61 - .70	5	45	44 - 46	2	43	42 - 44
.71 - .80	5	44	40 - 46	2	44	43 - 45
.81 - .90	4	46	46 - 46	3	44	44 - 45
.91 - 1.00	3	46	46 - 47	2	45	44 - 46
1.01 - .20	4	48	47 - 49	2	44	43 - 46
.21 - .40	3	48	47 - 48	3	45	43 - 48
.41 - .60	3	48	47 - 49	3	47	45 - 48
.61 - .80	3	48	48 - 49	2	49	48 - 50
.81 - 2.00	4	50	48 - 51	3	49	47 - 50
2.01 - .20	6	52	44 - 54	2	51	50 - 52
.21 - .40	8	54	50 - 58	3	51	50 - 52
.41 - .60	7	54	50 - 58	4	50	49 - 53
.61 - .80	9	54	48 - 58	4	52	50 - 54
.81 - 3.00	11	55	50 - 59	4	53	50 - 58
3.01 - .20	7	56	52 - 60	0	—	—
.21 - .40	6	59	53 - 61	4	53	51 - 56
.41 - .60	6	60	58 - 63	2	53	51 - 55
.61 - .80	7	61	58 - 64			
.81 - 4.00	4	63	60 - 66			
4.01 - .20	4	63	60 - 67			
.21 - .40	3	65	62 - 67			
.41 - .60	2	62	58 - 67			
.61 - .80	1	69	—			

TABLE 59. POST-NATAL GROWTH: INTER-ORBITAL BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	8.0	7 - 9	6	8.8	8 - 10
.11 - .20	4	9.0	8 - 10	4	8.5	8 - 9
.21 - .30	6	8.3	8 - 9	3	9.0	8 - 10
.31 - .40	5	9.0	8 - 10	2	9.0	8 - 10
.41 - .50	6	9.3	8 - 11	2	8.5	8 - 9
.51 - .60	5	9.2	8 - 11	4	9.0	8 - 10
.61 - .70	5	9.6	9 - 11	2	8.5	8 - 9
.71 - .80	5	9.8	9 - 11	2	8.5	8 - 9
.81 - .90	4	10.0	9 - 11	2	9.5	9 - 10
.91 - 1.00	3	10.0	9 - 11	2	9.5	9 - 10
1.01 - .20	4	9.8	9 - 11	2	10.0	9 - 11
.21 - .40	3	10.0	9 - 11	3	9.7	9 - 10
.41 - .60	3	10.0	9 - 11	3	9.7	9 - 10
.61 - .80	3	10.0	9 - 11	2	10.5	10 - 11
.81 - 2.00	4	10.2	9 - 11	3	10.3	9 - 11
2.01 - .20	6	10.5	8 - 12	2	10.5	10 - 11
.21 - .40	8	11.2	10 - 13	3	10.3	9 - 11
.41 - .60	7	11.7	10 - 14	4	11.0	10 - 12
.61 - .80	9	11.7	10 - 14	4	11.7	10 - 15
.81 - 3.00	11	11.7	10 - 14	4	12.0	10 - 14
3.01 - .20	7	12.4	11 - 15	1	14.0	——
.21 - .40	6	12.6	13 - 15	4	12.2	11 - 14
.41 - .60	6	14.2	12 - 16	2	12.5	12 - 13
.61 - .80	7	15.0	14 - 16			
.81 - 4.00	4	16.0	14 - 18			
4.01 - .20	4	17.2	16 - 19			
.21 - .40	3	18.3	18 - 19			
.41 - .60	2	18.0	17 - 19			
.61 - .80	2	19.0	——			

TABLE 60. POST-NATAL GROWTH: NASAL BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	15.3	14 - 16	6	14.0	12 - 15
.11 - .20	4	17.0	16 - 18	4	15.8	14 - 17
.21 - .30	6	17.8	17 - 19	3	17.7	16 - 19
.31 - .40	5	18.4	17 - 20	2	18.5	18 - 19
.41 - .50	6	19.2	18 - 20	2	17.5	17 - 18
.51 - .60	5	19.6	18 - 20	4	19.0	18 - 20
.61 - .70	5	20.0	19 - 21	2	19.0	18 - 20
.71 - .80	5	20.8	20 - 22	2	18.5	17 - 20
.81 - .90	4	21.2	21 - 22	3	19.7	18 - 21
.91 - 1.00	3	21.0	20 - 22	2	19.0	18 - 20
1.01 - .20	4	20.5	19 - 22	2	19.0	18 - 20
.21 - .40	3	21.7	20 - 24	3	19.3	16 - 22
.41 - .60	3	21.7	21 - 23	3	20.3	18 - 22
.61 - .80	3	21.7	20 - 24	2	20.5	19 - 22
.81 - 2.00	4	21.8	19 - 26	3	20.7	20 - 21
2.01 - .20	6	22.2	21 - 25	2	21.0	20 - 22
.21 - .40	8	22.5	21 - 24	3	21.0	20 - 22
.41 - .60	7	23.9	21 - 26	4	21.5	21 - 22
.61 - .80	9	24.1	22 - 26	4	21.5	20 - 22
.81 - 3.00	11	24.9	23 - 28	4	22.2	21 - 23
3.01 - .20	7	25.0	23 - 28	1	22.0	—
.21 - .40	6	25.2	24 - 29	4	23.2	23 - 24
.41 - .60	6	27.3	26 - 30	2	24.5	24 - 25
.61 - .80	7	28.4	26 - 30			
.81 - 4.00	4	29.8	28 - 31			
4.01 - .20	4	30.0	29 - 32			
.21 - .40	3	31.7	30 - 33			
.41 - .60	2	32.5	32 - 33			
.61 - .80	1	32.0				

TABLE 61. POST-NATAL GROWTH: BIGONIAL BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	33	31 - 35	6	28	27 - 31
.11 - .20	4	35	32 - 37	4	35	30 - 38
.21 - .30	6	38	35 - 42	3	36	36 - 37
.31 - .40	5	40	38 - 44	2	38	36 - 38
.41 - .50	6	41	38 - 46	2	40	40 - 41
.51 - .60	5	43	40 - 47	4	41	40 - 43
.61 - .70	5	44	41 - 48	2	43	42 - 44
.71 - .80	5	45	41 - 50	2	44	43 - 44
.81 - .90	4	44	42 - 47	3	42	40 - 45
.91 - 1.00	3	44	42 - 48	2	46	45 - 46
1.01 - .20	4	48	46 - 50	2	46	46 - 47
.21 - .40	3	49	46 - 53	3	48	44 - 51
.41 - .60	3	50	49 - 54	3	49	46 - 52
.61 - .80	3	51	47 - 52	2	52	50 - 53
.81 - 2.00	4	49	48 - 54	3	51	50 - 54
2.01 - .20	6	50	49 - 56	2	54	53 - 55
.21 - .40	8	52	51 - 57	3	52	45 - 56
.41 - .60	7	54	53 - 58	4	50	44 - 57
.61 - .80	9	55	53 - 63	4	54	48 - 59
.81 - 3.00	11	58	56 - 64	4	55	52 - 58
3.01 - .20	7	58	57 - 66	1	59	——
.21 - .40	6	60	58 - 70	4	54	51 - 58
.41 - .60	6	63	59 - 72	2	52	51 - 52
.61 - .80	7	65	59 - 72			
.81 - 4.00	4	66	60 - 73			
4.01 - .20	4	72	68 - 79			
.21 - .40	3	72	60 - 74			
.41 - .60	2	74	71 - 78			
.61 - .80	2	74	71 - 78			

TABLE 62. POST-NATAL GROWTH: EAR LENGTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	38	37 - 39	6	33	32 - 36
.11 - .20	4	40	40 - 43	4	38	37 - 40
.21 - .30	6	42	39 - 45	3	40	38 - 44
.31 - .40	5	43	40 - 46	2	44	40 - 48
.41 - .50	6	43	40 - 46	2	45	41 - 49
.51 - .60	5	45	43 - 47	4	42	39 - 49
.61 - .70	5	46	44 - 48	2	46	42 - 50
.71 - .80	5	46	45 - 48	2	46	43 - 50
.81 - .90	4	46	45 - 48	3	45	42 - 51
.91 - 1.00	3	45	45 - 49	2	50	46 - 53
1.01 - .20	4	48	46 - 51	2	51	48 - 54
.21 - .40	3	49	49 - 49	3	48	45 - 53
.41 - .60	3	48	45 - 50	3	49	45 - 53
.61 - .80	3	49	45 - 51	2	48	44 - 53
.81 - 2.00	4	50	46 - 53	3	48	45 - 53
2.01 - .20	6	50	47 - 53	2	50	46 - 53
.21 - .40	8	50	47 - 54	3	49	47 - 52
.41 - .60	7	51	48 - 55	4	49	44 - 52
.61 - .80	9	51	48 - 56	4	50	46 - 53
.81 - 3.00	11	53	48 - 57	4	49	47 - 54
3.01 - .20	7	53	49 - 57	1	46	——
.21 - .40	6	54	50 - 56	4	50	46 - 50
.41 - .60	6	55	51 - 57	2	48	48 - 49
.61 - .80	7	55	51 - 58			
.81 - 4.00	5	56	52 - 59			
4.01 - .20	4	58	55 - 59			
.21 - .40	3	60	57 - 64			
.41 - .60	2	62	59 - 64			
.61 - .80	1	62	——			

