THE PROCESS OF PHYSICAL GROWTH OF THE CHINESE

By Gabries Ward Lasker

Among the various problems of physical anthropology that of growth is interesting because it may give a clue to the question of the cause of structural similarities and differences by indicating whether they are produced by diverse or similar processes. Further study is needed on the effect of environmental factors on growth and on the function of growth in determining adult structure.

Although only a start has been made in the study of the physical growth of the Chinese, still a review of the material available might be of value. As the findings concerning the growth of Chinese by some authors are incompatible with those of others it is high time to compare these studies. Not only may some light be shed on the anthropological question of racial differences in the physical process of growth, but the clinician also may obtain a better idea of the applicability and reliability of the measure of nutritional state now commonly used in China.

I. AVAILABLE DATA

For over twenty-five years physicians in China have felt the need for a standard of growth for the Chinese. Crook (1) studied 659 males from ten to 23 years old at Hongkong as long ago as 1908. Merrins (2) not only studied 219 boys but also investigated 69 girls. Schoemaker (3) gave height, weight and lung capacity of some Chinese, but did not state their six. Pyle (4) studied 500 boys and girls, from 10 to 18 years of age, at Canton. Whyte (5) published the height and weight of 1,417 males of whom 675 were boys, and of 613 females of whom 411 were girls in South and Central China. He also

gave Schoemaker's figures of 1,895 males in Peking of whom 1,515 were boys. An effort to set up norms for the Chinese was made by an anonymous author (6) who measured 104 Chinese boys and 155 girls. He recorded the height and weight in a chart like those used by T. D. Wood. Hawks (7) has pointed out that in these early studies errors arose from the difficulty of determining the date of birth and from the improper technique and inaccurate measuring instruments of the observers. However, some of these data are still interesting for comparison with more recent studies.

The largest group of individuals studied is that collected by Stevenson (8) from the material of over 30 investigators. He published the height and weight of 10,863 Chinese (9,630 males and 1,233 females) ranging in age from 2 to 70 years, and representing all the different provinces of China, but presenting a certain unevenness in both age and geographical distribution. In his paper the material is presented by provinces, but in order to have enough material for significant averages, the provinces are grouped together into North, Central, and South China. The material constitutes the most extensive compilation of growth data yet published and is very valuable in spite of a technical point[1] and a second point raised later.

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[1] In presenting this material Stevenson (8) not only tabulates the annual averages, but also plots a three-year moving average. Todd (9), whose use of this moving average is followed, states with regard to it: "The plotting of these three-year averages will not give an entirely smooth curve, for the number of instances naturally varies from year to year in a small series." Stevenson's instances, however, do not "vary" from year to year, they *increase* almost steadily in number each year over the previous one until the age of 16, and hence it is unfortunate that his method of calculating the moving average actually worked out to make all his averages for the younger years somewhat too high, or his ages too young. The corrected average for any age, n_2, is: $\frac{an_1+bn_2+cn_3}{a+b+c}$ in which a, b, and c, are the number of instances for the consecutive ages, n_1, n_2 and n_3 respectively.

Another way to weight the moving average, is simply to use the average of three consecutive annual averages. This method gives almost identical curves to those found by applying the above formula. In Graphs I, II, and III the averages of the three consecutive yearly averages were used.

Li and Chang (10) have combined Stevenson's material into two Height-Weight-Age tables, one each for males and females. They were derived in a manner similar to Baldwin's tables for Americans.

At about the same time that the Stevenson paper was published, Appleton, who had been making careful measurements of Chinese in different parts of China, and Shirokogoroff, published a series of reports (11, 12, 13, 14, 15). In these papers separate data of Chekiang, Kiangsu, Fukien, and a mixed group of Central China were presented; in Kiangsu and Fukien for males only, however. The Chekiang and Kiangsu studies (13) were much more intensive and thorough than any previously made, containing all the anthropometric measurements suggested by the International Commission at Geneva.

The nature of the environment was next considered. In 1925 Hammond and Hsia Sheng (16) studied 96 North and Central Chinese boys in a poor-home in Peiping, and 280 odd children in summer schools for comparison. The next year, Keys and Cadbury (17) published a study of 1,013 school boys in a superior environment in Canton, taking special care about the age. Their data is especially valuable not only because the determination of the exact ages is reliable, but also because the study was continuous and most of the individuals were measured on several occasions over a period of years. Hsu and Liang (18), who studied 721 boys and a few girls in Peiping, consider their subjects to have a superior environment in that they came from well-to-do families and were under the supervision of the Public Health Demonstration Station. Miss Sun (19), in her thesis, also derives her material from the same public health station, and there may be some overlapping of her material with that of Hsu and Liang.

Studies of the growth of the Chinese have been conducted by Westbrook and Lai (20) who presented data on nearly two thousand children from South and Central China. They were interested in the problem of correlation of physical measurements and mental traits. Klineberg (21) and others have pointed out the difficulties of this type of study.

Several studies have been made of Chinese abroad. Bobbitt (22) studied Chinese in the Philippines. Cox (23) studied 282 Chinese boys and 296 girls in Hawaii. Appleton herself (15, 24, and 25) studied the anthropometry of second and third generation Chinese of both sexes in Hawaii and found height

and weight curves in close agreement with the observations of Cox. Wissler (26) published Sullivan's data on school children in Hawaii which included 804 male and 730 female Chinese as well as a series of Hawaiian-Asiatic crosses. He took a comprehensive list of measurements and gives observations and statistical compilations. Hawks (7) studied 22 Chinese children in Chicago, but the smallness of the group makes any conclusions most tentative. Preston (27) has recently published a study of American born Oriental children in which she has included height and weight data on 184 male and 196 female children of Chinese descent.[1]

Besides the study of children of school age, some work has been done on the growth of infants. In a valuable recent paper, Guy, Chiang, Huang, and Yeh (28) made 2,447 sets of measurements of length and weight on 577 boys and 425 girls of from 16 days to 36 months of age. These measurements on healthy North Chinese from Peiping are compared by the authors to an American series. They show that until the fourth month in males and until the third month in females, the Peiping infants equal the infants in the American series in both length and weight. From then on, and in all the series of later ages which we have reviewed, standards on Americans exceed those on Chinese.

In a study of the growth of normal infants by Tso (29), the birth weights of 678 male and 657 famale Chinese babies in Peiping were studied. He also records 1,619 weighings of 584 Chinese infants up to 45 weeks of age. His study shows that Chinese weight at birth is lower than Occidental standards, but the length averages are quite comparable, the males being fully as tall as in several European series. The average weight curve for both sexes during the first post-natal growth cycle describes a more or less even sweep and is

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1. Preston, in her graphs, shows Chinese children in America to be both shorter and lighter than Chinese from Hawaii and in China itself. This is due to a mistake in the drawing of the curves. Whereas Preston takes any age group, n, to be from n $-\frac{1}{2}$ to n $+\frac{1}{2}$ years, the other authors whom she quotes use the ordinary system of reckoning, age group n being taken from n to n + 1 years Preston is therefore comparing her series with groups that average six months older.

intermediate between the figures for males and females of Guy et al. A study of 1,000 infants at Cheeloo, by King and Tiang (30) gives birth weights and lengths very similar to those of Tso.

We see in all the available studies that the stature of Chinese of both sexes is approximately the same as for Occidentals until the third or fourth month, after which it is consistently less than in American and European series. There seems to be a significant difference in growth rate during the early months.

There are also studies of adult Chinese which might help us determine the upper limits of the growth process. Tung (31), for instance, published a study of 351 healthy young Chinese adults. Necheles (32), who was interested in the effect of migration on growth, measured a group of young South and Central Chinese who had lived in Peiping for a variable number of years. However, in this short paper we shall not attempt to give a systematic bibliography of anthropometric studies on Chinese adults.

II. DIFFERENCES IN THE GROWTH PROCESS OF CHINESE IN VARIOUS REGIONS

Differences in Adult Structure

Various workers have presented material indicating that groups of the adult peoples of China bear certain more or less definite similarities to and differences from each other. Cadbury (33), Tung (31), Stevenson (8), Whyte (5), and others have shown that Northern Chinese are taller, for instance, than Central and Southern Chinese. It has been pointed out by Necheles (32) that adult Kwangtung Chinese in China are taller than Kwangtung Chinese who have moved while still young to Sumatra, but are shorter than young Chinese adults in Hawaii who are descended from emigrants from Kwangtung. Necheles' own short series of twenty cases of Southern Chinese who had lived for part of their growing period in more temperate climates have even a higher average stature. This brings up the problem of the degrees to which growth is determined by racial inheritance and affected by environmental influences. We are also led to wonder whether eventual differences in structure and size are due to qualitative or only to purely quantitative differences in growth.

