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From the Eighth Annual Report of the State Board of Health of Massachusetts.

THE
GROWTH OF CHILDREN.

By H. P. BOWDITCH, M.D.

PROFESSOR OF PHYSIOLOGY, HARVARD MEDICAL SCHOOL.

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1877.

THE GROWTH OF CHILDREN.

BY H. P. BOWDITCH, M. D.,
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THE GROWTH OF CHILDREN.*

On the 24th of September, 1872, at a meeting of the Boston Society of Medical Sciences, a communication was made of which the following report was published in the "Boston Medical and Surgical Journal" for December 19, 1872:—

"Dr. Bowditch exhibited a diagram showing the rate of growth, in height, in the two sexes. The curves of growth were so drawn that the abscissas gave the age in years, and the ordinates the height in feet and inches. They represented the average measurements on thirteen individuals of the female and twelve of the male sex. The measurements were all taken annually during the last twenty-five years, and the individuals were all nearly related to each other. An examination of the curves shows the following facts:—

"1. Growth is most rapid during the earliest years of life.

"2. During the first twelve years boys are from one to two inches taller than girls of the same age.

"3. At about twelve and a half years of age girls begin to grow faster than boys, and, during the fourteenth year, are about one inch taller than boys of the same age.

"4. At fourteen and a half years of age boys again become the taller, girls having, at this period, very nearly completed their growth, while boys continue to grow rapidly till nineteen years of age.

"The tables and curves of growth, given by Quetelet, show that, in Belgium, girls are, at no period of their lives, taller than boys of the same age, though at twelve years of age their weight is precisely the same as that of boys, and decidedly less both before and

* The investigation, of which the results are given in this Report, was originally undertaken under the auspices of the health department of the Social Science Association, but in view of the extended character which the inquiry gradually assumed in its progress, and of the direct bearing of the question on the sanitary condition of the people, it was decided to make it the subject of a report to the State Board of Health.

after that period. Measurements taken among the lower classes, in Manchester and Stockport, show that, during the thirteenth and fourteenth years, girls are superior to boys of the same age, both in height and weight.

“It would be interesting to determine, by more extended observations, in what races and under what climatic conditions the growth of girls, at about the period of puberty, is the most rapid. It is possible that in this way, facts may be discovered bearing upon the alleged inferiority in physique of American women.”

To explain the discrepancy thus apparent in the results of observations in different countries, a renewed investigation seemed to be necessary, and, as a contribution to our knowledge of the subject, a systematic measurement of the pupils, in the public schools of Boston, was undertaken.*

The nature and object of the inquiry are explained in the following letter read by Dr. D. F. Lincoln at the meeting of the Social Science Association at Detroit, in 1875, with the hope of exciting an interest in the subject, which might lead to similar investigations in other parts of the country.

“The object of ascertaining the heights and weights of the pupils in the public schools of Boston is to determine the rate of growth of the human race under the conditions which Boston presents. It is, of course, very desirable that similar observations should be made in other parts of the country, in order to enlarge the number of data from which conclusions may be drawn. This country offers an excellent field for investigations of this sort, not only on account of the wide range of climatic conditions which it presents, but from the fact that the inhabitants are the immediate descendants of a large number of different races. If we can compare, therefore, the rate of growth of a race in their native land, with the rate of growth of the same race after emigration to this country, we shall be able to study the effect of transplantation into new climatic conditions; and if we compare together the amount of change which the rate of growth of different races undergoes after emigration to this country,

* The necessary authority for the work was granted by the school committee in the following order:—

IN SCHOOL COMMITTEE, March 9, 1875.

Ordered, That permission be given to Prof. Henry P. Bowditch, of Harvard University, to ascertain the height and weight of the pupils attending the public schools, through such an arrangement as the respective chairmen and the head masters, or masters, may deem most convenient.

Attest: BERNARD CAPEN, *Secretary*.

we shall have data for estimating the relative adaptability of the races in question to the new climate. Moreover, if it shall be found that the rate of growth of the female sex is more seriously modified by emigration than that of the male sex, light may be thrown on the question of the cause of the alleged inferiority of the physique of American women. As the value of observations of this sort depends entirely upon their accuracy, it is important that the height should be measured without shoes, on rods graduated to one-tenth of an inch. The weight should be determined on scales weighing pounds and ounces.

METHOD OF INVESTIGATION.

In order to obtain the necessary data, blanks, with the following headings, were prepared and distributed to the various schools :—

*Record of the Height and Weight of the Pupils in the
School for , Boston, 187 .*

| Number. | NAME. | AGE. | | HEIGHT WITHOUT SHOES. | | WEIGHT IN ORDINARY CLOTHES. | | Birthplace. | NATIONALITY OF PARENTS. | | Occupation of Parents. | Remarks. |
|---------|-------|--------|---------|-----------------------|---------|-----------------------------|---------|-------------|-------------------------|---------|------------------------|----------|
| | | Years. | Months. | Inches. | Tenths. | Pounds. | Ounces. | | Father. | Mother. | | |
| | | | | | | | | | | | | |

The principals of the schools were personally visited, the nature of the inquiry explained to them, and their coöperation in the work requested. It is to the friendly and intelligent interest shown by these gentlemen that the success of the work is in great measure to be attributed. The above-mentioned blanks were filled out by the various teachers for their respective classes, the weighing and measuring being done under the personal superintendence of the principals themselves, or, in a few instances, under that of a trustworthy deputy. The heights, without shoes, were measured by means of a rod graduated to tenths of an inch and furnished with a sliding horizontal bar and a clamp by which it could be fixed firmly to any table in a vertical position. The heights were usually recorded at the nearest tenth of an inch, but in some instances at the nearest quarter inch. In the case of

one set of papers, where they were given at the nearest inch, the observations were rejected in calculating the averages.

The weights were determined by Fairbanks' platform scales weighing to ounces; but, in view of the error necessarily introduced by the unknown weight of the clothing, they were recorded only at the nearest quarter pound. The allowance to be made for clothing in calculating the average net weight will be considered later.*

The birthplace of the pupils was recorded with the view of discriminating between native- and foreign-born children, but the latter were found to be so few in number, that it was thought best to disregard entirely the data of this column.

The nationality (*i. e.*, the native country) of the parents was ascertained by questioning the pupils. In a few instances, where, owing to the youth or ignorance of the pupils, the result of this inquiry was unsatisfactory, the necessary information was obtained through the police. It is not to be supposed that the data recorded under this heading are absolutely accurate. There are doubtless instances where foreign-born parents are recorded as American; but this probably occurs chiefly in those instances where the parents have emigrated to this country in very early life, and have thus become completely acclimated before the birth of their children. For a thorough study of the effect of climate in modifying the rate of growth of different races, it would, of course, be important to ascertain the nationality of the ancestors of the pupils for several generations; but this inquiry seemed quite impracticable for the generality of public-school pupils, and was therefore not attempted. Data of this sort were, however, obtained, through the kindness of Lieut. Zalinsky, from a number of the pupils in the Massachusetts Institute of Technology.

The occupation of parents was copied from the school records, with a view of ascertaining approximately the effect of the social condition of the parents on the growth of the children; but the utilization of the data thus obtained has been

* Notwithstanding the many advantages of the metric system of weights and measures, it was not employed in this investigation, because it was considered that, the measurements being taken by many different individuals, greater accuracy would be secured by the use of familiar units. Moreover, the general results being expressed in comparatively few figures, can be readily calculated in the metric system, and thus made comparable with those of observations taken in Continental Europe.

necessarily postponed for the present, on account of the great addition to the labor of this investigation which it would involve.

Under the head of remarks, the teachers were requested to note any deformity of the pupils which might render it expedient to exclude their measurements from the calculation of a normal average. The fact of color was also noted under this heading, in order that negro and mulatto children might be distinguished from white children of American parents.

The statistical data above described were collected in nearly all the public schools of the city proper, in several schools in South Boston, Roxbury, Charlestown and Jamaica Plain, in the Massachusetts Institute of Technology, in Mr. J. P. Hopkinson's private Latin School, in Miss Hubbard's school for young ladies, and, through the kindness of Dr. Robert Amory, in several of the public schools of Brookline. About 24,500 observations were thus collected, a number which was considered sufficiently large to justify conclusions on the subjects to which the inquiry was directed.

On the receipt of the records from the various schools, the observations were at once tabulated according to the nationality of the parents, those of each nationality being arranged on a separate series of sheets, showing at a glance, in parallel columns, all the observations of any given age. The greater part of this work of tabulation was performed by Miss Mary P. Nichols, to whose accurate and patient labor the value of the results obtained is largely due. Mr. James Dike also rendered valuable assistance in this work.

In this tabulation, it was important to select only those nationalities which would give at each age a sufficient number of observations to justify the calculation of an average. The selection was of course at the outset to a great extent conjectural and tentative, and could be definitely made only as the work progressed. It was finally decided to limit the tabulation by nationality of parents to the following groups:—

- I. Parents, both American.
- II. Parents, both Irish.
- III. Parents, one American and one Irish.
- IV. Parents, both German.
- V. Parents, one or both English.

In the last three of these groups the observations were not sufficiently numerous to establish the rate of growth with very great precision; but the results have a certain value as approximations to the truth.

The observations thus tabulated were placed in the hands of professional accountants, by whom the average heights and weights for the different ages and nationalities were calculated both in the English and in the French systems of weights and measures. The results are given in Tables Nos. 1 and 2, at the end of this article.

It will be noticed that it has been assumed in this investigation that the rate of growth of children may be ascertained by computing at any one time the average height and weight of children of different ages, as well as by determining the average height and weight of a given set of children in successive years. This assumption is doubtless perfectly justifiable, though certain theoretical objections may be urged against it. It may be said, for instance, to involve the further assumption of the prevalence at any given time of equally favorable conditions for the growth of children of *all* ages. It is, however, conceivable, that at a certain time, particularly favorable or unfavorable conditions for the growth of young children may prevail, while the growth of older children may be less affected. The rate of growth determined by observations taken at this time will therefore show a deviation from the normal type. This objection is deprived of whatever weight it may have by extending the observations over a considerable length of time. It is probable that when the investigation is carried on, as in the present instance, during the greater part of a year, the effect of such disturbing influences may be regarded as, to a great extent, eliminated, though a series of investigations undertaken at intervals of several years would be necessary to definitely settle the question. For a further discussion of this method of ascertaining the rate of growth, the reader is referred to the statistical investigations of Dr. B. A. Gould,* p. 115.

From the averages given in Tables Nos. 1 and 2, Table No. 3 was then computed, showing the annual increase both in

* Investigations in the Military and Anthropological Statistics of American Soldiers. By Benjamin Apthorp Gould. New York. 1869.

height and weight of children of both sexes, and of the above-mentioned parentage. In this table is also given in the columns headed "pounds per inch," a series of figures obtained by dividing the weight in pounds by the height in inches, and showing what, for want of a better word, may be called the "stoutness" of the children at different ages, etc.*

In order to obtain a more adequate idea of the growth of the children in this community than that furnished by the average heights and weights, another set of tables was computed by Miss Nichols, showing for every age the number of observations at each height and weight. Tables of this sort for children of American and of Irish parents, and for the whole number of observations irrespective of nationality, are given at the end of the article. (See Tables Nos. 4 to 15.) The observations on children of other nationalities were so few in number that it was not considered important to present them in this form. To facilitate a comparison of the distribution of the observations at different ages, a second column of figures is given under each age, showing the *percentage* of the observations occurring at any given height or weight.

A tabulation of this sort renders it possible to see at a glance the extreme range of variation of the individual observations. In the progress of the work, many cases were met with of heights and weights differing so widely from the average measurements of the age to which they belonged, as to excite a suspicion of error in the observation. In these cases application was made to the principals of the schools for a confirmation or a correction of the measurements. About forty errors were thus detected, the necessary corrections

* It will be noticed that in Tables Nos. 1 and 2 the ages are given "at the last birthday." Hence, the *average age* of the children thus grouped together will be six months greater than the age given in the tables. For instance, 5 years 6 months is the average age of the 201 boys of American parentage, whose height is 41.74 inches, and whose weight is 41.20 pounds. Now, since the figures in the columns headed annual increase, in Table No. 3, are the differences between the successive heights and weights in Tables Nos. 1 and 2, it is evident that they express the yearly growth precisely at the age given in the table. For instance, if the average height of the above-mentioned boys of 5½ years old is 41.74 inches, and that of the boys of the same parentage, one year older, is 44.10 inches, then 2.36 inches is the average annual increase in height of boys at 6 years of age. On the other hand, the figures in the columns of Table No. 3, headed pounds per inch, express (as in Tables Nos. 1 and 2) the ratio of the weight to the height of the children whose age *at last birthday* is placed opposite to them in the table.

made, and the tables of averages made more accurate than they otherwise would have been.

RESULTS.

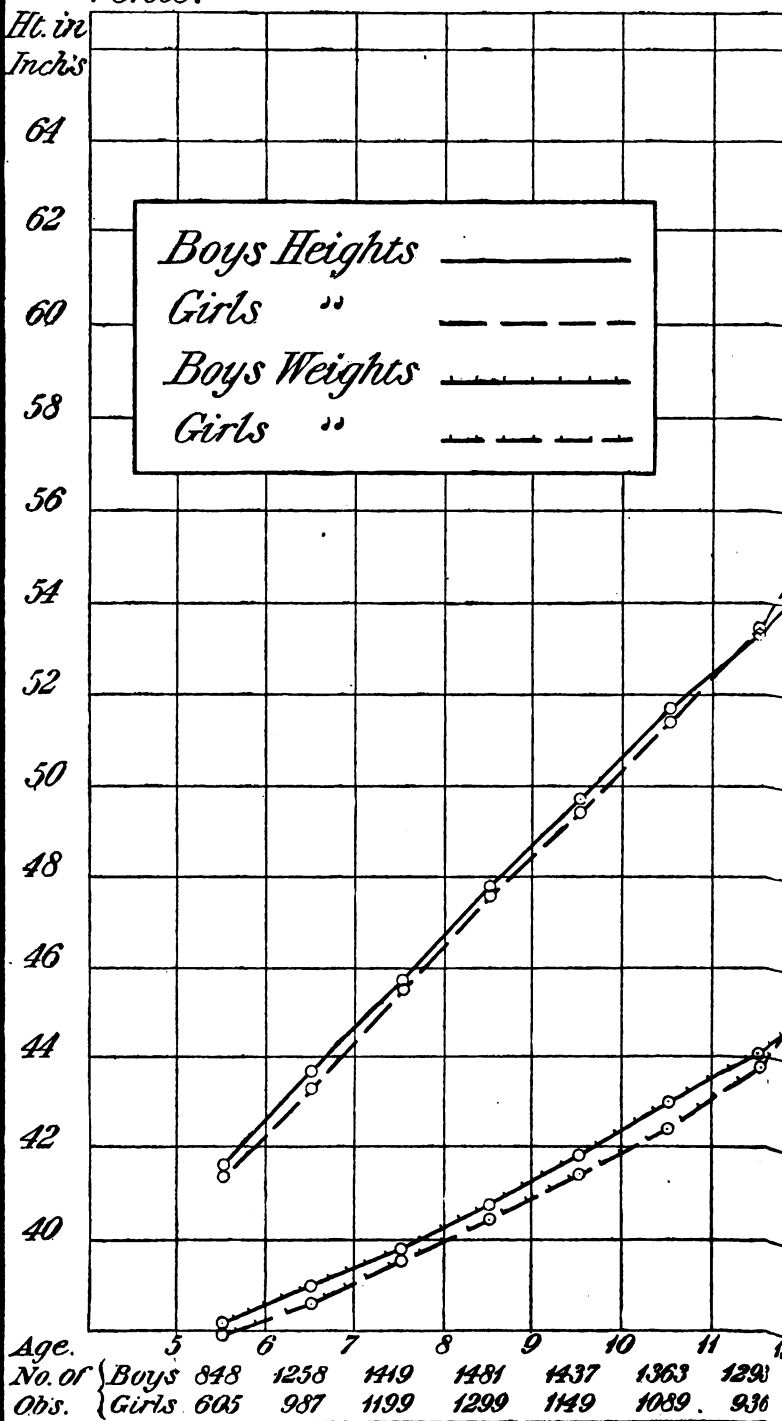
The results of the whole investigation are embodied in the tables at the end of the article; but, in order to facilitate their comprehension, the graphic method has been adopted for their expression, curves having been constructed which indicate at a glance the more important conclusions which can be drawn from an examination of the tables. Thus, on Plate I., the ordinates of the two upper curves express the average heights for each age of all the children measured, irrespective of the nationality of their parents, the full line representing the boys' rate of growth and the broken line that of the girls. The two lower curves indicate the average weights in the same set of observations. The age is expressed by the row of figures on the line of abscissas, the height in inches by the column on the left (corresponding to the two upper curves) and the weight in pounds by the column on the right of the plate (corresponding to the two lower curves). The figures at the bottom of the plate show for each age the number of observations from which the averages were computed.

Plates II. and III. exhibit in a similar way the rate of growth in height and weight of children of American and of Irish parentage. .

The curves on these plates are less regular than those of Plate I., owing to their being constructed from a smaller number of observations; but they have the same general character. The observations on children of other than American or Irish parentage were so few in number, that it was not considered important to construct curves to express the results. An examination of the figures in Tables Nos. 1 and 2 shows that the curves of growth present everywhere the same general features.

The curves on the other plates are constructed in a similar way, and will be described in connection with the subjects which they illustrate.

Plate I. Showing rate of growth of B
 Whole number of observations irr
 rents.



| Age. | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|--------|-----|------|------|------|------|------|------|
| No. of | 848 | 1258 | 1419 | 1481 | 1437 | 1363 | 1298 |
| Obs. { | 605 | 987 | 1199 | 1299 | 1149 | 1089 | 936 |

A. N. HOUGHTON, BOSTON

*Boston school children
irrespective of nationality of pa-*

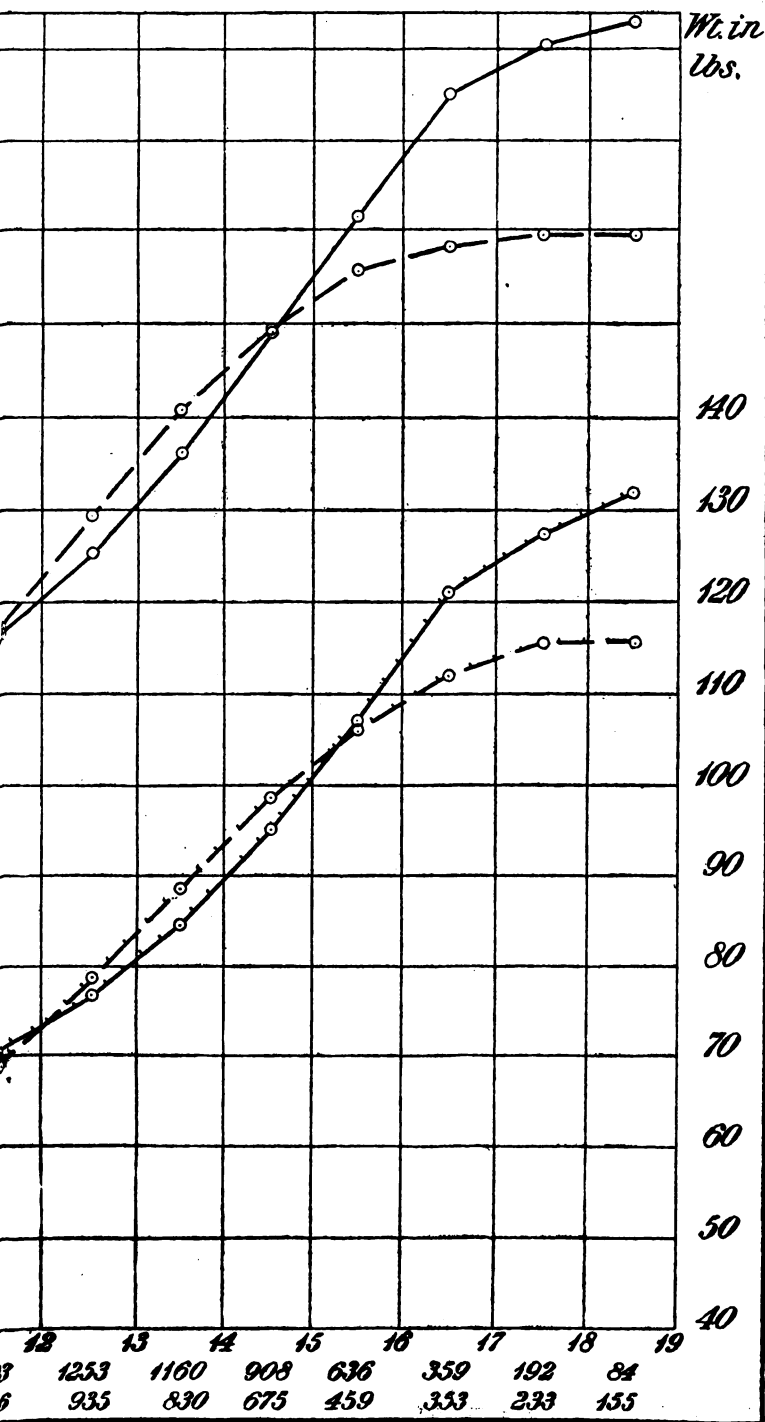
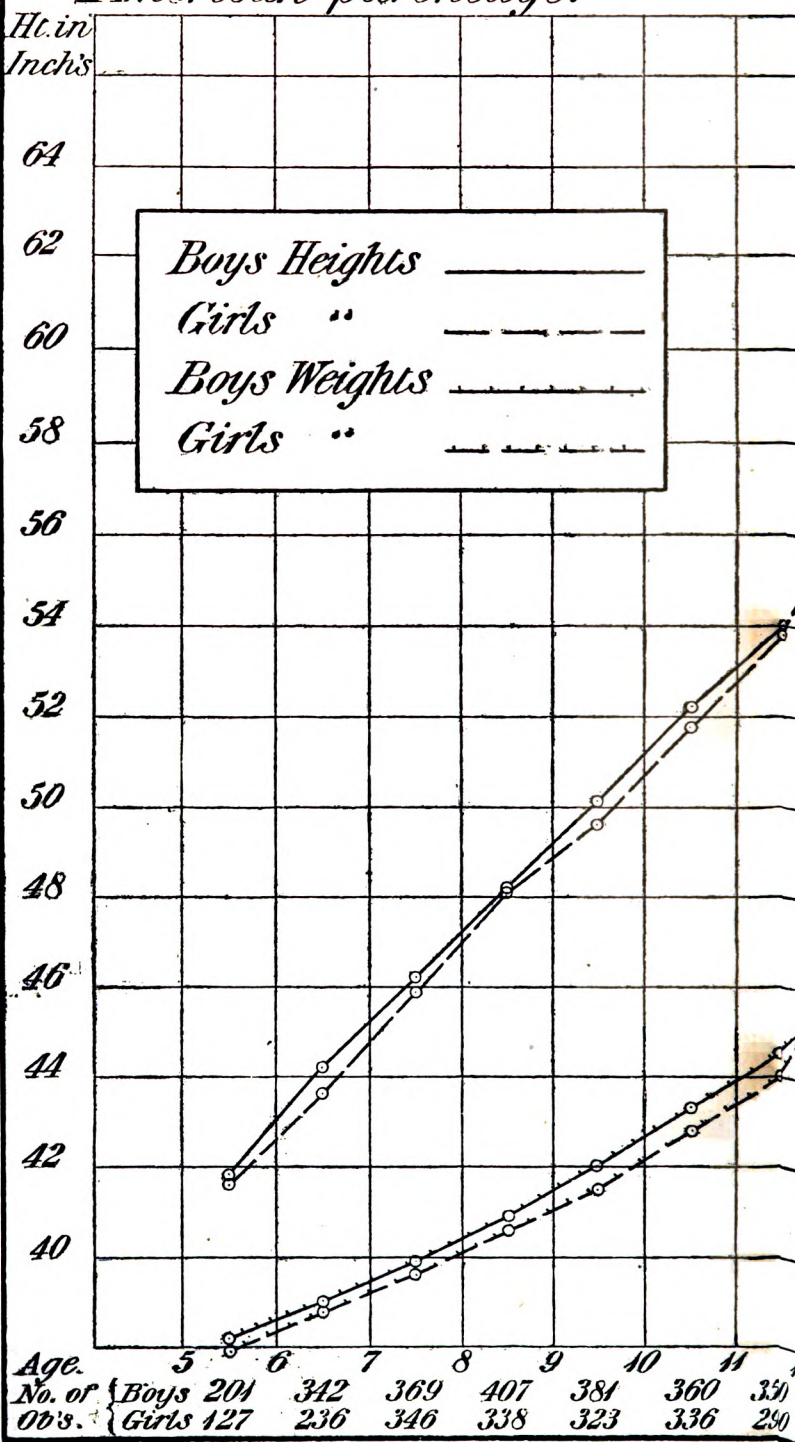


Plate II. Showing rate of growth of American parentage.



| Age | No. of Boys | No. of Girls |
|-----|-------------|--------------|
| 5 | 201 | 127 |
| 6 | 342 | 236 |
| 7 | 369 | 346 |
| 8 | 407 | 338 |
| 9 | 381 | 323 |
| 10 | 360 | 336 |
| 11 | 350 | 290 |

of Boston school children of

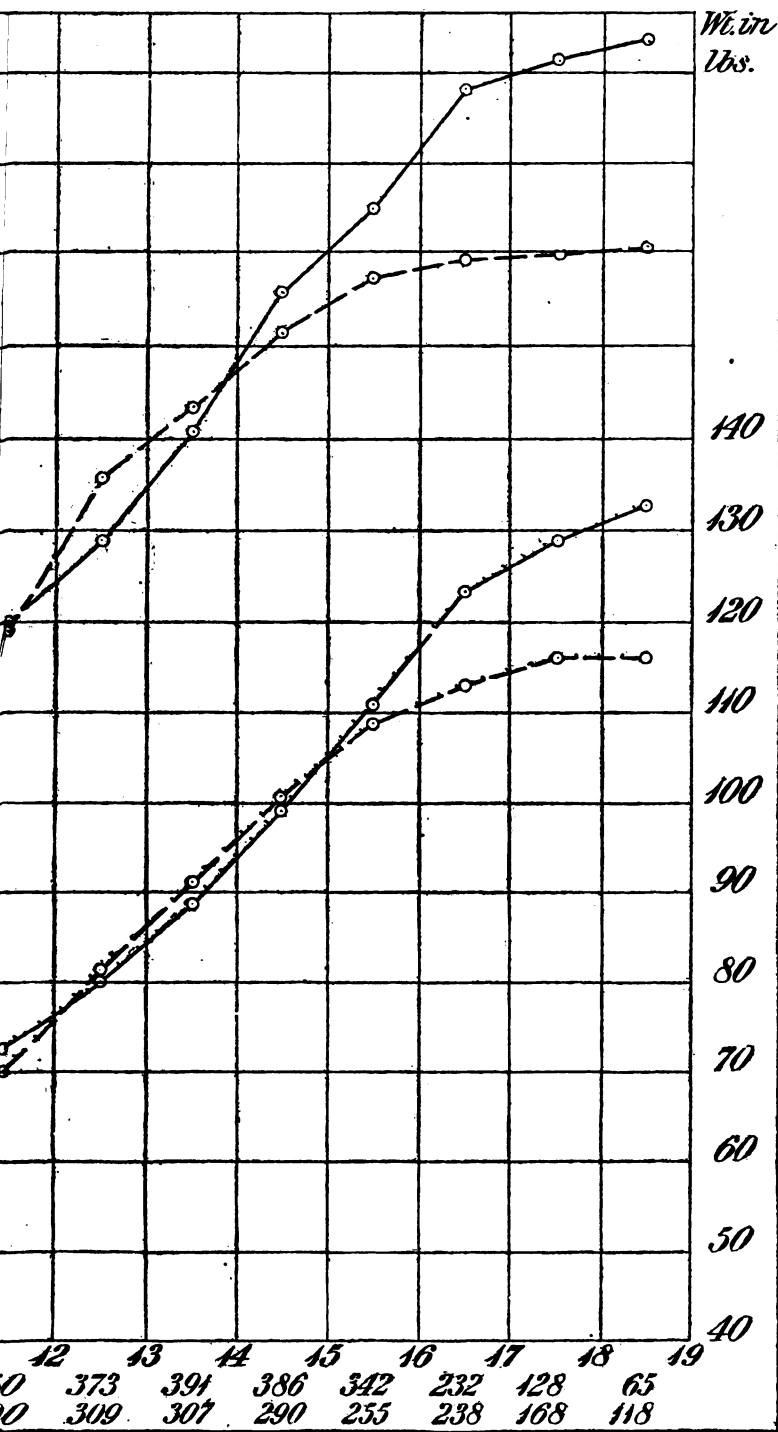
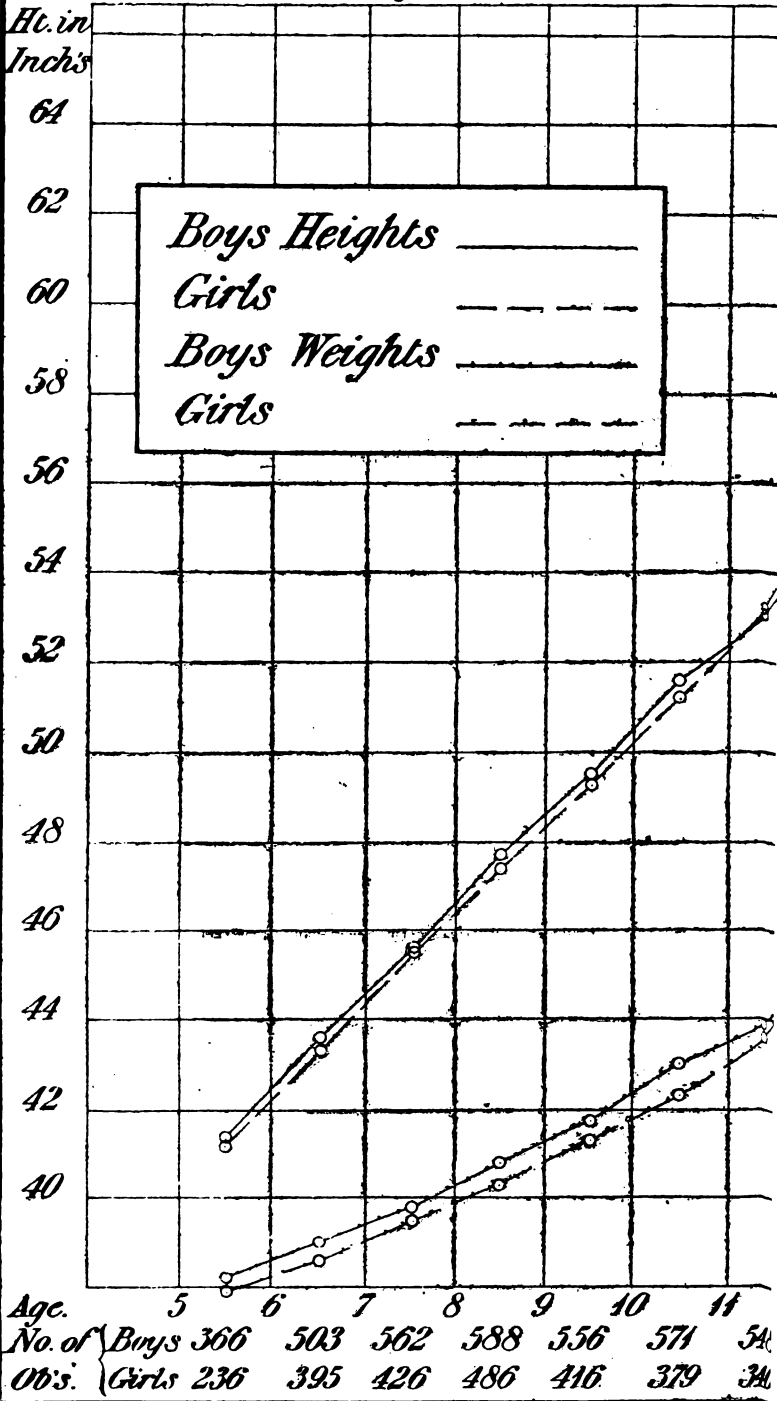
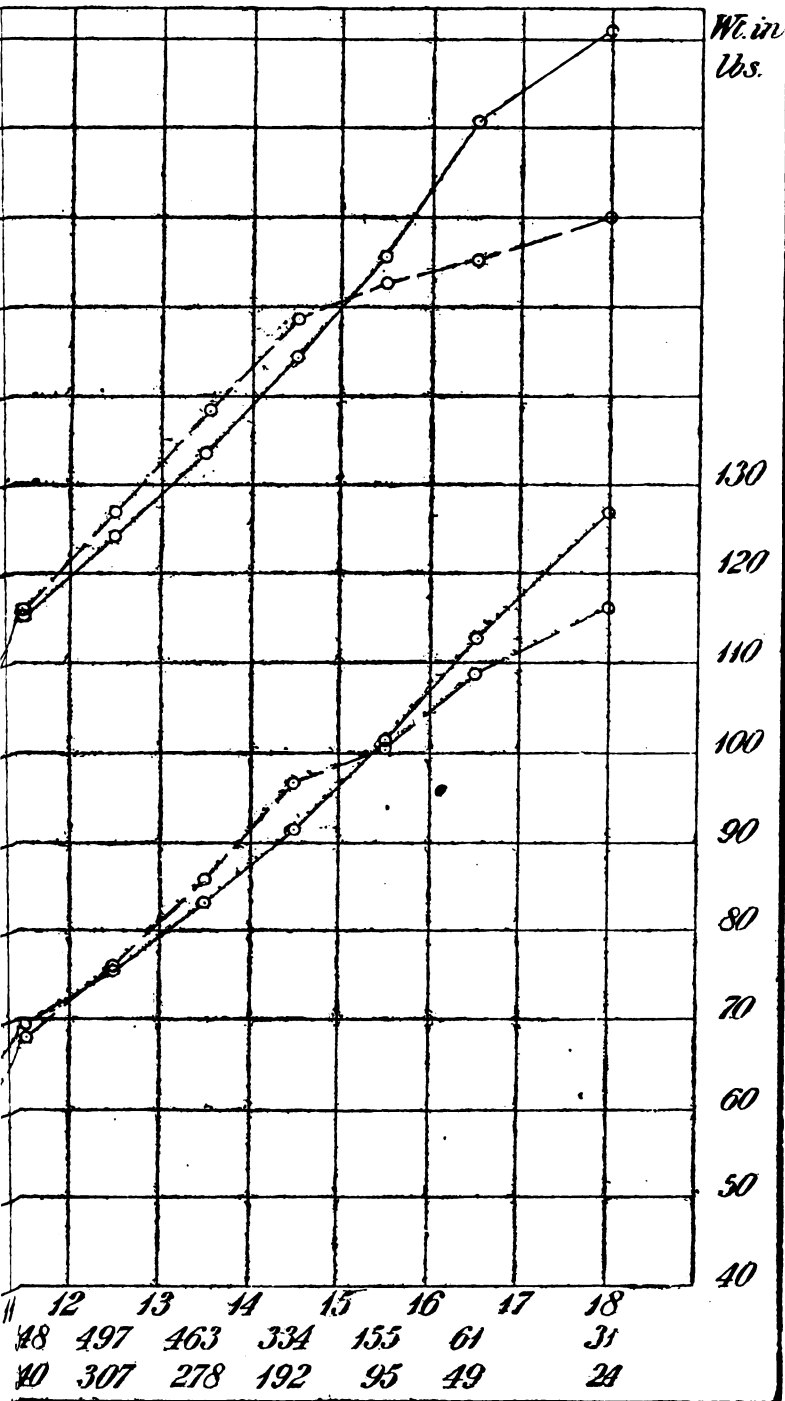