TABLE 63. POST-NATAL GROWTH: EAR BREADTH

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	3	28	27 - 30	6	25	23 - 26
.11 - .20	4	28	25 - 32	4	27	26 - 28
.21 - .30	6	30	28 - 33	3	28	27 - 31
.31 - .40	5	31	29 - 33	2	31	29 - 33
.41 - .50	6	31	29 - 34	2	32	31 - 33
.51 - .60	5	32	30 - 34	4	30	28 - 33
.61 - .70	5	32	30 - 35	2	32	32 - 33
.71 - .80	5	33	30 - 35	2	33	32 - 34
.81 - .90	4	33	31 - 35	3	31	29 - 34
.91 - 1.00	3	33	31 - 34	2	32	30 - 35
1.01 - .20	4	34	32 - 35	2	33	30 - 36
.21 - .40	3	32	31 - 33	3	33	29 - 35
.41 - .60	3	34	33 - 34	3	34	32 - 36
.61 - .80	3	34	32 - 36	2	34	33 - 36
.81 - 2.00	4	34	33 - 37	3	35	33 - 37
2.01 - .20	6	35	32 - 37	2	36	35 - 38
.21 - .40	8	35	32 - 38	3	34	32 - 36
.41 - .60	7	36	32 - 40	4	34	32 - 36
.61 - .80	9	37	31 - 41	4	34	33 - 35
.81 - 3.00	11	37	33 - 42	4	36	34 - 38
3.01 - .20	7	38	34 - 43	1	34	——
.21 - .40	6	40	37 - 42	4	36	33 - 40
.41 - .60	6	40	36 - 45	2	36	35 - 37
.61 - .80	7	40	37 - 45			
.81 - 4.00	5	42	40 - 44			
4.01 - .20	4	42	40 - 44			
.21 - .40	3	42	39 - 44			
.41 - .60	2	45	-45-			
.61 - .80	1	42	——			

TABLE 64. POST-NATAL GROWTH: CRANIAL CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	222	217 - 227	4	213	204 - 217
.11 - .20	1	227	——	1	226	——
.21 - .30	3	240	225 - 256	2	241	236 - 246
.31 - .40	2	246	245 - 247	1	256	——
.41 - .50	2	256	249 - 263	2	264	263 - 266
.51 - .60	3	264	260 - 266	4	256	250 - 265
.61 - .70	4	271	258 - 290	2	265	262 - 268
.71 - .80	4	277	270 - 290	2	270	268 - 272
.81 - .90	4	280	272 - 292	2	268	259 - 278
.91 - 1.00	3	283	270 - 295	0	-	——
1.01 - .20	3	284	274 - 287	0	-	——
.21 - .40	2	276	263 - 288	2	271	262 - 280
.41 - .60	3	288	278 - 300	2	275	268 - 282
.61 - .80	3	293	286 - 306	1	272	——
.81 - 2.00	4	288	285 - 292	3	285	274 - 292
2.01 - .20	6	297	292 - 302	2	290	282 - 298
.21 - .40	8	300	292 - 309	2	285	284 - 286
.41 - .60	6	307	300 - 312	3	284	280 - 293
.61 - .80	9	312	303 - 321	2	296	286 - 305
.81 - 3.00	10	318	305 - 330	3	299	292 - 310
3.01 - .20	6	322	308 - 329	1	304	——
.21 - .40	3	324	311 - 331	3	307	299 - 314
.41 - .60	4	339	321 - 352			
.61 - .80	5	345	330 - 356			
.81 - 4.00	3	355	350 - 358			
4.01 - .20	4	362	360 - 365			
.21 - .40	2	363	357 - 369			
.41 - .60	-	-	——			
.61 - .80	-	-	——			

TABLE 65. POST-NATAL GROWTH: NECK CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	106	96 - 115	4	104	92 - 115
.11 - .20	1	99	——	1	113	——
.21 - .30	3	120	103 - 136	2	117	112 - 122
.31 - .40	2	124	105 - 144	1	124	——
.41 - .50	3	131	115 - 147	2	126	125 - 127
.51 - .60	3	143	140 - 149	4	138	135 - 142
.61 - .70	4	148	141 - 153	2	146	144 - 147
.71 - .80	4	154	150 - 162	2	144	142 - 147
.81 - .90	4	157	150 - 166	2	144	141 - 150
.91 - 1.00	3	162	154 - 170	0	-	——
1.01 - .20	3	172	165 - 180	0	-	——
.21 - .40	2	171	162 - 180	2	161	150 - 172
.41 - .60	3	170	168 - 172	2	182	176 - 187
.61 - .80	3	175	170 - 185	1	177	——
.81 - 2.00	3	171	167 - 173	3	174	173 - 175
2.01 - .20	6	182	171 - 198	2	190	175 - 206
.21 - .40	8	192	178 - 210	2	186	169 - 204
.41 - .60	6	202	190 - 225	3	191	170 - 202
.61 - .80	9	207	194 - 235	2	178	177 - 180
.81 - 3.00	10	210	192 - 233	3	194	185 - 208
3.01 - .20	6	225	205 - 235	1	202	——
.21 - .40	3	221	212 - 232	3	199	186 - 210
.41 - .60	4	242	235 - 246			
.61 - .80	5	250	237 - 265			
.81 - 4.00	3	259	255 - 265			
4.01 - .20	4	268	261 - 285			
.21 - .40	2	270	266 - 274			
.41 - .60	-	-	——			
.61 - .80	-	-	——			

TABLE 66. POST-NATAL GROWTH: CHEST CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	1	169	——	4	164	155 - 180
.11 - .20	1	187	——	1	193	——
.21 - .30	3	240	209 - 290	2	236	223 - 246
.31 - .40	2	256	222 - 290	1	245	——
.41 - .50	2	272	248 - 295	2	275	267 - 283
.51 - .60	2	279	267 - 291	4	278	260 - 299
.61 - .70	4	291	276 - 300	2	298	285 - 310
.71 - .80	4	304	295 - 318	3	308	295 - 320
.81 - .90	3	315	301 - 326	2	301	297 - 305
.91 - 1.00	2	326	318 - 335	0	—	——
1.01 - .20	3	310	273 - 338	0	—	——
.21 - .40	2	346	331 - 360	2	318	303 - 334
.41 - .60	3	342	340 - 345	2	325	309 - 341
.61 - .80	3	351	345 - 358	1	338	——
.81 - 2.00	4	353	332 - 372	3	357	342 - 375
2.01 - .20	6	368	343 - 384	2	387	385 - 389
.21 - .40	8	373	343 - 399	2	364	341 - 387
.41 - .60	6	388	372 - 406	3	367	330 - 390
.61 - .80	9	397	373 - 445	2	370	350 - 390
.81 - 3.00	10	405	379 - 430	3	387	369 - 419
3.01 - .20	6	418	400 - 440	1	415	——
.21 - .40	3	441	425 - 450	3	410	380 - 420
.41 - .60	4	457	425 - 481			
.61 - .80	5	469	439 - 500			
.81 - 4.00	3	496	483 - 504			
4.01 - .20	4	512	593 - 519			
.21 - .40	2	521	515 - 527			
.41 - .60	—	—	——			
.61 - .80	—	—	——			

TABLE 67. POST-NATAL GROWTH: ABDOMINAL CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	1	150	——	4	149	125 - 170
.11 - .20	1	170	——	1	174	——
.21 - .30	3	240	196 - 255	2	204	185 - 222
.31 - .40	2	235	211 - 265	1	191	——
.41 - .50	3	239	218 - 260	2	244	198 - 290
.51 - .60	3	272	252 - 310	4	249	233 - 268
.61 - .70	4	258	244 - 275	2	269	-269-
.71 - .80	4	266	249 - 279	2	286	282 - 290
.81 - .90	4	277	236 - 304	2	264	251 - 295
.91 - 1.00	3	304	285 - 322	0	—	——
1.01 - .20	3	291	225 - 340	0	—	——
.21 - .40	2	323	296 - 350	2	264	254 - 275
.41 - .60	3	319	307 - 330	2	280	272 - 288
.61 - .80	3	301	282 - 329	1	294	——
.81 - 2.00	4	320	290 - 351	3	307	275 - 325
2.01 - .20	7	326	290 - 358	2	343	332 - 356
.21 - .40	8	320	289 - 344	2	317	299 - 336
.41 - .60	6	342	300 - 360	3	308	277 - 340
.61 - .80	9	340	312 - 368	2	306	292 - 320
.81 - 3.00	10	344	300 - 377	3	314	300 - 337
3.01 - .20	6	353	325 - 400	1	345	——
.21 - .40	3	368	358 - 375	3	326	301 - 345
.41 - .60	4	387	374 - 420			
.61 - .80	5	387	373 - 405			
.81 - 4.00	3	406	389 - 421			
4.01 - .20	4	454	430 - 480			
.21 - .40	2	432	422 - 442			
.41 - .60	—	—	——			
.61 - .80	—	—	——			