Cessation of Growth

Stevenson (8) in his reasonably large series shows that Chinese males from North China grow more slowly at the earlier ages, but later relatively more quickly and for a longer period than the Chinese males from the South, while the Central Chinese are intermediate (see Table III [A, C, H]).

From Table III it may be seen that several of the South Chinese series show relatively high average stature for different age periods. Westbrook and Lai (20), Keys and Cadbury (17), Pyle (4), and Crook (1) studied groups of Southern Chinese who continued to grow taller than Stevenson's (8), Southern series, but none of them continued to grow late than Schoemaker's Peking series published by Whyte (5) nor as late as Stevenson's (8) Northern series. Tung 31) made his study in Peking, where he said that he found growth occasionally after the age of 24. Our curves of the combined data, Graphs I and II, seem to show that for both males and females and in respect both to height and weight, the Northern Chinese grow more rapidly in the years after 14 and would seem to continue growing later.

In our tables several of the series (III [North, G, Central, H, T, and Average], IV [North, G, Central, H, and Average], V [H, I, South, and Average], and VI, [H, I, South, and Average]) show lower adult figures than in some previous years. This cannot be accounted for in all cases by sparseness of data. It seems to be due in some cases to differences in the part of the population from which the growing children and adults were drawn. Whereas the growing children are nearly all from schools and colleges the adults may come from other, generally more mixed and possibly less well-to-do, strata of the population. It has been reported for many peoples that the stature is increasing and this would show youths to be taller than old adults. In either case, even if the adult are more representative of the general population, these adult figures have to be ignored in determining the age of cessation of growth.

Necheles (32), by making two measurements about twenty months apart, was able to determine the upper limit of the growth period in his short series. In the Northern-bred Southerners, growth occurred up to 24 years of age in the male, and 23 in the female. This limit is markedly higher than that of homebred Kwangtung Chinese and is the same as that which we might expect

among home-bred Northerners: This might indicate that there is an important geographic effect upon the age of cessation of the growth process.[1]

Regional Differences During the Process of Growth

In graphs I and II it can be seen that the curves for the growth of Chinese in different regions are not parallel. Several groups of North Chinese of growing ages are taller than Central and Southern group.[2]

We have already pointed out that the growth of Chinese of the same racial origin may cease earlies in more tropical climates, the further South the earlier. To a certain extent the differences in the growth curves for the different regions of China might be explained on the grounds that the further south, the earlier each phase of the growth process occurs. This analysis does not entirely follow regional lines however. Quite regardless of region, the curves given in Tables IV and VI show that the taller the group during the years preceding, the earlier the retardation in the rate of growth sets in.

The growth of both Chinese boys and girls in North China and Hawaii is more similar than that in any other pair of regions. In racial heritage, however, the Chinese of Hawaii are very similar to the Chinese of South China

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1. It should be mentioned, however, that the location of an exact limit to the growth period is not practicable on even large series unless the measurements are continuous as in the cases of Necheles, and even then the determination will be affected by the degree of instrumental error:—the less the error, the higher the limit will tend to be.

2. Hsu and Liang (18) say: "The boys from North China measured by us approximated closely to the heights of American boys, whereas in Central China and even more strikingly in Southern China they were shorter. In each region they were probably taller than the group from which Stevenson's curves were prepared although the difference is less evident in the growth from South China."

Miss Sun (19), though she did not classify according to sex, found that 141 Southern children were on the average shorter than the 132 Northern children in every age group (from 6 to 17) except the ninth, and lighter except in the eighth and ninth.

Whyte's (5) study also shows much higher growth curves of Northern Chinese than those of Southern and Central.

and America, and of all groups are least similar to the Northern Chinese. Therefore, though the growth process is different in the various regions where Chinese live, these differences cannot be ascribed to differences in the racial stock in the various regions of China.

Anthropological Difference between Male and Female Chinese in the Same Province

In China there are differences between the growth process of boys and girls. As the number of studies on girls is very small, and as, even after being weighted, the curves for the various regions show no very definite comparable features (see Graphs I and II), the discussion of the relationship of the male to the female curves will be left until we compare the Chinese to the non-Chinese. The suggestion that the males and females of the same region are different anthropologically may be considered now, however.

Shirokogoroff (12) concludes from his study of the growth process that the female students of Chekiang are composed of anthropological elements different, at least with reference to the numerical proportion of types, from those of males. In the same paper he says: "If we suppose that the females (students) compared with the males (students) are not selected but represent, roughly speaking, the same social and ethnical (typological) element, then the fact of difference between females and males (students) may be explained only by another supposition, i.e., females better preserve the original anthropological type than males." The figures quoted show that the growth of females of Chekiang is, in fact, in many instances closer to the Kiangsu males than to the Chekiang males.

We think that the predication of a difference in anthropological types between males and females even of this given series is less likely than anthropological differences between any two age groups of the same sex such as the 8 and 18 year olds, whom Shirokogoroff uses for roughly defining the growth process. In fact, quite on the contrary, the normal variation in *individuals* of the same sex, age, and race would be likely to influence markedly the figures for such small samples as the 10 eight-year old Chekiang males or the 7 eight-year old Kiangsu males.

III. COMPARISON OF THE GROWTH OF CHINESE WITH OTHER RACIAL GROUPS

The First Period of Retardation

Shirokogoroff (13) p. 14, noted an age period during which the rate of growth was slower. He said: "There seem to be two critical moments in the process of growth: first, at the age 12 among Chekiang and at the age of 11 years among Kiangsu males . . . At the first critical moment the stature shows a retardation which is gained during the following period."

Of this Appleton (24) says: "The critical period of retardation preceding acceleration of growth found in the East China series and not in the Hawaiian group may be a period during which growth is most influenced by unfavorable influences. It is not a racial characteristic as believed by Shirokogoroff." The material of other authors shows no regularity about a period of retardation. From Table III it can be seen that there is probably some retardation between the tenth and twelfth years in the curves of Crook (1), Stevenson (8) Central Appleton (15) Fukien, Whyte (5) South and Central, and Pyle (4) as well as in both of Shirokogoroff's (13). A marked retardation is not common to all the studies, however. It is absent from all the Hawaiian curves of Appletion (24, 25, 15), Wissler (26), and Cox (23), and from the more privileged groups of Keys and Cadbury (17), Hsu and Liang (18), and Sun (19). *This absence from the groups in better circumstances supports the theory that during the age of ten to twelve unfavorable environment is most influential in retarding growth.*

Such a retardation preceding the growth spurt is not peculiar to the Chinese, though in some of the Chinese curves their retardation is well defined. In the comprehensive compilation by Baldwin (34) it can be seen that almost all of the 163 studies on the height of boys of different nations and races show a distinct retardation in growth; they grow less rapidly during the 9-12 year-old period. We notice also that those curves which show the greatest retardation during this period are also the slowest to show the pre-pubescent growth spurt. This is true also of the Chinese studies. Those groups which are retarded most during the 10-12 year-old period continue to grow relatively less rapidly until the age of 15. Graph III shows this to be true for both the

height and weight of the boys in the few curves indicated there. Some Chinese grow faster, and some Chinese grow slower than Americans in the age groups under consideration.

The Second Period of Retardation

Another point of distinction which has been suggested as differentiating the Chinese from other ethnic groups is the abrupt retardation of Chinese growth at 15 to 16 years. From Table IV it will be seen that there is a quite sharp retardation in the rate of growth of most of the groups at about that age. This seems to be somewhat earlier than for other ethnic groups such as those included by Shirokogoroff (13) in his table on page 93. In view of the fact that cessation of growth may take place at an early age when Chinese live in a warmer climate, we are not surprised to find that the retardation of the rate of growth preceding cessation also sets in earlier among Chinese (especially those in the warmer parts of China). The growth curve of Chinese during the adolescent period is similar to that noted in other peoples though the phases may appear at younger ages.

The Chinese girls, as is true also of studies on other racial groups, reach the critical point where retardation of growth sets in at an earlier age than the comparable boys.[1] Shirokogoroff (12) notes a retardation in the growth of females at the age of 13 or 14 years which he ascribes to the sexual development among the females which begins at that age. He says that at 13 and 14 years over 50% of his series of females menstruate and all of them have their breasts more or less developed. At 15 years, he says, almost all Chekiang females are menstruating. Klineberg (21) pp. 102 ff., follows others in pointing out that living conditions as affected by economic status and possibly climate may have a marked effect on the age of puberty. Hotter climates and poorer living conditions tend to produce an earlier onset of menstruation. At puberty growth tends to be retarded. Therefore the early occurrence of the second critical period among some of the Chinese groups may be due to environmental rather than to racial factors.