Plate III. Showing rate of growth of Irish parentage.



h of Boston school children of



COMPARATIVE RATE OF GROWTH OF THE TWO SEXES.

An inspection of Tables Nos. 1 and 2, or of Plates I., II., and III., shows in the most conclusive manner that at about 13 or 14 years of age girls in this community are, during more than two years, both taller and heavier than boys at the same age, though before and after that period the reverse is the case. Table No. 3, giving the annual rates of growth, shows the same thing in a different way. Here we see, in the column of totals, that the greatest annual increase in height occurs for girls at 12 and for boys at 16 years of age, while the maximum increase in weight is for boys at the same age and for girls one year later than the maximum increase in height. Similar, though not identical facts, are obtained by examination of the columns in which the observations are distributed according to the nationality of the parents.

This difference in the age at which the rate of growth attains its maximum in the two sexes, suggests a connection of the phenomenon with the period of puberty which presents a similar difference in the time of its occurrence. On the principle, clearly enunciated by Carpenter* and by Herbert Spencer,† that growth and reproduction are to some extent antagonistic processes, it may perhaps be reasonably supposed that at the age at which the organism becomes potentially reproductive will not be a period of excessive growth, and an examination of the data at our disposal seems to show that this is the case. It is of course almost impossible to determine statistically the average age at which males become capable of reproduction; but for the female sex the first appearance of the catamenia furnishes a satisfactory indication that this period has been reached. Few data have been collected for determining the age at which American women

* "There is a certain degree of antagonism between the nutritive and reproductive functions, the one being executed at the expense of the other. The reproductive apparatus derives the materials of its operations through the nutritive system, and is entirely dependent upon it for the continuance of its function. If, therefore, it be in a state of excessive activity, it will necessarily draw off from the individual fabric some portion of the aliment destined for its maintenance. It may be universally observed that, when the nutritive functions are particularly active in supporting the individual, the reproductive system is in a corresponding degree undeveloped, and *vice versa*."—*Principles of Physiology, General and Comparative*. Third edition, 1851, p. 592.

† The Principles of Biology. Vol. II., chap. 6.

begin to menstruate, but Dr. J. R. Chadwick has kindly permitted the use of his manuscript tables containing the records of observations on patients at the Boston Dispensary and the Boston City Hospital. From these records observations on 575 American-born women have been selected and arranged in the following table in such a way as to indicate whether the date of the first menstruation was given approximately or accurately.

TABLE No. 16.

Showing the Age at which Menstruation begins in American Women.

| AGE AT LAST BIRTHDAY. | NUMBER OF OBSERVATIONS. | | |
|-------------------------|-------------------------|------------------|-----------------|
| | Approximate. | Accurate. | Total. |
| 10, | 4 | — | 4 |
| 11, | 18 | 8 | 26 |
| 12, | 44 | 5 | 49 |
| 13, | 87 | 20 | 107 |
| 14, | 126 | 16 | 142 |
| 15, | 96 | 16 | 112 |
| 16, | 72 | 11 | 83 |
| 17, | 18 | 6 | 14 |
| 18, | 16 | 4 | 20 |
| 19, | 4 | 1 | 5 |
| 20, | 3 | — | 3 |
| Whole number, | 488 | 87 | 575 |
| Average age, | 14 yrs. 5 mos., | 14 yrs. 7½ mos., | 14 yrs. 5½ mos. |

A comparison of these data with the figures in Table No. 3 shows that the period of rapid growth which gives to girls their temporary superiority over boys precedes the average age of puberty by at least two years, and that at the age of puberty the annual growth in height is less than at any previous period of life. Whether a similar relation prevails in other countries and in the male sex, are questions to be settled by future investigations.

An examination of the curves on Plates I.—III. shows that the statements in regard to the rate of growth of the two sexes, made in 1872,* as the result of a very small number of observations, are fully confirmed by a more extended investigation, and that the facts announced at that time in

* See beginning of this article.

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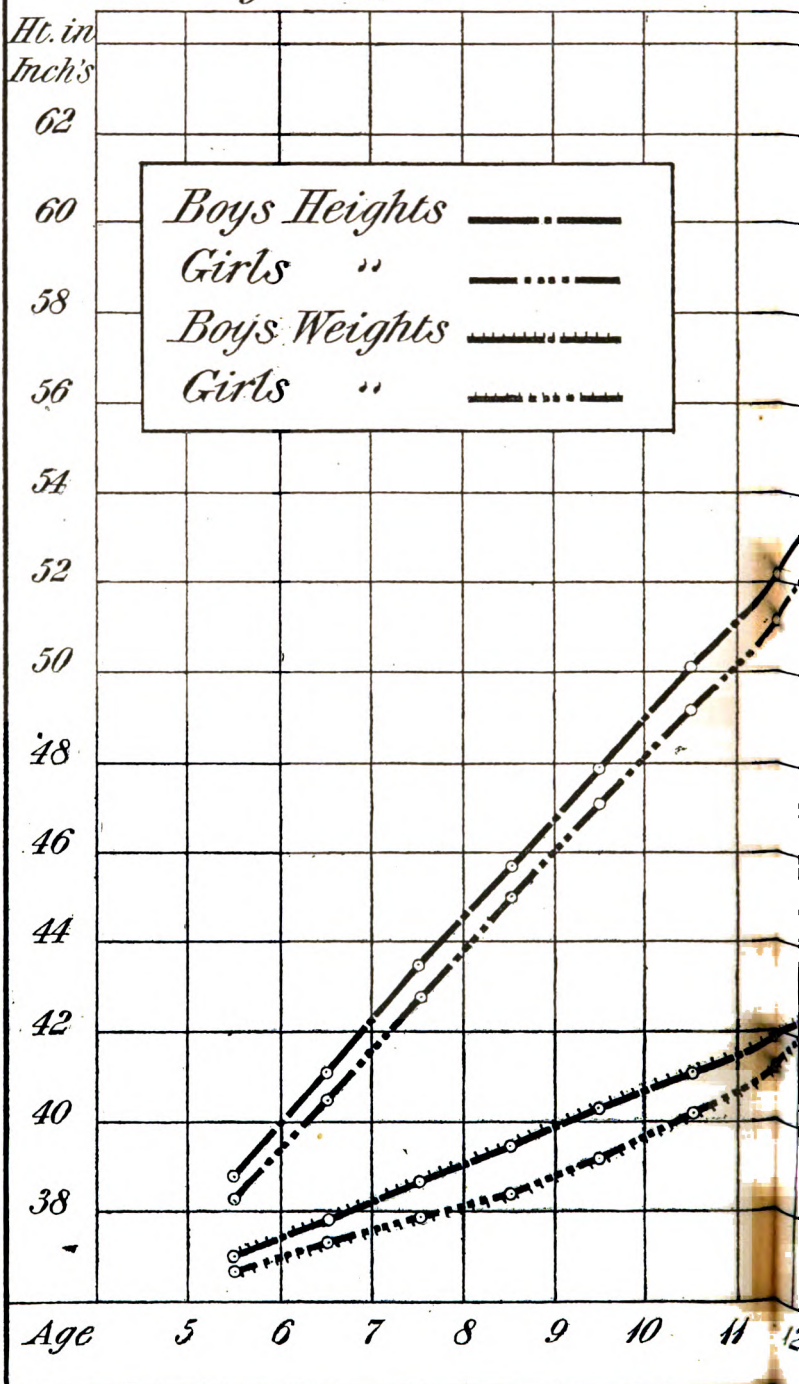
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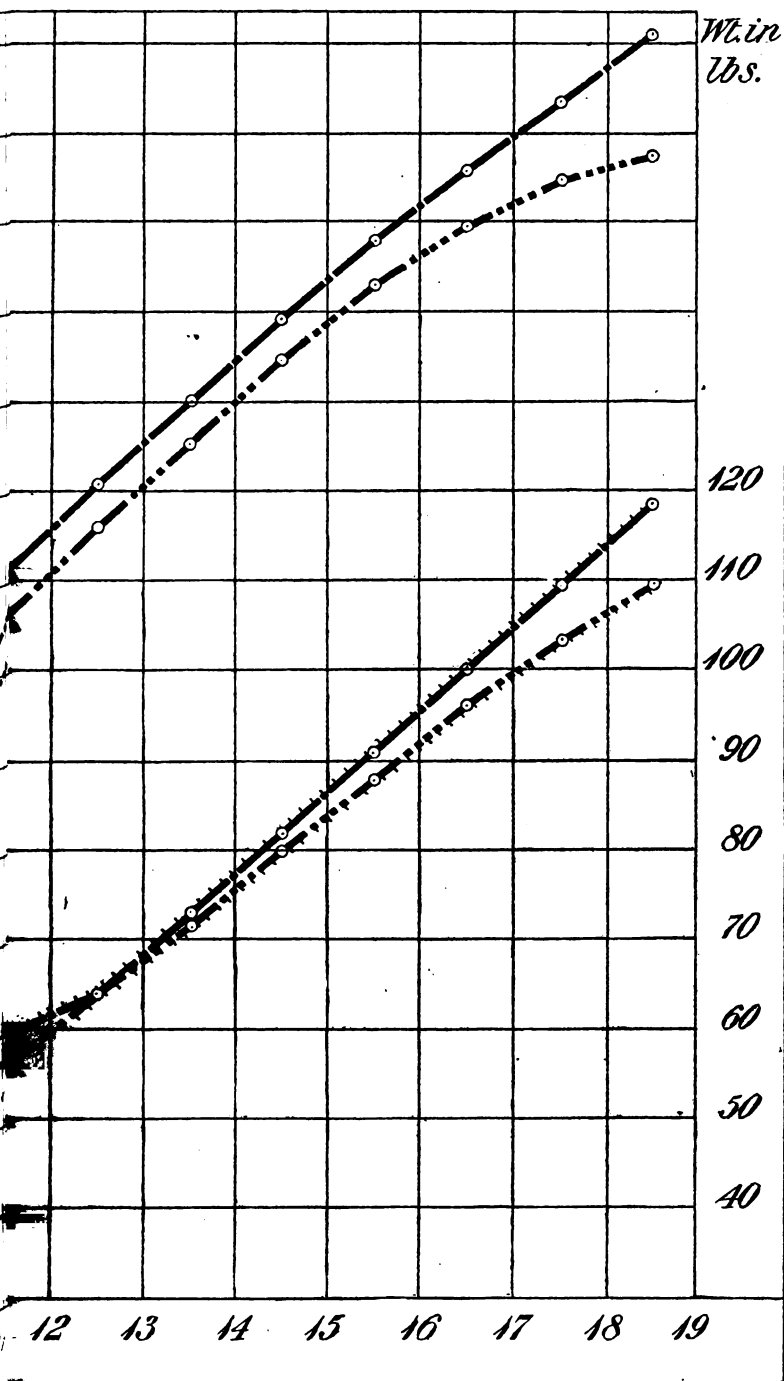
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Plate IV. Showing rate of growth according to Quetelet's observations



Growth of Belgian children acc-
urations.



regard to the growth in height are found to be equally true of the growth in weight. It was hoped at the beginning of this investigation that it would be possible, by comparing these observations with those taken in foreign countries, to determine how far the peculiarities in the rate of growth, thus made manifest, depend upon differences of race or climate. This seemed the more desirable from the fact, that, according to Quetelet, the curves of growth of the two sexes never intersect, as they are shown to do in these observations. For purposes of comparison, an extract from Quetelet's tables is here given, showing the height and weight of the children of

TABLE No. 17.

Showing Height and Weight of Belgian Children of both Sexes from 5 to 18 years of age. (Quetelet, Anthropométrie, p. 418.)

| AGE. | BOYS. | | | | GIRLS. | | | |
|-------|---------|---------|---------|-------|---------|---------|---------|-------|
| | HEIGHT. | | WEIGHT. | | HEIGHT. | | WEIGHT. | |
| | Inches. | Centim. | Pounds. | Kilo. | Inches. | Centim. | Pounds. | Kilo. |
| 5, . | 38.86 | 98.7 | 35.05 | 15.9 | 38.35 | 97.4 | 33.73 | 15.3 |
| 6, . | 41.18 | 104.6 | 39.19 | 17.8 | 40.58 | 103.1 | 36.82 | 16.7 |
| 7, . | 43.46 | 110.4 | 43.43 | 19.7 | 42.81 | 108.7 | 39.24 | 17.8 |
| 8, . | 45.75 | 116.2 | 47.62 | 21.6 | 44.97 | 114.2 | 41.90 | 19.0 |
| 9, . | 47.95 | 121.8 | 51.81 | 23.5 | 47.10 | 119.6 | 46.29 | 21.0 |
| 10, . | 50.12 | 127.3 | 55.55 | 25.2 | 49.17 | 124.9 | 50.92 | 23.1 |
| 11, . | 52.17 | 132.5 | 59.53 | 27.0 | 51.21 | 130.1 | 56.21 | 25.5 |
| 12, . | 54.14 | 137.5 | 63.93 | 29.0 | 53.23 | 135.2 | 63.93 | 29.0 |
| 13, . | 56.02 | 142.3 | 72.96 | 33.1 | 55.11 | 140.0 | 71.65 | 32.5 |
| 14, . | 57.84 | 146.9 | 81.80 | 37.1 | 56.94 | 144.6 | 80.01 | 36.3 |
| 15, . | 59.57 | 151.3 | 90.82 | 41.2 | 58.60 | 148.8 | 88.28 | 40.0 |
| 16, . | 61.18 | 155.4 | 100.10 | 45.4 | 59.90 | 152.1 | 95.90 | 43.5 |
| 17, . | 62.76 | 159.4 | 109.51 | 49.7 | 60.87 | 154.6 | 103.20 | 46.8 |
| 18, . | 64.17 | 163.0 | 118.80 | 53.9 | 61.53 | 156.3 | 109.71 | 49.8 |

both sexes in Belgium at the ages included in our observations. On Plate IV. are given curves of growth constructed from this table, by which it will be seen that the height of girls is always less than that of boys of the same age; while the weight, though the same at twelve years of age, is less both before and after that period.

Unfortunately, observations on the size of growing girls have rarely been made in any country; and it is, therefore, almost impossible to institute the desired comparison. In anthropo-

metrical investigations, the female sex seems to have been strangely neglected, though, in all questions relating to the growth and development of the race, its importance is at least equal to that of the male sex. The only accessible observations on girls, except those of Quetelet, seem to have been made in Great Britain. Quetelet himself quotes * the following observations made by Cowell among the lower classes of the population of Manchester and Stockport, by which it appears that the relative size of the two sexes varies very much, as in this community. The curves on Plate V. show the rate of growth of the factory operatives of both sexes, the values of the ordinates being taken from the above tables. It will be seen that these curves, though rather irregular, owing to the small number of observations from which they are constructed, are very different in their character from those given by Quetelet; a discrepancy to which this author, however, does not allude.

Through the kindness of Mr. C. Roberts of London, the writer has obtained manuscript tables showing the height and weight of children, of both sexes, in various classes of the community. From these records, it is evident that in England girls of 13 years of age are, as a rule, taller and heavier than boys of the same age.

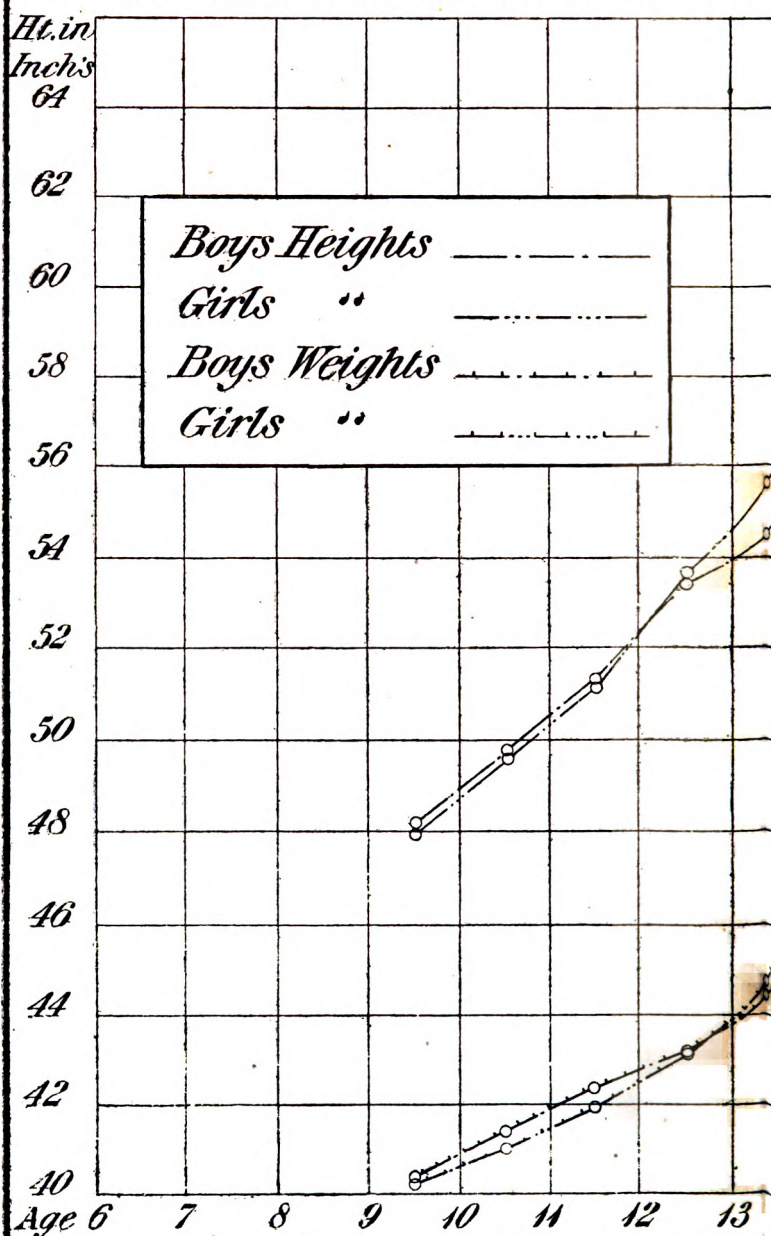
It must, therefore, be assumed either that children in Belgium grow in accordance with a different law from that which is found to prevail in England and with us, or that Quetelet's tables and curves do not truly represent average heights and weights. A consideration of the method by which Quetelet's results were reached renders the latter assumption not improbable. It will be noticed that Quetelet nowhere gives the number of observations on which his average results are based. He speaks, to be sure, of his investigations having extended over a quarter of a century,† and yet he accounts for the small differences between the maximum and minimum heights for the different ages (averaging 17.6 centimeters [6.93 in.] for males, and 19.1 centimeters [7.52 in.] for females) by the statement that his observations were limited to individuals "régulièrement con-

* Sur l'Homme, II. 19 and 51; Original Observations in Parliamentary Reports, 1833, XX., D 1, p. 87.

† Anthropométrie, p. 178.

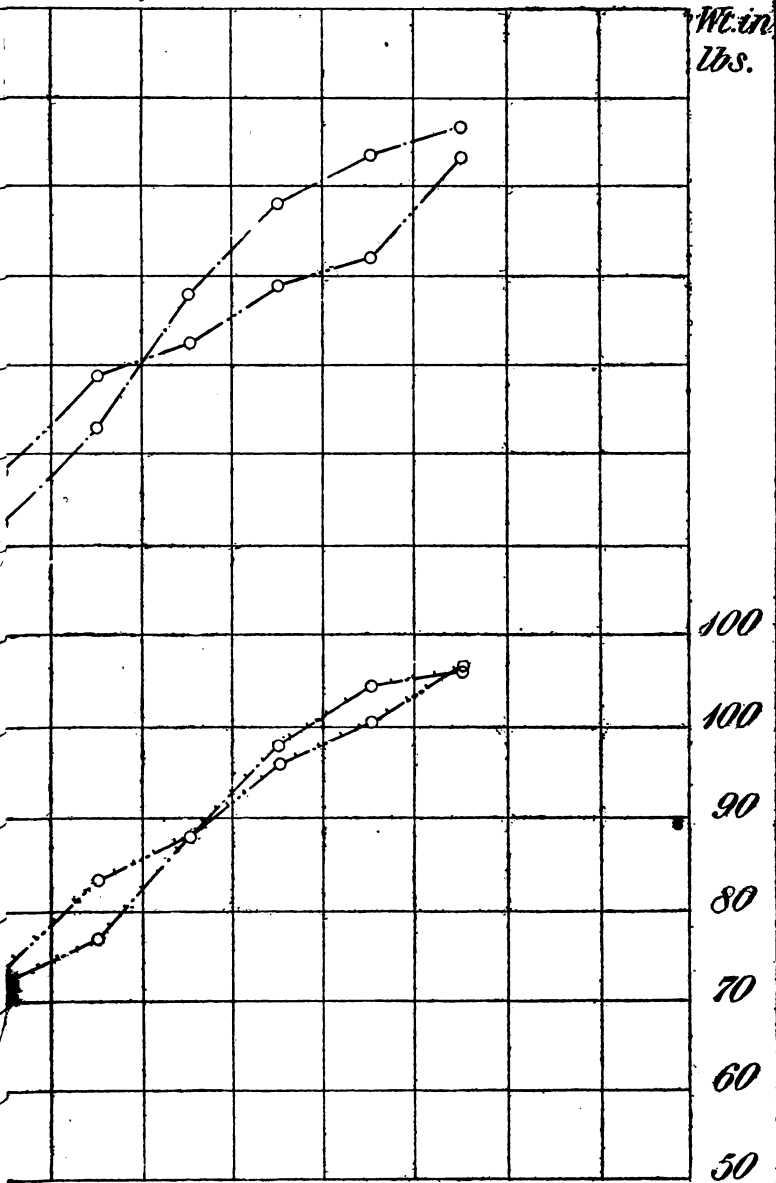
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Plate V. Showing rate of growth
in factories of Manchester and



| | | | | | | |
|---------------------------|--------------|----|----|----|----|----|
| Number of Observations | Boys Heights | 17 | 48 | 53 | 42 | 30 |
| | Girls " | 30 | 41 | 53 | 80 | 60 |
| | Boys Weights | 17 | 48 | 53 | 42 | 30 |
| | Girls " | 30 | 41 | 53 | 80 | 60 |

Weight of English children employed in Stockport. - Cowell.



| | 14 | 15 | 16 | 17 | 18 | 19 |
|---|----|----|----|----|----|----|
| 5 | 51 | 54 | 52 | 26 | 22 | |
| 3 | 81 | 81 | 83 | 75 | 65 | |
| 5 | 61 | 54 | 52 | 26 | 22 | |
| 3 | 80 | 81 | 83 | 75 | 65 | |

TABLE No. 18.
Showing Comparative Heights of English Boys and Girls in Manchester and Stockport. (COWELL.)

| A G E. | EMPLOYED IN FACTORIES. | | | | | | NOT EMPLOYED IN FACTORIES. | | | | | |
|---------|------------------------|---------|---------------|-------------|---------|---------------|----------------------------|---------|---------------|-------------|---------|---------------|
| | BOYS. | | | GIRLS. | | | BOYS. | | | GIRLS. | | |
| | No. of Obs. | Inches. | Centi-meters. | No. of Obs. | Inches. | Centi-meters. | No. of Obs. | Inches. | Centi-meters. | No. of Obs. | Inches. | Centi-meters. |
| 9, | 17 | 48.139 | 122.2 | 30 | 47.970 | 121.8 | 41 | 48.564 | 123.3 | 43 | 48.438 | 123.0 |
| 10, | 48 | 49.789 | 127.0 | 41 | 49.624 | 126.0 | 28 | 50.650 | 128.6 | 38 | 49.371 | 126.4 |
| 11, | 53 | 51.261 | 130.2 | 53 | 51.155 | 129.9 | 25 | 51.005 | 129.6 | 29 | 52.099 | 132.3 |
| 12, | 42 | 53.380 | 135.5 | 80 | 53.703 | 136.4 | 20 | 52.962 | 134.5 | 27 | 53.666 | 136.3 |
| 13, | 45 | 54.477 | 138.3 | 63 | 55.686 | 141.3 | 22 | 54.977 | 139.6 | 18 | 55.069 | 139.9 |
| 14, | 51 | 56.585 | 143.7 | 81 | 57.745 | 146.7 | 16 | 56.625 | 144.0 | 16 | 58.226 | 147.9 |
| 15, | 54 | 59.638 | 151.5 | 81 | 58.503 | 148.6 | 24 | 58.020 | 147.4 | 13 | 59.153 | 150.2 |
| 16, | 52 | 61.600 | 156.5 | 83 | 59.811 | 152.1 | 16 | 63.201 | 160.5 | 6 | 58.083 | 147.5 |
| 17, | 26 | 62.673 | 159.2 | 75 | 60.413 | 153.5 | 20 | 64.068 | 162.7 | 9 | 60.708 | 154.2 |
| 18, | 22 | 63.318 | 160.8 | 65 | 62.721 | 159.3 | 15 | 69.891 | 177.5 | 2 | 64.750 | 164.5 |
| Totals, | 410 | | | 652 | | | 227 | | | 201 | | |

TABLE No. 19.
Showing Comparative Weight of English Boys and Girls in Manchester and Stockport. (COWELL.)

| AGE. | EMPLOYED IN FACTORIES. | | | | | | NOT EMPLOYED IN FACTORIES. | | | | | |
|---------|------------------------|---------|------------|-------------|---------|------------|----------------------------|---------|------------|-------------|---------|------------|
| | BOYS. | | | GIRLS. | | | BOYS. | | | GIRLS. | | |
| | No. of Obs. | Pounds. | Kilograms. | No. of Obs. | Pounds. | Kilograms. | No. of Obs. | Pounds. | Kilograms. | No. of Obs. | Pounds. | Kilograms. |
| 9, | 17 | 51.76 | 23.47 | 30 | 51.13 | 23.18 | 41 | 53.26 | 24.15 | 43 | 50.44 | 22.87 |
| 10, | 48 | 57.00 | 25.84 | 41 | 54.80 | 24.85 | 28 | 60.28 | 27.33 | 38 | 54.44 | 24.68 |
| 11, | 53 | 61.84 | 28.04 | 53 | 59.69 | 27.06 | 25 | 58.36 | 26.46 | 29 | 61.13 | 27.72 |
| 12, | 42 | 65.97 | 29.91 | 80 | 66.08 | 29.96 | 20 | 67.25 | 30.49 | 27 | 66.07 | 29.96 |
| 13, | 45 | 72.11 | 32.69 | 63 | 73.25 | 33.21 | 22 | 75.36 | 34.17 | 18 | 72.72 | 32.97 |
| 14, | 61 | 77.09 | 34.95 | 80 | 83.41 | 37.82 | 16 | 78.68 | 35.67 | 16 | 83.43 | 37.83 |
| 15, | 54 | 88.35 | 40.06 | 81 | 87.86 | 39.84 | 24 | 86.88 | 39.37 | 13 | 93.61 | 42.44 |
| 16, | 52 | 98.00 | 44.43 | 83 | 96.22 | 43.62 | 13 | 110.30 | 50.01 | 6 | 91.16 | 41.33 |
| 17, | 26 | 104.46 | 47.36 | 75 | 100.21 | 45.44 | 20 | 117.80 | 53.41 | 9 | 102.44 | 46.45 |
| 18, | 22 | 106.13 | 48.12 | 65 | 106.35 | 48.22 | 14 | 126.30 | 57.27 | 2 | 122.00 | 55.32 |
| Totals, | 420 | | | 651 | | | 223 | | | 201 | | |

struits," and that the number of persons subjected to measurement was "peu considérable." * In the introductory portion of the work, he describes as follows † his method of ascertaining the proportions of the human body: "I contented myself, therefore, with measuring carefully ten individuals of each age, of the male as well as of the female sex, but choosing them in general of a form which could be regarded as regular. The averages of the different groups gave me the condition of development of man from year to year." ‡ It seems, therefore, evident that Quetelet's observations were made on a comparatively small number of individuals, selected on account of their more or less close conformity to what was regarded as a normal type. No measurements seem to have been taken except on persons having a "regular form." This determination of the normal type in advance of the measurements must, of course, have been largely a matter of conjecture, and might well have led to the rejection of perfectly healthy and normal individuals whose dimensions did not correspond to a preconceived idea of the typical man or woman. It is therefore probable that if Quetelet's observations had been more numerous and less selected, it would have been found that the curves of growth of the two sexes in Belgium intersect each other much in the same way as in England and in this community.