TABLE 68. POST-NATAL GROWTH: UPPER ARM CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	58	55 - 62	4	58	54 - 62
.11 - .20	1	60	—	1	66	—
.21 - .30	3	78	67 - 92	2	78	77 - 80
.31 - .40	2	82	71 - 93	1	83	—
.41 - .50	3	89	83 - 95	2	90	89 - 92
.51 - .60	3	96	90 - 100	4	91	88 - 96
.61 - .70	4	100	94 - 103	2	95	90 - 100
.71 - .80	3	109	101 - 115	2	95	92 - 98
.81 - .90	4	114	103 - 122	2	104	100 - 109
.91 - 1.00	3	119	114 - 124	0	—	—
1.01 - .20	3	116	110 - 120	0	—	—
.21 - .40	2	125	112 - 138	2	115	103 - 127
.41 - .60	3	128	122 - 131	2	128	127 - 129
.61 - .80	3	134	125 - 145	1	126	—
.81 - 2.00	4	129	125 - 135	3	131	128 - 135
2.01 - .20	6	141	131 - 153	2	148	143 - 152
.21 - .40	8	146	132 - 159	2	138	131 - 156
.41 - .60	6	151	146 - 157	3	146	129 - 161
.61 - .80	9	156	144 - 169	2	146	141 - 151
.81 - 3.00	10	161	148 - 172	3	159	152 - 172
3.01 - .20	6	166	153 - 184	1	171	—
.21 - .40	3	188	183 - 195	3	161	143 - 175
.41 - .60	4	193	185 - 200			
.61 - .80	5	196	179 - 205			
.81 - 4.00	3	208	199 - 215			
4.01 - .20	4	207	187 - 221			
.21 - .40	2	206	186 - 224			
.41 - .60	-	—	—			
.61 - .80	-	—	—			

TABLE 69. POST-NATAL GROWTH: FOREARM CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	56	54 - 59	4	54	53 - 55
.11 - .20	1	58	—	1	58	—
.21 - .30	3	70	67 - 92	2	72	71 - 72
.31 - .40	2	74	66 - 83	1	74	—
.41 - .50	3	78	70 - 87	2	77	74 - 78
.51 - .60	3	85	80 - 90	4	81	80 - 82
.61 - .70	4	86	83 - 92	2	84	82 - 87
.71 - .80	4	92	91 - 94	2	86	84 - 89
.81 - .90	4	94	90 - 97	2	86	80 - 91
.91 - 1.00	3	96	93 - 101	0	—	—
1.01 - .20	3	95	92 - 97	0	—	—
.21 - .40	2	104	90 - 119	2	86	82 - 90
.41 - .60	3	97	92 - 100	2	94	89 - 99
.61 - .80	3	103	97 - 110	1	96	—
.81 - 2.00	4	99	96 - 104	3	100	95 - 104
2.01 - .20	6	103	98 - 107	2	110	109 - 111
.21 - .40	8	101	92 - 109	2	106	98 - 115
.41 - .60	6	109	106 - 111	3	106	92 - 121
.61 - .80	9	117	103 - 134	2	106	102 - 110
.81 - 3.00	10	123	111 - 142	3	116	112 - 120
3.01 - .20	6	122	114 - 132	1	125	—
.21 - .40	3	130	118 - 140	3	120	109 - 130
.41 - .60	4	136	128 - 142			
.61 - .80	5	142	133 - 150			
.81 - 4.00	3	146	145 - 147			
4.01 - .20	4	149	145 - 150			
.21 - .40	2	156	153 - 158			
.41 - .60	-	—	—			
.61 - .80	-	—	—			

TABLE 70. POST-NATAL GROWTH: WRIST CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	46	44 - 48	4	47	45 - 50
.11 - .20	1	48	—	1	47	—
.21 - .30	3	60	53 - 70	2	58	57 - 58
.31 - .40	2	63	56 - 71	1	60	—
.41 - .50	3	64	56 - 72	2	66	61 - 72
.51 - .60	3	70	62 - 75	4	66	64 - 70
.61 - .70	3	73	63 - 79	2	68	66 - 69
.71 - .80	4	74	63 - 80	2	70	69 - 72
.81 - .90	4	72	66 - 80	2	70	65 - 75
.91 - 1.00	3	76	68 - 80	0	—	—
1.01 - .20	3	74	69 - 81	0	—	—
.21 - .40	2	78	72 - 83	2	68	67 - 70
.41 - .60	3	78	74 - 81	2	70	69 - 71
.61 - .80	3	80	76 - 82	1	72	—
.81 - 2.00	4	78	71 - 84	3	77	75 - 81
2.01 - .20	6	79	71 - 85	2	80	78 - 81
.21 - .40	8	79	72 - 85	2	76	72 - 81
.41 - .60	6	82	80 - 86	3	79	73 - 85
.61 - .80	9	86	80 - 95	2	77	74 - 80
.81 - 3.00	10	88	81 - 96	3	81	75 - 84
3.01 - .20	6	88	82 - 96	1	83	—
.21 - .40	3	96	95 - 97	3	87	81 - 90
.41 - .60	4	98	91 - 101			
.61 - .80	5	101	94 - 105			
.81 - 4.00	3	105	103 - 108			
4.01 - .20	4	106	97 - 111			
.21 - .40	2	107	103 - 111			
.41 - .60	—	—	—			
.61 - .80	—	—	—			

TABLE 71. POST-NATAL GROWTH: THIGH CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	64	60 - 67	4	66	61 - 73
.11 - .20	1	67	——	1	80	——
.21 - .30	3	87	76 - 105	2	90	89 - 90
.31 - .40	2	94	82 - 107	1	93	——
.41 - .50	3	102	93 - 110	2	98	97 - 100
.51 - .60	2	120	115 - 125	4	111	105 - 120
.61 - .70	4	124	115 - 135	2	126	123 - 128
.71 - .80	4	138	126 - 152	2	133	-133-
.81 - .90	4	142	128 - 156	2	140	135 - 144
.91 - 1.00	3	149	135 - 170	0	—	——
1.01 - .20	3	137	130 - 142	0	—	——
.21 - .40	2	161	156 - 167	2	148	145 - 150
.41 - .60	3	167	165 - 168	2	168	165 - 170
.61 - .80	3	177	168 - 185	1	169	——
.81 - 2.00	4	169	157 - 186	3	171	160 - 177
2.01 - .20	6	189	174 - 208	2	191	183 - 199
.21 - .40	8	192	181 - 201	2	181	172 - 190
.41 - .60	6	204	187 - 226	3	189	175 - 206
.61 - .80	8	203	188 - 228	2	202	188 - 216
.81 - 3.00	10	213	187 - 232	3	210	200 - 229
3.01 - .20	6	222	205 - 237	1	230	——
.21 - .40	3	243	233 - 250	3	221	207 - 231
.41 - .60	4	254	242 - 261			
.61 - .80	5	260	229 - 271			
.81 - 4.00	3	258	240 - 268			
4.01 - .20	4	248	220 - 270			
.21 - .40	2	284	267 - 301			
.41 - .60	—	—	——			
.61 - .80	—	—	——			

TABLE 72. POST-NATAL GROWTH: CALF CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	55	52 - 58	4	55	50 - 60
.11 - .20	1	57	—	1	58	—
.21 - .30	3	73	63 - 86	2	71	69 - 73
.31 - .40	2	83	67 - 90	1	74	—
.41 - .50	3	86	75 - 97	2	84	79 - 90
.51 - .60	2	95	90 - 100	4	90	85 - 94
.61 - .70	4	97	91 - 102	2	98	96 - 100
.71 - .80	4	105	100 - 112	2	107	104 - 110
.81 - .90	4	106	103 - 111	2	102	89 - 115
.91 - 1.00	3	112	106 - 120	0	—	—
1.01 - .20	3	113	106 - 117	0	—	—
.21 - .40	2	118	111 - 125	2	103	98 - 108
.41 - .60	3	123	120 - 127	2	116	113 - 118
.61 - .80	3	126	125 - 129	1	121	—
.81 - 2.00	4	127	122 - 136	3	128	124 - 134
2.01 - .20	6	134	130 - 138	2	138	132 - 145
.21 - .40	8	136	130 - 146	2	130	123 - 137
.41 - .60	6	142	135 - 152	3	133	119 - 146
.61 - .80	8	145	134 - 158	2	135	127 - 143
.81 - 3.00	10	150	135 - 169	3	147	135 - 154
3.01 - .20	6	157	148 - 167	1	155	—
.21 - .40	3	158	146 - 166	3	151	140 - 165
.41 - .60	4	172	164 - 179			
.61 - .80	5	175	163 - 180			
.81 - 4.00	3	183	179 - 187			
4.01 - .20	4	186	180 - 190			
.21 - .40	2	191	187 - 195			
.41 - .60	—	—	—			
.61 - .80	—	—	—			

TABLE 73. POST-NATAL GROWTH: ANKLE CIRCUMFERENCE

AGE	MALE			FEMALE		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)		(mm.)	(mm.)		(mm.)	(mm.)
0.00 - .10	2	48	46 - 50	4	45	44 - 47
.11 - .20	1	50	—	1	47	—
.21 - .30	3	58	54 - 65	2	59	58 - 60
.31 - .40	2	63	57 - 70	1	59	—
.41 - .50	3	66	56 - 75	2	64	60 - 68
.51 - .60	3	70	65 - 76	4	66	65 - 67
.61 - .70	4	73	67 - 76	2	70	68 - 71
.71 - .80	4	76	71 - 78	2	73	70 - 76
.81 - .90	4	77	72 - 81	2	71	68 - 74
.91 - 1.00	3	80	75 - 85	0	—	—
1.01 - .20	3	76	68 - 83	0	—	—
.21 - .40	2	80	74 - 85	2	68	65 - 70
.41 - .60	3	80	76 - 88	2	72	71 - 74
.61 - .80	3	87	82 - 92	1	75	—
.81 - 2.00	4	80	76 - 88	3	79	75 - 81
2.01 - .20	6	84	78 - 91	2	84	80 - 88
.21 - .40	8	85	79 - 92	2	78	75 - 82
.41 - .60	6	88	84 - 92	3	84	78 - 88
.61 - .80	8	90	82 - 98	2	82	80 - 84
.81 - 3.00	10	91	84 - 96	3	86	82 - 88
3.01 - .20	6	93	85 - 99	1	88	—
.21 - .40	3	97	95 - 100	3	88	85 - 89
.41 - .60	4	100	97 - 104			
.61 - .80	5	101	90 - 105			
.81 - 4.00	3	106	104 - 108			
4.01 - .20	4	109	108 - 111			
.21 - .40	2	110	109 - 112			
.41 - .60	—	—	—			
.61 - .80	—	—	—			