1. See also below, "Comparison of the Growth of Females with the Growth of Males."

Comparison of the Growth of Females with the Growth of Males

As it has been suggested that a difference between the growth of Chinese and the growth of non-Chinese might be noticed in the growth of females relative to males, this problem is an interesting one.

In reference to his superimposed curves for males and females, Stevenson (8) says: "In these the discrepancy in the heights of the pre-adolescent girls and boys in favor of the former in the Northern and Central Chinese groups immediately arouses our interest. This observation is apparently at distinct variance with the facts established through extensive observation on other races We should expect, as indeed we do find in the case of our Southern material, that the boys would be both taller and heavier than the girls, until the relatively early pubescent acceleration in growth characteristic of the female produces a distinct crossing of the curves at approximately the 9-12 year period and results in a brief period of time (usually between the 10th and 14th year) during which the girls may equal or even exceed the boys of corresponding ages in height and weight. After this brief period the difference in size between the two sexes in favor of the males gradually increases until the usual adult proportions are reached. Returning to the pre-adolescent portions of the Northern and Central Chinese growth curves and the unusual discrepancy noted therein between the two sexes (Tables III, IV, V, and VI), a careful survey of the amount and character of data available for the plotting for this portion of these particular curves is in order before accepting this apparent anomaly as a possible significant racial variation. The disproportionately small number of female individuals measured in the early age periods has already been commented on in the first section of this report. Since in the curves for South China, where the number of girls is nearly twice that in either of the other two sections, this unexpected condition does not obtain, we are led to believe that measurements of a more nearly adequate number of girls of the other regions of China will substantially alter the discrepancy in question."

Stevenson's statement of relative adequacy of the female measurements, however, refers to his female total for all age groups, As a matter of fact, between the ages of five and ten inclusive, during which period the unexpected

conditions were found, it is evident that the curve for the Southern region is no better supported by adequate data, indeed not as well as the curves of the other two regions. The point is that though there is certainly not enough material in the Northern and Central areas from which to draw reliable conclusions about the pre-adolescent girls, *there is much less evidence that the curve for the South can be relied upon.* It is to be further noted that the growth of Chinese girls from the South is like that of Chinese girls from North and Central China; it is the males of the South who have a different growth curve.[1]

Stevenson, however, gives perhaps a more tenable reason for the large size of the girls in his series: "Another pertinent factor is to be found in the fact that most of the data on Chinese girls have been obtained in mission boarding schools where nutritional standards are better than the average, while a considerable amount of the data on the heights and weights of the boys, of North China at least, was gathered in day schools and orphanages conducted by Chinese A combination of these two factors—relatively scanty data on the girls in question and a fortuitous selection of oppositely weighted material from the stand-point of nutrition—may account for the apparent discrepancy here observed."[3]

1. Furthermore, when the age corrections derived by the formula in footnote (1) are applied to the curves, the young girls between five and ten are in each area younger on the average than the boys of the same age group, which means that the girls are relatively *taller and heavier* (though absolutely shorter and lighter) than would appear from Stevenson's curves.

2. Though the ponderal index cannot be relied upon as an index of nutrition, it is interesting to note that the ponderal index of females in China, according to Stevenson, exceeds the males in the fifth year, but with the exception of the 8th, 9th, and 7th year in North, Central, and South China respectively, *the ponderal index for males exceeds that for females* until the females showing an earlier onset of maturity fill out and exceed the males from the 15th, 13th, and 11th years respectively. It is unfortunate that some other measurements, including sitting height for Pirquet index and a general description of the state of nutrition, have not been included, as a comparative analysis of nutritional state might at least give a clue to the extent to which this second explanation of Stevenson's is valid.

Stevenson continues: "On the other hand a large percentage of the writer's Chinese students and others whom he has questioned on the point declare that Chinese girls of the age under discussion are as a rule actually large than Chinese boys of the same age."

Fortunately a certain amount of comparable material is available. Miss Sun (19) has collected stature and weight data on 551 males and 260 females of 6-16 years from schools in Peiping. In her series 17.4% are reported as Southerners and 16.3% are Northerners. In Tables III, IV, V, and VI (B) it can be seen that the stature of the girls exceeds that of the boys in the 12th, 13th, and 14th years, and the weight in the 11th, 12th, 13th, and 14th years, which is the same period as that in which European and American girls usually exceed the boys in weight and stature. In Miss Sun's data the weight of the girls of 6 and 8 years also exceeds the boys but the weights for the girls of these ages must obviously be revised downwards as it is impossible that they can exceed the absolute weights of girls of 7 and 9 years old respectively.

Whyte (5), in his figures for Central and Southern Chinese (see Tables III, IV, V, and VI [I]) begins only with eleven yearsolds, but it is interesting to note, though the females are heavier than the males in all his figures up to seventeen years, that from 11 to 15 years the difference gradually increases. In his tables the females are taller than the males only at 13 and 15 years of age.

In the study of Central Chinese, Shirokogoroff and Appleton (11), find the males heavier than the females, except when the females are just as heavy at 14 years of age (see Tables V and VI [D]). The females are taller in their 13th year (Tables III and IV [D]). Shirokogoroff (12) gives some figures which were collected by Dr. Appleton (14) on 224 Chekiang females. When this series (see Tables IV and VI [F]) is compared with Shirokogoroff's (13) series of males from the same province (see Tables III and V [F]) it will be noted that the females exceed the males in weight after the ninth year and the males do not catch up again until the 16th year. In height the females exceed the males in their 11th, 12th, and 13th years (after the 12th year female figure from Table IV [F], which could not be lower than in the eleventh year, has been raised).

Appleton (24, 25) has studied 388 males of pure Chinese extraction now living in Hawaii, and 354 comparable females. She says: "Chinese girls in Hawaii are taller than boys of the same ethnic group in the same environment from eleven to thirteen years of age . . . After fourteen the growth curve which expresses stature of girls forms the plateau which rises only slightly, while rapid growth continues over a more prolonged period for boys . . . Kwangtung girls in Hawaii are heavier than boys from ten to fourteen years of age, but from fifteen years onward boys are decidedly heavier." Tables V and VI (O) show that at 7, 8, and 9 years the girls are as heavy as the boys.

In the figures which Wissler (26) reports for Chinese in Hawaii, there is again some support for Stevenson's evidence that the girls are larger at an earlier age. These data show the girls to be taller from six to thirteen and heavier at five, seven, and ten till fourteen. Wissler considers the age at which the males overtake the females, in weight at least, to be younger for Chinese than for his other ethnic groups, but this is not substantiated as a constant feature when all the other Chinese material is considered.

In several studies the males were consistently larger. Westbrook and Lai (20), in comparing 170 females, who were unfortunately all over 15 years old, with 1,704 males, said: "From 15 to 23 years of age the boys were much taller and heavier than the girls." Pyle (19) in his study of 230 girls and 270 boys of from 10 to 18 years old, shows the latter at all ages taller and heavier than the former.

Merrins (2) studied 69 Chinese girls and 219 boys of 11 years and older. His males were taller than his females for all ages, but at 13 and 14 years of age the females were heavier (Tables V and VI [V]).

From the available material there is evidence that the differences in growth between males and females are similar to those differences among European peoples who have been studied. Stevenson's (8) expectation that the boys would be both taller and heavier than the girls until the pubescent acceleration of the girls, appears to be well supported, contrary evidence in his own series being accounted for by the scantiness of the data for particular age periods and by the fact that his series of males do not all live in the same environment as his series of females.

IV. ENVIRONMENT AND GROWTH

Similarity of the Growth of Well-to-do Peoples

We have already noted that the members of more privileged groups of Chinese are larger. A glance at Graph III will show that the curves of the boys from favorable environment of Keys and Cadbury (K) (17) and Hsu and Liang (T) (18) are considerably higher than Stevenson's curves for less favored individuals. Miss Sun's (19) boys, from private schools and under medical supervision, were also taller and heavier than the Stevenson (8) Northern series which was based on public schools and orphanages. On the other hand her girls were not as large as the mission school girls whom Stevenson has reported. Hawks (7) says of her 22 American born Chinese: "In general, the children who apparently had the best environment were the largest."

In Appleton's Hawaiian studies the influence of environment can be more easily seen perhaps She points out that: "The percentage of difference between measurements of stature, weight, weight-height index, and arm length of Chinese boys in Hawaii at eight years and at eighteen years are strikingly higher than for boys in Chekiang and Kiangsu and approach very closely the measurements of Germans which Shirokogoroff has taken for comparison." The most logical explanation of this greater similarity would be on the grounds of a more similar environment, especially in that the climate, sanitation, and food habits in Hawaii are more like those in Europe than they are like those of Eastern China.