This view derives confirmation from the admission of Quetelet, § that the growth of any one individual is far from being as regular as that indicated by the table of averages. He writes: "There are always, in the development of an individual, periods of slow as well as of rapid growth. These anomalies are to be observed about the age of puberty, and especially as the result of diseases. The perfectly normal development of all the physical faculties would require a rare combination of favorable circumstances. In dealing with a large number of individuals, these little

* Anthropométrie, p. 182.

† Anthropométrie. p. 24.

‡ As a reason for being satisfied with so small a number as ten observations, he states that on dividing the measurements made on thirty individuals into three groups of ten each, so chosen that the average heights for all three groups were about alike, he found that the other average measurements of these three groups differed from each other less than might have been expected in three successive measurements made on the same individual.

§ Anthropométrie, p. 183.

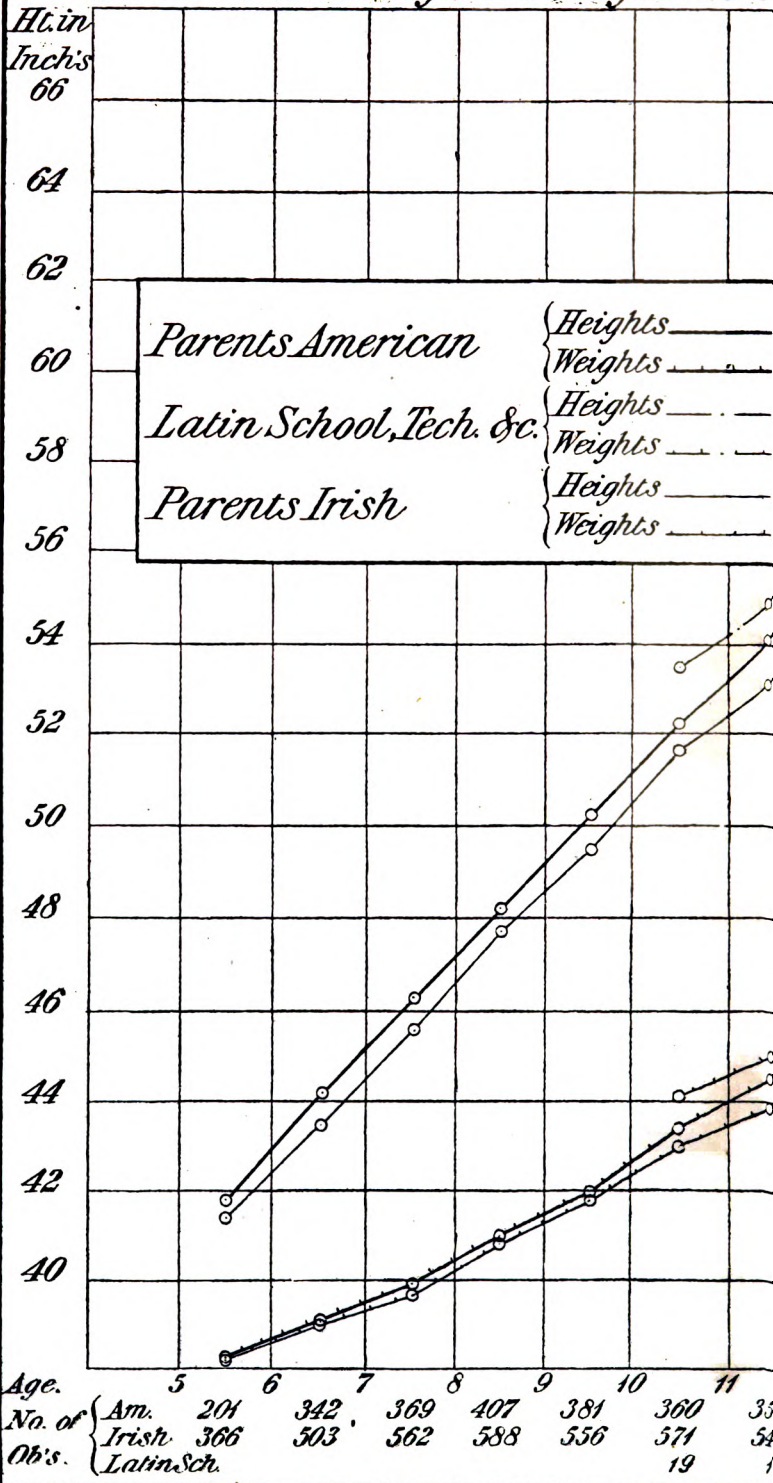
anomalies disappear in the general average, and the deficient development of one individual is balanced by the excessive growth of another; at least this is what experiment tends to teach us."

In referring to the rate of growth of a boy whose height had been annually recorded, he writes: "It will be noticed that the development was very rapid in the early years of life; then there were slight irregularities of growth between the ages of eight and fifteen years. At this latter period a rapid increase of height took place; and I have noticed the same thing in the case of my son. This increase preceded the age of puberty. Something of the same sort is to be observed in the case of girls, but here it occurs a year or two earlier. It seems, however, that there is nothing constant in the matter; hence these periods of retarded and accelerated growth balance each other to a certain extent, and leave but slight trace of their passage." It seems, therefore, that the period of rapid growth preceding the age of puberty had, in individual cases, attracted Quetelet's attention, though he found no trace of it in his tables of averages, and was inclined to regard it as a pathological result of civilization.* Inasmuch, however, as the phenomenon has in this community and in England, been found to be sufficiently constant and sufficiently marked to impress itself upon the curves representing the averages of large numbers of measurements, it seems reasonable to conclude that if similar methods of investigation (viz., measuring large numbers of individuals and rejecting none except for manifest deformity) had been adopted in Belgium, similar results would have been reached.

The curves of growth of the two sexes being recognized as so distinctly different, it is of interest to inquire what practical application can be made of the knowledge thus acquired. The first question which suggests itself is: How far should this difference in the rate of growth be allowed to modify the system of mental training to which the children of the two sexes are subjected? The physical conditions upon which the manifestation of mental activity depend are too little understood, and the whole question is too complicated to be discussed in this connection, but it seems to be almost self-

* Du Système Social, p. 24.

Plate VI. Showing rate of growth of



of Boston school boys.

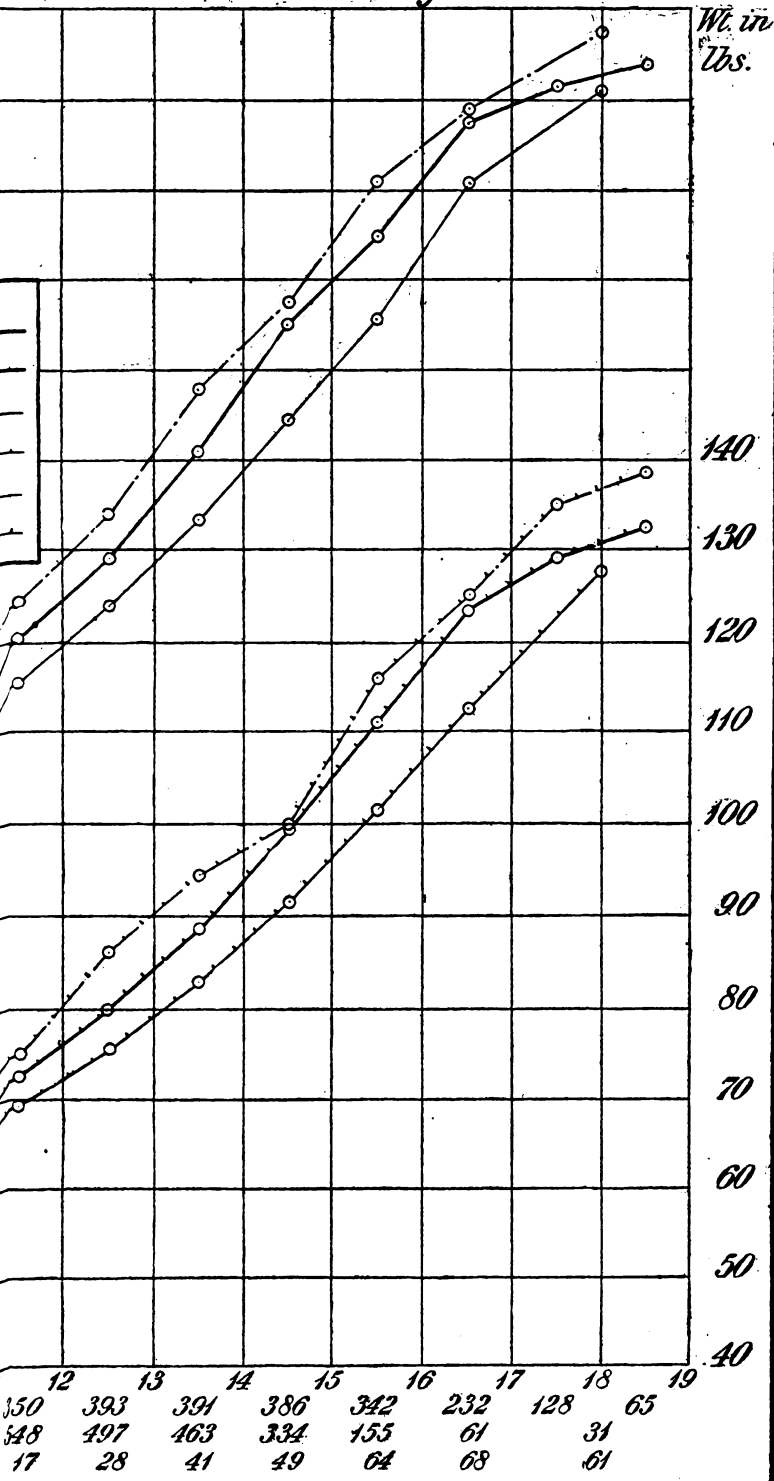
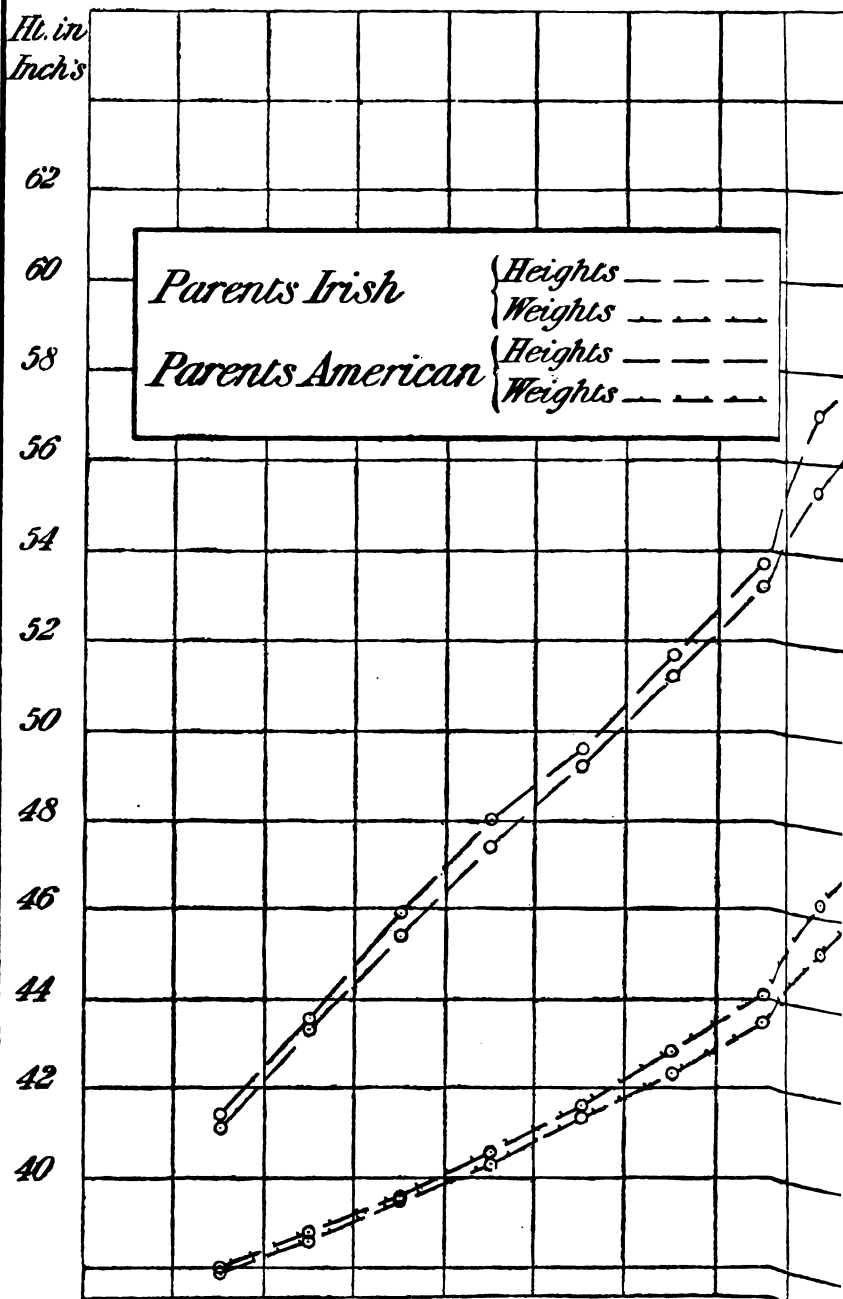


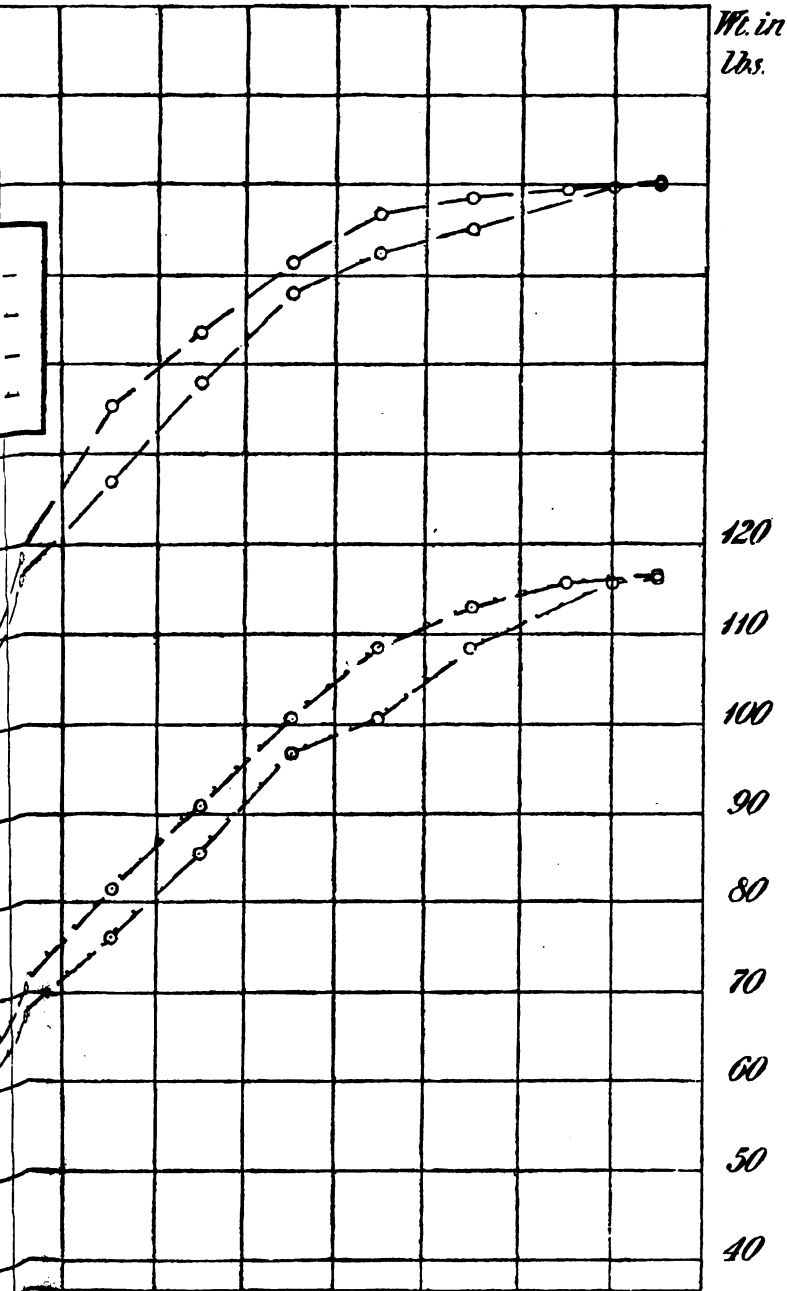
Plate VII. Showing rate of growth of B



| Age. | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|
| No. of Am. | 127 | 236 | 346 | 338 | 323 | 336 | 290 | 309 |
| Ob's. Irish | 236 | 395 | 426 | 486 | 416 | 379 | 340 | 307 |

A. N. HOUGHTON.

Weight of Boston school girls.



| Age | Weight (lbs) | Weight (lbs) | Weight (lbs) | Weight (lbs) | Weight (lbs) | Weight (lbs) | Weight (lbs) |
|-----|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 12 | 309 | 307 | 290 | 255 | 238 | 168 | 118 |
| 13 | 307 | 278 | 192 | 95 | 49 | | 24 |

evident that at those periods when the forces of the organism are engaged in producing rapid growth and development of the physique, the requirements in the way of mental effort should be reduced. The fact that these periods occur at different ages in the two sexes, may therefore be regarded as an argument against the co-education of boys and girls, except during the earlier years of life in which rates of growth are practically the same; *i. e.*, up to ten or eleven years of age. How much importance is to be attached to this argument is a question which demands for its solution an extended series of observations on the annual growth in height and weight of a large number of individuals, taken in connection with a record of their mental progress.

EFFECT OF RACE ON SIZE AND ON RATE OF GROWTH.

An examination of Tables Nos. 1 and 2 shows that boys and girls of American parentage are, almost without exception, both taller and heavier than children of the same age and sex whose parents are of other nationalities. The curves on Plates VI. and VII. illustrate this fact for children of American and Irish parents. It has not been thought desirable to construct curves for the other nationalities, owing to the irregularities which they would necessarily present in consequence of the small number of observations.

In considering this result, the question naturally suggests itself, How far are the superior dimensions of children of American parentage dependent upon differences of race and stock, and how far are they due to other conditions accidentally associated in this community with these differences? Owing to the fact that emigrants to this country belong almost wholly to the poorer classes of the communities from which they come, it is evident that in this city children of American parents must belong to families of greater average wealth, and live, therefore, in greater comfort than children whose parents were born in foreign countries. It is important, therefore, to inquire what effect comfort and misery have upon the growth and development of the human race. Most of the investigations bearing directly upon this point have reference to the influence of these conditions on the size of the full-grown individual, and not on that of growing children.

Thus Villermé* concludes, as the result of his investigations, that "the stature is greater and the growth sooner completed, all other things being equal, in proportion as the country is richer and the comfort of its inhabitants more general." On the other hand, Boudin,† from an examination of the measurements of recruits to the army in different departments of France, arrives at the conclusion that stature is, to a great extent, "independent of comfort and misery, and is, on the contrary, closely connected with race." Villermé's results, as far as the duration of the period of growth is concerned, have also been disputed by Dr. Gould,‡ who has shown most conclusively that in the United States where "misery, in the sense of excessive poverty, affecting the supply of nutriment, physical protection from the weather and needful rest, hardly exists, the epoch of full development appears to be later than in any other country," the maximum height being attained between the thirty-first and thirty-fourth years. The effect of privations and exposure in preventing the attainment of the normal height, is, however, clearly pointed out by this writer,§ and is regarded by him as the cause of the small stature of sailors as compared with that of soldiers of the same age and state of enlistment. A similar conclusion in regard to the age at which the full stature is attained, has been reached by Dr. Baxter,|| as the result of an examination of the records of the Provost-Marshal-General's Bureau. It would, however, be manifestly unsafe to argue with this writer,¶ that "if comfort and plenty do not hasten growth, but, on the contrary, coexist with an unusually tardy and prolonged development of it, as is shown to be the case in the United States, it is fairly to be inferred that they exert little if any influence in increasing the stature"; for a prolongation of the period of growth must necessarily result in an increased stature unless the *rate* of growth is at the same time proportionately diminished, and that comfort and plenty should have the

* Quoted by Dr. Gould. *Investigations in the Military and Anthropological Statistics of American Soldiers*. U. S. Sanitary Commission, p. 120.

† *Recueil de mémoires de Médecine, de Chirurgie et de pharmacie militaires*. Paris, 1863. Vol. IX., p. 181.

‡ *Loco citato*.

§ *Op. cit.*, p. 132.

|| *Statistics Medical and Anthropological*. Washington, 1875.

¶ *Op. cit.*, p. 20.

latter effect is not only in itself highly improbable, but is opposed to such evidence as we have on the subject. Moreover, Dr. Baxter has himself shown* that of the 501,068 individuals, the records of whose examinations are preserved in the Provost-Marshal-General's Bureau, the natives of the United States are taller than those of any other country. He calls attention† also to the fact that natives of foreign countries enlisting in the United States have a greater average height than natives of the same countries enlisting at home. He is inclined, however, to explain this circumstance by a difference in the average age of the individuals measured; but Dr. Gould‡ has shown, that making allowance for differences of average age and of minimum limit of stature for military service, in different countries, the conclusion is unavoidable that natives of European countries who enlist in America are, on the average, taller than those who enlist at home. In searching for the causes which give to Americans, and even to persons growing up in America, though not born there, this superiority of stature, it seems not unreasonable to attribute a certain importance to the greater average comfort of the inhabitants. The prolonged period of growth in this country is certainly not to be regarded as an argument against this view, for, in the absence of any evidence of a diminished rate of growth, this may well be regarded as a result of abundant nutrition.

Statistics from which evidence can be drawn as to the effect of comfort and misery on the size of growing children are not numerous. The observations of Quetelet, Villermé, and Cowell§ seem to show that in a given community the children of the wealthier classes are, as a rule, larger than those of the poorer classes. The following table, for which I am indebted to the kindness of Mr. Roberts, throws light upon this question.

An examination of this table shows that children of the laboring classes, inhabiting towns, are, at all ages, decidedly shorter than the children of the non-laboring classes attending public schools and universities, the difference attaining a maximum of over four inches at thirteen years of age. The difference of weight is also, as a rule, decidedly in favor of

* Op. cit., p. 23.

† Op. cit., p. 180.

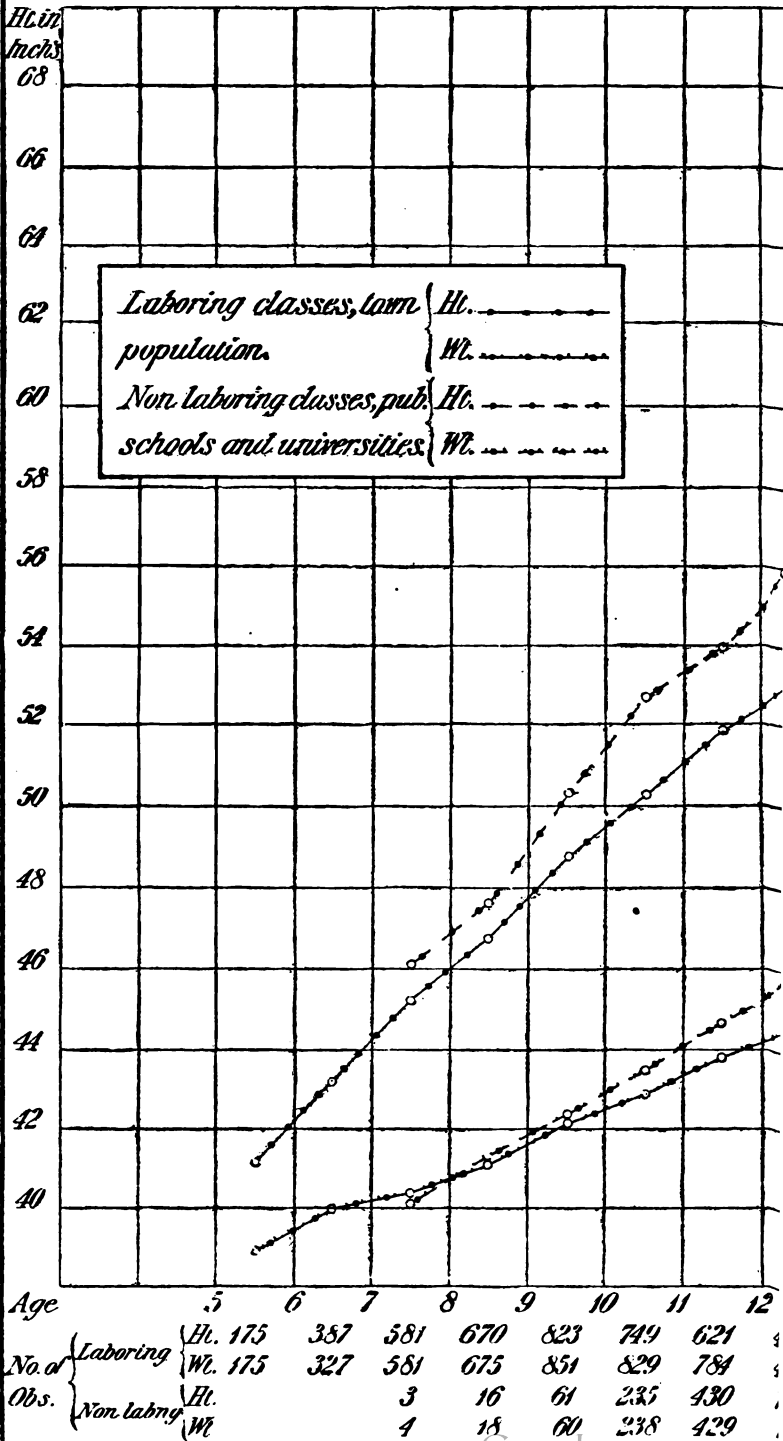
‡ Op. cit., p. 16.

§ Ludwig: *Physiologie*, II., 717.