TABLE 74. MEANS OF GENERAL BODY MEASUREMENTS, BODY WEIGHT, AND DENTAL SCORE OF MALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

TRUNK HEIGHT CLASS INTERVAL	N	TRUNK HEIGHT	SITTING HEIGHT	STEM LENGTH	TOTAL HEAD HEIGHT	SUBSTERNAL HEIGHT	TAIL LENGTH	BODY WEIGHT	DENTAL SCORE
		MEANS							
mm.				mm.				kg.	No. Teeth
110-129	1	121	224	203	82	80	241	0.87	6.00
130-149	3	141	242	222	81	86	250	1.18	6.33
150-169	5	158	278	245	87	101	266	1.60	11.40
170-189	3	180	313	278	98	116	293	2.06	16.00
190-209	4	196	336	299	103	122	325	2.38	16.75
210-229	6	215	360	325	110	145	341	2.97	19.41
230-249	9	241	395	349	108	168	377	3.66	20.11
250-269	7	262	430	377	115	183	386	4.85	22.00
270-289	5	281	456	402	121	187	418	5.62	23.40
290-309	15	301	482	425	124	206	400	6.53	24.01
310-329	13	321	513	450	129	220	448	7.90	26.01
330-349	5	337	533	473	136	238	469	8.98	27.70
350-369	7	358	564	502	144	250	470	10.24	31.82
370-389	8	377	600	524	147	256	525	12.49	40.37
390-409	3	396	624	549	153	266	565	14.21	43.41
410-429	3	416	655	574	158	318	561	18.72	49.58

TABLE 75. MEANS OF GENERAL BODY MEASUREMENTS, BODY WEIGHT AND DENTAL SCORE OF FEMALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

		MEANS							
TRUNK HEIGHT CLASS INTERVAL	N	TRUNK HEIGHT	SITTING HEIGHT	STEM LENGTH	TOTAL HEAD HEIGHT	SUBSTERNAL HEIGHT	TAIL LENGTH	BODY WEIGHT	DENTAL SCORE
mm.				mm.				kg.	No. Teeth
90-109	2	101	187	173	72	53	184	0.48	0.00
110-129	5	122	208	192	70	79	206	0.64	0.00
130-149	5	138	230	216	78	91	241	0.88	5.25
150-169	3	165	277	246	81	105	278	1.46	13.08
170-189	1	187	321	281	94	114	285	2.00	16.00
190-209	1	199	339	309	110	136	302	2.40	16.00
210-229	3	221	368	325	104	148	318	2.77	18.33
230-249	3	237	388	348	111	166	362	3.29	20.00
250-269	7	257	417	370	113	181	378	3.95	21.92
270-289	8	280	448	400	120	200	384	5.08	22.59
290-309	7	299	481	424	125	215	413	6.73	27.67
310-329	6	320	503	449	129	223	360	7.77	33.29
330-349	5	340	535	475	135	239	446	8.53	36.06
350-369	13	359	564	501	142	251	465	9.62	44.55
370-389	14	381	593	527	146	269	462	12.04	50.73

TABLE 76. MEANS OF MEASUREMENTS OF THE TRUNK OF MALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

		MEANS IN MILLIMETERS						
TRUNK HEIGHT CLASS INTERVALS mm.	N	BIACROMIAL BREADTH	CHEST BREADTH	CHEST DEPTH	PELVIC LENGTH	BICRISTAL BREADTH	BITROCHAN-TERIC BREADTH	BITUBEROSITY BREADTH
110-129	1	62	45	60	-	42	56	-
130-149	3	65	65	68	-	46	59	-
150-169	5	77	75	79	76	52	67	52
170-189	3	91	80	85	88	60	76	53
190-209	4	95	88	93	96	62	81	58
210-229	6	98	90	101	105	67	89	56
230-249	9	108	95	105	109	69	94	60
250-269	7	120	103	120	121	79	105	67
270-289	5	123	111	124	130	82	115	71
290-309	15	129	114	130	138	85	121	76
310-329	13	139	117	138	149	93	132	83
330-349	5	147	119	142	155	99	143	90
350-369	7	152	123	146	164	104	150	98
370-389	8	163	128	152	176	115	164	108
390-409	3	160	132	158	186	121	172	119
410-429	3	183	151	188	194	139	192	137

TABLE 77. MEANS OF MEASUREMENTS OF THE TRUNK OF FEMALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

		MEANS IN MILLIMETERS						
TRUNK HEIGHT CLASS INTERVAL mm.	N	BIACROMIAL BREADTH	CHEST BREADTH	CHEST DEPTH	PELVIC LENGTH	BICRISTAL BREADTH	BIOCHAN-TERIC BREADTH	BITUBEROSITY BREADTH
90-109	2	44	39	47	-	31	45	-
110-129	5	56	54	54	56	38	50	34
130-149	5	64	59	61	61	41	56	36
150-169	3	78	72	81	76	51	67	47
170-189	1	89	75	86	-	59	74	-
190-209	1	93	87	88	-	63	83	-
210-229	3	95	91	97	102	66	86	64
230-249	3	107	97	105	109	69	92	67
250-269	7	107	97	109	117	75	101	70
270-289	8	122	108	119	127	82	112	77
290-309	7	128	112	129	137	89	126	86
310-329	6	137	113	132	145	96	134	94
330-349	5	142	114	139	153	98	141	98
350-369	13	147	125	145	164	110	151	111
370-389	14	153	133	156	170	118	157	119

TABLE 78. MEANS OF MEASUREMENTS OF THE UPPER EXTREMITY OF MALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

		MEANS IN MILLIMETERS								
TRUNK HEIGHT CLASS INTERVAL	N	UPPER ARM	FOREARM LENGTH (ULNAR)	FOREARM LENGTH (RADIAL)	HAND LENGTH	POLLUX LENGTH	ELBOW BREADTH	WRIST BREADTH	HAND BREADTH	TOTAL ARM LENGTH
mm.										
110-129	1	67	82	74	63	-	17	-	22	212
130-149	3	74	88	80	65	-	19	-	24	230
150-169	5	81	93	84	70	56	22	21	27	245
170-189	3	91	102	93	75	57	25	23	28	268
190-209	4	95	108	100	79	60	25	24	29	283
210-229	6	110	125	117	88	63	27	25	30	323
230-249	9	118	134	122	93	67	28	26	32	346
250-269	7	132	155	140	100	74	30	29	35	387
270-289	5	144	168	154	106	76	32	30	36	418
290-309	15	153	177	162	113	80	34	31	37	444
310-329	13	165	190	173	122	87	37	33	40	478
330-349	5	171	195	180	124	89	37	33	41	491
350-369	7	182	203	189	130	93	38	36	43	515
370-389	8	199	217	206	137	99	41	40	46	555
390-409	3	211	229	214	141	104	41	38	47	582
410-429	3	230	251	228	145	105	44	41	49	626

TABLE 79. MEANS OF MEASUREMENTS OF THE UPPER EXTREMITY OF FEMALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

MEANS IN MILLIMETERS

TRUNK HEIGHT CLASS INTERVAL mm.	N	UPPER ARM	FOREARM LENGTH (ULNAR)	FOREARM LENGTH (RADIAL)	HAND LENGTH	POLLUX LENGTH	ELBOW BREADTH	WRIST BREADTH	HAND BREADTH	TOTAL ARM LENGTH
90-109	2	55	62	56	52	38	15	16	20	170
110-129	5	66	72	67	60	42	16	17	22	199
130-149	5	72	82	75	64	44	17	18	22	218
150-169	3	83	94	87	69	51	20	19	26	247
170-189	1	91	100	93	78	56	23	22	27	269
190-209	1	96	109	101	79	58	24	23	28	284
210-229	3	106	119	112	85	62	25	25	30	311
230-249	3	115	135	125	92	64	26	25	31	343
250-269	7	131	151	138	98	68	28	26	32	381
270-289	8	140	163	149	105	74	30	28	34	409
290-309	7	152	176	164	113	81	32	30	37	442
310-329	6	163	185	173	117	85	34	31	38	466
330-349	5	173	203	187	121	88	34	31	39	498
350-369	13	189	208	197	126	91	35	32	40	524
370-389	14	191	213	198	126	90	35	33	41	530

TABLE 80. MEANS OF MEASUREMENTS OF LOWER EXTREMITY OF MALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

		MEANS IN MILLIMETERS									
TRUNK HEIGHT CLASS INTERVAL mm.	N	THIGH LENGTH	LEG LENGTH	KNEE HEIGHT	FOOT LENGTH	HALLUX LENGTH	KNEE BREADTH	ANKLE BREADTH	FOOT BREADTH	TOTAL LOWER LIMB LENGTH	THIGH L. + KNEE HEIGHT
110-129	1	80	70	81	88	-	18	-	22	238	161
130-149	3	86	75	87	90	-	19	-	23	252	173
150-169	5	96	84	96	96	78	22	20	25	277	192
170-189	3	105	92	106	105	84	25	21	27	303	211
190-209	4	113	99	112	112	88	26	23	28	325	225
210-229	6	132	115	130	120	95	28	24	30	368	262
230-249	9	141	123	139	126	98	30	25	30	390	280
250-269	7	161	138	157	136	107	32	27	32	436	318
270-289	5	176	152	170	145	114	34	29	34	474	346
290-309	15	185	159	181	153	120	36	30	35	498	366
310-329	13	198	172	194	165	127	38	32	38	535	392
330-349	5	208	180	202	169	130	39	33	40	557	410
350-369	7	219	187	211	176	136	40	34	42	583	430
370-389	8	230	198	222	183	139	42	34	44	612	452
390-409	3	242	208	232	191	143	43	35	46	641	474
410-429	3	259	220	248	196	149	44	38	46	675	507