Graph III shows this very well. In the four parts of this graph the "Average Curve" is represented as a straight line and the points on the other curves indicate how much taller or shorter, heavier or lighter, are the other groups than the average Chinese. It is interesting to notice that the two curves of definitely superior males on the mainland (K and T) are very similar to each other though one is Southern Chinese and the other is a mixed group with Central and Northern Chinese predominating. The Hawaiian curve (which, for the males, is itself composed of four curves all very similar to each other) is also very much like the (K) and (T) curves. All the Chinese curves from superior environments are very much alike even though the

individuals represented come from different districts. This is also true of the girls (at least in regard to height) for the mission school North China (A) curve of Stevenson (8) is parallel to the Hawaiian curve (which is composed of three very similar series). The relative positions of the (A) curves to the average for females are different from the male curves. This could be explained by the fact, discussed above, that the males and females come from very different types of environment and represent different economic classes in the same region. In the case of Hawaii; however, both sexes bear a similar relationship to the average growth curves for all the Chinese groups combined. Males and females from Hawaii show parallelly greater growth in both weight and height during the ten to fifteen year old period. It will be suggested that during this period environment most affects the growth.

Nourishment and Standards of Nutrition

This brings to our attention the problem of nourishment. Shirokogoroff (13) says p. 77: "... according to the *index ponderalis* the Chinese of Chekiang are better nourished than the well-to-do class of Germans (!). On the other hand, Americans of the same class are better nourished than Germans and *slightly better nourished than the Chinese of Chekiang*, except at the age of 16 years when the Chinese are better nourished than Americans (!!). Russians of Moscow Erissman in the year 1888 *of a poor social stratum, are the best nourished of all groups.* [Italics are Shirokogoroff's]

"Thus, the conclusion that ought to be drawn from the above facts is that the Chinese comparatively are not undernourished, but they are superior to some Europeans (Germans) and are very close to Americans, the best nourished group belonging to the "poor" class; also Belgians and Jews belong to groups superior to some others. However, at some moments they show index of Pirquet lower than the Chinese. The investigation carried out by Dr. Whyte (5) shows us that the Chinese at any rate cannot be considered undernourished, and they occupy a place not far from Britishers, though significantly lower than Russians . . . "

The ponderal index, however, is not an adequate standard of nutrition by reason of its variability as has been noted by Stevenson (35, 36).

and Klineberg (21). That the ponderal and the height-weight indices may give a distinctly wrong clue to the standards of growth of the Chinese may be noticed in the work of Hammond and Hsia Sheng (16) who studied the growth and diet of two groups of Chinese boys from the same community. Their charts show that the group with the inferior diet, inmates of a poor-home, are much shorter, have a somewhat shorter sitting height, and are slightly lighter in weight, but *the weight for height curve seems to be higher than the superior summer school group.*

As Shirokogoroff has mentioned, (13) the process of growth cannot be represented very accurately unless there are data on the growth in fractions of stature—the leg and the trunk—as well as some other indirect indications of the process of growth. Only the papers of Shirokogoroff (13), Appleton (14, 24, 25), and Wissler (26) have adequate measurements of the fractions in young Chinese. Shirokogoroff says further, p. 10: "The stature and weight are not enough for demonstrating how the Chinese grow and what the difference between the process of growth of the Chinese as compared with other ethnical groups is." This is significant because he says later, p. 27: ". . . Besides it ought to be pointed out that the final result of the growth is not so distinct among different groups as the process itself. Thus, the essential difference in the Chinese as compared with other ethnical groups consists in *a very intensive growth of trunk in efficiency of some cause which affects the final result of growth, while among the Chinese groups the difference consists in a marked acceleration of trunk growth among Kiangsu males.*" He points out p. 58 ff., that in his figures the length of the the trunk and leg as well as the sitting height is different among Chinese than others, though the result is not so distinct. ". . . *the same result is attained by different means of the process of growth.*"

Shirokogoroff (13) p. 22, says: "Thus, *the difference in stature of Americans and Chinese is due to the absolute length of the leg* and only partly to the sitting height." [Italics are Shirogoroff's.]

Appleton (25) states: "For girls as for boys yearly increase of average length of lower limb is greater and more regular in Hawaii than in Chekiang, and after eleven years of age average length of limb greater in Hawaii. It is reasonable to suppose that this greater length of lower limb in

Kwangtung Chinese in Hawaii, as compared with Chekiang Chinese in China, is due to the absence of unfavorable environmental factors, since it is not a constant racial difference between the two ethnic groups. In China Shirokogoroff found male adults taller and longer limbed in Chekiang than in Kwangtung, while in Hawaii the writer found Kwangtung youths from eighteen to twenty years of age to have greater stature and longer limbs than Chekiang youths in China and also found them to be taller and longer limbed than male adults measured by Shirokogoroff in Kwangtung province in China."

We see from the fore going quotations that *where most of the dissimilarity between the growth process of Chinese and Americans occurs,—the leg,—the growth process is probably most influenced by environmental factors.* Appleton (24) says: "Growth of lower limb of Chinese boys in Hawaii is seen to resemble growth of lower limbs of Europeans more than that of Chinese of China."

Stevenson (35, 36) adheres to von Pirquet's contention that the "Pelidisi" index $\sqrt[3]{\frac{10 \times \text{weight in gm.}}{\text{sitting height in cm.}}}$ is the best objective test for the state of nutrition. He shows that the average Pelidisi for Chinese of all groups and both sexes is about 90, and that the range from 80 to 100 can be considered normal. This figure is significantly lower than the Pelidisi found among Occidental peoples, but it should be pointed out that this does not necessarily mean that a Chinese group with a Pelidisi of 90 is as well nourished as a Western group with 95 [which Stevenson (35) says is usually considered as representing the normal state of nutrition in most Occidental peoples]; on the contray, it may mean that the Chinese group is "normally" under-nourished.

Another test for nutritional state is the general clinical appearance. Appleton (25) says: "General nutritional condition, judged from subcutaneous fat, bone development, muscle tone, and general appearance, showed among Chekiang girls more than 50% poorly nourished in all but two age groups under thirteen years, while in Hawaii no age group, either girls or boys, had as high as 50% poorly nourished."

In Shirokogoroff's figures (13), p. 73, we see that the Chekiang males of ages 11 and 12 were 46% under-nourished, and in Kiangsu 35%. After this age the proportion of poorly nourished drops. It is unfortunate that

Shirokogoroff and Appleton have not published material for the other ages, especially since it might have been collected by a single worker, Dr. Appleton, in a comparable form. When it is noted that Chekiang males have shorter legs, it is easy to understand how they have a higher ponderal index and compare favorably with European groups, but at the same time have a high percentage of poorly nourished individuals. Pending further study of this problem, the following statement of Shirokogoroff cannot be accepted, (13), p. 78: "In our considerations as to the process of growth the idea of under-nourishment, as an influential factor disturbing the growth among the Chinese must be rejected."

On the contrary Appleton says that growth of the distal portion of the lower limb would be slowed up by poor environment. *This in turn could give a relatively high ponderal index even if the nutritional state were poor.*

In the Chinese, a high ratio of weight to height seems to be not only possible in spite of poor nutrition, but *because* of poor nutrition. The work done by Appleton (24), Hammond and Hsia Sheng (16), and Stevenson (35, 36), would lead one to distrust any measure of the nutritive state of Chinese which is dependent on the weight-height relationship. The use of the Pelidisi tables of Stevenson rather than the tables of Li and Cheng (10) in clinical determination of the nutritive state would seem to promise safer conclusions, though the arbitrary nature of this index must be admitted.

V. NEED FOR FURTHER STUDY

We have seen from several studies of the physical growth of Chinese, that but little is known of the growth processes even of the body as a whole (stature and weight) for large parts of China, and for certain age groups in any part. T. L Woo of the Academia Sinica is now collecting data on a large number of measurements on many children, however. There still exists the very important gap of the second post-natal growth cycle, from the time of weaning to five years of age. Some work is now being undertaken (37). Such a study might be of great help not only to the clinician but also to the anthropologist.

As far as we know, only Keys and Cadbury (17), and Guy et al (28) have published continuous studies of the growth of Chinese individuals over a period of time. Even just a few charts of individual growth would offer a check for

the curves drawn from studies of different individuals at different ages, but the real need is for a study by an institution which could keep in touch with the subjects over a long period of time.

It is to be hoped that further studies will be made of different anthropological stocks in the same environment, and of the same anthropological stock in different environments. Further study of the problem of the physiology of Chinese migrants to Hawaii and elsewhere, with an analysis of the question of selective migration might help us to understand the factors which control the growth process.