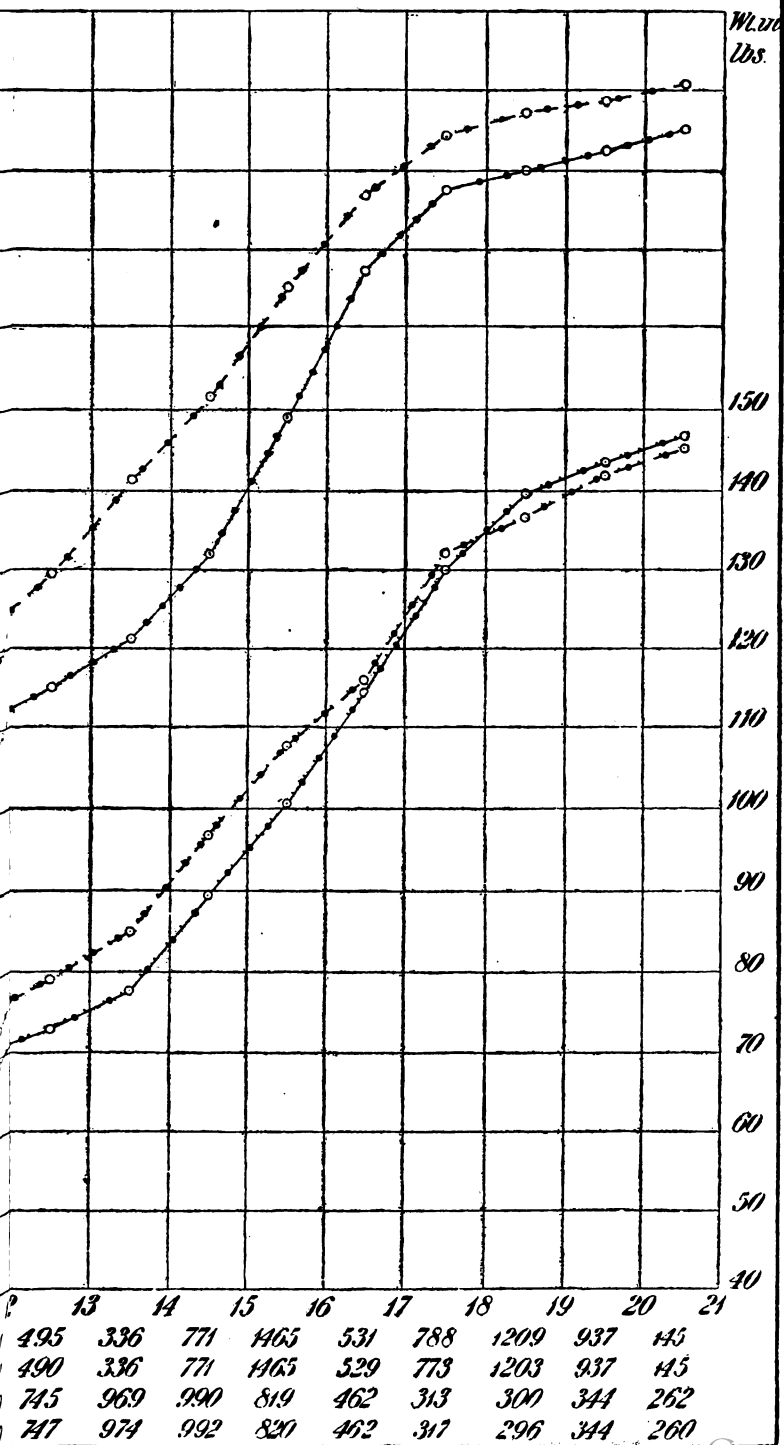
TABLE NO. 20.
Showing Average Height and Weight of English Boys.—(ROBERTS.)

| AGE AT LAST BIRTHDAY. | LABORING CLASSES, TOWN POPULATION ONLY. | | | | | | NON-LABORING CLASSES, PUBLIC SCHOOLS, UNIVERSITIES, ETC. | | | | | |
|-----------------------|---|---------|---------|-----------------------------|---------|---------|--|---------|---------|-----------------------------|---------|---------|
| | HEIGHT WITHOUT SHOES. | | | WEIGHT IN ORDINARY CLOTHES. | | | HEIGHT WITHOUT SHOES. | | | WEIGHT IN ORDINARY CLOTHES. | | |
| | No. of Observations. | Inches. | Pounds. | No. of Observations. | Inches. | Pounds. | No. of Observations. | Inches. | Pounds. | No. of Observations. | Inches. | Pounds. |
| 5, | 175 | 41.15 | 44.20 | 175 | 41.15 | 44.20 | - | - | - | - | - | |
| 6, | 887 | 43.18 | 49.68 | 927 | 43.18 | 49.68 | - | - | - | - | 50.16 | |
| 7, | 581 | 45.15 | 51.89 | 581 | 45.15 | 51.89 | 3 | 46.10 | 46.10 | 4 | 50.16 | |
| 8, | 670 | 46.81 | 55.15 | 675 | 46.81 | 55.15 | 16 | 47.56 | 47.56 | 18 | 56.40 | |
| 9, | 823 | 48.82 | 60.58 | 851 | 48.82 | 60.58 | 61 | 50.30 | 50.30 | 60 | 61.96 | |
| 10, | 749 | 50.28 | 64.59 | 829 | 50.28 | 64.59 | 235 | 52.65 | 52.65 | 238 | 67.22 | |
| 11, | 621 | 51.83 | 69.00 | 784 | 51.83 | 69.00 | 430 | 53.93 | 53.93 | 429 | 73.31 | |
| 12, | 495 | 53.02 | 72.78 | 490 | 53.02 | 72.78 | 745 | 55.90 | 55.90 | 747 | 78.96 | |
| 13, | 386 | 54.24 | 77.38 | 336 | 54.24 | 77.38 | 969 | 58.30 | 58.30 | 974 | 85.27 | |
| 14, | 771 | 56.37 | 89.39 | 771 | 56.37 | 89.39 | 990 | 60.27 | 60.27 | 992 | 96.40 | |
| 15, | 1,465 | 59.81 | 100.66 | 1,465 | 59.81 | 100.66 | 819 | 63.00 | 63.00 | 820 | 107.25 | |
| 16, | 531 | 63.45 | 114.55 | 529 | 63.45 | 114.55 | 462 | 65.34 | 65.34 | 462 | 115.96 | |
| 17, | 788 | 65.50 | 130.45 | 773 | 65.50 | 130.45 | 313 | 66.91 | 66.91 | 317 | 131.93 | |
| 18, | 1,209 | 66.00 | 139.50 | 1,203 | 66.00 | 139.50 | 300 | 67.88 | 67.88 | 296 | 136.68 | |
| 19, | 937 | 66.50 | 143.00 | 937 | 66.50 | 143.00 | 344 | 67.74 | 67.74 | 344 | 142.00 | |
| 20, | 145 | 67.00 | 146.55 | 145 | 67.00 | 146.55 | 262 | 68.09 | 68.09 | 260 | 145.23 | |

Plate VIII. Showing comparative rate of growth
non laboring classes.



Growth of English Boys of the laboring and the



the non-laboring classes, the exceptions being chiefly between the ages of eighteen and twenty-one. These facts are rendered apparent by the curves constructed on Plate VIII.

In searching for the cause of this great disparity in size, it is to be noticed, in the first place, that the laboring classes in the above table are taken from the town population only, while in the case of the non-laboring classes no such restriction is observed. In the absence of exact information as to the way in which these statistics were obtained, it is difficult to draw positive conclusions, but it is probable that the influences which tend to produce a physical degeneration of urban populations,* exhibit here their effect upon the size of growing children. This tendency of city life depends upon the fact that, in the struggle for existence, physical vigor plays, in cities, a less decisive part than in the country, owing to the greater number of sedentary occupations and trades there presenting themselves, which, for their successful prosecution, neither demand nor favor a full development of the physique. It is difficult to decide how much importance should be attached to this consideration in the present case; but it must be borne in mind that wealth implies ability to choose one's occupation, and that, in England at least, an occupation exclusively sedentary is rarely adopted, except from necessity. Hence, if the term "comfort" be used to include all the favorable conditions, alimentary, hygienic, etc., which can be secured by wealth, it seems fair to conclude that, in view of the stationary character of the English population, and of the small variety of climatic conditions to which it is exposed, the above-mentioned disparity in size must be mainly due to the greater comfort enjoyed by the non-laboring classes.

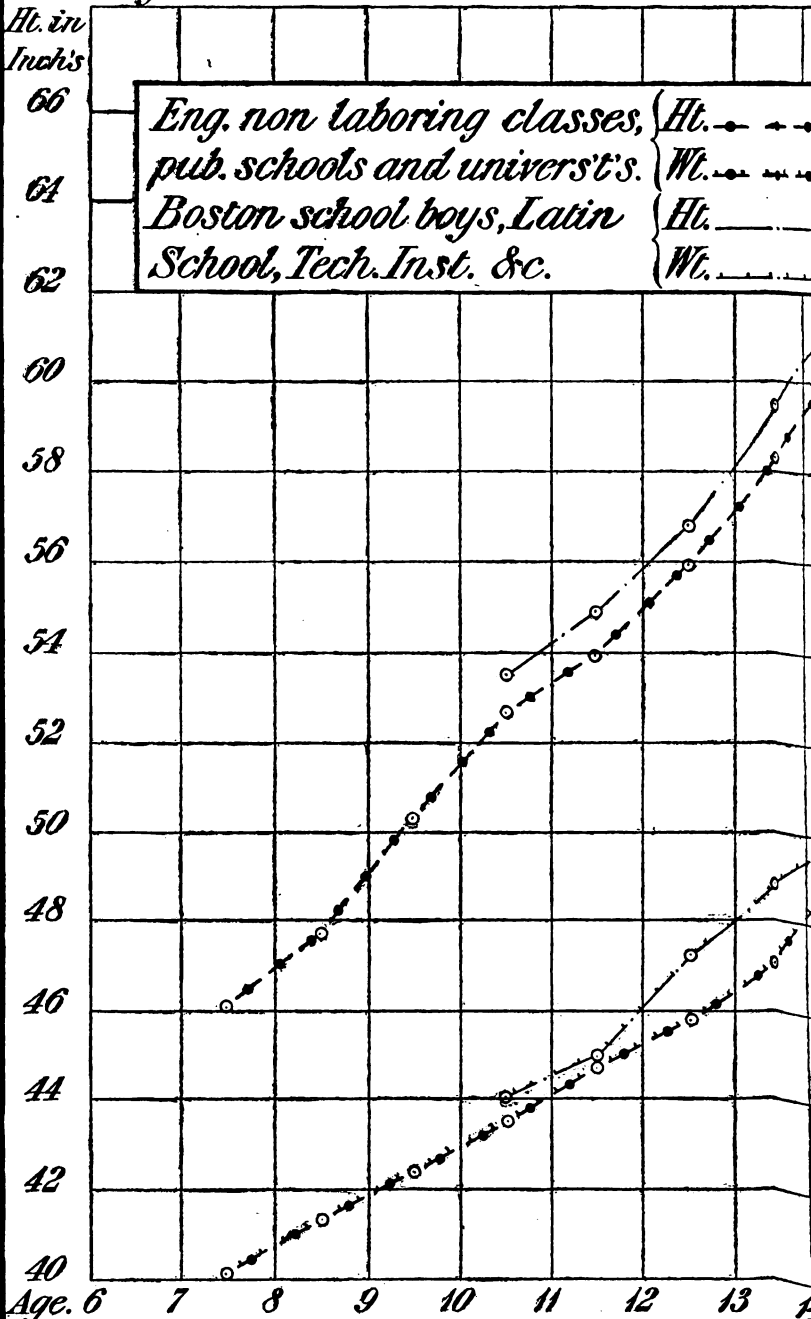
If this view is correct, it seems reasonable to suppose that the difference in size between Boston school children of American and those of Irish parentage may be, to some extent, dependent upon the greater comfort and luxury in which the former live and grow up. Whether the whole difference can be thus accounted for, or whether some other agency is concerned in bringing about this result, is a question which must be next considered.

* See De Candolle's *Histoire des Sciences et des Savants*, p. 368.

We have already seen that, according to Dr. Baxter's and Dr. Gould's investigations, the average height of the *adult* native American is greater than that of the native of any other country, and that natives of other countries, growing up in America, acquire a greater height than natives of the same countries growing up at home. We must now inquire whether similar conclusions can be reached in regard to the size of *growing children*; and in order to eliminate the effect which comfort and misery may have on the rate of growth, it is important to select, for comparison, sets of observations made upon children belonging to corresponding classes in the communities in which they live. If a comparison is made between the children of the non-laboring classes in the English public schools and universities (see Table No. 20) and the Boston school boys of American parentage (see Table No. 1), it will be seen that there is very little difference in the heights of the two sets of boys, and that the curves of growth, if constructed on the same sheet, would intersect each other at seven different points, and be nearly coincident through their whole course. In regard to weight, the American boys are, up to twelve years of age, lighter; from twelve to seventeen years heavier, and then again lighter, than English boys of the same ages. It is, however, manifest that the boys, whose dimensions are thus compared, cannot be regarded as belonging to corresponding classes in their respective communities; for there are, doubtless, a large number of native Americans to be found in the laboring classes of this city. In order to obtain a set of observations more comparable to those made on the children of the non-laboring classes in the English public schools and universities, the following table has been prepared by bringing together the measurements of the pupils of American parentage attending the public Latin School, the Massachusetts Institute of Technology, and the private Latin School of Mr. J. P. Hopkinson. It is believed that these pupils represent a class in the community corresponding sufficiently well in social condition to that class in England which sends children to the public schools and universities. A comparison of the two sets of figures shows the superiority of the American boy

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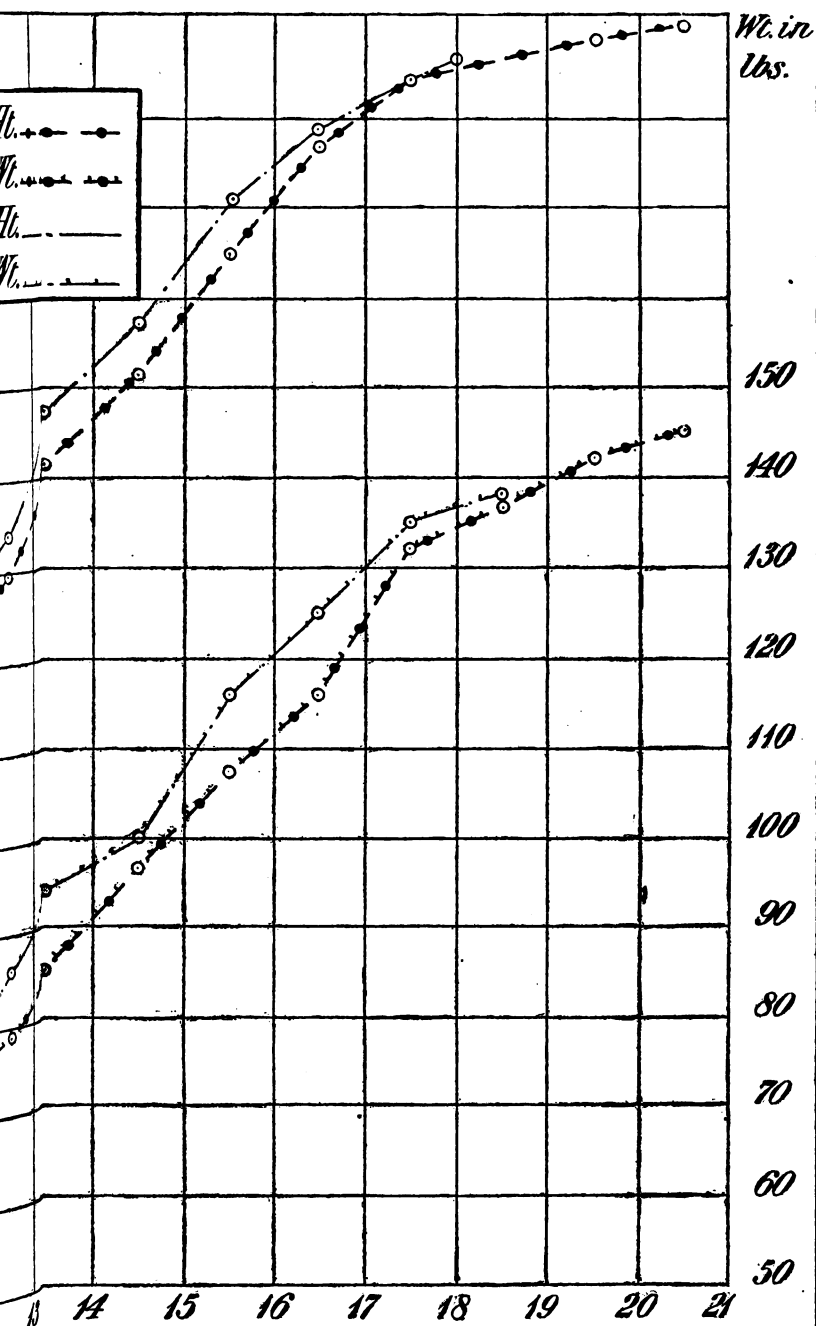
Plate IX. Showing comparative rate of Boys.



| | | | | | | | | | |
|--------|---------|-----|---|----|----|-----|-----|-----|-----|
| No. of | Eng. | Ht. | 3 | 16 | 61 | 235 | 430 | 745 | 969 |
| | | Wt. | 4 | 18 | 60 | 238 | 429 | 747 | 972 |
| Ob's. | Boston. | Ht. | | | | 19 | 17 | 28 | 41 |
| | | Wt. | | | | | | | |

A. N. HOUGHTON.

rate of growth of English and American



| | | | | | | | | |
|----|----|-----|-----|-----|-----|-----|-----|-----|
| 45 | 89 | 990 | 819 | 462 | 313 | 300 | 344 | 262 |
| 47 | 74 | 992 | 820 | 462 | 317 | 296 | 344 | 260 |
| 28 | 4 | 49 | 64 | 68 | | 61 | | |

both in height and weight.* The difference is rendered at once apparent by an inspection of the curves on Plate IX. It seems, therefore, that there are influences prevailing in this community, other than those connected with the comfort or

TABLE No. 21.

Showing Average Height and Weight of Boston School-boys of American Parentage attending Public Latin School, Private Latin School, and Massachusetts Institute of Technology.

| AGE AT LAST BIRTHDAY. | No. of Observations. | HEIGHT WITHOUT SHOES. | | WEIGHT IN ORDINARY DRESS. | |
|-----------------------|----------------------|-----------------------|--------------|---------------------------|------------|
| | | Inches. | Centimeters. | Pounds. | Kilograms. |
| 9, | 2 | 52.00 | 132.1 | 60.1 | 27.27 |
| 10, | 19 | 53.51 | 135.9 | 70.6 | 32.03 |
| 11, | 17 | 54.90 | 139.4 | 75.3 | 34.16 |
| 12, | 28 | 56.78 | 144.2 | 85.9 | 38.97 |
| 13, | 41 | 59.60 | 151.4 | 94.4 | 42.83 |
| 14, | 49 | 61.51 | 156.3 | 99.9 | 45.32 |
| 15, | 46 | 64.20 | 163.1 | 116.0 | 52.62 |
| 16, | 40 | 65.83 | 167.2 | 125.8 | 57.07 |
| 17, | 32 | } 67.44 | 171.3 { | 135.2 | 61.31 |
| 18, | 29 | | | 138.2 | 62.69 |
| Total, | 303 | | | | |

misery of existence, which give to a growing boy a greater height and weight than are attained by an English boy of the same age. While, therefore, the conclusions of Gould and of Baxter, as to the superior height of the adult native American, are found to be equally applicable to growing children, we find also here evidence that this superiority of stature is not dependent *solely* upon the more abundant distribution of the comforts of existence in this country, though for the reasons given above (p. 23) it seems probable that the difference is to be *partly* accounted for in this way.

In view of this result, it is reasonable to assume that the superior size of children of American parentage in the Boston schools is due in part to the greater comfort in which they live

* In confirmation of this result, it is interesting to note the statement made to the writer by a lady of his acquaintance, that London dealers in ready-made children's clothing recommend, to American customers, sizes adapted to English children one year older than those for whom the garments are purchased.

and grow up, and in part to other conditions which may be described collectively as differences of race or stock. To which of these agencies in bringing about the result the greater importance is to be attributed, is a question which we are at present without the means of deciding. Some light might be thrown upon the subject by tabulating the observations for each nationality according to the occupation of the parents, and it is possible that at some future time, should circumstances favor the undertaking, the data now on hand may be utilized in this way.

The curves showing the rate of growth of the above-mentioned selected American boys have been introduced into Plate VI. for comparison with the curves corresponding to the observations on children of American and of Irish parentage. It is evident that the superior size of these boys, in comparison with the average boys of American parentage attending the public schools, cannot be attributed exclusively to either of the factors which have been recognized as influencing the dimensions of growing children; for in the first place, the comfort in which the pupils of these selected schools live and grow up must be greater than that enjoyed by the *generality* of children of American parentage attending the public schools; and in the second place, their ancestors for several generations are probably, in the majority of cases, American; while the children with whom they are compared, though of American parentage, doubtless have, in a great many instances, foreign grandparents. Hence, whatever tendency residence in America may have to increase the size of growing children, will, in their cases, be intensified by transmission through several generations.

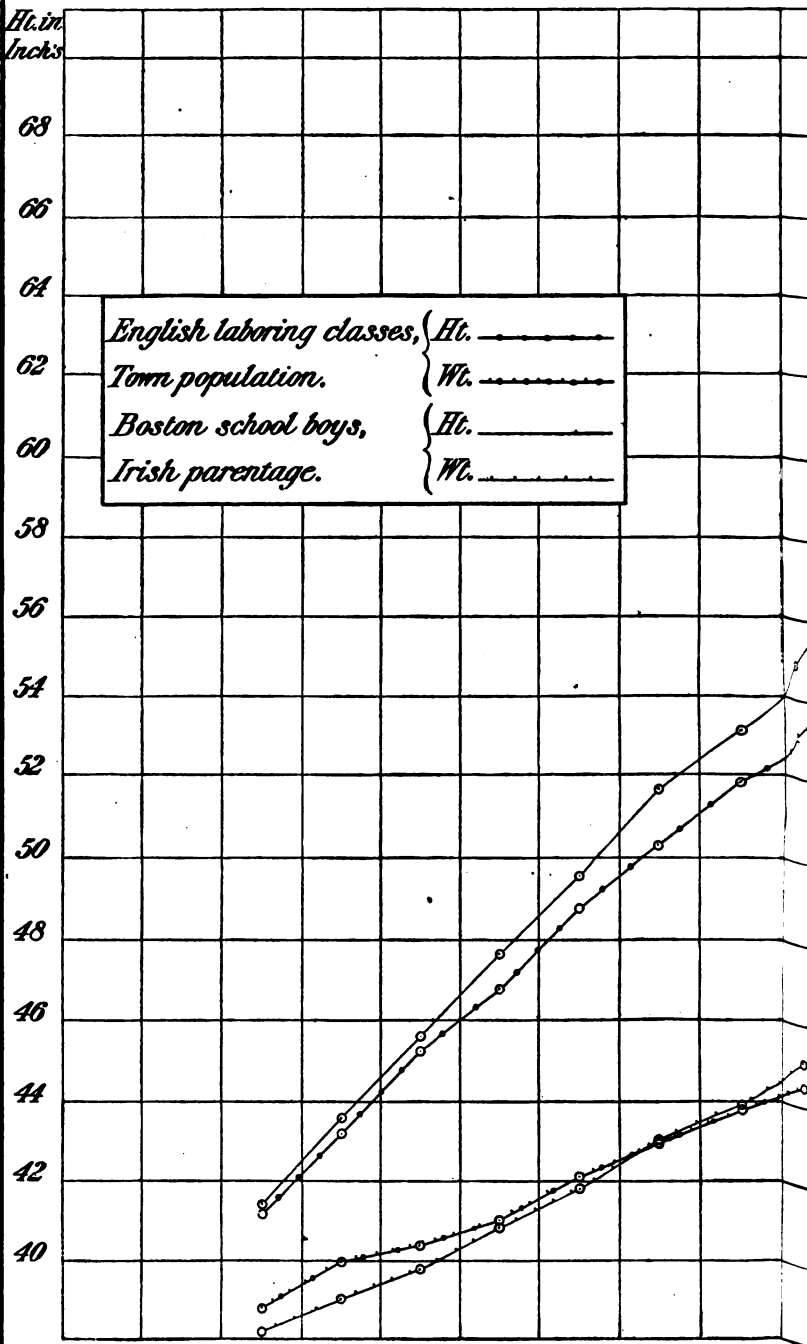
The characteristics which distinguish the various races of men result from slow modifications of a common ancestral type by the action through successive generations of the varying conditions under which growth and development take place. It is therefore interesting to inquire how *quickly* the type of a race may be altered by a change in the external conditions of development. We have already seen that, as far as the height of the adult individual is concerned, a single generation is, according to Dr. Gould, sufficient to produce a marked effect. A most striking proof of this statement is

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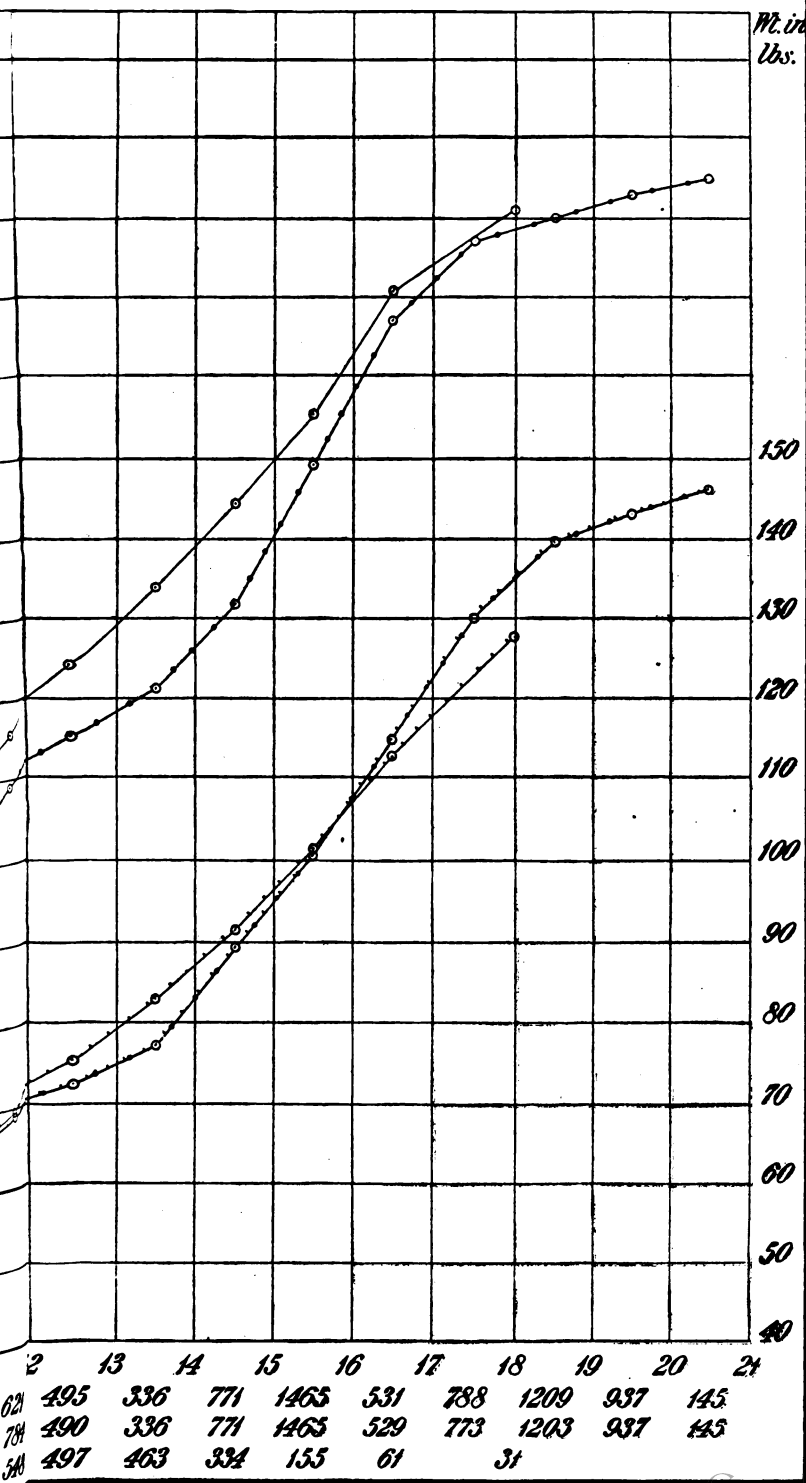
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Plate X. Showing comparative rate of growth of



| Age | | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
|-------------|---------|-----|-----|-----|-----|-----|-----|-----|-----|----|
| No. of Obs. | English | Ht. | 175 | 387 | 581 | 670 | 823 | 749 | 621 | 48 |
| | | Wt. | 175 | 327 | 581 | 675 | 851 | 829 | 784 | 48 |
| Boston | | 336 | 503 | 562 | 588 | 556 | 571 | 548 | 48 | |

Weight of English and American Boys.



afforded by the tables given by this writer,* showing that natives of New England and New York enlisting in the Western States have, at all ages from eighteen years upwards, a greater average height than natives of the same regions enlisting at home, thus approximating to the stature of the natives of those States where they grew up and enlisted. It was hoped at the beginning of this inquiry that it might be possible to ascertain whether local conditions have a similar effect on the size of growing children, but it has been found impossible to collect data which will warrant any positive conclusions on this subject. The only foreign nation largely represented in this community is the Irish; and all attempts by correspondence with English statisticians to discover any record of observations on the size of Irish children in their native country have been unavailing. A comparison may be instituted between the children of the laboring classes in England (see Table No. 20) and those of Irish parentage in this community (see Table No. 1); and the difference shown by the curves on Plate X. is, as far as height is concerned, in favor of the Boston children; while in regard to weight, the English children are at first heavier, then lighter, and then again heavier than Boston children of the same ages. Conclusions as to the effect of climatic conditions on the size of growing children could, however, be drawn from this comparison only on the assumption, first, that among the laboring classes the size of Irish children does not differ greatly from that of English children; secondly, that the children of Irish parents in this community belong wholly, or in a large proportion, to the laboring classes; and thirdly, that the condition of the laboring classes in this community is comparable, as to comforts of life, with that of the laboring classes of England. None of these assumptions can be safely made, and it must therefore remain doubtful to what cause the difference of size between the two sets of children (amounting at thirteen years of age to over two inches in height) is really to be attributed.

A comparison between the heights of boys of German parentage in this city and that of growing boys in German cities is not without interest. The following table shows in

* *Op. cit.*, pp. 126, 127.

parallel columns the heights of boys measured in Berlin by Schadow, and of boys measured in Cologne by Angerstein, compared with the heights of boys of German and American parentage attending the schools of this city. The curves on Plate XI. have been constructed from the figures of this table (the curve of growth of children of American parents being omitted in order not to confuse the diagram). It will be noticed that while the curves of growth of boys living in the German cities indicate a great difference in the rate of increase before and after eleven years of age, the rate of growth of boys of both German and American parentage in this city is much more uniform throughout the whole growing period.

TABLE NO. 22.