TABLE 81. MEANS OF MEASUREMENTS OF LOWER EXTREMITY OF FEMALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

MEANS IN MILLIMETERS

TRUNK HEIGHT CLASS INTERVAL mm.	N	THIGH LENGTH	LEG LENGTH	KNEE HEIGHT	FOOT LENGTH	HALLUX LENGTH	KNEE BREADTH	ANKLE BREADTH	FOOT BREADTH	TOTAL LOWER LIMB LENGTH	THIGH L. + KNEE HEIGHT
90-109	2	61	51	64	69	54	14	12	18	186	125
110-129	5	76	66	77	80	62	17	15	20	223	153
130-149	5	84	75	85	85	66	18	16	21	245	169
150-169	3	99	86	99	96	76	20	19	24	282	198
170-189	1	113	97	111	107	84	24	22	27	317	224
190-209	1	117	106	121	111	86	26	23	27	334	238
210-229	3	127	115	131	121	95	27	25	28	363	258
230-249	3	142	127	144	124	99	28	25	29	395	286
250-269	7	158	136	156	131	102	29	26	32	426	314
270-289	8	170	148	166	140	110	32	28	34	454	336
290-309	7	184	159	180	150	115	33	29	36	494	364
310-329	6	196	167	189	156	120	34	29	37	520	385
330-349	5	206	180	201	165	124	35	31	37	551	407
350-369	13	218	188	208	169	130	37	31	39	574	426
370-389	14	223	186	209	169	130	36	31	39	579	432

TABLE 82. MEANS OF CRANIAL AND FACIAL MEASUREMENTS OF MALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

		MEANS IN MILLIMETERS														
TRUNK HEIGHT CLASS INTERVAL mm.	N	TOTAL HEAD LENGTH	CRANIAL LENGTH	CRANIAL BREADTH	TOTAL FACE HEIGHT	UPPER FACE HEIGHT	NOSE HEIGHT	BIZYGOMATIC BREADTH	BIORBITAL BREADTH	BIOCULAR BREADTH	INTEROCULAR BREADTH	NOSE BREADTH	BIGONIAL BREADTH	EAR LENGTH	EAR BREADTH
110-129	1	-	76	60	39	28	31	47	45	36	7	14	34	39	27
130-149	3	-	81	63	47	33	31	56	49	39	8	16	34	40	27
150-169	5	102	85	67	51	35	34	60	53	41	9	18	37	41	29
170-189	3	106	90	70	53	36	35	64	55	43	9	18	40	43	30
190-209	4	108	89	69	57	38	39	64	55	44	10	19	42	45	31
210-229	6	110	91	71	62	43	44	69	58	45	9	18	43	47	32
230-249	9	114	91	73	65	46	46	73	59	46	9	20	44	48	33
250-269	7	120	93	78	74	55	52	80	63	47	10	21	49	48	33
270-289	5	126	96	80	77	58	55	82	66	49	10	21	49	50	35
290-309	15	132	99	82	81	60	58	85	69	52	11	22	52	50	35
310-329	13	138	102	86	88	65	62	89	70	55	12	25	55	51	37
330-349	5	143	104	89	89	68	65	93	71	54	12	25	59	52	36
350-369	7	151	107	89	95	75	70	95	73	57	13	26	60	52	36
370-389	8	165	109	95	103	81	77	103	79	58	15	29	61	53	36
390-409	3	174	112	94	110	89	81	105	82	59	15	29	63	53	36
410-429	3	193	115	102	121	106	98	114	88	63	18	34	66	57	39

TABLE 83. MEANS OF CRANIAL AND FACIAL MEASUREMENTS OF FEMALE BABOONS GROUPED ACCORDING TO TRUNK HEIGHT CLASS INTERVALS

		MEANS IN MILLIMETERS													
TRUNK HEIGHT CLASS INTERVAL mm.	N	TOTAL HEAD LENGTH	CRANIAL LENGTH	CRANIAL BREADTH	TOTAL FACE HEIGHT	UPPER FACE HEIGHT	NOSE HEIGHT	BIZYGOMATIC BREADTH	BIORBITAL BREADTH	BIOCULAR BREADTH	INTEROCULAR BREADTH	NOSE BREADTH	BIGONIAL BREADTH	EAR LENGTH	EAR BREADTH
90-109	2	76	65	57	36	26	27	47	42	31	8	12	25	31	20
110-129	5	83	73	59	41	28	28	53	45	34	8	13	28	33	25
130-149	5	90	77	61	43	30	28	53	47	36	8	14	31	38	27
150-169	3	101	85	64	48	34	32	58	52	40	8	17	36	43	30
170-189	1	103	88	66	52	37	35	61	54	42	9	18	38	48	33
190-209	1	106	90	67	59	41	44	63	55	42	8	17	41	49	33
210-229	3	107	89	70	60	43	43	66	56	43	9	17	41	48	32
230-249	3	110	90	72	64	47	46	68	59	46	9	17	44	48	32
250-269	7	119	91	75	69	52	49	75	60	48	10	20	43	47	33
270-289	8	122	93	77	74	55	52	77	64	48	10	21	48	48	33
290-309	7	133	96	80	80	61	57	84	66	51	12	22	49	46	33
310-329	6	141	100	81	84	67	62	88	68	53	12	24	51	47	34
330-349	5	141	100	82	87	69	63	88	71	54	12	23	53	49	34
350-369	13	152	102	84	93	76	71	92	72	55	13	24	53	49	34
370-389	14	161	104	84	98	83	76	96	75	56	14	25	56	52	36

TABLE 84. SOME INDICES OF GENERAL BODY CONFIGURATION OF NEWBORN SAVANNAH BABOONS COMPARED WITH THOSE OF ADULT MALES AND FEMALES

Index	Newborn	Adult Female	Adult Male
Chest Depth / Chest Breadth	1.04	1.18	1.14
Bicristal Breadth / Biacromial Breadth	0.68	0.79	0.77
Bicristal Breadth / Pelvic Length	0.66	0.72	0.71
Total Arm Length / Trunk Height	1.62	1.37	1.45
Total Leg Length / Trunk Height	1.78	1.51	1.59
Cranial Length / Trunk Height	0.57	0.26	0.27
Biacromial Breadth / Trunk Height	0.43	0.43	0.40
Tail Length / Sitting Height	0.99	0.76	0.82

TABLE 85. SOME INDICES OF THE ARM AND LEG OF THE NEWBORN SAVANNAH BABOON COMPARED WITH THOSE OF ADULT MALES AND FEMALES

Index	Newborn	Adult Female	Adult Male
Humerus Length / Total Arm Length	0.33	0.36	0.36
Ulnar Length / Total Arm Length	0.38	0.40	0.40
Hand Length / Total Arm Length	0.29	0.24	0.24
Thumb Length / Hand Length	0.72	0.71	0.71
Hand Breadth / Hand Length	0.37	0.33	0.32
Femur Length / Total Leg Length	0.34	0.39	0.38
Tibial Length / Total Leg Length	0.29	0.36	0.36
Foot Length / Total Leg Length	0.36	0.29	0.29
Great Toe Length / Foot Length	0.78	0.77	0.77
Foot Breadth / Foot Length	0.26	0.24	0.24
Total Arm Length / Total Leg Length	0.91	0.91	0.91

TABLE 86. SOME INDICES OF THE HEAD AND FACE OF THE NEWBORN SAVANNAH BABOONS COMPARED WITH THOSE OF ADULT MALES AND FEMALES

Index	Newborn	Adult	
		Female	Male
Cranial Breadth / Cranial Length	0.74	0.82	0.83
Upper Face Height / Cranial Length	0.37	0.81	1.00
Bizygomatic Breadth / Cranial Breadth	0.88	0.93	1.00
Bizygomatic Breadth / Upper Facial Height	1.93	1.15	1.00
Bigonial Breadth / Bizygomatic Breadth	0.56	0.61	0.62
Nasal Breadth / Nasal Length	0.53	0.33	0.33
Ear Breadth / Ear Length	0.78	0.72	0.70

TABLE 87. TESTICULAR GROWTH IN SAVANNAH BABOONS OF KNOWN CHRONOLOGICAL AGE

Age	N	Testicular Length	Testicular Breadth
		mm.	mm.
0.71 - 0.80	1	16	5
0.81 - 0.90	0	-	-
0.91 - 1.00	1	14	6
1.01 - 1.20	0	-	-
1.21 - 1.40	1	11	7
1.41 - 1.60	2	14	6
1.61 - 1.80	0	-	-
1.81 - 2.00	2	14	6
2.01 - 2.20	1	14	7
2.21 - 2.40	2	14	6
2.41 - 2.60	1	15	8
2.61 - 2.80	3	13	7
2.81 - 3.00	3	17	10
3.01 - 3.20	3	19	10
3.21 - 3.40	6	21	15
3.41 - 3.60	7	25	16
3.61 - 3.80	7	27	16
3.81 - 4.00	5	29	18
4.01 - 4.20	4	31	19
4.21 - 4.40	4	34	21
4.41 - 4.60	2	42	26
4.61 - 4.80	2	44	30
Adult	10	51.0	29.8
Observed Range of Adult		35-64	21-37