It is the hope of the author that this review of the literature on growth of Chinese may encourage new projects and indicate the more promising directions for future studies.

VI. SUMMARY

1. Various individual studies on the growth of Chinese are enumerated.
2. The stature of new born and young Chinese is found to be comparable to Western standard until three or four months of age after which it is consistently less.
3. Differences in the growth process for Chinese of different regions are discussed. It is suggested that these may be due to climatic rather than racial differences.
4. The growth of certain groups of Chinese of school age is compared to the growth of non-Chinese. It is seen that the process is similar but that in the Chinese the various phases of growth may occur at an earlier age than in some other racial groups.
5. The growth of Chinese girls is found to bear a relationship to the growth of boys similar to that observed in other racial groups.
6. The close similarity in the process of growth of well-to-do Chinese groups from different regions is noted.
7. A poor nutritive state of some Chinese groups (as shown by the Pelidisi index or clinical judgment of general apparance) is reported to inhibit the growth of the leg especially. The shorter leg in turn may give a higher weight-for-height or ponderal index, and make it seem that the group is relatively well nourished. Therefore, though some groups of

Chinese do not have a very low ponderal index, this fact does not designate a high state of nutrition.

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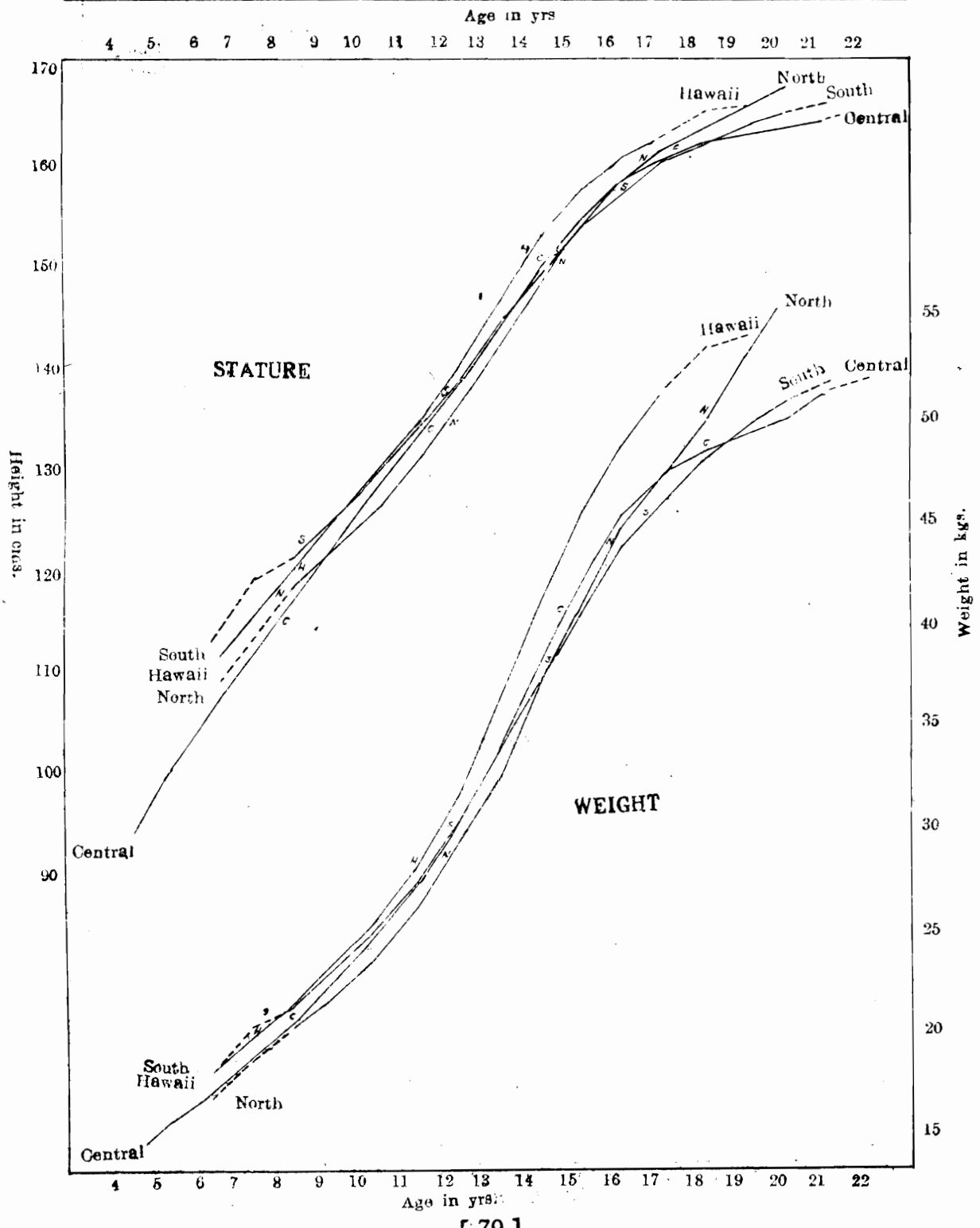
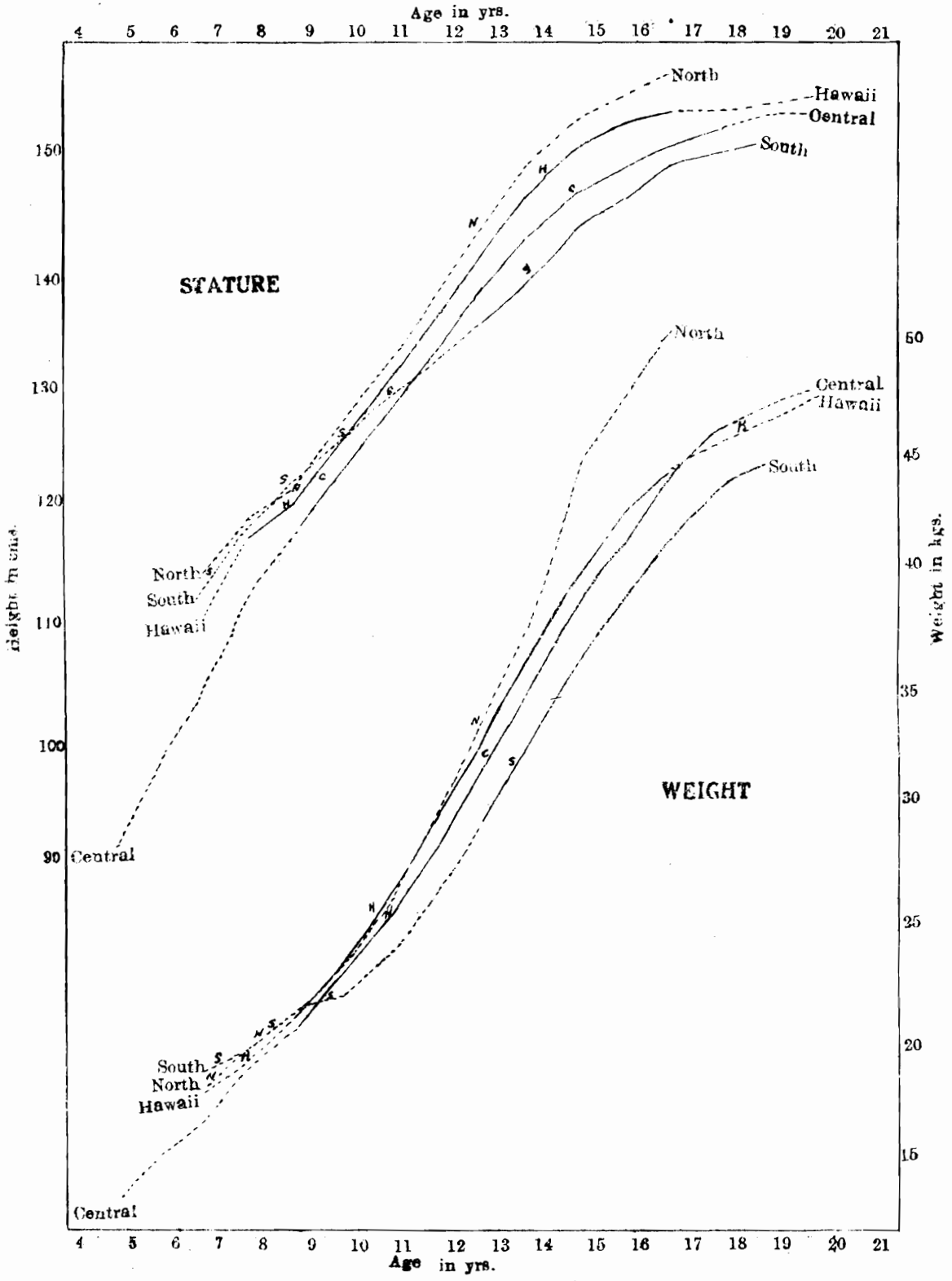
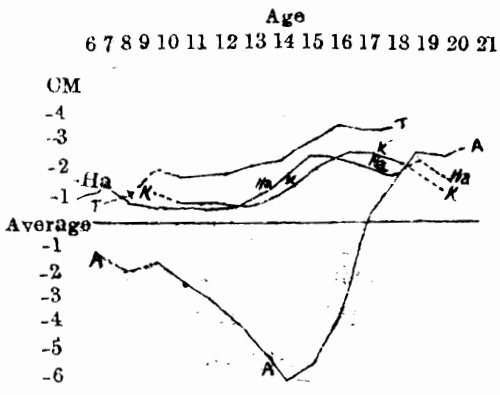
GRAPH I. GROWTH OF THE STATURE AND WEIGHT (MALES)