Showing Comparative Rate of Growth of American and German Boys.

| AGE. | BERLIN. (SCHADOW.) | | COLOGNE. (ANGERSTEIN.) | | BOSTON. | | | |
|-------|-----------------------|---------|---------------------------|---------|----------------------|---------|------------------------|---------|
| | | | | | GERMAN PARENTAGE. | | AMERICAN PARENTAGE. | |
| | Inches. | Centim. | Inches. | Centim. | Inches. | Centim. | Inches. | Centim. |
| 5, . | 43.24 | 109.8 | — | — | 41.08 | 104.3 | 41.74 | 106.0 |
| 6, . | 45.32 | 115.1 | — | — | 43.50 | 110.5 | 44.10 | 112.0 |
| 7, . | 46.34 | 117.7 | 46.31 | 117.6 | 45.25 | 114.1 | 46.21 | 117.4 |
| 8, . | 47.35 | 120.3 | 47.83 | 121.5 | 47.13 | 119.7 | 48.16 | 122.3 |
| 9, . | 48.40 | 122.9 | 48.90 | 124.2 | 48.85 | 124.1 | 50.09 | 127.2 |
| 10, . | 49.38 | 125.4 | 50.43 | 128.1 | 51.21 | 130.1 | 52.21 | 132.6 |
| 11, . | 51.45 | 130.7 | 51.97 | 132.0 | 52.92 | 134.4 | 54.01 | 137.2 |
| 12, . | 54.57 | 138.6 | 54.54 | 138.5 | 54.55 | 138.6 | 55.78 | 141.7 |
| 13, . | 57.65 | 146.4 | 58.67 | 149.0 | 56.70 | 144.0 | 58.17 | 147.7 |
| 14, . | 60.71 | 154.2 | 61.77 | 156.9 | 59.14 | 151.2 | 61.08 | 155.1 |
| 15, . | 65.91 | 167.4 | 64.34 | 163.4 | 62.06 | 157.6 | 62.96 | 159.9 |
| 16, . | — | — | 65.88 | 167.3 | } 64.75 | 164.4 { | 65.58 | 166.5 |
| 17, . | — | — | 66.40 | 168.6 | | | 66.29 | 168.4 |
| 18, . | — | — | 66.91 | 169.9 | | | 66.76 | 169.5 |

The figures in the above table, representing the heights of Berlin and Cologne boys, though apparently averages of a number of observations, are really more of the nature of estimates. This is evident from an examination of the original tables as given by Angerstein,* where the heights for each age are, in most instances, expressed in an even number of German inches. Moreover, the observations on boys of German

* Deutsche Turnzeitung, 1864, p. 326.

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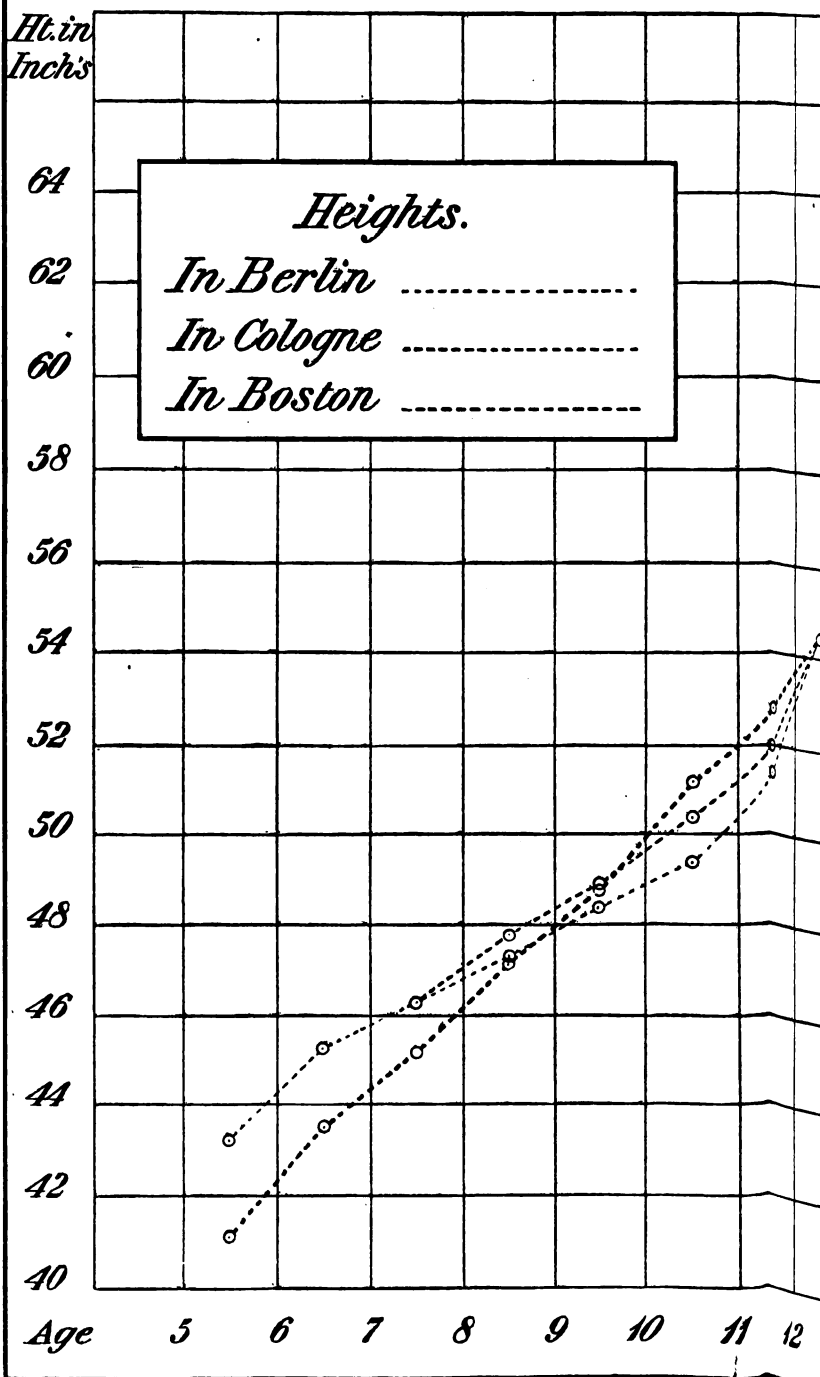
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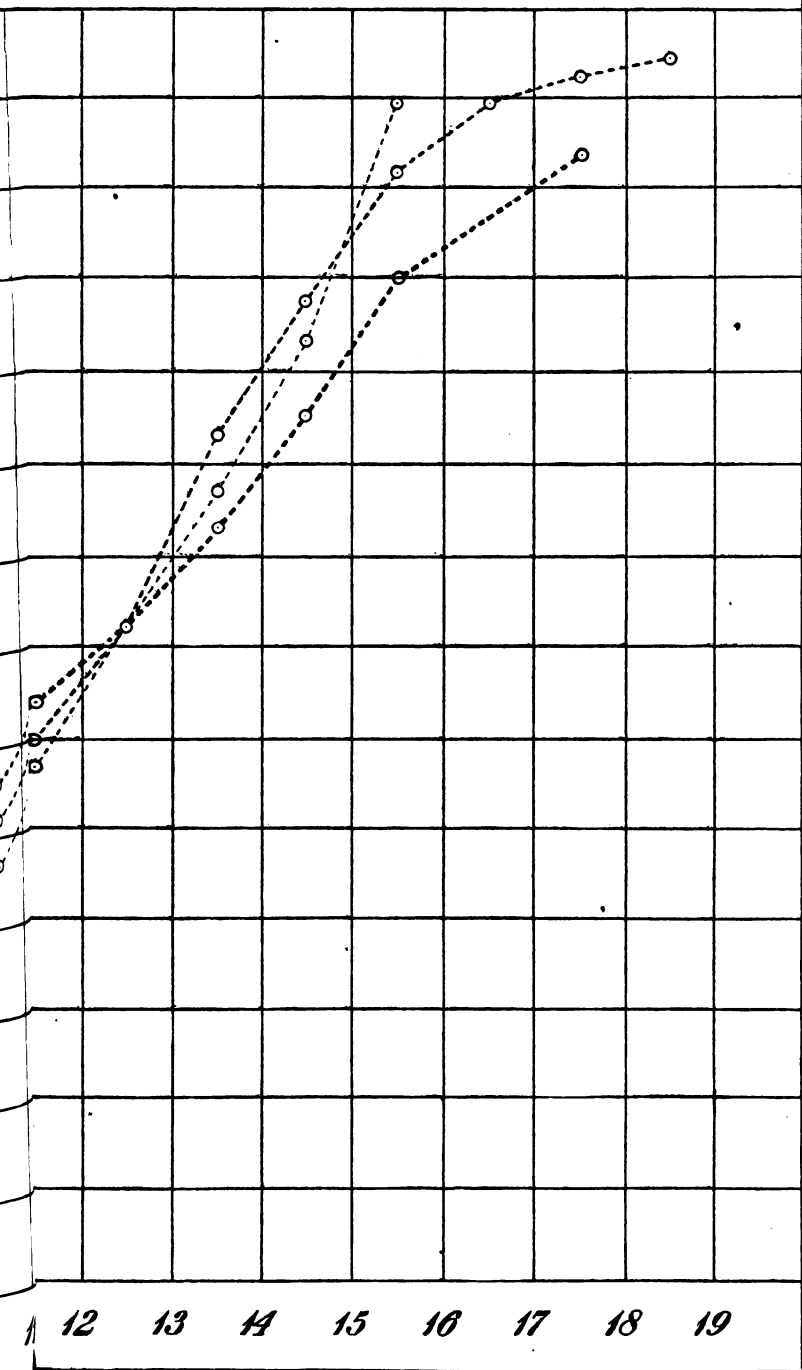
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Plate XI. *Showing rate of growth of
and in America.*



A. N. HOUGHTON.

Age of German boys in Germany



parentage in this city are few in number (752 of all ages), and there has been no attempt to distinguish between natives of different parts of Germany. It is therefore impossible to draw positive conclusions on the subject; but the evidence, as far as it goes, seems to indicate that even in the first generation after emigration, the rate of growth has been modified by new external conditions.

RELATION OF HEIGHT TO WEIGHT.

The data collected in this investigation afford the means for ascertaining the relation of height to weight in growing children of both sexes and of various races. This relation is for each age most simply expressed by the quotient of the weight in pounds divided by the height in inches. Series of quotients thus obtained are given in Table No. 3, in the columns headed "pounds per inch." Since, however, these quotients increase with the increasing height,* it is manifestly impossible to use them for ascertaining the relative stoutness of children who at a given age differ from each other in stature. To do this with absolute accuracy, it would be necessary to determine for each age, and in each set of observations, the average weight corresponding to each height. Since, however, the direct determination of this value would necessitate a complete retabulation of all the observations, it has been thought best to adopt an indirect and somewhat less accurate method of getting at the result. This method consists in arranging the heights and weights corresponding to each age, opposite to each other in parallel columns, and then determining by interpolation the weights corresponding to each even inch of height.†

* Uniform growth in all dimensions would of course cause the weights of growing children to vary as the cubes of the heights, but since growth is more rapid in the vertical than in the lateral dimensions, the weights increase approximately as a lower power of the heights. A logarithmic equation, however, as given in the appendix to this article, expresses the relation much more accurately. For a discussion of the question the reader is referred to the works of Quetelet and Gould.

† This method is defective, first, because it does not take into account the possible influence of age upon the ratio of a given height to its corresponding weight; and secondly, because it rests upon the assumption that the average weight for a given age is the same as the average weight of all individuals, without regard to age, whose height is equal to the average height for that age. This assumption clearly involves a trifling error, for, since the weights of growing children increase approximately as the 2.7 powers of the heights, it is evident that at any given age the weight of those children

The results of this calculation are given in Tables Nos. 23 and 24, which show for every inch of height the corresponding weight of growing children of both sexes and in various conditions of life.

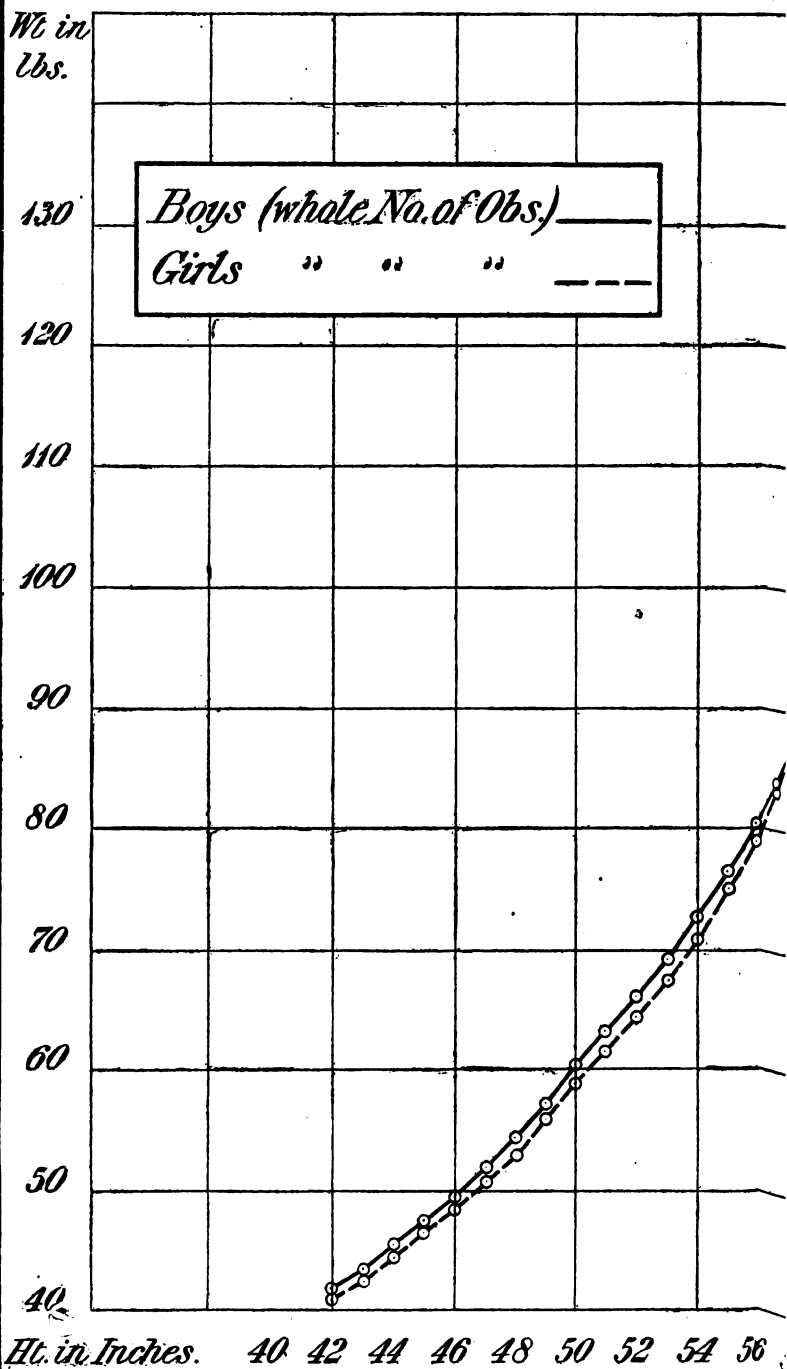
TABLE No. 23.

Showing Relation of Height to Weight in Growing Boys. (Weight given in Pounds.)

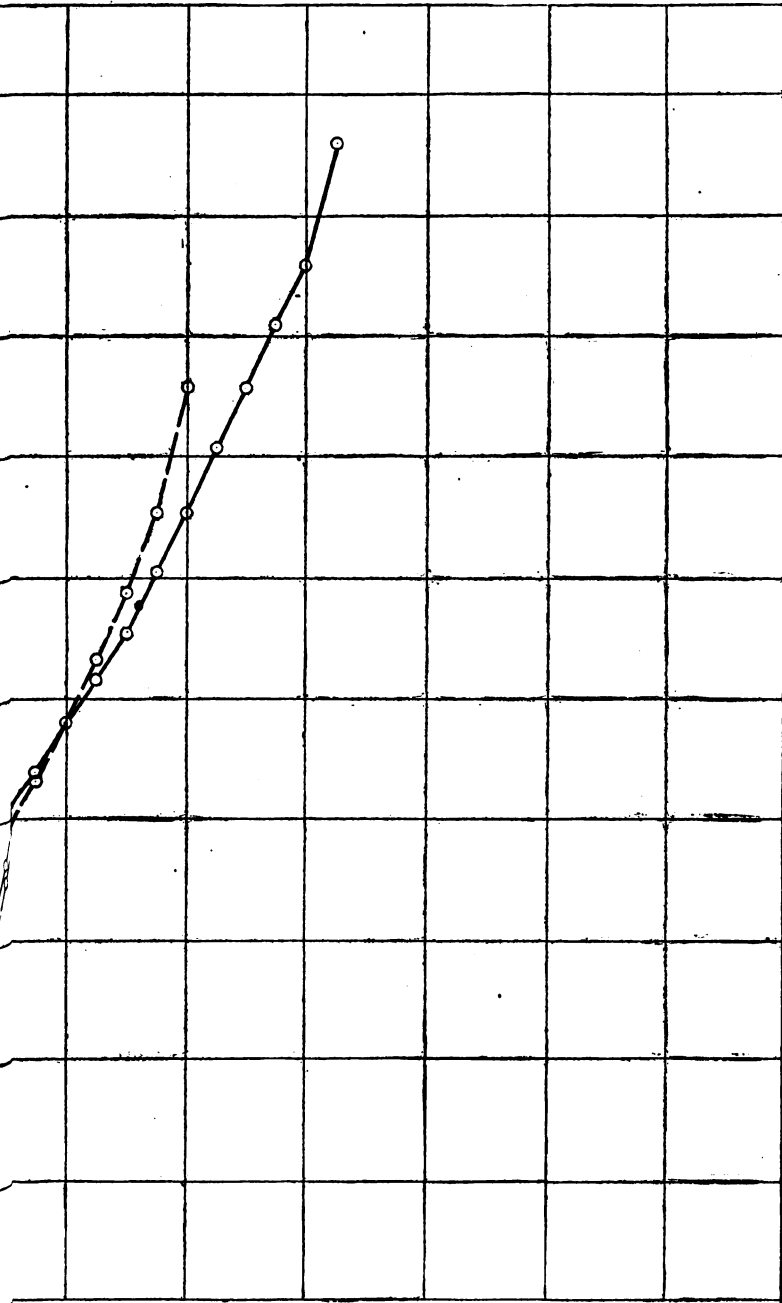
| HEIGHT, inches. | BOSTON SCHOOL BOYS. | | | | | | ENGLISH BOYS. | | |
|-----------------|---------------------|--------|---------------------|---------|----------------------|---------|---------------|---------------|--|
| | PARENTAGE. | | | | | Totals. | Laboring. | Non-laboring. | Latin School, Technology Institute, etc. |
| | American. | Irish. | American and Irish. | German. | One or both English. | | | | |
| 42 | 41.63 | 42.07 | 41.68 | 41.90 | 41.40 | 41.77 | 46.50 | - | - |
| 43 | 43.29 | 43.87 | 43.63 | 43.38 | 43.59 | 43.60 | 49.18 | - | - |
| 44 | 44.98 | 45.76 | 45.64 | 45.49 | 45.60 | 45.63 | 50.58 | - | - |
| 45 | 47.00 | 47.69 | 47.68 | 48.41 | 47.24 | 47.58 | 51.71 | - | - |
| 46 | 49.03 | 49.83 | 49.72 | 50.64 | 49.25 | 49.65 | 53.55 | - | - |
| 47 | 51.45 | 52.34 | 51.76 | 52.67 | 51.97 | 52.07 | 55.63 | 53.77 | - |
| 48 | 54.03 | 54.84 | 54.05 | 55.64 | 54.60 | 54.57 | 58.35 | 57.12 | - |
| 49 | 56.81 | 57.48 | 56.52 | 58.59 | 57.49 | 57.31 | 61.10 | 59.23 | - |
| 50 | 59.69 | 60.31 | 59.75 | 61.09 | 60.32 | 60.20 | 63.82 | 61.34 | - |
| 51 | 62.82 | 63.29 | 63.32 | 63.41 | 63.24 | 63.23 | 66.79 | 63.53 | - |
| 52 | 65.95 | 66.28 | 66.47 | 66.30 | 65.71 | 66.27 | 69.52 | 65.74 | 60.10 |
| 53 | 69.11 | 69.27 | 69.35 | 69.42 | 67.85 | 69.20 | 72.70 | 68.86 | 67.03 |
| 54 | 72.33 | 72.77 | 72.30 | 73.45 | 71.82 | 72.73 | 76.46 | 73.50 | 72.24 |
| 55 | 76.55 | 76.41 | 75.28 | 77.41 | 75.94 | 76.44 | 81.70 | 76.36 | 75.86 |
| 56 | 80.66 | 80.19 | 78.82 | 81.16 | 80.98 | 80.24 | 87.22 | 79.21 | 81.44 |
| 57 | 84.12 | 84.00 | 82.67 | 84.93 | 85.44 | 84.04 | 91.41 | 81.86 | 86.58 |
| 58 | 87.58 | 87.85 | 86.65 | 88.63 | 88.48 | 87.86 | 94.68 | 84.51 | 89.55 |
| 59 | 91.34 | 91.69 | 90.73 | 92.32 | 91.52 | 91.58 | 97.95 | 89.16 | 92.70 |
| 60 | 95.20 | 96.20 | - | 97.26 | 95.26 | 95.51 | 101.35 | 94.84 | 95.55 |
| 61 | 98.94 | 100.50 | - | 102.10 | 99.25 | 100.54 | 105.10 | 99.22 | 98.41 |
| 62 | 105.06 | 104.71 | - | 107.23 | 105.41 | 105.63 | 108.99 | 103.23 | 102.79 |
| 63 | 111.03 | 108.56 | - | - | 113.24 | 110.71 | 112.88 | 107.25 | 108.75 |
| 64 | 115.97 | 112.52 | - | - | - | 115.86 | 118.84 | 110.90 | 114.71 |
| 65 | 120.84 | - | - | - | - | 121.01 | 126.47 | 114.65 | 120.90 |
| 66 | 126.70 | - | - | - | - | 126.61 | 139.50 | 122.66 | 126.94 |
| 67 | - | - | - | - | - | 136.09 | 146.55 | 132.88 | 133.64 |
| 68 | - | - | - | - | - | - | - | 144.37 | - |

who are above the average height will tend to raise the average weight for that age more than the weights of the children below the average height will tend to lower it, supposing the observations to be uniformly distributed on both sides of the average according to the binomial curve of Quetelet; consequently the average weight for a given age will be somewhat greater than the average weight of all the individuals, regardless of age, whose height is equal to the average height for that age. Notwithstanding these defects, the method has been adopted, first, because it is believed that the errors involved are so small as to be of no practical importance; and secondly, because relative rather than absolute values were sought, and a comparison between several sets of observations is not prevented by a small constant error running through them all.

Plate XII. *Showing relation of height and weight of children.*



Freight to weight in Boston school



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TABLE No. 24.

Showing Relation of Height to Weight in Growing Girls. (Weight given in pounds.)

| HEIGHT, inches. | BOSTON SCHOOL GIRLS. | | | | | |
|-----------------|----------------------|--------|---------------------|---------|----------------------|---------|
| | PARENTAGE. | | | | | Totals. |
| | American. | Irish. | American and Irish. | German. | One or both English. | |
| 42, | 40.77 | 41.02 | 41.39 | 40.76 | 40.74 | 40.89 |
| 43, | 42.61 | 42.70 | 42.77 | 42.50 | 42.79 | 42.62 |
| 44, | 44.44 | 44.67 | 44.38 | 44.42 | 44.64 | 44.53 |
| 45, | 46.25 | 46.71 | 46.08 | 46.43 | 46.67 | 46.45 |
| 46, | 48.16 | 48.80 | 47.98 | 48.34 | 48.85 | 48.51 |
| 47, | 50.47 | 50.96 | 50.23 | 50.29 | 51.02 | 50.71 |
| 48, | 52.78 | 53.38 | 52.70 | 53.37 | 53.19 | 53.19 |
| 49, | 55.68 | 56.01 | 55.30 | 56.69 | 55.25 | 56.06 |
| 50, | 58.70 | 58.59 | 57.92 | 58.64 | 57.96 | 58.75 |
| 51, | 62.02 | 61.10 | 60.71 | 60.83 | 61.04 | 61.39 |
| 52, | 64.76 | 64.14 | 63.56 | 64.93 | 64.32 | 64.36 |
| 53, | 67.85 | 67.39 | 66.51 | 69.09 | 67.66 | 67.54 |
| 54, | 70.92 | 70.99 | 70.30 | 73.08 | 70.97 | 71.01 |
| 55, | 74.14 | 74.65 | 74.89 | 76.90 | 74.33 | 74.90 |
| 56, | 77.46 | 78.74 | 78.74 | 80.06 | 77.78 | 78.82 |
| 57, | 80.79 | 82.97 | 82.71 | 83.18 | 82.81 | 83.38 |
| 58, | 86.55 | 87.56 | 87.20 | 86.56 | 87.86 | 87.92 |
| 59, | 92.64 | 92.86 | 94.60 | 93.32 | 92.80 | 93.29 |
| 60, | 98.49 | 98.04 | 101.80 | - | 97.86 | 98.81 |
| 61, | 105.44 | 107.83 | 109.04 | - | 106.14 | 105.39 |
| 62, | 115.75 | 115.82 | - | - | 110.75 | 115.69 |

The following conclusions may be drawn from an examination of the tables:—

I. Growing boys are heavier in proportion to their height than growing girls until the height of 58 inches (147.9 c. m.) is reached. Above that point the reverse is the case. This is true in all the various sets of observations. The fact is rendered apparent by the curves on Plate XII., where the ordinates represent the weight in pounds corresponding to each inch of height, the values being calculated from the average dimensions of all the Boston school children measured, irrespective of the nationality of the parents. The height of 58 inches is attained in the 14th year, and it seems probable that the reversal in relative proportions of the two sexes may be connected with the accumulation of adipose tissue which occurs in girls at about the period of puberty.

II. The difference between children of American and those

of foreign parents is constant in one direction for all ages, only in the case of boys of German parentage. These, as will be seen by the curves on Plate XIII., are uniformly heavier in proportion to their height than the sons of American born parents.

III. The children of the laboring classes in England are, as shown by the curves on Plate XIV., decidedly heavier in proportion to their height than those of the non-laboring classes. This fact, taken in connection with the differences in absolute height and weight of the same children (as shown by the curve on Plate VIII.) seems to indicate that deprivation of the comforts of life has a greater tendency to diminish the stature than the weight of a growing child.

IV. A comparison of the pupils of the selected Boston schools above mentioned with the children of the English non-laboring classes at the public schools and universities, shows that the former are in general heavier, in proportion to their height, than the latter (see Plate XV.). It seems, therefore, that the influences above alluded to (p. 25) which give to a growing boy in this community a greater height and weight than are attained by an English boy of the same age, affect the weight more powerfully than the height, and that the Boston boy is therefore by no means to be described as tall and thin in comparison with his English cousin. Dr. Baxter's conclusion, "that the mean weight of the white native of the United States is not disproportionate to his stature"* seems, therefore, as far as these boys are concerned, as applicable to growing children as to adults.

It will thus be seen that the theory of the gradual physical degeneration of the Anglo-Saxon race in America derives no support from this investigation.†

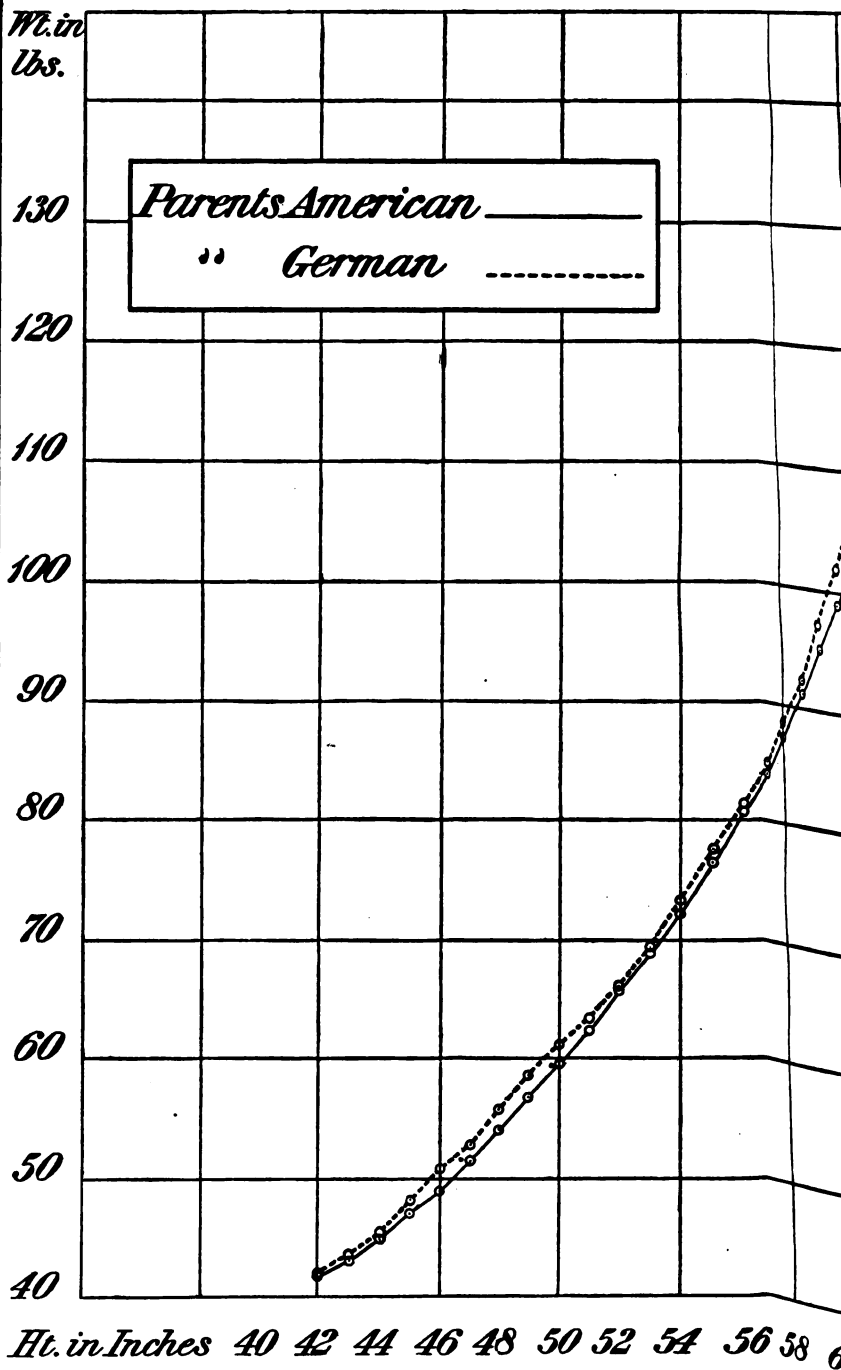
DISTRIBUTION OF OBSERVATIONS.

Tables Nos. 4 to 15, inclusive, show the distribution of the observations on both height and weight. For instance, from Table No. 4, it will be seen that, of the 848 boys of five years of age whose heights were measured, four (or 0.47 per cent. of the whole number) were between 47 and 48 inches high,

* Op. cit., p. 55.

† See an article on this subject by Rev. A. A. Livermore, in the February number of the "Unitarian Review and Religious Magazine."