TABLE 88. REGRESSION CONSTANTS OF INDIVIDUAL SEXES, COEFFICIENTS OF DETERMINATION (r^2), PROBABILITIES OF DIFFERENCE BETWEEN MALE AND FEMALE REGRESSION CONSTANTS, AND COMBINED REGRESSION CONSTANTS FOR LINEAR REGRESSION EQUATION OF RELATIVE GROWTH RELATIONSHIPS OF TRUNK DIMENSIONS OF SAVANNAH BABOONS (N = 97♂, 83♀)

Variable		Sex	r^2	Regression Constants		Probability of Difference		Combined Regression Constants	
y	x			a (Size)	b (Rate)	a (Size)	b (Rate)	a (Size)	b (Rate)
Biacromial Breadth	Trunk Height	♂	0.987	1.628	0.384	.45	.85	1.437	0.383
		♀	0.989	1.204	0.383				
Chest Breadth	Trunk Height	♂	0.952	2.572	0.285	.75	.45	2.243	2.293
		♀	0.966	1.883	0.303				
Chest Depth	Trunk Height	♂	0.979	1.734	0.375	.55	.75	1.471	0.377
		♀	0.988	1.182	0.380				
Chest Breadth	Chest Depth	♂	0.971	-1.277	1.280	.65	.45	-1.087	1.253
		♀	0.971	-0.911	1.224				
Bicristal Breadth	Biacromial Breadth	♂	0.976	-0.875	0.761	.65	.75	-0.805	0.763
		♀	0.980	-0.726	0.765				
Bicristal Breadth	Trunk Height	♂	0.986	0.344	0.293	.65	.85	0.221	0.295
		♀	0.993	0.112	0.296				
Bitrochanteric Brd.	Trunk Height	♂	0.983	-0.572	0.444	.55	.15	-0.402	0.432
		♀	0.994	-0.188	0.417				
Bituberosity Brd.	Trunk Height	♂	0.936	-0.869	0.309	.75	.65	-0.889	0.315
		♀	0.984	-0.870	0.321				
Pelvic Length	Trunk Height	♂	0.994	0.415	0.452	.08	.55	0.273	0.451
		♀	0.998	0.146	0.449				
Bicristal Breadth	Pelvic Length	♂	0.980	-0.073	0.657	.55	.75	-0.057	0.659
		♀	0.990	-0.101	0.669				
Tail Length	Trunk Height	♂	0.963	10.461	1.094	.55	.25	10.419	1.041
		♀	0.946	10.112	0.979				

TABLE 89. REGRESSION CONSTANTS OF INDIVIDUAL SEXES, COEFFICIENTS OF DETERMINATION (r^2), PROBABILITIES OF DIFFERENCE BETWEEN MALE AND FEMALE REGRESSION CONSTANTS, AND COMBINED REGRESSION CONSTANTS FOR LINEAR REGRESSION EQUATION OF RELATIVE GROWTH RELATIONSHIPS OF ARM DIMENSIONS OF SAVANNAH BABOONS (N = 97♂, 83♀)

Variable		Sex	r^2	Regression Constants		Probability of Difference		Combined Regression Constants	
y	x			a (Size)	b (Rate)	a (Size)	b (Rate)	a (Size)	b (Rate)
Upper Arm	Trunk Height	♂	0.989	-0.595	0.539	.45	.08	-0.313	0.524
		♀	0.994	-0.032	0.507				
Forearm Length (Ulnar)	Trunk Height	♂	0.987	0.328	0.573	.55	.85	0.286	0.576
		♀	0.991	-0.081	0.578				
Hand Length	Trunk Height	♂	0.996	2.335	0.297	.35	.07	2.40	0.290
		♀	0.991	2.479	0.281				
Forearm Length (Ulnar)	Upper Arm Length	♂	0.995	1.004	1.060	.35	.07	0.524	1.094
		♀	0.995	-0.032	1.139				
Hand Length	Forearm Length (Ulnar)	♂	0.992	2.217	0.515	.35	.07	2.378	0.501
		♀	0.993	2.534	0.485				
Total Arm Length	Trunk Height	♂	0.994	2.144	1.409	.45	.35	2.269	1.390
		♀	0.994	2.412	1.367				

TABLE 90. REGRESSION CONSTANTS OF INDIVIDUAL SEXES, COEFFICIENTS OF DETERMINATION (r^2), PROBABILITIES OF DIFFERENCE BETWEEN MALE AND FEMALE REGRESSION CONSTANTS, AND COMBINED REGRESSION CONSTANTS FOR LINEAR REGRESSION EQUATION OF RELATIVE GROWTH RELATIONSHIPS OF LOWER LIMB DIMENSIONS OF SAVANNAH BABOONS (N = 97♂, 83♀)

Variable		Sex	r^2	Regression Constants		Probability of Difference		Combined Regression Constants	
y	x			a (Size)	b (Rate)	a (Size)	b (Rate)	a (Size)	b (Rate)
Thigh Length	Trunk Height	♂	0.996	-0.222	0.620	.35	.15	-0.110	0.612
		♀	0.996	-0.046	0.601				
Leg Length	Trunk Height	♂	0.996	0.114	0.524	.35	.15	0.229	0.517
		♀	0.993	0.383	0.507				
Foot Length	Trunk Height	♂	0.996	3.612	0.389	.35	.15	3.560	0.382
		♀	0.991	3.520	0.373				
Leg Length	Thigh Length	♂	0.994	0.384	0.840	.45	.85	0.365	0.842
		♀	0.996	0.348	0.844				
Foot Length	Leg Length	♂	0.999	3.533	0.742	.25	.55	3.389	0.739
		♀	0.997	3.240	0.73				
Trunk Length + Knee Height	Trunk Height	♂	0.989	0.038	1.206	—	.04	—	—
		♀	0.991	1.181	1.145				
Total Lower Limb Length	Trunk Height	♂	0.997	3.566	1.533	.25	.08	3.869	1.506
		♀	0.996	4.211	1.473				
Total Arm Length	Thigh Length + Knee Height	♂	0.996	1.890	1.177	.35	.65	1.730	1.175
		♀	0.994	1.601	1.172				

TABLE 91. REGRESSION CONSTANTS OF INDIVIDUAL SEXES, COEFFICIENTS OF DETERMINATION (r^2), PROBABILITIES OF DIFFERENCES BETWEEN MALE AND FEMALE REGRESSION CONSTANTS, AND COMBINED REGRESSION CONSTANTS FOR LINEAR REGRESSION EQUATION OF RELATIVE GROWTH RELATIONSHIPS OF HEAD AND FACE DIMENSIONS OF SAVANNAH BABOONS (N = 97♂, 83♀)

Variable y	Variable x	Sex	r^2	Regression Constants a (Size)	Regression Constants b (Rate)	Probability of Difference a (Size)	Probability of Difference b (Rate)	Combined Regression Constants a (Size)	Combined Regression Constants b (Rate)
Cranial Length	Trunk Height	♂	0.989	6.252	0.132	.55	.25	6.176	0.126
		♀	0.905	6.116	0.118				
Cranial Breadth	Trunk Height	♂	0.978	4.430	0.130	.35	.45	4.612	0.120
		♀	0.986	4.688	0.104				
Cranial Breadth	Cranial Length	♂	0.986	-1.738	0.986	.65	.75	-1.764	0.989
		♀	0.910	-1.962	1.001				
Upper Face Height	Cranial Length	♂	0.946	NON-LINEAR					
		♀	0.843						
Bizygomatic Breadth	Cranial Breadth	♂	0.990	-4.254	1.545	.55	.15	-4.455	1.589
		♀	0.980	-4.906	1.673				

TABLE 92. POST-NATAL GROWTH: DENTAL SCORE

Age	Male			Female		
	No.	Mean	Observed Range	No.	Mean	Observed Range
(yrs.)						
0.00 - .10	3	2.00	0.00 - 6.00	6	0.30	0.00 - 1.50
.11 - .20	5	5.81	2.25 - 10.75	4	4.62	2.00 - 6.50
.21 - .30	6	10.29	5.25 - 16.00	3	10.17	5.50 - 14.75
.31 - .40	5	11.55	7.00 - 16.00	2	13.25	10.50 - 16.00
.41 - .50	6	15.92	12.50 - 18.00	2	16.00	16.00 - 16.00
.51 - .60	5	17.40	16.00 - 20.00	4	16.19	16.00 - 16.50
.61 - .70	5	18.10	16.50 - 20.00	2	17.88	17.25 - 18.50
.71 - .80	5	19.00	18.00 - 20.00	2	19.75	19.50 - 20.00
.81 - .90	4	19.60	18.25 - 20.00	3	20.00	20.00 - 20.00
.91 - 1.00	3	20.00	20.00 - 20.00	2	20.00	20.00 - 20.00
1.01 - .20	4	20.00	20.00 - 20.00	2	20.00	20.00 - 20.00
.21 - .40	4	20.12	20.00 - 20.50	3	20.00	20.00 - 20.00
.41 - .60	3	20.50	20.00 - 21.50	3	20.33	20.00 - 21.00
.61 - .80	3	21.83	20.00 - 24.00	2	21.88	21.00 - 22.75
.81 - 2.00	4	22.38	21.00 - 24.00	3	22.42	20.00 - 24.00
2.01 - .20	7	23.29	21.00 - 24.00	2	24.00	24.00 - 24.00
.21 - .40	8	24.00	24.00 - 24.00	3	24.00	24.00 - 24.00
.41 - .60	7	24.14	24.00 - 24.50	4	24.00	24.00 - 24.00
.61 - .80	9	24.69	24.00 - 26.00	4	24.50	24.00 - 25.00
.81 - 3.00	11	26.00	24.00 - 28.50	4	25.06	24.00 - 26.25
3.01 - .20	7	27.14	25.00 - 29.25	1	27.50	——
.21 - .40	7	29.03	26.25 - 32.50	4	29.44	25.25 - 34.25
.41 - .60	6	31.67	27.75 - 36.50	2	38.00	34.25 - 41.75
.61 - .80	7	33.28	29.00 - 38.25			
.81 - 4.00	5	35.71	30.00 - 39.25			
4.01 - .20	4	34.94	31.00 - 37.50			
.21 - .40	3	37.92	33.50 - 41.00			
.41 - .60	2	38.62	35.50 - 41.75			
.61 - .80	2	42.00	41.50 - 42.50			