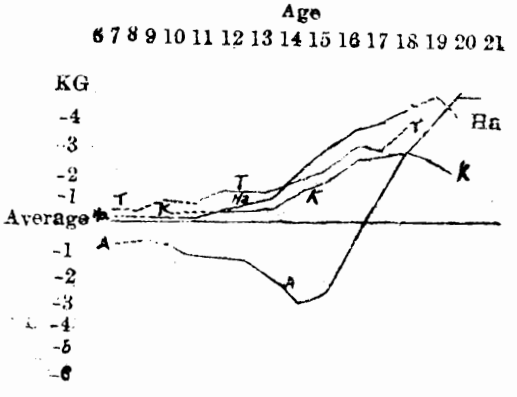
GRAPH II. GROWTH OF THE STATURE AND WEIGHT (FEMALES)



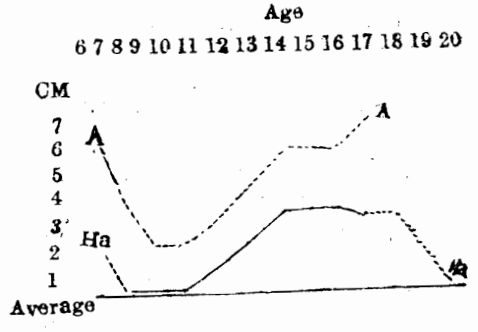
GRAPH III. GROWTH OF VARIOUS SUBGROUPS RELATIVE TO THE AVERAGE.



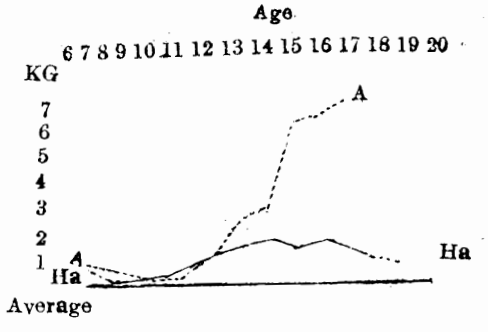
MALE STATURE



MALE WEIGHT



FEMALE STATURE



FEMALE WEIGHT

KEY TO CURVES
A North Stevenson (8)
K Canton Keys and Cadbury (17)
T Peiping Hsu and Liang (18)
Ha Hawaii
Average (19 Series of Chinese combined)

The figures in the graphs are weighted three year moving averages. For those segments of the curves where data on less than thirty (The number thirty) was taken arbitrarily This means that at least ninety cases are represented for each year. Experience has shown that this ensures a minimum of variation which could be ascribed to inadequate sampling. Individuals were available for any one of the three successive years, a broken line is used. Where data on thirty or more was available for each of the three years, a solid line is used. The end points (which cannot be weighted) have not been plotted.

In Graph I: North China (No) combines data A and B; (These letters refer to the series in the Tables which are used in the graphs) Central China (Ce) combines data C, D, E, F, and G, South China (So) combines data H, I, J, K, L, M, and N; Hawaii (Ha) includes data O, P, Q, and R. In Graph II: North China (No) is data A; Central China (Ce) is C, D, and F; South China (So) is H, I, and M; and Hawaii (Ha) is O, P, and R.

TABLE I. NUMBER OF MAEES

			3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	*adult*	*total*		
A	North	[1]				3	12	37	35	44	44	82	96	107	101	78	59	59	52	141	164	238		838	2200	Stevenson	(8)
B	Peiping												101	103	111	128	153	161	51 195	133 170	163	237		831 380	2182 1502	Whyte	(5)
	NORTH	[1]				3	12	37	35	44	44	82	197	210	212	296	222	220	217 246	311 303	164 163	238 237		1218 1211	3702 3684		
C	Central	[1]				1	3	6	10	9	9	40	81	117	215 214	315	418	434 433	403	380 379	234 233	276 226		497 495	3508 3452	Stevenson	(8)
D	Central	[1] [2] [5]	36 34	33 30		41	47	48	81	63	87	83	66	59	47	28	31	27	43	33	17 15				870 867	Shirokogoroff	(11)
E	Kiangsu								7	6	15	20	35	58	37	48	24	30	15						295	Shirokogoroff	(13)
F	Chekiang					5	3	4	10	4	12	11	21	33	44	55	49	28	11	8					301	Shirokogoroff	(13)
G	Central	[4]										3	7	15	44	49	63	51	64	66	69	42	31	5	513	West brook and Lai	(20)
	CENTRAL		36 34	33 30		47	63	58	108	82	123	157	213	232	387 386	495	585	570 569	536	487 486	350 381	318 268	31	5	501 499	5187 5428		
H	South	[1]				2	5	15	23	28 29	34	61 38	55 58	84 85	148 138	200 187	240 222	203 209	206 198	183 179	80	41 43			846 847	2469 2392	Stevenson	(8)
I	South											12	12	26	81	110	119	116	122	77					742	1417	Whyte	(5)
J	Fukien	[2]								7	19	26	36	35	51	42	36	40	20	14	8				11	345	Appleton	(15)
K	Canton							29	51	64	71	74	85	89	96	99	91	91	81	56	36					1013	Keys and Cadbury	(17)
L	Hongkong										3	6	15	27	55	95	133	112	93	63	34	21	3	3		668	Crook	(1)
M	Canton										14	23	57	62	55	40	19									270	Pyle	(4)
N	South	[4]											8	31	46	42	53	57	42	51	53	24	12	2		421	Westbrook and Lai	(20)
	SOUTH					2	5	44	74	99 100	141	202 179	268 271	354 355	532 522	628 615	691 673	619 625	569 561	449 440	211	86 88	15	5	1599 1600	6593 6526		
O	Hawaii						23	32	42	34	53	33	39	32	21	28	22	10	11		11					388	Appleton	(24)
P	Hawaii						18	24	29	38	31	32	38	36	36											282	Cox	(23)
Q	Hawaii					60	22	9	16	16	22	16	26	25	16	14										242	Appleton	(15)
R	Hawaii						5	49	82	70	76	73	79	57 56	66	68 67	50	45	36	30	10	8				604 602	Wissler	(26)
	HAWAII					65	112	137	187	164	179	160	169 159	159	141 140	92	67	46	41	17	19					1716 1714		
S	Shanghai					7	5	21	52	46	59	62	90	116	84	83	84	29	13							731	Westbrook and Lai	(20)
T	Peiping							16	69	54	71	90	110	163	145	186	149	150	135	135	86	60	58	17		1704	Hsu and Liang	(18)
U	Philippines									4	7	11	9	14	10	5										60	Bobbitt	(22)
	AVERAGE	[8]	36 34	33 30		124	187	313	475	503 504	624	761 738	1032 1034	1252 1243	1421 1403	1604 1591	1682 1664	1526 1531	1435 1426	1282 1264	733	636 587	61	20	3314 3306	19059 16913		
V	AMERICA	[3]		8	27	19	8	13	20	38	27	19	7													184	Preston	(27)
W	Peiping																									551	Sun	(19)
X	Hupeh	[2]																								219	Merrins	(2)

[1] Where two numbers are given it indicates that a different number of persons was examined for height than for weight. The upper figure is for height, the lower for weight.

[2] The ages which are given are probably about six months too high.

[3] The method of calculating the age groups makes them run from six months under to six months over the age limits.

[4] Included in the mixed group (S) by the same author.

[5] Includes 80 South Chinese in Fukien and 99 North Chinese in Shansi.

[6] Includes 63 South Chinese in Fukien and 21 North Chinese in Shansi.