Plate XIII. *Showing relation of height school boys.*



n of height to weight in Boston

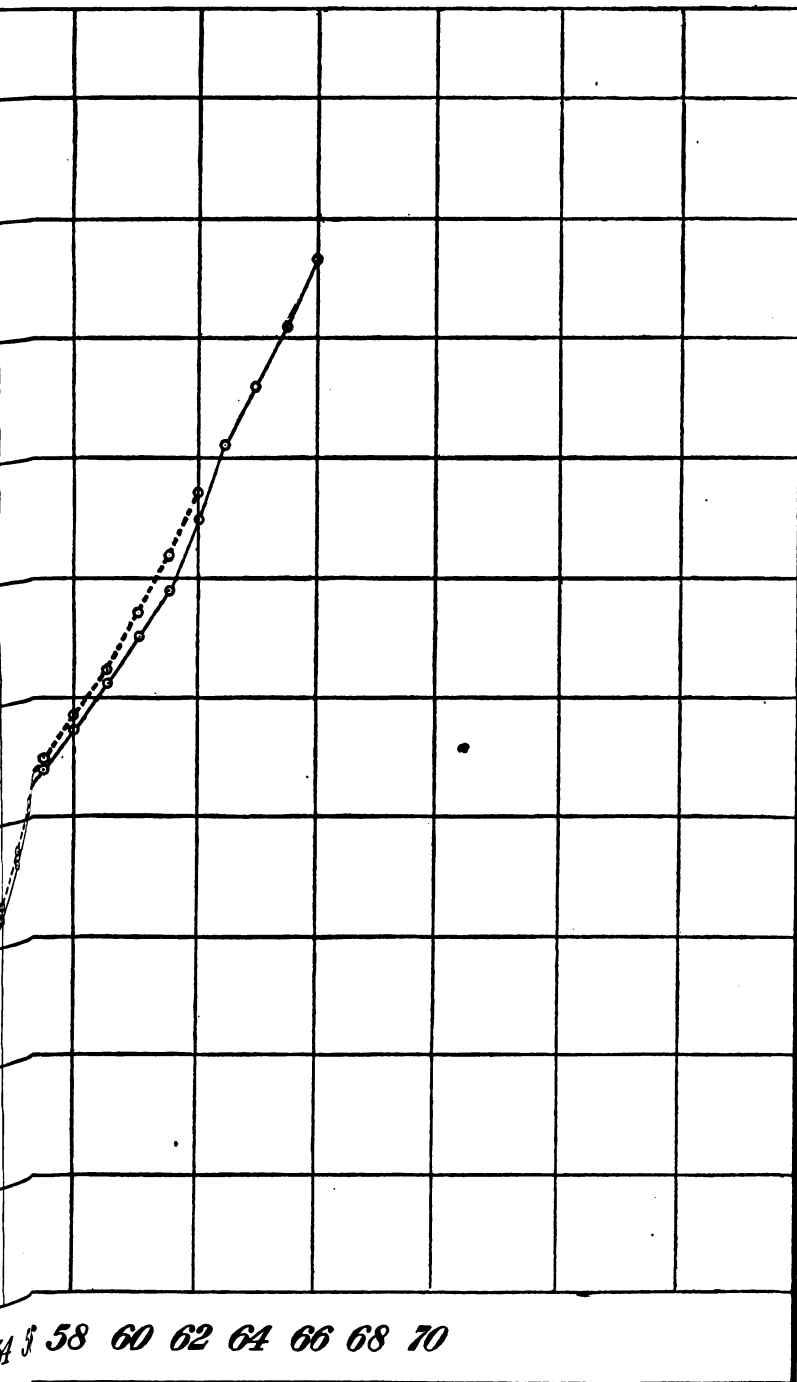
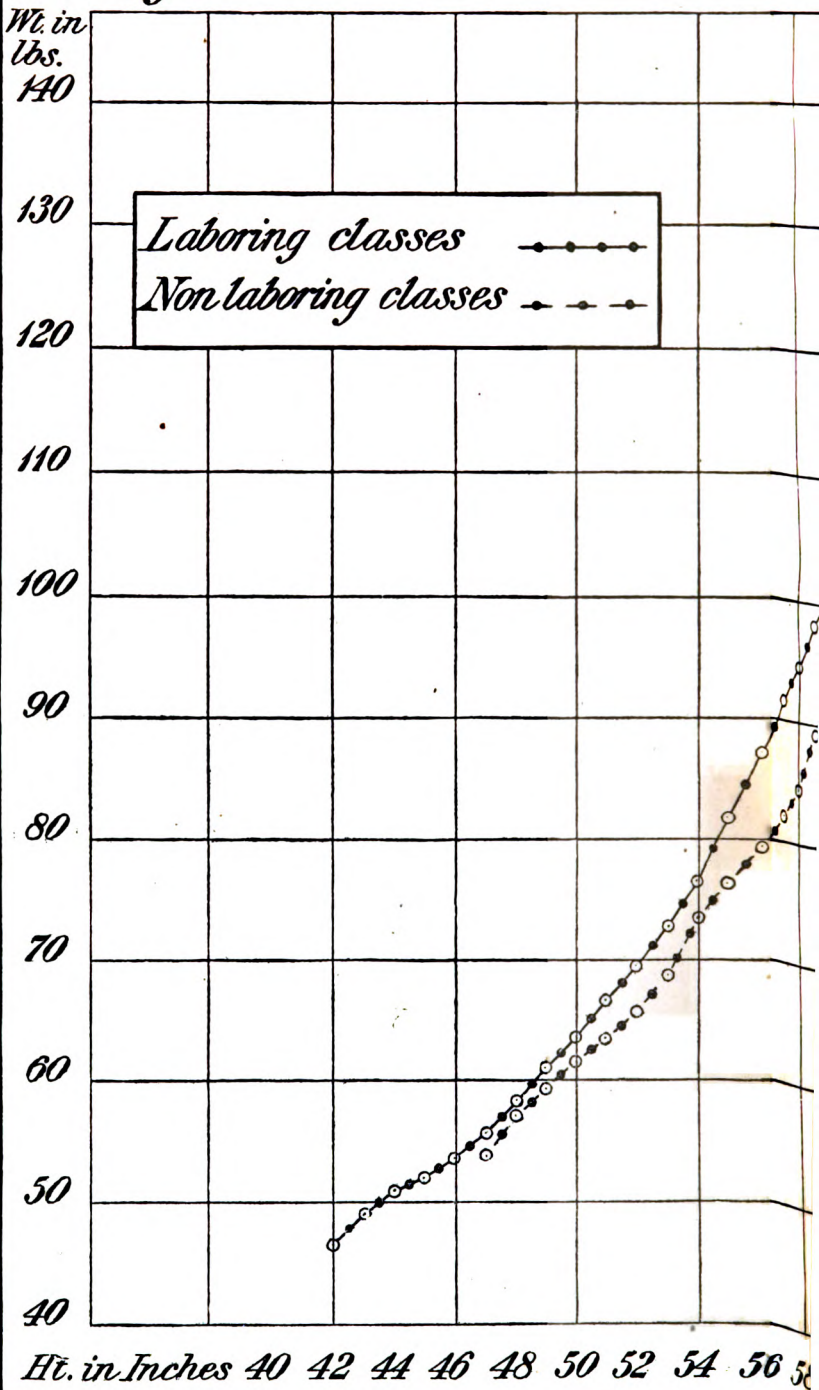
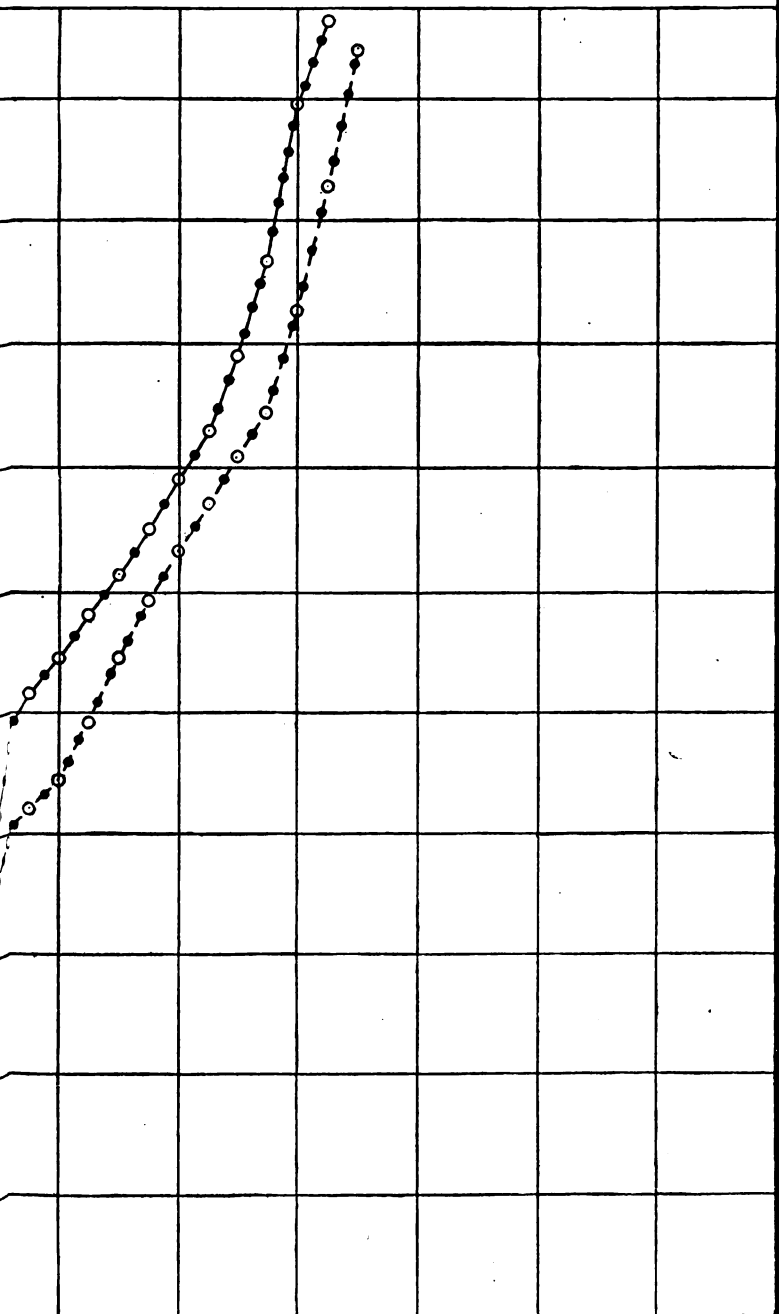


Plate XIV. *Showing relation of height and weight of*
Boys.

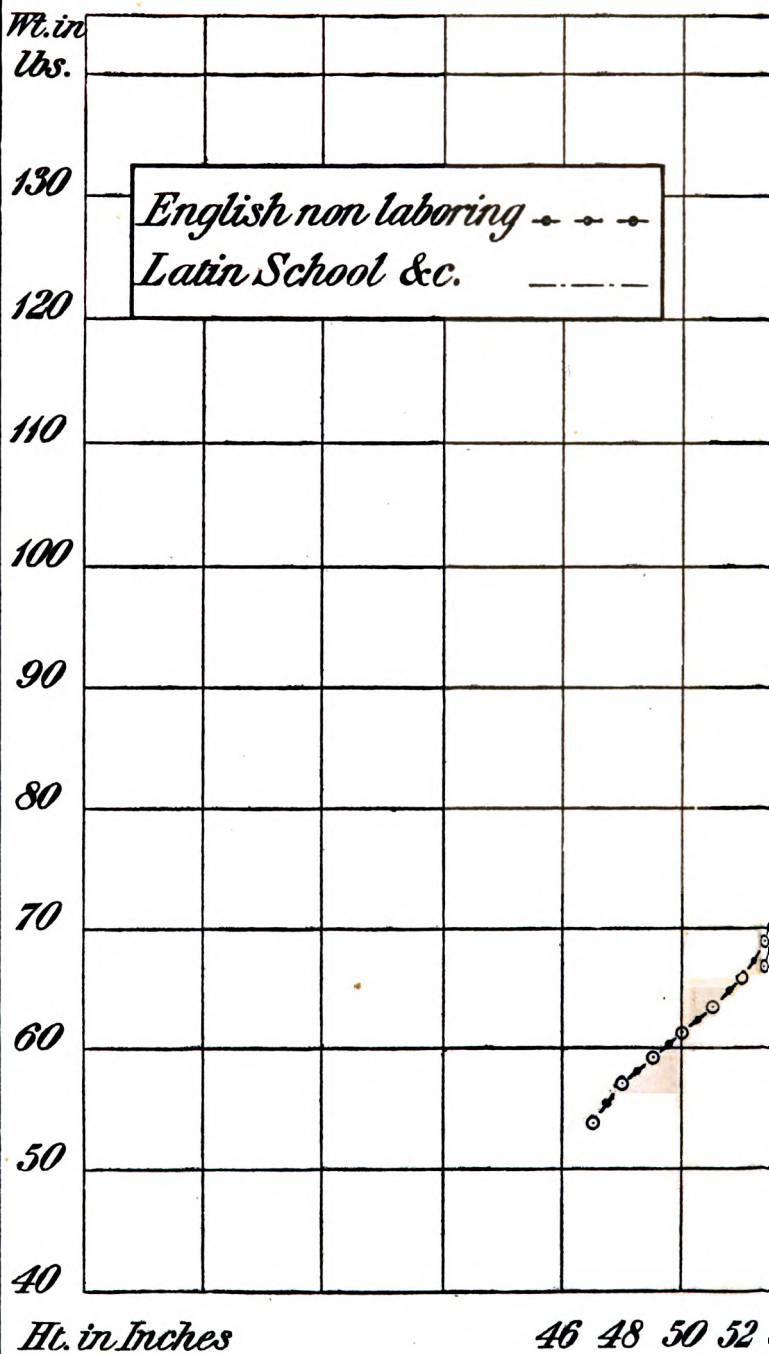


f height to weight in English

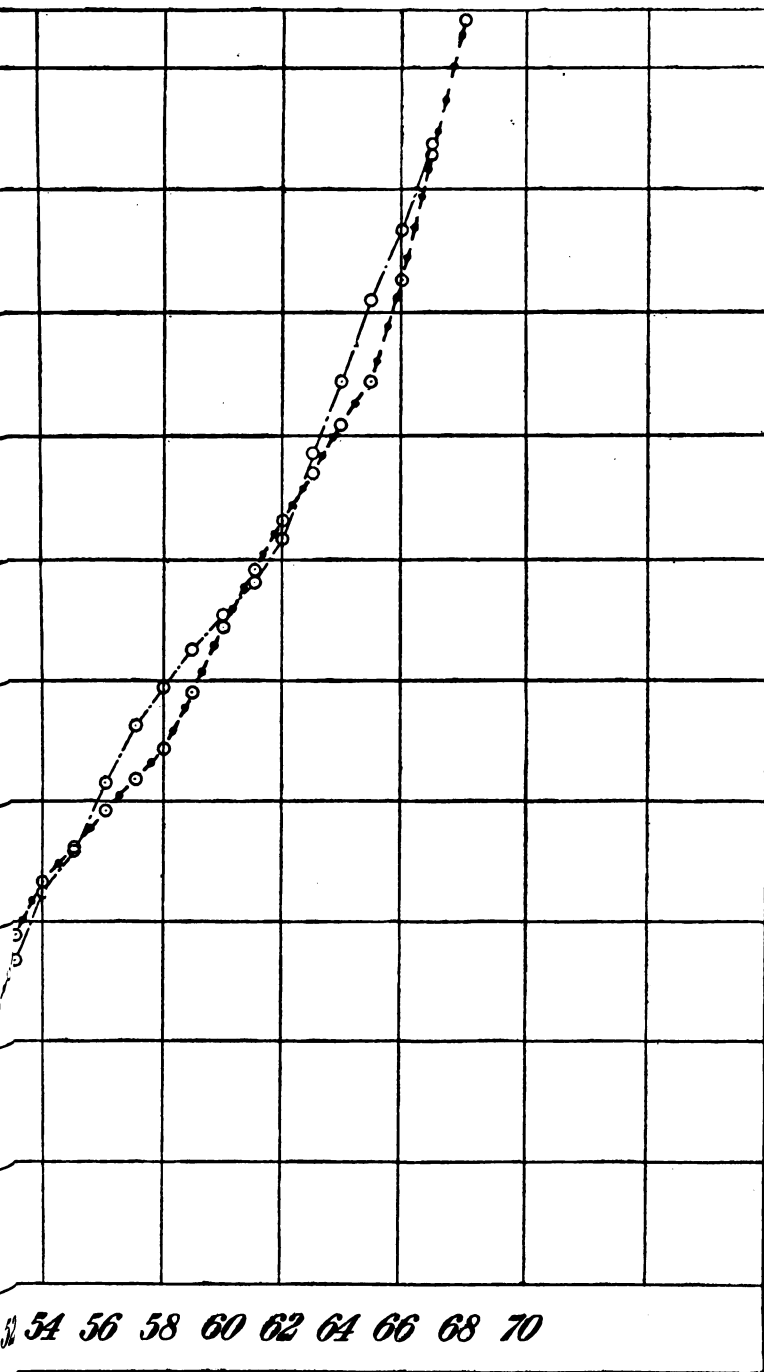


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Plate XV. *Showing relation of*
and American Boys.



height to weight in English



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190 (or 22.4 per cent. of the whole number) were between 41 and 42 inches high, etc. The distribution of observations on both sides of the average height or weight may be represented, according to Quetelet, by the binomial curve. That is, if the individuals measured are sufficiently numerous, it will be found that the number of observations at each successive inch (or pound) will first increase and then diminish in the same way as the successive coefficients of $(a + b)^n$, as determined by Newton's binomial theorem. It will be noticed that the figures in the above-mentioned tables do not increase and diminish with the regularity which a conformity with this law demands; but it must be borne in mind that the observations at each age are comparatively few in number, and that more numerous measurements or a distribution of the present observations in larger groups (*e. g.*, of two inches, or of eight pounds each) would doubtless cause the appearance of a closer agreement with the law.

These tables (Nos. 4 to 15) show at a glance the range of variation in height and weight at each age. It will be noticed that the range gradually increases with age (except where the whole number of observations is comparatively small), while the percentage of observations at the average height or weight, as a rule, diminishes. The most remarkable instances of variation from the normal dimensions are those of a boy five years old, and but thirty inches in height; and of three girls, 14, 16, and 18 years of age, weighing upwards of two hundred pounds.

WEIGHT OF CLOTHES.

It will be noticed that in this investigation the weight of the children has been given "in ordinary clothes," and no attempt has been made to ascertain the net weight by making an allowance for the clothing. This course was adopted because most of the observations with which comparisons were to be made had been taken in this way; but in order to facilitate a comparison of these records with others, in which a deduction is made for the weight of the clothes, an effort has been made to determine the average weight of the ordinary indoor clothing of children of different ages. For this purpose 317 pupils of both sexes, of various ages, and living in several different quarters of the city, were requested by the principals of their

respective schools to ascertain and to report the weight of the garments worn at the time the observations were taken. From the data thus collected at various seasons of the year, the following table has been computed, showing in parallel columns, for each age, the number of observations, the

TABLE NO. 25.

Showing Average Weight of Clothes Worn by School Children.

| AGE AT LAST BIRTHDAY. | BOYS. | | | | GIRLS. | | | |
|------------------------------------|----------------------|------------------------------|----------|----------------------------------|----------------------|------------------------------|----------|----------------------------------|
| | No. of Observations. | AVERAGE WEIGHT IN POUNDS. | | Percentage weight of clothes. | No. of Observations. | AVERAGE WEIGHT IN POUNDS. | | Percentage weight of clothes. |
| | | Gross weight. | Clothes. | | | Gross weight. | Clothes. | |
| 5, | 5 | 44.22 | 2.85 | 6.45 | 8 | 41.84 | 2.84 | 6.79 |
| 6, | 14 | 43.51 | 3.13 | 7.19 | 9 | 43.90 | 2.90 | 6.61 |
| 7, | 22 | 52.79 | 3.44 | 6.52 | 20 | 47.82 | 3.59 | 7.51 |
| 8, | 13 | 56.15 | 4.06 | 7.23 | 21 | 53.69 | 3.51 | 6.54 |
| 9, | 12 | 59.85 | 4.76 | 7.95 | 17 | 61.07 | 4.23 | 6.93 |
| 10, | 9 | 63.25 | 5.72 | 9.04 | 20 | 66.45 | 4.54 | 6.83 |
| 11, | 4 | 67.69 | 6.69 | 9.88 | 17 | 70.97 | 4.88 | 6.88 |
| 12, | 11 | 78.29 | 7.27 | 9.29 | 15 | 82.96 | 5.64 | 6.80 |
| 13, | 12 | 88.19 | 7.40 | 8.39 | 11 | 96.88 | 5.66 | 5.85 |
| 14, | 17 | 99.22 | 8.09 | 8.15 | 14 | 111.47 | 7.54 | 6.76 |
| 15, | 10 | 103.65 | 8.08 | 7.80 | 13 | 107.23 | 7.85 | 7.32 |
| 16, | 7 | 120.30 | 9.67 | 7.86 | 8 | 117.16 | 8.09 | 6.90 |
| Total, | 136 | - | - | - | 181 | - | - | - |
| Average for all ages, | - | - | - | 7.99 | - | - | - | 6.81 |

average gross weight of the pupils, the average weight of the clothes, and the percentage weight of the clothes referred to the gross weight of the individual. From this table it will be seen that, except in the case of very young children, both the absolute and the percentage weight of the clothing is, at any given age, greater for boys than for girls. The average weight of the clothes for all ages is, for boys, 8 per cent., and for girls, 6.8 per cent., of the gross weight.

This estimate is considerably larger than that given by Quetelet,* whose allowance for clothing is, for boys, $\frac{1}{18}$ (5.5

* Sur l'Homme, II. p. 44.

per cent.), and for girls, $\frac{1}{4}$ (4.17 per cent.), of the gross weight. This difference is, perhaps, to be in part accounted for by the fact that the pupils whose clothes were weighed were probably rather better clothed than the average children of the same age; for it was, of course, impossible to obtain, by the method adopted, any data from the poorest classes of the population, owing to their lack of an intelligent interest in the matter.

SUMMARY OF RESULTS.

The most important results of the foregoing investigation may be enumerated as follows:—

I. The growth of children takes place in such a way that until the age of eleven or twelve years, boys are both taller and heavier than girls of the same age. At this period of life girls begin to grow very rapidly, and for the next two or three years surpass boys of the same age in both height and weight. Boys then acquire and retain a size superior to that of girls who have now nearly completed their full growth. This statement is based upon observations on several different races and in various conditions of life.

II. Children of American-born parents are, in this community, taller and heavier than children of foreign-born parents, a superiority which seems to depend partly on the greater average comfort in which such children live and grow up, and partly upon differences of race or stock.

III. Pupils of American parentage at the public Latin School, private Latin School, and Massachusetts Institute of Technology are (apparently for similar reasons) superior in height and weight to the generality of boys of American parentage attending the public schools.

IV. Pupils of the same selected schools are also taller and heavier than English boys of the non-laboring classes attending public schools and universities, the superiority in weight being, as a rule, more marked than that in height.

V. The relation of weight to height in growing children is such that at heights below 58 inches, boys are heavier than girls in proportion to their stature. At heights above 58 inches the reverse is the case.

CONCLUSION.

Both the number and the value of the conclusions arrived at in this investigation are diminished by the lack of similar collections of statistics in other communities with which a comparison may be made. This being the case, the following brief enumeration of the points to which the attention of the collector of vital statistics may profitably be directed, will, perhaps, not be considered out of place:—

I. *The influence of geographical and climatic conditions on the size of growing children.*—It has been shown by the researches of Dr. Gould and Dr. Baxter, that the size of adult native Americans is very different in different States of the Union, and even in different parts of the same State. It would be interesting to determine by observations on children how early in life this difference becomes apparent.

II. *The number of generations necessary for the complete development of the influence of changed climatic conditions on the rate of growth of a given race.*—It has already been shown (see p. 27) that this influence apparently begins to be felt in the first generation, and it would be of interest to trace the accumulating effect through successive generations by means of inquiries as to the ancestry of the individuals measured. This could most readily be accomplished in those Western communities which consist almost exclusively of emigrants (and their descendants) from some limited region of the Old World.

III. *The effect (if any exists) of the season of the year on the rate of growth.*—This would be readily ascertained by successive spring and autumn observations on growing children; and it is in recording measurements of this sort that fathers of families and all others having charge of children have it in their power to contribute most efficiently to the solution of anthropometrical and ethnological questions.

IV. *The comparative effect of city and of country life on the rate of growth.*—In investigating this subject, the effect of climatic influences must be eliminated by restricting the comparison to cities and the *adjacent* country, and regard must be

paid to the race or stock and to the social condition of the individuals selected for comparison.

V. *The relation between diseases and the rate of growth.*—For example, it would be interesting to inquire whether, in the rapid growth which is said to follow certain diseases, especially fevers, the height and weight increase in their normal ratio; whether this accelerated growth *after* the disease is simply a compensation for a retardation *during* the disease; whether abnormally rapid growth causes a predisposition to disease, and whether any connection can be traced between the rate of growth and the frequency with which certain diseases of growing children (*e. g.*, chorea) occur at different ages.

VI. *The effect of local hygienic conditions on the physique of growing children.*—Since comfort and misery appear to have such a direct effect upon the size of growing children, it seems not improbable that a systematic comparative study of the physique of the growing population in different localities will throw light upon the relative sanitary conditions there prevalent.

It will thus be seen that a wide field is open for statistical research, in which nearly every one can do good work. The collection of physical data in regard to the human body has been, in the past, left almost exclusively in the hands of artists, who have sought to establish, as guides for their work, simple proportions between the various dimensions of the body, and of military statisticians, who have looked upon the human frame simply as a machine for performing a soldier's work, and have necessarily confined their observations to adult males. It is to be hoped that in the future the hygienist and the educator will recognize, in the physical measurements of growing children, a guide for the application of their sanitary regulations and a test for the efficiency of their systems of physical training.

APPENDIX.

By the kindness of President Runkle of the Massachusetts Institute of Technology, the writer is enabled to present formulas which express the relation between the weight and height of growing children, from five to eighteen years of age, with considerable accuracy.*

The figures of Tables Nos. 23 and 24, showing the weights corresponding to each inch of height in the whole number of observations were placed by President Runkle in the hands of Professor Gaetano Lanza, who kindly subjected them to a mathematical discussion, and reported on the subject substantially as follows:—

The results of Dr. Bowditch's observations on the relation between the weight and height of boys from 42 to 66 inches inclusive, are very fairly represented by the following empirical equation:—

Let y = weight in lbs., and x = height in inches; then

$$\log. y = 0.02007x + 0.77724, \text{ or } y = 10^{0.02007x + 0.77724}. \quad (\text{A})$$

The results of the observations on the relation between the weight and height of girls from 42 to 61 inches inclusive, are represented with tolerable accuracy by the following empirical equation:—

Let y = weight in lbs., and x = height in inches; then

$$\log. y = 0.02164x + 0.69017, \text{ or } y = 10^{0.02164x + 0.69017}. \quad (\text{B})$$

The greatest difference between calculated and observed values is, in the case of boys, 0.65 lb., and in that of girls, 1.41 lbs., with one exception, where it is 3.01 lbs.

The equations

$$y = 0.002428x^{2.59} \quad (\text{A}^1)$$

for the boys, and

$$y = 0.001277x^{2.75} \quad (\text{B}^1)$$

for the girls, represent quite roughly the results.

The following table, embodying the results of Professor Lanza's discussion, shows at a glance the superior accuracy of the logarithmic equations (A) and (B), as compared with the exponential equations (A¹) and (B¹).

* For older as well as for younger children, the formulas are obviously much less accurate.

TABLE No. 26.