LIST OF REFERENCES

Altman, P. L. and D. S. Dittmer (eds.)
1963 Growth. Technical Documentary Report #AMRL-TDR-63-2. Biomedical Laboratory, 6570th Aerospace Medical Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. pp 342-343.

Bingham, H. C.
1929 Observations on the Growth and Development of Chimpanzees. American Journal of Physical Anthropology 13: 433-468.

Bransby, E. R.
1945 The Seasonal Growth of Children. Medical Officer 73: 149-151, 157-159, 165-168.

Buettner-Janusch, J.
1963 Biochemical Genetics and Inbreeding of some Kenya Baboons (Papio doguera). American Journal of Physical Anthropology n.s. 21: 411 (1963).

Carpenter, C. R.
1940 A Field Study in Siam of the Behavior and Social Relations of the Gibbon (Hylobates lar). Comparative Psychology Monographs 16: 1-212.

Clark, W. E. LeGros
1959 The Antecedents of Man. Edinburgh University Press.

Clark, W. E. LeGros and L. S. B. Leakey
1951 The Miocene Hominoidea of East Africa. Fossil Mammals of Africa #1. British Museum. London.

Davenport, R. K.
1967 The Oran-utan in Sabah. Folia Primatologica 5: 247-263.

DeVore, I.
1963a Mother-Infant Relations in Free-Ranging Baboons. In: Maternal Behavior in Mammals (H. L. Rheingold, ed.) John Wiley and Sons, New York pp 305-335.

DeVore, I.
1963b A Comparison of the Ecology and Behavior of Monkeys and Apes. In: Classification and Human Evolution. (S. L. Washburn, ed.). Aldine Publishing Company, Chicago pp 301-319.

Etkin, W.
1964 Social Behavioral Factors in the Emergence of Man. In: Culture and the Direction of Human Evolution (S. M. Garn, ed.) Wayne State University Press, Detroit. pp 74-80.

Fisher, R. A.
1950 Statistical Methods for Research Workers, 11th Edition. Oliver and Boyd, Edinburgh.

Flower, S. S.
1931 Contributions to Our Knowledge of the Duration of Life in Vertebrate Animals. V. Mammals. Proceedings of the Zoological Society of London, pp 145-234.

Freedman, L.
1962a Quantitive Features of the Deciduous Dentition of Papio ursinus. South African Journal of Science 58: 229-236.

Freedman, L.
1962b Growth of Muzzle Length Relative to Calvaria Length in Papio. Growth 26: 117-128.

Gavan, J. A.
1952 "Growth of Guamian Children" - Some Methodological Questions. American Journal of Physical Anthropology n.s. 10: 132-135.

Gavan, J. A.
1953 Growth and Development of the Chimpanzee: a Longitudinal and Comparative Study. Human Biology 25: 93-143.

Gavan, J. A. and D. R. Swindler
1966 Growth Rates and Phylogeny in Primates. American Journal of Physical Anthropology n.s. 24: 181-190.

Gilbert, C. and J. Gillman
1960 Puberty in the Baboon (Papio ursinus) in Relation to Age and Body Weight. South African Journal of Medical Science 25: 99-103.

Gisler, D. B., S. G. Wilson, Jr. and G. L. Hekhuis
1960 Correlation of Skeletal Growth and Epiphyseal Ossification with Age of Monkeys. School of Aviation Medicine Report #61-11. USAF Aerospace Medical Center (ATC), Brooks Air Force Base, Texas.

Goodall, J. M.
1962 Nest Building Behavior in the Free Ranging Chimpanzee. Annals of the New York Academy of Sciences 102: 455-467.

Goodall, J. M.
1963 Feeding Behaviour of Wild Chimpanzees. A Preliminary Report. Symposium of the Zoological Society of London 10: 39-47.

Grand, T., E. Duro and W. Montagna
1964 Observations on the Development of the Potto Born in Captivity. American Journal of Physical Anthropology n.s. 22: 329-332.

Grether, W. F. and R. M. Yerkes
1940 Weight Norms and Relations for Chimpanzees. American Journal of Physical Anthropology 27: 181-197.

Grimmer, J. L.
1950 Observations on the Weight Gains of Gorillas. Proceedings of the International Union of Directors of Zoological Gardens, London, 2-6 June 1950.

Haigh, M. V. and A. Scott
1965 Some Radiological and Other Factors for Assessing Age in the Rhesus Monkey Using Animals of Known Age. Laboratory Animal Care 15: 57-73.

Hall, K. R. L.
1962 The Sexual, Agonistic and Derived Social Behaviour Patterns of the Wild Chacma Baboon, Papio ursinus. Proceedings of the Zoological Society of London 139: 283-327.

Hall, K. R. L.
1963 Variations in the Ecology of the Chacma Baboon, Papio ursinus. Symposia of the Zoological Society of London 10: 1-28.

Hall, K. R. L.
1965 Ecology and Behavior of Baboons, Patas and Vervet Monkeys in Uganda. In: The Baboon in Medical Research (H. Vagtborg, ed.) University of Texas Press, Austin. pp 43-64.

Harms, J. W.
1956 Fortflanzungsbiologie. In: Primatologia, Vol. I. (H. Hofer, ed.) S. Karger, Basel.

Harrison, G. A., J. S. Weiner, J. M. Tanner and N. A. Barnicot
1964 Human Biology, An Introduction to Human Evolution, Variation and Growth. Oxford University Press.

Hill, W. C. O.
1965 The Taxonomy of Baboons. Proceedings of the Second International Symposium on the Baboon and Its Use as an Experimental Animal. Southwest Foundation for Research and Education, San Antonio, Texas.

Hill, W. C. O.
1966 Primates, Comparative Anatomy and Taxonomy VI. Catarrhini. Edinburgh at the University Press.

Hurme, V. O. and G. van Wagenen
1953 Basic Data on the Emergence of the Deciduous Teeth in the Monkey (Macaca mulatta). Proceedings of the American Philosophical Society 97: 291-315.

Hurme, V. O. and G. van Wagenen
1956 Emergence of Permanent First Molars in the Monkey (Macaca mulatta). Association with Other Growth Phenomena. Yale Journal of Biology and Medicine 28: 538-567.

Hurst, C. M.
1965 Monthly Weight Increases in Growing Rhesus Monkeys. ARL-TR-65-24. 6571st Aeromedical Research Laboratory, Aerospace Medical Division. Air Force Systems Command, Holloman Air Force Base, New Mexico.

Huxley, J. S.
1932 Problems of Relative Growth. The Dial Press, New York.

Huxley, J. S.
1936 The Growth of the Infant Chimpanzee Born in the Society's Gardens, and a Comparison with that of a Chimpanzee Born in Florida. Proceedings of the Zoological Society of London, pp 587-589.

Itani, J.
1965 On the Acquisition and Propagation of a New Food Habit in the Troop of Japanese Monkeys at Takasakiyma. In: Japanese Monkeys, A Collection of Translations (S. A. Altmann, ed.) Published by the editor. pp 52-65.

Jacobsen, C. F., M. M. Jacobsen and J. G. Yoshioka
1934 Development of an Infant Chimpanzee During Her First Year. Comparative Psychology Monographs 9: 1-94.

Kerley, E. R.
1964 Skeletal Age Changes in the Chimpanzee. Tulane Studies in Zoology 13: 71-80.

Lashley, K. S. and J. B. Watson
1913 Notes on the Development of a Young Monkey. Journal of Animal Behavior 3: 114.

Leakey, L. S. B.
1967 An Early Miocene Member of Hominidae. Nature 213: 155-163.

Martin, R.
1928 Lehrbuch der Anthropologie, vol. II. Aufl. Fischer, Jena.

Mather, K.
1965 Statistical Analysis in Biology. University Paperbacks Edition, Methuen, London. pp 109-128.

Maxim, P. E. and J. Buettner-Janusch
1963 A Field Study of the Kenya Baboon. American Journal of Physical Anthropology n.s. 21: 165-180.

Miller, R. L. and A. J. Pallotta
1965 Comments on the Maintenance of a Small Baboon Colony. In: The Baboon in Medical Research (H. L. Vagtborg, ed.) University of Texas Press, Austin, Texas.

Morton, D. J.
1935 The Human Foot. Colombia University Press. New York

Nissen, H. W. and A. H. Riesen
1945 The Deciduous Dentition of Chimpanzee. Growth 9: 265-274.