[7] Includes 151 girls and 44 adult women in the Central provinces of Honan, Kiangsu, and Chekiang.

[8] Includes all the above groups except the regional subtotals and G and N. These have been excluded because they would duplicate material included in S.

TABLE II. NUMBER OF FEMALES

			3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	*adult*	*total*		
A	NORTH	[1]				6	11	20	18	28	28 27	34	46	24	24	20	13	4							276 275	Stevenson	(8)
C	Central	[1]				1	5	10	11		25 24	24 23	29 30	17	23	23	22	22	20						239 238	Stevenson	(8)
D	Central	[1] [2] [6]	20 19	16	31	18	20	9	18	18	22	22	22	17	11	11	6	5						266 265	Shirokogoroff	(11)
F	Chekiang						5	8	12	13	15	15	16	19	14	34	18	23	15	13	4			224	Shirokogoroff	(12)
	CENTRAL		20 19	16	32	28	38	32	38	58 57	61 60	67 58	58	54	68	51	51	40	13	4				729 727		
H	South	[1]			1	4	4	10	6	11	48	60 59	66	51	58 57	56 55	57	41	21 20		1			174 156	669 647	Stevenson	(8)
I	South	[7]									42	44	58	35	41	52	56	50	53					202	631	Whyte	(5)
M	Canton									11	12	16	32	24	34	41	35	25						25	255	Pyle	(4)
	SOUTH					1	4	4	10	6	22	102	120 119	156	110	133 132	149 148	148	116	54 53		1		401 383	1537 1515		
O	Hawaii						29	23	28	38	27	34	35	28	29	25	20	15	8	10	5				354	Appleton	(25)
P	Hawaii						11	37	37	33	44	41	38	28	27										296	Cox	(23)
R	Hawaii					9	37	77	61	73	67	55	67	55	69	56	43	38	14	8	1				730	Wissler	(26)
	HAWAII					9	77	137	126	144	138	130	140	111	125	81	63	53	22	18	6				1380		
S	Shanghai															2	7	23	30	36	31	13	18	10		170	Westbrook and Lai	(20)
	AVERAGE	[8]	20 19	16	48	120	199	186	216	246 244	327 326	373	349	313	304 303	283 282	279	208	121 120	41	14	18	10	401 383	4092 4067		
V	AMERICA	[3]		10	14	23	16	15	31	31	22	20	5	3											196	Preston	(26)
W	Peiping																								260	Sun	(19)
X	Hupeh	[2]																							69	Merrins	(2)

TABLE III. MALE HEIGHT

		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	*adult*		
North				103.3	105.5	113.9	118.6	121.6	125.7	130.1	133.6	138.7	142.8	151.9	159.0	164.4	164.6	167.8	168.2	169.1			169.2	Stevenson	(8)
Peiping											137.5	146.5	151.7	155.5	160.0	161.0	163.4	164.5					165.5	Whyte	(5)
NORTH				103.3	105.5	113.9	118.6	121.6	125.7	130.1	135.6	142.5	147.4	154.1	159.7	161.8	163.6	166.0	168.2	169.1			168.0		
Central				102.0	107.1	109.4	115.7	125.2	125.0	129.2	136.3	141.7	149.7	155.3	157.6	161.2	162.4	163.0	164.3	163.9			165.1	Stevenson	(8)
Central	[2] [5]	85.5	93.5	97.6	105.8	111.3	114.1	121.4	127.5	133.3	137.6	143.3	146.3	153.9	157.5	158.1	161.1	161.4	163.3					Shirokogoroff	(11)
Kiangsu							125.5	128.5	133.4	134.9	139.8	148.7	152.3	160.9	163.6	165.0	166.2							Shirokogoroff	(13)
Chekiang				111.5	116.0	121.7	123.7	129.0	132.6	136.8	137.8	142.7	150.1	155.8	160.1	162.0	163.9	161.3						Shirokogoroff	(13)
Central	[4]									137.2	137.2	152.4	154.9	154.9	162.6	164.6	165.4	165.6	165.6	165.9	166.6	167.6	165.1	Westbrook and Lai	(20)
CENTRAL		85.5	93.5	99.2	106.5	111.8	115.9	122.7	128.5	132.8	137.5	144.2	150.2	155.8	158.6	161.6	162.8	163.3	164.5	164.2	166.6	167.6	165.1		
South				102.9	117.3	120.7	123.8	124.3	130.0	134.8	139.0	143.1	149.7	150.9	158.3	161.7	162.5	164.2	164.6	165.1			163.0	Stevenson	(8
South										131.3	134.0	136.4	145.1	142.8	152.5	156.4	158.4	162.3					163.0	Whyte	(5)
Fukien	[2]							122.4	125.5	130.5	131.6	136.6	142.7	149.6	158.2	160.2	162.6	165.6	165.6					Appleton	(15)
Canton						116.4	120.1	125.2	129.5	134.0	139.1	145.5	152.4	158.1	162.0	163.9	165.1	165.8	165.8					Keys and Cadbury	(17)
Hongkang									137.4	137.2	142.2	151.4	158.0	159.8	161.3	163.1	162.6	163.9	166.6	165.1	164.1	153.5		Crook	(1)
Canton									131.0	132.6	139.5	143.8	152.7	159.6	159.1									Pyle	(4)
South	[4]										147.3	147.3	152.4	157.4	160.3	161.3	163.8	166.4	167.6	167.9	163.1	162.6		Westbrook and Lai	(20)
SOUTH				102.9	117.3	117.9	121.2	124.7	129.4	133.6	138.3	143.7	150.2	152.9	158.5	161.1	162.1	164.7	165.9	166.59	167.3	160.1	163.0		
Hawaii					111.1	115.6	120.6	124.6	128.7	134.1	139.1	145.1	153.8	159.7	162.1	165.0	163.1	168.6	165.4					Appleton	(24)
Hawaii					111.8	117.3	120.9	126.0	130.3	135.1	140.7	148.6	163.7											Cox	(23)
Hawaii				105.2	110.2	115.8	120.9	127.0	130.3	136.1	140.5	145.5	154.9	161.3										Appleton	(15)
Hawaii				106.0	110.5	113.8	119.5	124.4	128.5	132.4	139.6	145.9	151.5	157.5	166.2	162.8	165.7	167.3	165.6					Wissler	(25)
HAWAII				105.3	110.8	114.8	120.2	125.1	129.4	133.7	139.9	146.2	152.8	158.7	760.8	163.3	165.0	167.8	165.5						
Shanghai				104.0	107.8	117.1	121.8	125.5	130.6	136.0	140.2	147.4	153.3	159.0	163.5	164.2	165.8							Westbrook and Lai	(20)
Peiping						113.3	120.9	123.9	130.9	135.3	144.5	148.3	156.2	160.0	164.0	165.8	166.1	166.3	169.1	165.8	166.9	166.1	165.1	Hsu and Liang	(18)
Phlilppines								123.7	127.5	128.6	134.8	139.0	144.2	158.5										Boibbitt	(22)
AAVERAGE	[8]	85.5	93.5	102.8	109.3	114.7	119.5	124.2	129.1	133.4	138.6	144.6	150.6	155.2	159.3	161.9	162.9	164.6	166.0	166.1	166.8	165.0	165.2		
AMERICA	[3]	100.8	104.8	107.7	111.8	120.8	126.0	127.1	132.2	134.6	139.7	146.7												Preston	(27)
Peiping					103.8	113.8	118.7	122.3	129.5	133.5	139.7	142.0	146.3	146.1	160.2									Sun	(19)
Hupeh	[2]									127.0	138.9	141.0	149.4	157.5	162.1	163.1	162.6	164.3	163.8	167.1	167.8			Merrins	(2)