Showing the agreement between the observed weights corresponding to each inch of height, and those calculated by the equations A, A¹, B, and B¹.

| HEIGHT, in Inches. | BOYS—WEIGHT IN POUNDS. | | | | | GIRLS—WEIGHT IN POUNDS. | | | | |
|--------------------|------------------------|-------------|-------------|-----------------------|-------------|-------------------------|-------------|-------------|-----------------------|-------------|
| | Observed. | CALCULATED. | | | | Observed. | CALCULATED. | | | |
| | | By (A). | Correction. | By (A ¹). | Correction. | | By (B). | Correction. | By (B ¹). | Correction. |
| 42, . | 41.77 | 41.71 | +0.06 | 38.84 | +2.93 | 40.89 | 39.72 | +1.17 | 37.16 | +3.73 |
| 43, . | 43.60 | 43.68 | -0.08 | 41.28 | +2.32 | 42.62 | 41.75 | +0.87 | 39.65 | +2.97 |
| 44, . | 45.63 | 45.74 | -0.11 | 43.82 | +1.81 | 44.53 | 43.89 | +0.64 | 42.23 | +2.30 |
| 45, . | 47.58 | 47.91 | -0.36 | 46.44 | +1.11 | 46.45 | 46.13 | +0.32 | 44.92 | +1.53 |
| 46, . | 49.65 | 50.17 | -0.52 | 49.16 | +0.49 | 48.51 | 48.49 | +0.02 | 47.72 | +0.79 |
| 47, . | 52.07 | 52.55 | -0.48 | 51.98 | +0.09 | 50.71 | 50.96 | -0.25 | 50.63 | +0.08 |
| 48, . | 54.57 | 55.03 | -0.46 | 54.89 | -0.32 | 53.19 | 53.57 | -0.38 | 53.65 | -0.46 |
| 49, . | 57.31 | 57.63 | -0.32 | 57.90 | -0.59 | 56.06 | 56.30 | -0.24 | 56.78 | -0.71 |
| 50, . | 60.20 | 60.35 | -0.15 | 61.01 | -0.81 | 58.75 | 59.18 | -0.43 | 60.02 | -1.27 |
| 51, . | 63.23 | 63.21 | +0.02 | 64.22 | -0.99 | 61.39 | 62.20 | -0.81 | 63.38 | -1.99 |
| 52, . | 66.27 | 66.20 | +0.07 | 67.53 | -1.26 | 64.36 | 65.38 | -1.02 | 66.86 | -2.50 |
| 53, . | 69.20 | 69.34 | -0.14 | 70.95 | -1.75 | 67.54 | 68.72 | -1.18 | 70.46 | -2.92 |
| 54, . | 72.73 | 72.61 | +0.12 | 74.47 | -1.74 | 71.01 | 72.23 | -1.22 | 74.17 | -3.16 |
| 55, . | 76.44 | 76.05 | +0.39 | 78.09 | -1.65 | 74.90 | 75.92 | -1.02 | 78.01 | -3.11 |
| 56, . | 80.24 | 79.65 | +0.59 | 81.83 | -1.59 | 78.82 | 79.80 | -0.98 | 81.97 | -3.15 |
| 57, . | 84.04 | 83.41 | +0.63 | 85.66 | -1.22 | 83.38 | 83.88 | -0.50 | 86.06 | -2.68 |
| 58, . | 87.86 | 87.36 | +0.50 | 89.61 | -1.75 | 87.92 | 88.16 | -0.24 | 90.28 | -2.56 |
| 59, . | 91.58 | 91.48 | +0.10 | 93.67 | -2.09 | 93.29 | 92.67 | +0.62 | 94.62 | -1.33 |
| 60, . | 95.51 | 95.82 | -0.31 | 97.83 | -2.32 | 98.81 | 97.40 | +1.41 | 99.10 | -0.29 |
| 61, . | 100.54 | 100.35 | +0.19 | 102.11 | -1.57 | 105.39 | 102.38 | +3.01 | 103.70 | +1.69 |
| 62, . | 105.63 | 105.09 | +0.54 | 106.50 | -0.87 | - | - | - | - | - |
| 63, . | 110.71 | 110.06 | +0.65 | 111.01 | -0.30 | - | - | - | - | - |
| 64, . | 115.86 | 116.27 | +0.59 | 115.63 | +0.23 | - | - | - | - | - |
| 65, . | 121.01 | 120.72 | +0.29 | 120.37 | +0.64 | - | - | - | - | - |
| 66, . | 126.61 | 126.43 | +0.18 | 125.23 | +1.38 | - | - | - | - | - |

TABLE No. 1 (Continued).—Showing Average Heights and Weights of Boston School Boys.
AVERAGE HEIGHTS (without shoes).

| AGE AT LAST BIRTHDAY. | GERMAN. | | | | PARENTAGE. | | | | TOTALS. | |
|-----------------------|-------------|---------|----------------------|-------------|----------------------|--------------|-------------|---------|---------|--------------|
| | GERMAN. | | ONE OR BOTH ENGLISH. | | ONE OR BOTH ENGLISH. | | TOTALS. | | Inches. | Centimeters. |
| | No. of Obs. | Inches. | Centimeters. | No. of Obs. | Inches. | Centimeters. | No. of Obs. | Inches. | | |
| Five, . . . | 48 | 41.08 | 104.3 | 75 | 41.40 | 105.2 | 848 | 41.57 | 105.6 | |
| Six, . . . | 71 | 43.50 | 110.5 | 99 | 43.64 | 110.9 | 1,258 | 43.75 | 111.1 | |
| Seven, . . . | 87 | 45.25 | 114.1 | 118 | 45.00 | 115.8 | 1,419 | 45.74 | 116.2 | |
| Eight, . . . | 84 | 47.13 | 119.7 | 136 | 47.50 | 120.7 | 1,481 | 47.76 | 121.3 | |
| Nine, . . . | 87 | 48.85 | 124.1 | 130 | 49.39 | 125.4 | 1,437 | 49.69 | 126.2 | |
| Ten, . . . | 75 | 51.21 | 130.1 | 105 | 51.62 | 131.2 | 1,363 | 51.68 | 131.3 | |
| Eleven, . . . | 91 | 52.92 | 134.4 | 93 | 52.81 | 134.1 | 1,293 | 53.33 | 135.4 | |
| Twelve, . . . | 76 | 54.55 | 138.6 | 101 | 54.89 | 139.4 | 1,253 | 55.11 | 140.0 | |
| Thirteen, . . . | 53 | 56.70 | 144.0 | 84 | 56.76 | 144.2 | 1,160 | 57.21 | 145.3 | |
| Fourteen, . . . | 38 | 59.14 | 151.2 | 47 | 59.40 | 150.9 | 908 | 59.88 | 152.1 | |
| Fifteen, . . . | 26 | 62.06 | 157.6 | 51 | 61.48 | 156.2 | 636 | 62.30 | 158.2 | |
| Sixteen, . . . | 7 | 64.75 | 164.4 | 27 | 63.88 | 162.2 | 359 | 65.00 | 165.1 | |
| Seventeen, . . . | 7 | | | 84 | 192 | 66.16 | 168.0 | | | |
| Eighteen, . . . | 2 | | | | | | | | 169.3 | |
| Totals, . . . | 752 | | | 1,061 | | | 13,691 | | | |

TABLE No. 1 (Continued).—*Showing Average Heights and Weights of Boston School Boys.*
 AVERAGE WEIGHTS (in ordinary dress).

| AGE AT LAST BIRTHDAY. | P A R E N T A G E . | | | | | | | | |
|-----------------------|---------------------|---------|------------|-------------|---------|------------|---------------------|---------|------------|
| | AMERICAN. | | | IRISH. | | | AMERICAN AND IRISH. | | |
| | No. of Obs. | Pounds. | Kilograms. | No. of Obs. | Pounds. | Kilograms. | No. of Obs. | Pounds. | Kilograms. |
| Five, . . . | 201 | 41.20 | 18.71 | 366 | 41.33 | 18.75 | 42 | 41.99 | 19.05 |
| Six, . . . | 342 | 45.14 | 20.48 | 503 | 45.25 | 20.52 | 65 | 44.73 | 20.29 |
| Seven, . . . | 369 | 49.47 | 22.44 | 562 | 48.90 | 22.19 | 77 | 49.08 | 22.26 |
| Eight, . . . | 407 | 54.43 | 24.70 | 588 | 54.12 | 24.55 | 66 | 52.86 | 23.97 |
| Nine, . . . | 381 | 59.97 | 26.58 | 556 | 58.92 | 26.73 | 67 | 57.27 | 25.97 |
| Ten, . . . | 360 | 66.62 | 30.22 | 571 | 64.99 | 29.48 | 56 | 64.57 | 29.29 |
| Eleven, . . . | 350 | 72.39 | 32.83 | 548 | 69.00 | 31.56 | 55 | 70.34 | 31.91 |
| Twelve, . . . | 373 | 79.82 | 36.21 | 497 | 75.70 | 34.34 | 53 | 75.66 | 34.32 |
| Thirteen, . . . | 391 | 83.26 | 40.04 | 463 | 82.84 | 37.58 | 45 | 81.42 | 36.93 |
| Fourteen, . . . | 386 | 99.28 | 45.03 | 334 | 91.19 | 41.36 | 22 | 91.89 | 41.68 |
| Fifteen, . . . | 342 | 110.84 | 50.26 | 155 | 101.21 | 45.90 | 16 | 107.91 | 48.96 |
| Sixteen, . . . | 232 | 123.67 | 56.09 | 61 | 112.88 | 51.19 | 6 | | |
| Seventeen, . . . | 128 | 128.72 | 58.40 | 26 | 127.40 | 57.80 | 5 | 570 | |
| Eighteen, . . . | 65 | 132.71 | 60.20 | 5 | | | | | |
| Totals, . . . | 4,327 | | | 5,235 | | | | | |

TABLE No. 1 (Concluded).—Showing Average Heights and Weights of Boston School Boys.
AVERAGE WEIGHTS (in ordinary dress).

| AGE AT LAST BIRTHDAY. | PARENTAGE. | | | | | | | | | |
|-----------------------|-------------|---------|----------------------|-------------|---------|------------|-------------|---------|------------|--|
| | GERMAN. | | ONE OR BOTH ENGLISH. | | | | TOTALS. | | | |
| | No. of Obs. | Pounds. | Kilograms. | No. of Obs. | Pounds. | Kilograms. | No. of Obs. | Pounds. | Kilograms. | |
| Five, . . . | 48 | 40.57 | 18.39 | 75 | 40.07 | 18.18 | 848 | 41.09 | 18.64 | |
| Six, . . . | 71 | 44.09 | 20.01 | 99 | 45.03 | 20.48 | 1,258 | 45.17 | 20.49 | |
| Seven, . . . | 87 | 49.12 | 22.29 | 113 | 48.20 | 21.86 | 1,419 | 49.07 | 22.26 | |
| Eight, . . . | 84 | 52.94 | 24.02 | 136 | 53.21 | 24.14 | 1,481 | 53.92 | 24.46 | |
| Nine, . . . | 87 | 58.25 | 26.43 | 130 | 58.57 | 26.58 | 1,437 | 59.23 | 26.87 | |
| Ten, . . . | 75 | 63.93 | 29.00 | 105 | 65.06 | 29.51 | 1,363 | 65.30 | 29.62 | |
| Eleven, . . . | 91 | 69.09 | 31.34 | 93 | 67.11 | 30.44 | 1,293 | 70.18 | 31.84 | |
| Twelve, . . . | 76 | 75.70 | 34.34 | 101 | 75.39 | 34.20* | 1,253 | 76.92 | 34.89 | |
| Thirteen, . . . | 53 | 83.85 | 38.04 | 84 | 84.72 | 38.44 | 1,160 | 84.84 | 38.49 | |
| Fourteen, . . . | 38 | 92.87 | 42.12 | 47 | 92.72 | 42.07 | 908 | 94.91 | 42.95 | |
| Fifteen, . . . | 26 | 107.53 | 48.80 | 51 | 101.21 | 45.90 | 636 | 107.10 | 48.59 | |
| Sixteen, . . . | 7 | 123.67 | 56.09 | 27 | 120.32 | 54.57 | 359 | 121.01 | 54.90 | |
| Seventeen, . . . | 7 | | | 192 | 127.49 | 57.84 | | | | |
| Eighteen, . . . | 2 | | | 84 | 132.55 | 60.13 | | | | |
| Totals, . . . | 752 | | | 1,061 | | | 13,691 | | | |

TABLE No. 2.—Showing Average Heights and Weights of Boston School Girls.
AVERAGE HEIGHTS (without shoes).

| AGE AT LAST BIRTHDAY. | PARENTAGE. | | | | | | | | | |
|-----------------------|-------------|---------|--------------|-------------|---------|--------------|---------------------|---------|--------------|--|
| | AMERICAN. | | | IRISH. | | | AMERICAN AND IRISH. | | | |
| | No. of Obs. | Inches. | Centimeters. | No. of Obs. | Inches. | Centimeters. | No. of Obs. | Inches. | Centimeters. | |
| Five, . . . | 127 | 41.47 | 105.3 | 236 | 41.18 | 104.6 | 29 | 41.42 | 105.2 | |
| Six, . . . | 236 | 43.66 | 110.9 | 395 | 43.29 | 109.9 | 43 | 43.18 | 109.6 | |
| Seven, . . . | 346 | 45.94 | 116.7 | 426 | 45.45 | 115.4 | 53 | 45.69 | 116.0 | |
| Eight, . . . | 338 | 48.07 | 122.1 | 486 | 47.39 | 120.4 | 59 | 47.40 | 120.4 | |
| Nine, . . . | 323 | 49.61 | 126.0 | 416 | 49.27 | 125.2 | 48 | 48.77 | 123.9 | |
| Ten, . . . | 336 | 51.78 | 131.5 | 379 | 51.20 | 130.1 | 51 | 51.17 | 129.9 | |
| Eleven, . . . | 290 | 53.79 | 136.6 | 340 | 53.13 | 134.9 | 36 | 53.51 | 135.9 | |
| Twelve, . . . | 309 | 57.16 | 145.2 | 307 | 55.41 | 140.8 | 28 | 54.91 | 139.5 | |
| Thirteen, . . . | 307 | 58.75 | 149.2 | 278 | 57.64 | 146.3 | 28 | 57.81 | 146.8 | |
| Fourteen, . . . | 290 | 60.32 | 153.2 | 192 | 59.67 | 151.5 | 23 | 59.44 | 151.0 | |
| Fifteen, . . . | 255 | 61.39 | 155.9 | 95 | 60.47 | 153.5 | 11 | } 61.07 | 155.0 | |
| Sixteen, . . . | 238 | 61.72 | 156.7 | 49 | 61.05 | 155.1 | 9 | | | |
| Seventeen, . . . | 168 | 61.99 | 157.4 | 18 | } 62.00 | 157.5 | 418 | | | |
| Eighteen, . . . | 118 | 62.01 | 157.5 | 6 | | | | | | |
| Totals, . . . | 3,681 | | | 3,623 | | | | | | |

TABLE No. 2 (Continued).—Showing Average Heights and Weights of Boston School Girls.
AVERAGE HEIGHTS (without shoes).

| AGE AT LAST BIRTHDAY. | P A R E N T A G E . | | | | | | TOTALS. | | | |
|-----------------------|---------------------|---------|----------------------|-------------|-------------|---------|--------------|-------------|---------|--------------|
| | GERMAN. | | ONE OR BOTH ENGLISH. | | No. of Obs. | Inches. | Centimeters. | No. of Obs. | Inches. | Centimeters. |
| | No. of Obs. | Inches. | Centimeters. | No. of Obs. | | | | | | |
| Five, . . . | 50 | 41.40 | 105.1 | 75 | 41.14 | 104.5 | 605 | 41.29 | 104.9 | |
| Six, . . . | 66 | 43.09 | 109.4 | 98 | 43.32 | 110.0 | 987 | 43.35 | 110.1 | |
| Seven, . . . | 82 | 44.91 | 114.0 | 104 | 44.81 | 113.8 | 1,199 | 45.52 | 115.6 | |
| Eight, . . . | 75 | 47.15 | 119.7 | 117 | 47.63 | 121.0 | 1,299 | 47.58 | 120.9 | |
| Nine, . . . | 76 | 49.20 | 125.0 | 96 | 49.37 | 125.4 | 1,149 | 49.37 | 125.4 | |
| Ten, . . . | 57 | 50.76 | 128.9 | 112 | 50.98 | 129.5 | 1,089 | 51.34 | 130.4 | |
| Eleven, . . . | 57 | 52.62 | 133.9 | 88 | 53.63 | 136.2 | 936 | 53.42 | 135.7 | |
| Twelve, . . . | 53 | 54.73 | 139.0 | 89 | 55.89 | 141.9 | 935 | 55.88 | 141.9 | |
| Thirteen, . . . | 31 | 57.82 | 146.8 | 69 | 57.71 | 146.6 | 880 | 58.16 | 147.7 | |
| Fourteen, . . . | 28 | 58.55 | 148.7 | 56 | 60.15 | 152.8 | 675 | 59.94 | 152.3 | |
| Fifteen, . . . | 10 | 59.81 | 151.9 | 48 | 60.93 | 154.7 | 459 | 61.10 | 155.2 | |
| Sixteen, . . . | 4 | | | 62.17 | 157.9 | 358 | 61.59 | 156.4 | | |
| Seventeen, . . . | 1 | | | 27 | | | 233 | 61.92 | 157.2 | |
| Eighteen, . . . | | | | | | | 155 | 61.95 | 157.3 | |
| Totals, . . . | 585 | | | 979 | | | 10,904 | | | |

TABLE No. 3.—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.
BOYS.

| AGE.* | PARENTAGE. | | | | | | | | | | | |
|------------|------------------|-----------------|--------|------------------|------------------|-----------------|--------|------------------|---------------------|-----------------|--------|------------------|
| | AMERICAN. | | | | IRISH. | | | | AMERICAN AND IRISH. | | | |
| | Annual Increase. | | | Pounds per inch. | Annual Increase. | | | Pounds per inch. | Annual Increase. | | | Pounds per inch. |
| | Height, inches. | Weight, pounds. | Ratio. | | Height, inches. | Weight, pounds. | Ratio. | | Height, inches. | Weight, pounds. | Ratio. | |
| Five, | 2.36 | 3.94 | .987 | 2.15 | 3.92 | .993 | 1.40 | 2.74 | .996 | | | |
| Six, | 2.11 | 4.53 | 1.070 | 1.87 | 3.65 | 1.034 | 2.12 | 4.35 | 1.074 | | | |
| Seven, | 1.95 | 4.96 | 1.130 | 2.11 | 5.22 | 1.134 | 1.85 | 3.78 | 1.112 | | | |
| Eight, | 1.93 | 5.54 | 1.197 | 1.81 | 4.80 | 1.189 | 1.77 | 4.41 | 1.161 | | | |
| Nine, | 2.12 | 6.65 | 1.276 | 2.04 | 6.07 | 1.260 | 2.05 | 7.30 | 1.257 | | | |
| Ten, | 1.80 | 5.77 | 1.840 | 1.53 | 4.61 | 1.310 | 1.98 | 5.77 | 1.319 | | | |
| Eleven, | 1.77 | 7.43 | 1.431 | 1.72 | 6.10 | 1.381 | 1.80 | 5.32 | 1.372 | | | |
| Twelve, | 2.39 | 8.44 | 1.517 | 1.88 | 7.14 | 1.461 | 1.56 | 5.76 | 1.436 | | | |
| Thirteen, | 2.91 | 11.02 | 1.625 | 2.18 | 8.35 | 1.548 | 2.59 | 10.47 | 1.550 | | | |
| Fourteen, | 1.88 | 11.56 | 1.760 | 2.27 | 10.02 | 1.655 | | | | | | |
| Fifteen, | 2.62 | 12.83 | 1.885 | 2.94 | 11.67 | 1.761 | | | | | | |
| Sixteen, | .71 | 5.05 | 1.941 | | | | | | | | | |
| Seventeen, | .47 | 3.99 | 1.988 | | | | | | | | | |
| Eighteen, | | | | | | | | | | | | |

* See foot-note, p. 9.

TABLE No. 3 (Continued).—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.

BOYS.

| A G E . * | P A R E N T A G E . | | | | | | | | | | | |
|----------------------|-------------------------------|-----------------|-----------------|-----------------------------|-------------------------------|-----------------------------------|-----------------|-----------------------------|-------------------------------|--|-----------------------------|--|
| | G E R M A N . | | | | | O N E O R B O T H E N G L I S H . | | | | | T O T A L S . | |
| | A n n u a l I n c r e a s e . | | | P o u n d s p e r I n c h . | A n n u a l I n c r e a s e . | | | P o u n d s p e r I n c h . | A n n u a l I n c r e a s e . | | P o u n d s p e r I n c h . | |
| | Height, inches. | Weight, pounds. | Height, inches. | | Weight, pounds. | Height, inches. | Weight, pounds. | | | | | |
| Five, | 2.42 | 3.52 | .987 | 2.24 | 4.96 | .967 | 2.18 | 4.08 | .988 | | | |
| Six, | 1.75 | 5.03 | 1.013 | 1.96 | 3.17 | 1.031 | 1.99 | 3.90 | 1.032 | | | |
| Seven, | 1.88 | 3.82 | 1.085 | 1.90 | 5.01 | 1.057 | 2.02 | 4.85 | 1.072 | | | |
| Eight, | 1.72 | 5.31 | 1.123 | 1.89 | 5.96 | 1.119 | 1.93 | 5.31 | 1.129 | | | |
| Nine, | 2.36 | 5.68 | 1.192 | 2.23 | 6.49 | 1.185 | 1.99 | 6.07 | 1.191 | | | |
| Ten, | 1.71 | 5.16 | 1.248 | 1.19 | 2.05 | 1.260 | 1.65 | 4.88 | 1.263 | | | |
| Eleven, | 1.63 | 6.61 | 1.305 | 2.08 | 8.28 | 1.270 | 1.78 | 6.74 | 1.315 | | | |
| Twelve, | 2.15 | 8.15 | 1.388 | 1.87 | 9.33 | 1.373 | 2.10 | 7.92 | 1.395 | | | |
| Thirteen, | 2.44 | 9.02 | 1.477 | 2.64 | 8.00 | 1.492 | 2.67 | 10.07 | 1.482 | | | |
| Fourteen, | 2.92 | 14.65 | 1.570 | 2.08 | 8.49 | 1.561 | 2.42 | 12.19 | 1.585 | | | |
| Fifteen, | | | 1.732 | 2.40 | 19.11 | 1.646 | 2.70 | 13.91 | 1.719 | | | |
| Sixteen, | | | 1.952 | | | 1.883 | 1.16 | 6.48 | 1.861 | | | |
| Seventeen, | | | | | | | .50 | 5.06 | 1.927 | | | |
| Eighteen, | | | | | | | | | 1.988 | | | |

* See foot-note, p. 9.

TABLE NO. 3 (Continued).—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.

GIRLS.

| AGE.* | PARENTAGE. | | | | | | | | | |
|----------------------|------------------|-----------------|-----------------|------------------|------------------|-----------------|-----------------|------------------|---------------------|--|
| | AMERICAN. | | | | IRISH. | | | | AMERICAN AND IRISH. | |
| | Annual Increase. | | | Pounds per inch. | Annual Increase. | | | Pounds per inch. | Annual Increase. | |
| | Height, inches. | Weight, pounds. | Height, inches. | | Weight, pounds. | Height, inches. | Weight, pounds. | | | |
| Five, | 2.19 | 3.99 | .960 | 2.11 | 3.58 | .962 | 1.76 | 2.43 | .980 | |
| Six, | 2.28 | 4.21 | 1.003 | 2.16 | 4.43 | .998 | 2.51 | 4.26 | .996 | |
| Seven, | 2.13 | 4.91 | 1.045 | 1.94 | 4.16 | 1.048 | 1.71 | 3.89 | 1.034 | |
| Eight, | 1.54 | 4.59 | 1.101 | 1.88 | 4.96 | 1.093 | 1.37 | 3.49 | 1.079 | |
| Nine, | 2.17 | 6.57 | 1.159 | 1.93 | 4.83 | 1.152 | 2.40 | 6.51 | 1.120 | |
| Ten, | 2.01 | 6.17 | 1.237 | 1.93 | 6.24 | 1.203 | 2.34 | 6.85 | 1.195 | |
| Eleven, | 3.37 | 11.09 | 1.306 | 2.28 | 8.32 | 1.276 | 1.40 | 6.53 | 1.271 | |
| Twelve, | 1.59 | 9.83 | 1.423 | 2.23 | 9.61 | 1.374 | 1.40 | 6.53 | 1.357 | |
| Thirteen, | 1.57 | 9.14 | 1.552 | 2.03 | 10.60 | 1.487 | 2.90 | 11.34 | 1.486 | |
| Fourteen, | 1.07 | 8.10 | 1.663 | .80 | 4.10 | 1.614 | 1.63 | 11.94 | 1.645 | |
| Fifteen, | .33 | 4.55 | 1.766 | .58 | 8.10 | 1.661 | | | | |
| Sixteen, | .27 | 2.87 | 1.830 | | | 1.778 | | | | |
| Seventeen, | .02 | — .04 | 1.869 | | | 1.870 | | | | |
| Eighteen, | | | 1.867 | | | | | | | |

* See foot-note, p. 9.

TABLE No. 3 (Concluded).—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.
GIRLS.

| A G E.* | P A R E N T A G E. | | | | | | | | | | | |
|--------------|--------------------|-----------------|-----------------|------------------|------------------|----------------------|-----------------|------------------|------------------|--|------------------|--|
| | GEMMEX. | | | | | ONE OR BOTH ENGLISH. | | | | | TOTALS. | |
| | Annual Increase. | | | Pounds per inch. | Annual Increase. | | | Pounds per inch. | Annual Increase. | | Pounds per inch. | |
| | Height, inches. | Weight, pounds. | Height, inches. | | Weight, pounds. | Height, inches. | Weight, pounds. | | | | | |
| Five, | | | .959 | 2.18 | 4.21 | .947 | 2.06 | 3.62 | .965 | | | |
| Six, . | 1.69 | 2.95 | .990 | 2.18 | 4.21 | .998 | 2.06 | 3.62 | .998 | | | |
| Seven, . | 1.82 | 3.58 | 1.030 | 1.49 | 3.00 | 1.032 | 2.17 | 4.18 | 1.042 | | | |
| Eight, . | 2.24 | 4.34 | 1.073 | 2.82 | 6.19 | 1.101 | 2.06 | 4.58 | 1.093 | | | |
| Nine, . | 2.05 | 6.77 | 1.166 | 1.74 | 3.51 | 1.133 | 1.79 | 5.03 | 1.156 | | | |
| Ten, . | 1.56 | 2.46 | 1.178 | 1.61 | 5.02 | 1.197 | 1.97 | 5.28 | 1.214 | | | |
| Eleven, . | 1.86 | 7.73 | 1.284 | 2.65 | 8.80 | 1.301 | 2.08 | 6.49 | 1.288 | | | |
| Twelve, . | 2.11 | 8.50 | 1.393 | 2.26 | 7.46 | 1.382 | 2.46 | 9.47 | 1.401 | | | |
| Thirteen, . | 3.09 | 9.76 | 1.484 | 1.82 | 9.14 | 1.497 | 2.28 | 10.34 | 1.524 | | | |
| Fourteen, . | .73 | 3.09 | 1.518 | 2.44 | 12.85 | 1.641 | 1.78 | 9.78 | 1.642 | | | |
| Fifteen, . | | | | .78 | 6.80 | 1.732 | 1.16 | 7.65 | 1.736 | | | |
| Sixteen, . | | | 1.691 | 1.24 | 6.41 | 1.800 | .49 | 5.95 | 1.819 | | | |
| Seventeen, . | | | | | | | .93 | 3.50 | 1.865 | | | |
| Eighteen, . | | | | | | | .03 | — .37 | 1.859 | | | |

* See foot-note, p. 9.

TABLE No. 5.—Showing Heights of Boston School Boys of American

AGE AT LAST BIRTHDAY.

| cent. | 9 Yrs. | | 10 Yrs. | | 11 Yrs. | | 12 Yrs. | | 13 Yrs. | |
|-------|--------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|
| | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. |
| 74,- | - | - | - | - | - | - | - | - | - | - |
| 73,- | - | - | - | - | - | - | - | - | - | - |
| 72,- | - | - | - | - | - | - | - | - | - | - |
| 71,- | - | - | - | - | - | - | - | - | - | - |
| 70,- | - | - | - | - | - | - | - | - | - | - |
| 69,- | - | - | - | - | - | - | - | - | - | - |
| 68,- | - | - | - | - | - | - | - | - | 1 | .26 |
| 67,- | - | - | - | - | - | - | - | - | 3 | .77 |
| 66,- | - | - | - | - | - | - | - | - | 1 | .26 |
| 65,- | - | - | - | - | - | - | - | - | 6 | 1.53 |
| 64,- | - | - | - | - | - | - | 1 | .27 | 4 | 1.02 |
| 63,- | - | - | - | - | 1 | .29 | 3 | .80 | 13 | 3.33 |
| 62,- | - | - | - | - | - | - | 6 | 1.61 | 18 | 4.60 |
| 61,- | - | - | - | - | 1 | .29 | 4 | 1.07 | 30 | 7.67 |
| 60,- | - | - | - | - | 2 | .57 | 16 | 4.29 | 32 | 8.18 |
| 59,- | - | - | - | - | 5 | 1.43 | 23 | 6.17 | 46 | 11.74 |
| 58,- | - | - | 3 | .83 | 12 | 3.43 | 38 | 10.19 | 48 | 12.28 |
| 57,- | 1 | .26 | 5 | 1.39 | 19 | 5.43 | 28 | 7.51 | 44 | 11.25 |
| 56,- | 2 | .53 | 15 | 4.17 | 48 | 13.71 | 48 | 12.87 | 58 | 14.83 |
| 55.25 | 4 | 1.04 | 26 | 7.22 | 45 | 12.85 | 61 | 16.35 | 28 | 7.16 |
| 54.73 | 12 | 3.15 | 34 | 9.45 | 49 | 14.00 | 52 | 13.94 | 26 | 6.65 |
| 53.22 | 21 | 5.51 | 45 | 12.47 | 46 | 13.14 | 40 | 10.72 | 20 | 5.12 |
| 52.45 | 34 | 8.92 | 68 | 18.89 | 53 | 15.14 | 24 | 6.43 | 4 | 1.02 |
| 51.16 | 54 | 14.17 | 57 | 15.83 | 28 | 8.00 | 20 | 5.36 | 5 | 1.28 |
| 50.81 | 67 | 17.59 | 44 | 12.22 | 25 | 7.14 | 4 | 1.07 | 2 | .51 |
| 49.19 | 75 | 19.69 | 44 | 12.22 | 11 | 3.14 | 2 | .53 | 1 | .26 |
| 48.43 | 50 | 13.12 | 11 | 3.06 | 3 | .85 | 2 | .53 | - | - |
| 47.71 | 41 | 10.76 | 6 | 1.67 | - | - | 1 | .27 | 1 | .26 |
| 46.29 | 12 | 3.15 | - | - | 1 | .29 | - | - | - | - |
| 45.60 | 6 | 1.57 | - | - | 1 | .29 | - | - | - | - |
| 44.70 | 1 | .26 | 2 | .56 | - | - | - | - | - | - |
| 43.70 | - | - | - | - | - | - | - | - | - | - |
| 42,- | - | - | - | - | - | - | - | - | - | - |
| 41,- | 1 | .26 | - | - | - | - | - | - | - | - |
| 40.25 | - | - | - | - | - | - | - | - | - | - |
| 39,- | - | - | - | - | - | - | - | - | - | - |
| 38.25 | - | - | - | - | - | - | - | - | - | - |
| 37.25 | - | - | - | - | - | - | - | - | - | - |
| 36,- | - | - | - | - | - | - | - | - | - | - |
| 35,- | - | - | - | - | - | - | - | - | - | - |
| 34,- | - | - | - | - | - | - | - | - | - | - |
| 33,- | - | - | - | - | - | - | - | - | - | - |
| 32,- | - | - | - | - | - | - | - | - | - | - |
| 31,- | - | - | - | - | - | - | - | - | - | - |
| 30,- | - | - | - | - | - | - | - | - | - | - |
| | 381 | | 360 | | 350 | | 373 | | 391 | |

Parentage.