Nissen, H. W. and A. H. Riesen
1964 The Eruption of the Permanent Dentition of Chimpanzee. American Journal of Physical Anthropology n.s. 22: 285-294.

Nylin, A.
1929 Periodical Variation in Growth, Standard Metabolism and Oxygen Capacity of the Blood in Children. Acta Scandinavica Medica, Supplement 31: 1-207.

Oglivie, A. W.
1923 Breeding of the Gibbon in Captivity. Journal of the Natural History Society of Siam 6: 137.

Orr, J. B. and M. L. Clark
1930 A Report on Seasonal Variation in the Growth of School-Children. Lancet 2: 365-367.

Pett, L. B. and G. F. Ogilvie
1956 The Canadian Weight-Height Survey. Human Biology 28: 177-188.

Piveteau, J.
1961 Behavior and the Ways of Life of the Fossil Primates. In: Social Life of Early Man (S. L. Washburn, ed.) Aldine Publishing Company. Chicago 11-16.

Reed, O. M.
1965 Studies of the Dentition and Eruption Pattern in the San Antonio Baboon Colony. In: The Baboon in Medical Research (H. L. Vagtborg, ed.) University of Texas Press. Austin, Texas. pp 167-180.

Reed, O. M.
In Press: Cephalometric Studies of the Growth and Development and Eruption Patterns of the Baboon.

Roth, W. T.
1965 The Taxonomy of the Baboon and Its Position in the Order of Primates. In: The Baboon in Medical Research (H. L. Vagtborg, ed.) University of Texas Press. Austin, Texas. pp 3-16.

Schaller, G. B.
1963 The Mountain Gorilla. University of Chicago Press.

Schultz, A. H.
1929 The Technique of Measuring the Outer Body of Human Fetuses and of Primates in General. Carnegie Institute of Washington. Contributions to Embryology No. 20. pp 213-257.

Schultz, A. H.
1933 Growth and Development. In: The Anatomy of the Rhesus Monkey (C. G. Hartman, ed.) The Williams and Wilkins Company, Baltimore, Maryland. pp 10-28.

Schultz, A. H.
1935 Eruption and Decay of the Permanent Teeth in Primates. American Journal of Physical Anthropology 19: 489-581.

Schultz, A. H.
1940 Growth and Development of the Chimpanzee. Carnegie Institute of Washington. Contributions to Embryology, No. 170.

Schultz, A. H.
1941 Growth and Development of the Orang-utan. Carnegie Institute of Washington. Contributions to Embryology, No. 182.

Schultz, A. H.
1942a Growth and Development of the Proboscis Monkey. Bulletin of the Museum of Comparative Zoology, Harvard College. 89: 277-314.

Schultz, A. H.
1942b Morphological Observations on a Gorilla and an Orang of Closely Known Ages. American Journal of Physical Anthropology 29: 1-21.

Schultz, A. H.
1944 Age Changes and Variability in Gibbons. American Journal of Physical Anthropology n.s. 2: 1-129.

Schultz, A. H.
1949 Sex Differences in the Pelves of Primates. American Journal of Physical Anthropology n.s. 7: 401-424.

Schultz, A. H.
1956 Postembryonic Age Changes. In: Primatologia, Vol. I. (H. Hofer, ed.) S. Karger, Basel.

Schultz, A. H.
1961 Some Factors Influencing the Social Life of Primates in General and Early Man in Particular. In: Social Life of Early Man. (S. L. Washburn, ed.) Aldine Publishing Company. Chicago pp 58-90.

Schultz, A. H.
1962 Metric Age Changes and Sex Differences in Primate Skulls. Zeitschrift für Morphologie und Anthropologie 52: 239-255.

Schultz, A. H.
1963 Age Changes, Sex Differences, and Variability as Factors in the Classification of Primates. In: Classification and Human Evolution (S. L. Washburn, ed.) Aldine Publishing Company. Chicago pp 85-115.

Schultz, A. H. and W. L. Straus, Jr.
1945 The Numbers of Vertebrae in Primates. Proceedings of the American Philosophical Society 89: 601-625.

Simmons, K.
1944 The Brush Foundation Study of Child Growth and Development II. Physical Growth and Development. Monographs of the Society for Research in Child Development, Washington, D. C. v. 9, #1.

Simpson, G. G., A. Roe and R. C. Lewontin
1960 Quantitative Zoology, 2nd edition. Harcourt, Brace and Company, New York.

Snow, C. C. and R. G. Snyder
1965 Anthropometry of Air Traffic Control Trainees. Office of Aviation Medicine Report #65-26. Federal Aviation Agency, Washington, D. C.

Snow, C. C. and T. Vice
1965 Organ Weight Allometry and Sexual Dimorphism in the Olive Baboon, Papio anubis. In: The Baboon in Medical Research (H. L. Vagtborg, ed.) University of Texas Press, Austin, Texas. pp 151-163.

Snow, C. C., M. Oviatt, and V. Smith.
In Press: A Multiunit Incubator for Newborn Monkeys.

Spence, K. W. and R. M. Yerkes
1937 Weight, Growth and Age in Chimpanzee. American Journal of Physical Anthropology 22: 229-246.

Spiegel, A.
1929 3. Biologische Beobachtungen an Javamakaken, Macacus irus F. Cuv. (cynomolgus L.). Zoologischer Anzeiger 81: 45.

Spiegel, A.
1950 Weitere Beobachtungen und Untersuchungen uber die Fortplflanzung bei Javamakaken [Macaca irus mordax Th. und Wr. (cynomolgus K.)] Archiv für Gynaekologie 117: 590-629.

Stark, F.
1965 Personal Communication.

Stoudt, H. W., A. Damon and R. A. McFarland
1964 Heights and Weights of White Americans. Human Biology 32: 331-341.

Stoudt, H. W., A. Damon, R. A. McFarland and J. Roberts
1965 Weight, Height and Selected Body Dimensions of Adults, United States, 1960-1962. Public Health Service Publication No. 1000, Series 11, No. 8, U. S. Government Printing Office, Washington, D. C.

Taback, M.
1951 Birth Weight and Length of the Gestation Period. Journal of the American Medical Association 146: 897-901.

Takahashi, E.
1966 Growth and Environmental Factors in Japan. Human Biology 38: 112-130.

Tanner, J. M.
1951 Some Notes on the Reporting of Growth Data. Human Biology 23: 93-159.

Tanner, J. M.
1962 Growth at Adolescence. 2nd Edition. Blackwell Scientific Publications. London.

Tappan, N. C.
1960 Problems of Distribution and Adaptation of the African Monkeys. Current Anthropology 1(2): 91-120.

Thompson, D. W.
1942 On Growth and Form, 2nd. Edition. Cambridge at the University Press.

Thompson, H.
1951 Data on the Growth of Children during the First Year after Birth. Human Biology 23: 75-92.

Vagtborg, H.
1965 The Baboon in Medical Research. Proceedings of the First International Symposium on the Baboon and Its Use as an Experimental Animal. University of Texas Press, p. vii.

Vanderplank, F. L.
1937 Growth and Dentition of an Infant Chimpanzee at the Bristol Zoo. Proceedings of the Zoological Society of London, pp 175-176.

Vice, T. E., H. A. Britton, I. A. Ratner and S. S. Kalter
1964 Care and Raising of Newborn Baboons. Laboratory Animal Care 14: 330.

Vice, T. E. and A. R. Rodriguez
1965 Care and Maintenance of Baboon Colonies in San Antonio, Texas, and Darajani, Kenya, East Africa. In: The Baboon in Medical Research, (H. Vagtborg, ed.) University of Texas Press, Austin. pp 125-140.

van Wagenen, G.
1952 Age at Menarche of the Laboratory Rhesus Monkey. Anatomical Record 112: 134.

van Wagenen, G.
1954 Body Weight and Length of the Newborn Laboratory Rhesus Monkey (Macaca mulatta). Federation Proceedings 13: 157.

van Wagenen, G., and C. W. Asling
1958 Roentgenographic Estimation of Bone Age in the Rhesus Monkey. American Journal of Anatomy 103: 172-185.

van Wagenen, G., and H. R. Catchpole
1956 Physical Growth of the Rhesus Monkey (Macaca mulatta). American Journal of Physical Anthropology n.s. 14: 245-274.

van Wagenen, G., and H. R. Catchpole
1965 Growth of the Fetus and Placenta of the Monkey (Macaca mulatta). American Journal of Physical Anthropology n.s. 23: 23-34.

van Wagenen, G., and M. E. Simpson
1954 Testicular Development in the Rhesus Monkey. Anatomical Record 118: 231-252.

Washburn, S. L. and I. DeVore
1961 Social Behavior of Baboons and Early Man. In: Social Life of Early Man (S. L. Washburn, ed.) Aldine Publishing Company, Chicago. pp 91-104.

Watson, E. H. and G. H. Lowrey
1962 Growth and Development of Children, 4th Edition. Year Book Publishers, Chicago.

Zuckerman, S.
1926 Growth Changes in the Skull of the Baboon, Papio porcarius. Proceedings of the Zoological Society of London 55: 843-873.

Zuckerman, S.
1931 The Menstrual Cycle of the Primates. III. The Alleged Breeding Season of Primates, with Special Reference to the Chacma Baboon, (Papio porcarius). Proceedings of the Zoological Society of London, pp 325-343.

Zuckerman, S. and A. S. Parkes
1932 The Menstrual Cycle of Primates. Part V. The Cycle of the Baboon. Proceedings of the Zoological Society of London, pp 139-191.