TABLE V. FEMALE HEIGHT

		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	*adult*		
A	NORTH			107.6	116.4	116.6	122.3	126.2	131.7	137.4	144.1	149.2	153.7	154.8	155.4	160.5								Stevenson	(8)
C	Central			112.0	110.4	116.3	123.9	127.5	131.0	136.3	140.5	146.1	146.1	144.5	149.5	150.0	150.3							Stevenson	(8)
D	Central	[2] [6]	83.8	91.4	95.8	103.3	106.9	111.3	116.0	122.8	126.2	135.6	140.4	145.5	150.4	149.7	152.3	147.6						Shirokogoroff	(11)
F	Chekiang					114.2	120.8	121.7	125.5	130.0	139.8	137.8	147.6	148.4	151.2	152.4	152.8	157.5	154.3	152.4				Shirokogoroff	(12)
	CENTRAL		83.8	91.4	96.3	106.5	112.3	119.5	121.4	128.2	133.5	138.2	144.4	146.5	148.8	150.6	152.0	152.8	154.3	152.4					
H	South				104.5	114.3	118.4	121.2	126.2	138.2	132.6	136.8	141.8	141.5	150.8	147.8	152.4	151.6	152.0		156.0		151.4	Stevenson	(8)
	South	[7]								130.0	133.8	139.5	141.0	147.3	147.3	146.5	150.7	151.3					150.3	Whyte	(5)
M	Canton								122.1	126.2	134.3	139.5	143.3	146.4	150.6	150.7	150.5						151.5	Pyle	(4)
	SOUTH				104.5	114.3	118.4	121.1	126.2	130.1	130.8	135.4	140.5	141.7	148.6	148.4	149.8	151.0	151.6		156.0		150.9		
O	Hawaii					109.8	116.4	119.4	124.5	128.7	135.1	141.5	148.0	151.5	152.5	152.3	155.0	155.2	154.5	154.6				Appleton	(25)
P	Hawaii					110.2	115.1	120.6	126.5	131.6	136.4	144.0	147.8	155.4										Cox	(23)
R	Hawaii				103.9	111.0	114.3	119.5	125.0	128.6	135.1	141.2	145.9	149.2	152.9	153.7	154.0	153.6	155.8	153.0				Wissler	(26)
	HAWAII				103.9	110.4	114.9	119.8	125.2	129.6	135.5	142.0	146.9	151.1	152.8	153.3	154.3	152.7	155.1	153.0					
S	Shanghai													152.7	153.2	152.4	155.2	153.9	158.8	153.3	154.9	155.9	150.9	Westbrook and Lai	(20)
	AVERAGE	[8]	83.8	91.4	99.3	110.2	114.6	120.1	124.7	129.5	133.9	139.5	144.2	147.2	149.9	150.3	151.4	152.1	153.1	157.5	153.5	154.9	155.9	150.9	
V	AMERICA	[3]	97.5	103.3	107.3	115.7	118.5	122.4	127.3	131.1	138.6	144.5	145.6											Preston	(26)
W	Peiping					104.4	105.7	113.6	121.1	127.4	130.8	139.8	145.5	149.0	150.7	150.1								Sun	(19)
X	Hupeh	[2]									132.6	139.7	145.3	147.3	149.9	150.4		152.4		153.7				Merrins	(2)

TABLE V. FEMALE HEIGHT

		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	*adult*		
A NORTH				107.6	116.4	116.6	122.3	126.2	131.7	137.4	144.1	149.2	153.7	154.8	155.4	160.5								Stevenson	(8)
C Central				112.0	110.4	116.3	123.9	127.5	131.0	136.3	140.5	146.1	146.1	144.5	149.5	150.0	150.3							Stevenson	(8)
D Central	[2] [6]	83.8	91.4	95.8	103.3	106.9	111.3	116.0	122.8	126.2	135.6	140.4	145.5	150.4	149.7	152.3	147.6							Shirokogoroff	(11)
F Chekiang					114.2	120.8	121.7	125.5	130.0	139.3	137.8	147.6	148.4	151.2	152.4	152.8	157.5	154.3	152.4					Shirokogoroff	(12)
CENTRAL		83.8	91.4	96.3	106.5	112.3	119.5	121.4	128.2	133.5	138.2	144.4	146.5	148.8	150.6	152.0	152.8	154.3	152.4						
H South				104.5	114.3	118.4	121.2	126.2	138.2	132.6	136.8	141.8	141.5	150.8	147.8	152.4	151.6	152.0		156.0			151.4	Stevenson	(8)
I South	[7]									130.0	133.8	139.5	141.0	147.3	147.3	146.5	150.7	151.3					150.3	Whyte	(5)
M Canton									122.1	126.2	134.3	139.5	143.3	146.4	150.6	150.7	150.5						151.5	Pyle	(4)
SOUTH				104.5	114.3	118.4	121.1	126.2	130.1	130.8	135.4	140.5	141.7	148.6	148.4	149.8	151.0	151.6		156.0			150.9		
O Hawaii					109.8	116.4	119.4	124.5	128.7	135.1	141.5	148.0	151.5	152.5	152.3	155.0	155.2	154.5	154.6					Appleton	(25)
P Hawaii					110.2	115.1	120.6	126.5	131.6	136.4	144.0	147.8	155.4											Cox	(23)
R Hawaii				103.9	111.0	114.3	119.5	125.0	128.6	135.1	141.2	145.9	149.2	152.9	153.7	154.0	153.6	155.8	153.0					Wissler	(26)
HAWAII				103.9	110.4	114.9	119.8	125.2	129.6	135.5	142.0	146.9	151.1	152.8	153.3	154.3	152.7	155.1	153.0						
S Shanghai														152.7	153.2	152.4	155.2	153.9	158.8	153.3	154.9	155.9	150.9	Westbrook and Lai	(20)
AVERAGE	[8]	83.8	91.4	99.3	110.2	114.6	120.1	124.7	129.5	133.9	139.5	144.2	147.2	149.9	150.3	151.4	152.1	153.1	157.5	153.5	154.9	155.9	150.9		
V AMERICA	[3]	97.5	103.3	107.3	115.7	118.5	122.4	127.3	131.1	138.6	144.5	145.6												Preston	(26)
W Peiping					104.4	105.7	113.6	121.1	127.4	130.8	139.8	145.5	149.0	150.7	150.1									Sun	(19)
X Hupeh	[2]										132.6	139.7	145.3	147.3	149.9	150.4		152.4		153.7				Merrins	(2)

TABLE VI. FEMALE WEIGHT

		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	*adult*		
A	NORTH			16.9	19.1	19.3	21.6	23.9	25.4	29.6	34.3	38.9	41.8	54.1	47.8	50.2								Stevenson	(8
C	Central				18.0	19.3	18.8	22.0	24.4	27.0	30.0	33.2	38.7	39.7	40.6	43.0	48.3	47.2						Stevenson	(8
D	Central	[2] [6] 11.4	13.4	13.9	16.1	17.0	18.4	20.4	22.4	24.5	28.0	31.0	35.1	40.0	41.6	41.6	41.5							Shirokogoroff	(11
F	Chekiang				20.5	22.0	22.6	24.2	28.3	32.6	31.8	40.0	40.4	44.0	47.4	48.2	50.9	47.2	49.6					Shirokogoroff	(12
	CENTRAL	11.4	13.4	13.9	17.5	18.5	21.2	22.4	25.9	28.6	31.2	36.2	38.4	42.2	44.3	47.5	47.8	47.1	49.6						
H	South			16.6	17.2	22.3	20.4	22.0	24.9	26.6	30.2	33.5	36.6	40.4	41.1	44.2	45.2	44.2		49.0			46.0	Stevenson	(8
I	South	[7]								26.1	28.7	32.8	34.5	39.2	40.7	42.9	46.2	44.7					42.7	Whyte	(5
M	Canton								22.8	25.2	30.5	34.6	37.5	39.6	43.7	45.2	47.0						50.8	Pyle	(4
	SOUTH			16.6	17.2	22.3	20.4	22.0	23.8	26.2	29.7	33.5	36.1	39.8	41.7	43.9	46.0	44.5		49.0			44.6		
O	Hawaii				17.3	20.6	21.7	23.5	26.3	28.8	33.2	37.4	41.9	43.0	46.4	45.9	44.3	47.5	45.6					Appleton	(25
P	Hawaii				18.1	19.6	21.8	24.6	28.1	30.5	35.2	38.0	41.7											Cox	(23
R	Hawaii			16.8	18.0	19.2	20.5	23.0	25.8	28.6	32.4	36.5	39.7	42.6	45.2	46.6	46.6	49.2	69.4					Wissler	(26
	HAWAII			16.8	17.8	19.5	21.1	23.5	26.6	29.3	33.4	37.1	40.6	42.7	45.6	46.4	45.8	48.3	49.6						
S	Shanghai													43.5	45.0	45.5	46.5	47.4	47.1	41.9	47.2	46.0		Westbrook and Lai	(20
	AVERAGE	[8] 11.4	13.4	15.0	17.8	19.4	21.2	23.3	26.1	28.2	31.9	35.5	38.8	42.1	43.4	45.3	46.4	46.2	47.7	42.4	47.2	46.0	44.6		
V	AMERICA	[3] 14.7	16.2	17.7	19.8	21.0	23.1	24.8	28.0	31.5	35.3	38.4												Preston	(26
W	Peiping				18.7	18.6	22.4	23.2	25.7	29.1	32.4	37.2	39.9	42.2	45.5									Sun	(19
X	Hupeh	[2]									25.9	32.9	37.4	41.1	45.2	46.7		47.2		52.6				Merrins	(2