| 14 Yrs. | | 15 Yrs. | | 16 Yrs. | | 17 Yrs. | | 18 Yrs. | | INCHES. |
|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|
| No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | |
| - | - | 1 | .29 | - | - | 1 | .78 | - | - | . 74 |
| - | - | - | - | 1 | .43 | 1 | .78 | - | - | . 73 |
| - | - | - | - | 1 | .43 | 1 | .78 | - | - | . 72 |
| - | - | 1 | .29 | 1 | .43 | 3 | 2.34 | 3 | 4.61 | . 71 |
| - | - | 3 | .88 | 11 | 4.77 | 7 | 5.47 | 6 | 9.23 | . 70 |
| 6 | 1.56 | 4 | 1.17 | 11 | 4.77 | 8 | 6.25 | 3 | 4.62 | . 69 |
| 5 | 1.29 | 14 | 4.09 | 15 | 6.46 | 19 | 14.80 | 7 | 10.76 | . 68 |
| 12 | 3.11 | 19 | 5.56 | 38 | 16.38 | 13 | 10.16 | 11 | 16.92 | . 67 |
| 8 | 2.07 | 25 | 7.31 | 39 | 16.81 | 18 | 14.06 | 11 | 16.92 | . 66 |
| 20 | 5.18 | 37 | 10.82 | 29 | 12.41 | 21 | 16.41 | 12 | 18.46 | . 65 |
| 32 | 8.29 | 38 | 11.11 | 25 | 10.78 | 13 | 10.16 | 6 | 9.23 | . 64 |
| 32 | 8.29 | 35 | 10.23 | 20 | 8.62 | 7 | 5.47 | 3 | 4.62 | . 63 |
| 35 | 9.07 | 42 | 12.28 | 17 | 7.33 | 9 | 7.03 | 1 | 1.54 | . 62 |
| 34 | 8.81 | 26 | 7.60 | 11 | 4.77 | 2 | 1.56 | 1 | 1.54 | . 61 |
| 39 | 10.10 | 31 | 9.06 | 7 | 3.02 | 2 | 1.56 | 1 | 1.54 | . 60 |
| 42 | 10.88 | 29 | 8.48 | 5 | 2.15 | 2 | 1.56 | - | - | . 59 |
| 49 | 12.69 | 14 | 4.09 | - | - | - | - | - | - | . 58 |
| 27 | 6.99 | 6 | 1.75 | - | - | - | - | - | - | . 57 |
| 14 | 3.63 | 5 | 1.46 | 1 | .43 | - | - | - | - | . 56 |
| 11 | 2.84 | 5 | 1.46 | - | - | - | - | - | - | . 55 |
| 11 | 2.84 | 4 | 1.17 | - | - | 1 | .78 | - | - | . 54 |
| 6 | 1.56 | 2 | .58 | - | - | - | - | - | - | . 53 |
| - | - | 1 | .29 | - | - | - | - | - | - | . 52 |
| 1 | .26 | - | - | - | - | - | - | - | - | . 51 |
| 2 | .52 | - | - | - | - | - | - | - | - | . 50 |
| - | - | - | - | - | - | - | - | - | - | . 49 |
| - | - | - | - | - | - | - | - | - | - | . 48 |
| - | - | - | - | - | - | - | - | - | - | . 47 |
| - | - | - | - | - | - | - | - | - | - | . 46 |
| - | - | - | - | - | - | - | - | - | - | . 45 |
| - | - | - | - | - | - | - | - | - | - | . 44 |
| - | - | - | - | - | - | - | - | - | - | . 43 |
| - | - | - | - | - | - | - | - | - | - | . 42 |
| - | - | - | - | - | - | - | - | - | - | . 41 |
| - | - | - | - | - | - | - | - | - | - | . 40 |
| - | - | - | - | - | - | - | - | - | - | . 39 |
| - | - | - | - | - | - | - | - | - | - | . 38 |
| - | - | - | - | - | - | - | - | - | - | . 37 |
| - | - | - | - | - | - | - | - | - | - | . 36 |
| - | - | - | - | - | - | - | - | - | - | . 35 |
| - | - | - | - | - | - | - | - | - | - | . 34 |
| 386 | | 342 | | 232 | | 128 | | 65 | | |

Table 7.—Showing Weights of Boston School Boys. Whole Number of Observations

| AGE AT LAST BIRTHDAY. | | | | | | | | | | | |
|-----------------------|--------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|-------|
| Age | 9 Yrs. | | 10 Yrs. | | 11 Yrs. | | 12 Yrs. | | 13 Yrs. | | |
| | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | |
| 72 | - | - | - | - | - | - | - | - | - | - | |
| 71 | - | - | - | - | - | - | - | - | - | - | |
| 70 | - | - | - | - | - | - | - | - | - | - | |
| 69 | - | - | - | - | - | - | - | - | - | - | |
| 68 | - | - | - | - | - | - | - | - | - | - | |
| 67 | - | - | - | - | - | - | - | - | - | - | |
| 66 | - | - | - | - | - | - | - | - | - | - | |
| 65 | - | - | - | - | - | - | - | - | - | - | |
| 64 | - | - | - | - | - | - | - | - | - | - | |
| 63 | - | - | - | - | - | - | - | - | - | - | |
| 62 | - | - | - | - | - | - | - | - | - | - | |
| 61 | - | - | - | - | - | - | 1 | .08 | - | - | |
| 60 | - | - | - | - | - | - | - | - | 2 | .17 | |
| 59 | - | - | - | - | - | - | - | - | 1 | .09 | |
| 58 | - | - | - | - | - | - | 1 | .08 | 3 | .20 | |
| 57 | - | - | - | - | - | - | 1 | .08 | 1 | .09 | |
| 56 | - | - | - | - | - | - | - | - | 3 | .26 | |
| 55 | - | - | - | - | - | - | 2 | .16 | 3 | .26 | |
| 54 | - | - | - | - | - | - | 2 | .16 | 4 | .34 | |
| 53 | - | - | - | - | - | - | - | - | 5 | .43 | |
| 52 | - | - | - | - | - | - | 4 | .32 | 12 | 1.03 | |
| 51 | - | - | - | - | - | - | 5 | .40 | 15 | 1.29 | |
| 50 | - | - | 1 | .07 | - | - | 8 | .64 | 30 | 2.59 | |
| 49 | - | - | 2 | .15 | 3 | .23 | 12 | .96 | 41 | 3.53 | |
| 48 | - | - | - | - | 3 | .23 | 16 | 1.28 | 59 | 5.09 | |
| 47 | - | - | 1 | .07 | 13 | 1.00 | 32 | 2.55 | 60 | 5.17 | |
| 46 | - | 1 | .06 | 4 | .29 | 16 | 1.24 | 57 | 4.55 | 98 | 8.02 |
| 45 | - | 1 | .06 | 12 | .88 | 29 | 2.24 | 76 | 6.06 | 131 | 11.29 |
| 44 | .07 | 3 | .20 | 18 | 1.32 | 56 | 4.33 | 129 | 10.30 | 151 | 13.02 |
| 43 | .07 | 2 | .13 | 42 | 3.08 | 100 | 7.73 | 157 | 12.53 | 177 | 15.26 |
| 42 | .20 | 23 | 1.60 | 112 | 8.22 | 175 | 13.53 | 219 | 17.48 | 158 | 13.62 |
| 41 | .74 | 55 | 3.82 | 166 | 12.18 | 235 | 18.18 | 219 | 17.48 | 117 | 10.10 |
| 40 | 2.02 | 121 | 8.42 | 270 | 19.81 | 258 | 19.95 | 144 | 11.50 | 52 | 4.48 |
| 39 | 7.15 | 251 | 17.47 | 262 | 19.22 | 201 | 15.55 | 100 | 6.37 | 28 | 2.41 |
| 38 | 4.18 | 343 | 23.87 | 227 | 16.65 | 117 | 9.05 | 36 | 2.87 | 10 | .90 |
| 37 | 2.49 | 336 | 23.38 | 150 | 11.00 | 64 | 4.95 | 24 | 1.92 | 4 | .34 |
| 36 | 8.63 | 208 | 14.48 | 79 | 5.79 | 18 | 1.39 | 8 | .64 | - | - |
| 35 | 6.94 | 76 | 5.29 | 14 | 1.03 | 5 | .38 | - | - | - | - |
| 34 | 6.14 | 14 | .97 | 2 | .15 | - | - | - | - | - | - |
| 33 | 1.28 | 3 | .20 | 1 | .07 | - | - | - | - | - | - |
| 32 | .07 | - | - | - | - | - | - | - | - | - | - |
| 31 | - | - | - | - | - | - | - | - | - | - | - |
| 30 | - | - | - | - | - | - | - | - | - | - | - |
| | | 1,437 | | 1,363 | | 1,293 | | 1,253 | | 1,160 | |

ns, Irrespective of Nationality.

| | | | | | | | | | | POUNDS. |
|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|------------|
| 14 Yrs. | | 15 Yrs. | | 16 Yrs. | | 17 Yrs. | | 18 Yrs. | | |
| No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | |
| - | - | - | - | 1 | .28 | - | - | - | - | 194 to 198 |
| - | - | - | - | - | - | 2 | 1.04 | - | - | 190 to 194 |
| 1 | .11 | - | - | - | - | - | - | - | - | 186 to 190 |
| - | - | - | - | - | - | - | - | - | - | 182 to 186 |
| - | - | - | - | 1 | .28 | - | - | - | - | 178 to 182 |
| - | - | - | - | 1 | .28 | - | - | 1 | 1.19 | 174 to 178 |
| - | - | - | - | 2 | .56 | 1 | .52 | 1 | 1.19 | 170 to 174 |
| 1 | .11 | 1 | .16 | 1 | .28 | - | - | - | - | 166 to 170 |
| - | - | 1 | .16 | 3 | .83 | 2 | 1.04 | 1 | 1.19 | 162 to 166 |
| - | - | 1 | .16 | 1 | .28 | 3 | 1.56 | 1 | 1.19 | 158 to 162 |
| 1 | .11 | 1 | .16 | 1 | .28 | 4 | 2.08 | 1 | 1.19 | 154 to 158 |
| - | - | 4 | .63 | 1 | .28 | 8 | 4.16 | 2 | 2.38 | 150 to 154 |
| - | - | 2 | .31 | 12 | 3.34 | 3 | 1.58 | 2 | 2.38 | 146 to 150 |
| 1 | .11 | 14 | 2.20 | 12 | 3.34 | 9 | 4.68 | 8 | 9.52 | 142 to 146 |
| 5 | .55 | 12 | 1.88 | 16 | 4.45 | 21 | 10.93 | 9 | 10.71 | 138 to 142 |
| 9 | .99 | 13 | 2.04 | 18 | 5.01 | 15 | 7.81 | 12 | 14.29 | 134 to 138 |
| 9 | .99 | 20 | 3.14 | 24 | 6.68 | 16 | 8.33 | 7 | 8.33 | 130 to 134 |
| 14 | 1.54 | 26 | 4.09 | 31 | 8.63 | 14 | 7.29 | 11 | 13.10 | 126 to 130 |
| 15 | 1.65 | 30 | 4.72 | 50 | 13.92 | 19 | 9.90 | 11 | 13.10 | 122 to 126 |
| 26 | 2.86 | 37 | 5.82 | 29 | 8.08 | 22 | 11.45 | 6 | 7.14 | 118 to 122 |
| 35 | 3.85 | 44 | 6.92 | 37 | 10.31 | 18 | 9.38 | 5 | 5.95 | 114 to 118 |
| 34 | 3.74 | 59 | 9.27 | 37 | 10.31 | 15 | 7.81 | 4 | 4.76 | 110 to 114 |
| 47 | 5.17 | 53 | 8.33 | 23 | 6.41 | 4 | 2.08 | - | - | 106 to 110 |
| 70 | 7.71 | 60 | 9.43 | 11 | 3.06 | 6 | 3.12 | - | - | 102 to 106 |
| 69 | 7.60 | 56 | 8.80 | 12 | 3.34 | 2 | 1.04 | - | - | 98 to 102 |
| 92 | 10.13 | 47 | 7.39 | 15 | 4.18 | 5 | 2.60 | 2 | 2.38 | 94 to 98 |
| 103 | 11.34 | 50 | 7.86 | 8 | 2.22 | 2 | 1.04 | - | - | 90 to 94 |
| 97 | 10.68 | 37 | 5.82 | 4 | 1.11 | - | - | - | - | 86 to 90 |
| 96 | 10.57 | 30 | 4.72 | 7 | 1.94 | 1 | .52 | - | - | 82 to 86 |
| 72 | 7.93 | 19 | 2.99 | - | - | - | - | - | - | 78 to 82 |
| 50 | 5.51 | 11 | 1.73 | 1 | .28 | - | - | - | - | 74 to 78 |
| 34 | 3.74 | 5 | .79 | - | - | - | - | - | - | 70 to 74 |
| 20 | 2.20 | 3 | .47 | - | - | - | - | - | - | 66 to 70 |
| 3 | .33 | - | - | - | - | - | - | - | - | 62 to 66 |
| 2 | .22 | - | - | - | - | - | - | - | - | 58 to 62 |
| 1 | .11 | - | - | - | - | - | - | - | - | 54 to 58 |
| 1 | .11 | - | - | - | - | - | - | - | - | 50 to 54 |
| - | - | - | - | - | - | - | - | - | - | 46 to 50 |
| - | - | - | - | - | - | - | - | - | - | 42 to 46 |
| - | - | - | - | - | - | - | - | - | - | 38 to 42 |
| - | - | - | - | - | - | - | - | - | - | 34 to 38 |
| - | - | - | - | - | - | - | - | - | - | 30 to 34 |
| - | - | - | - | - | - | - | - | - | - | 26 to 30 |
| 908 | | 636 | | 359 | | 192 | | 84 | | |

ntage.

| 14 Yrs. | | 15 Yrs. | | 16 Yrs. | | 17 Yrs. | | 18 Yrs. | | POUNDS. |
|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|------------|
| No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | |
| 1 | - | - | - | - | - | - | - | 1 | 20.00 | 174 to 178 |
| No. | - | - | - | - | - | - | - | - | - | 170 to 174 |
| - | - | - | - | - | - | - | - | - | - | 166 to 170 |
| - | - | - | - | - | - | - | - | - | - | 162 to 166 |
| - | - | - | - | - | - | 1 | 3.84 | - | - | 158 to 162 |
| - | - | - | - | - | - | 1 | 3.84 | - | - | 154 to 158 |
| 1 | - | - | - | - | - | - | - | - | - | 150 to 154 |
| - | - | - | - | 1 | 1.63 | - | - | - | - | 146 to 150 |
| - | - | 2 | 1.29 | 2 | 3.28 | 2 | 7.69 | 2 | 40.00 | 142 to 146 |
| 2 | .60 | - | - | - | - | 1 | 3.84 | 1 | 20.00 | 138 to 142 |
| - | - | - | - | 2 | 3.28 | 2 | 7.69 | - | - | 134 to 138 |
| 1 | .30 | 1 | .64 | 5 | 8.20 | 4 | 15.39 | - | - | 130 to 134 |
| 2 | .60 | 3 | 1.93 | 5 | 8.20 | 2 | 7.69 | 1 | 20.00 | 126 to 130 |
| 3 | .90 | 8 | 5.16 | 6 | 9.84 | - | - | - | - | 122 to 126 |
| 5 | 1.49 | 8 | 5.16 | 5 | 8.20 | 3 | 11.53 | - | - | 118 to 122 |
| 6 | 1.79 | 9 | 5.80 | 7 | 11.47 | 1 | 3.84 | - | - | 114 to 118 |
| 8 | 2.39 | 11 | 7.09 | 9 | 14.75 | 4 | 15.39 | - | - | 110 to 114 |
| 17 | 5.09 | 14 | 9.03 | 3 | 4.92 | 1 | 3.84 | - | - | 106 to 110 |
| 24 | 7.18 | 14 | 9.03 | 2 | 3.28 | 3 | 11.53 | - | - | 102 to 106 |
| 26 | 7.78 | 13 | 8.38 | 1 | 1.63 | - | - | - | - | 98 to 102 |
| 33 | 9.88 | 17 | 10.96 | 5 | 8.20 | - | - | - | - | 94 to 98 |
| 43 | 12.87 | 20 | 12.93 | 3 | 4.92 | - | - | - | - | 90 to 94 |
| 41 | 12.27 | 16 | 10.32 | 1 | 1.63 | - | - | - | - | 86 to 90 |
| 46 | 13.77 | 9 | 5.81 | 2 | 3.28 | 1 | 3.84 | - | - | 82 to 86 |
| 28 | 8.38 | 7 | 4.51 | 2 | 3.28 | - | - | - | - | 78 to 82 |
| 20 | 6.00 | 2 | 1.29 | - | - | - | - | - | - | 74 to 78 |
| 19 | 5.67 | 1 | .64 | - | - | - | - | - | - | 70 to 74 |
| 5 | 1.49 | - | - | - | - | - | - | - | - | 66 to 70 |
| 7 | .60 | - | - | - | - | - | - | - | - | 62 to 66 |
| 2 | .30 | - | - | - | - | - | - | - | - | 58 to 62 |
| 1 | .30 | - | - | - | - | - | - | - | - | 54 to 58 |
| 1 | .30 | - | - | - | - | - | - | - | - | 50 to 54 |
| 9 | - | - | - | - | - | - | - | - | - | 46 to 50 |
| 9 | - | - | - | - | - | - | - | - | - | 42 to 46 |
| 7 | - | - | - | - | - | - | - | - | - | 38 to 42 |
| 5 | - | - | - | - | - | - | - | - | - | 34 to 38 |
| 3 | - | - | - | - | - | - | - | - | - | 30 to 34 |
| 2 | - | - | - | - | - | - | - | - | - | 26 to 30 |
| 334 | | 155 | | 61 | | 26 | | 5 | | |

ns, 1 Parentage.

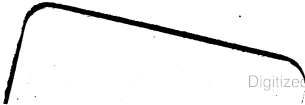
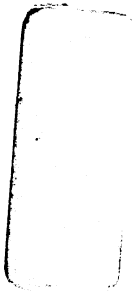
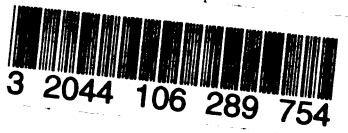
| 14 Yrs. | | | 15 Yrs. | | 16 Yrs. | | 17 Yrs. | | 18 Yrs. | | INCHES. |
|---------|-----|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|
| No. | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | |
| - | - | - | - | - | - | - | - | - | - | - | 70 |
| - | - | - | - | - | - | - | - | - | - | - | 69 |
| - | - | - | - | - | - | - | - | - | - | - | 68 |
| - | 1 | .34 | 2 | .78 | 3 | 1.26 | 2 | 1.19 | 3 | 2.54 | 67 |
| - | 1 | .34 | 5 | 1.96 | 4 | 1.68 | 4 | 2.38 | 1 | .85 | 66 |
| - | 3 | 1.02 | 7 | 2.74 | 14 | 5.88 | 8 | 4.76 | 6 | 5.09 | 65 |
| - | 13 | 4.48 | 18 | 7.06 | 20 | 8.40 | 15 | 8.93 | 18 | 12.26 | 64 |
| - | 15 | 5.17 | 27 | 10.59 | 33 | 13.86 | 31 | 18.46 | 8 | 6.78 | 63 |
| - | 34 | 11.72 | 37 | 14.51 | 46 | 19.33 | 34 | 20.24 | 21 | 17.80 | 62 |
| - | 43 | 14.83 | 55 | 21.57 | 33 | 13.86 | 24 | 14.29 | 26 | 22.03 | 61 |
| - | 66 | 22.76 | 45 | 17.65 | 30 | 12.60 | 18 | 10.72 | 17 | 14.40 | 60 |
| - | 45 | 15.51 | 32 | 12.55 | 25 | 10.50 | 16 | 9.52 | 10 | 8.47 | 59 |
| - | 35 | 12.07 | 16 | 6.28 | 18 | 7.56 | 8 | 4.76 | 5 | 4.24 | 58 |
| - | 21 | 5.86 | 9 | 3.53 | 8 | 3.36 | 6 | 3.58 | 2 | 1.69 | 57 |
| - | 8 | 2.76 | - | - | 4 | 1.68 | 1 | .59 | 1 | .85 | 56 |
| - | 4 | 1.38 | 2 | .78 | - | - | - | - | - | - | 55 |
| - | 5 | 1.72 | - | - | - | - | - | - | - | - | 54 |
| 14 | - | - | - | - | - | - | - | - | - | - | 53 |
| 14 | - | - | - | - | - | - | - | - | - | - | 52 |
| 21 | - | - | - | - | - | - | - | - | - | - | 51 |
| 21 | - | - | - | - | - | - | - | - | - | - | 50 |
| 11 | - | - | - | - | - | - | - | - | - | - | 49 |
| 4 | - | - | - | - | - | - | - | - | - | - | 48 |
| - | - | - | - | - | - | - | - | - | - | - | 47 |
| - | - | - | - | - | - | - | - | - | - | - | 46 |
| - | - | - | - | - | - | - | - | - | - | - | 45 |
| 10 | - | - | - | - | - | - | - | - | - | - | 44 |
| - | - | - | - | - | - | - | - | - | - | - | 43 |
| - | - | - | - | - | - | - | - | - | - | - | 42 |
| - | - | - | - | - | - | - | - | - | - | - | 41 |
| - | - | - | - | - | - | - | - | - | - | - | 40 |
| - | - | - | - | - | - | - | - | - | - | - | 39 |
| - | - | - | - | - | - | - | - | - | - | - | 38 |
| - | - | - | - | - | - | - | - | - | - | - | 37 |
| 33 | - | - | - | - | - | - | - | - | - | - | 36 |
| - | - | - | - | - | - | - | - | - | - | - | 35 |
| - | - | - | - | - | - | - | - | - | - | - | 34 |
| 290 | | | 255 | | 238 | | 168 | | 118 | | |

Irrespective of Nationality.

| 14 Yrs. | | 15 Yrs. | | 16 Yrs. | | 17 Yrs. | | 18 Yrs. | | POUNDS. | cent. |
|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|------------|-------|
| No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | | |
| - | - | - | - | - | - | - | - | 1 | .64 | 218 to 222 | |
| - | - | - | - | - | - | - | - | - | - | 214 to 218 | |
| - | - | - | - | - | - | - | - | - | - | 210 to 214 | - |
| 1 | .14 | - | - | 1 | .28 | - | - | - | - | 206 to 210 | - |
| - | - | - | - | - | - | - | - | - | - | 202 to 206 | - |
| - | - | - | - | - | - | - | - | - | - | 198 to 202 | - |
| - | - | - | - | - | - | - | - | - | - | 194 to 198 | - |
| - | - | - | - | - | - | - | - | - | - | 190 to 194 | - |
| - | - | - | - | - | - | - | - | - | - | 186 to 190 | - |
| - | - | - | - | - | - | - | - | - | - | 182 to 186 | - |
| - | - | - | - | 1 | .28 | - | - | - | - | 178 to 182 | - |
| - | - | - | - | - | - | 1 | .43 | 1 | .64 | 174 to 178 | - |
| - | - | - | - | - | - | - | - | - | - | 170 to 174 | - |
| - | - | - | - | - | - | - | - | 1 | .64 | 166 to 170 | - |
| 1 | .14 | 1 | .22 | - | - | - | - | - | - | 162 to 166 | - |
| - | - | - | - | 1 | .28 | 3 | 1.29 | - | - | 158 to 162 | - |
| 2 | .29 | 1 | .22 | - | - | 1 | .43 | - | - | 154 to 158 | - |
| 1 | .14 | 1 | .22 | 2 | .56 | - | - | - | - | 150 to 154 | - |
| 2 | .29 | - | - | 1 | .28 | 2 | .86 | - | - | 146 to 150 | - |
| - | - | 4 | .87 | 1 | .28 | 3 | 1.29 | 4 | 2.60 | 142 to 146 | - |
| 4 | .59 | 3 | .65 | 4 | 1.13 | 8 | 3.43 | 1 | .64 | 138 to 142 | - |
| 5 | .74 | 9 | 1.96 | 13 | 3.68 | 10 | 4.30 | 6 | 3.87 | 134 to 138 | - |
| 2 | .29 | 9 | 1.96 | 15 | 4.25 | 10 | 4.30 | 11 | 7.09 | 130 to 134 | - |
| 12 | 1.80 | 10 | 2.18 | 24 | 6.80 | 14 | 6.01 | 9 | 5.81 | 126 to 130 | - |
| 12 | 1.80 | 17 | 3.70 | 25 | 7.08 | 22 | 9.44 | 16 | 10.32 | 122 to 126 | - |
| 18 | 2.66 | 34 | 7.41 | 35 | 9.90 | 16 | 6.87 | 9 | 5.81 | 118 to 122 | - |
| 34 | 5.04 | 31 | 6.75 | 33 | 9.35 | 16 | 6.87 | 10 | 6.45 | 114 to 118 | - |
| 40 | 5.92 | 44 | 9.58 | 30 | 8.50 | 34 | 14.16 | 25 | 16.13 | 110 to 114 | - |
| 64 | 9.48 | 50 | 10.90 | 38 | 10.76 | 38 | 16.31 | 10 | 6.45 | 106 to 110 | - |
| 57 | 8.44 | 70 | 15.25 | 37 | 10.48 | 20 | 8.61 | 22 | 14.20 | 102 to 106 | - |
| 78 | 11.55 | 62 | 13.50 | 29 | 8.22 | 11 | 4.72 | 15 | 9.68 | 98 to 102 | - |
| 72 | 10.66 | 33 | 7.19 | 26 | 7.36 | 11 | 4.72 | 9 | 5.81 | 94 to 98 | - |
| 70 | 10.37 | 29 | 6.32 | 14 | 3.96 | 7 | 3.00 | 2 | 1.29 | 90 to 94 | - |
| 62 | 9.18 | 17 | 3.70 | 14 | 3.96 | 1 | .43 | 2 | 1.29 | 86 to 90 | - |
| 50 | 7.41 | 17 | 3.70 | 3 | .85 | 4 | 1.71 | 1 | .64 | 82 to 86 | - |
| 50 | 7.41 | 7 | 1.52 | 4 | 1.13 | - | - | - | - | 78 to 82 | - |
| 12 | 1.80 | 7 | 1.52 | 1 | .28 | 1 | .43 | - | - | 74 to 78 | - |
| 15 | 2.22 | 3 | .65 | 1 | .28 | - | - | - | - | 70 to 74 | - |
| 7 | 1.03 | - | - | - | - | - | - | - | - | 66 to 70 | .21 |
| 3 | .44 | - | - | - | - | - | - | - | - | 62 to 66 | .21 |
| 1 | .14 | - | - | - | - | - | - | - | - | 58 to 62 | .62 |
| - | - | - | - | - | - | - | - | - | - | 54 to 58 | 4.12 |
| - | - | - | - | - | - | - | - | - | - | 50 to 54 | 1.11 |
| - | - | - | - | - | - | - | - | - | - | 46 to 50 | 0.37 |
| - | - | - | - | - | - | - | - | - | - | 42 to 46 | 5.92 |
| - | - | - | - | - | - | - | - | - | - | 38 to 42 | 9.54 |
| - | - | - | - | - | - | - | - | - | - | 34 to 38 | 3.40 |
| - | - | - | - | - | - | - | - | - | - | 30 to 34 | 3.70 |
| - | - | - | - | - | - | - | - | - | - | 26 to 30 | .2 |
| 675 | | 459 | | 353 | | 233 | | 155 | | | |

centage.

| 14 Yrs. | | 15 Yrs. | | 16 Yrs. | | 17 Yrs. | | 18 Yrs. | | POUNDS. |
|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|------------|
| Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | No. | Per cent. | | |
| - | - | - | - | - | - | - | - | - | - | 218 to 222 |
| - | - | - | - | - | - | - | - | - | - | 214 to 218 |
| - | - | - | - | - | - | - | - | - | - | 210 to 214 |
| - | - | - | - | - | - | - | - | - | - | 206 to 210 |
| - | - | - | - | - | - | - | - | - | - | 202 to 206 |
| - | - | - | - | - | - | - | - | - | - | 198 to 202 |
| - | - | - | - | - | - | - | - | - | - | 194 to 198 |
| - | - | - | - | - | - | - | - | - | - | 190 to 194 |
| - | - | - | - | - | - | - | - | - | - | 186 to 190 |
| - | - | - | - | - | - | - | - | - | - | 182 to 186 |
| - | - | - | - | - | - | - | - | - | - | 178 to 182 |
| - | - | - | - | - | - | 1 | 5.55 | - | - | 174 to 178 |
| - | - | - | - | - | - | - | - | - | - | 170 to 174 |
| - | - | - | - | - | - | - | - | - | - | 166 to 170 |
| - | - | - | - | - | - | - | - | - | - | 162 to 166 |
| - | - | - | - | - | - | 1 | 5.55 | - | - | 158 to 162 |
| - | - | - | - | - | - | - | - | - | - | 154 to 158 |
| 1 | .52 | - | - | 1 | 2.04 | - | - | - | - | 150 to 154 |
| 2 | 1.04 | - | - | - | - | - | - | - | - | 146 to 150 |
| | - | 1 | 1.05 | - | - | 1 | 5.55 | - | - | 142 to 146 |
| 1 | .52 | - | - | 1 | 2.04 | - | - | - | - | 138 to 142 |
| 1 | .52 | 2 | 2.10 | 1 | 2.04 | - | - | - | - | 134 to 138 |
| | - | 2 | 4.21 | 2 | 4.08 | - | - | - | - | 130 to 134 |
| 2 | 1.04 | - | - | 2 | 4.08 | 1 | 5.55 | - | - | 126 to 130 |
| 3 | 1.56 | 4 | 4.21 | 1 | 2.04 | 2 | 11.11 | - | - | 122 to 126 |
| 6 | 1.56 | - | - | 5 | 10.20 | - | - | - | - | 118 to 122 |
| 2 | 3.12 | 3 | 3.16 | 3 | 6.12 | - | - | - | - | 114 to 118 |
| 7 | 6.25 | 8 | 8.42 | 3 | 6.12 | 4 | 22.22 | 2 | 33.33 | 110 to 114 |
| 6 | 8.85 | 8 | 8.42 | 5 | 10.20 | 5 | 27.77 | 1 | 16.66 | 106 to 110 |
| 3 | 8.33 | 15 | 15.80 | 5 | 10.20 | 2 | 11.11 | 1 | 16.66 | 102 to 106 |
| 1 | 10.93 | 13 | 13.68 | 10 | 20.41 | 1 | 5.55 | 1 | 16.66 | 98 to 102 |
| 1 | 10.93 | 9 | 9.47 | 5 | 10.20 | - | - | 1 | 16.66 | 94 to 98 |
| 6 | 11.45 | 9 | 9.47 | 2 | 4.08 | - | - | - | - | 90 to 94 |
| 3 | 8.33 | 6 | 6.31 | 1 | 2.04 | - | - | - | - | 86 to 90 |
| 3 | 6.77 | 8 | 8.42 | 1 | 2.04 | - | - | - | - | 82 to 86 |
| 3 | 12.00 | 2 | 2.10 | - | - | - | - | - | - | 78 to 82 |
| 3 | 1.56 | 2 | 2.10 | 1 | 2.04 | - | - | - | - | 74 to 78 |
| 3 | 1.56 | 3 | 3.16 | - | - | - | - | - | - | 70 to 74 |
| 3 | 1.56 | - | - | - | - | - | - | - | - | 66 to 70 |
| 2 | 1.04 | - | - | - | - | - | - | - | - | 62 to 66 |
| 1 | .52 | - | - | - | - | - | - | - | - | 58 to 62 |
| | - | - | - | - | - | - | - | - | - | 54 to 58 |
| | - | - | - | - | - | - | - | - | - | 50 to 54 |
| | - | - | - | - | - | - | - | - | - | 46 to 50 |
| | - | - | - | - | - | - | - | - | - | 42 to 46 |
| | - | - | - | - | - | - | - | - | - | 38 to 42 |
| | - | - | - | - | - | - | - | - | - | 34 to 38 |
| | - | - | - | - | - | - | - | - | - | 30 to 34 |
| | | 95 | | 49 | | 18 | | 6 | | |





M