as on the slippers, etc.; in some cases a wooden model seems to be carved, and the gold beaten over it; gilding is not used, but overlaying with plates of gold instead, often rudely pinned together. Soldering, properly so-called, seems comparatively little practised; but welding together the gold in a very complete and ingenious manner is employed.

---

The thanks of the meeting were unanimously voted to Messrs. Garrard for lending the objects for exhibition and examination.

---

The following paper was read by the Mr. F. Galton:

*On a* SERIES *of* MEASUREMENTS *for* STATISTICAL PURPOSES, *recently made at* MARLBOROUGH COLLEGE. By WALTER FERGUS, M.D., and G. F. RODWELL, F.R.A.S. [With Plate x.]

IN accordance with the wishes of the Institute, as expressed by Mr. Francis Galton, we have submitted to various measurements 550 boys belonging to this school, and we propose to give a brief account of the modes of measurement and of the results obtained.

It was considered desirable to obtain the following details:

1. Weight. 2. Height. 3. Head measurement. (The head was measured near the base of the skull, the tape being placed immediately above the occipital protuberance behind, and immediately above the sinuses in front.) 4. Girth of chest. 5. Girth of the flexed arm, measured at the broadest portion of the biceps muscle near the shoulder, the muscle being at rest. 6. Girth of the leg measured at the broadest portion of the calf.

Each complete measurement occupied (with the weighing to quarters of a pound) somewhat less than two minutes; when one person undertook the measurement, a second the weighing, a third recorded the results. The requisite appliances consisted of: 1. A small five-guinea lever balance (by Hawksley) carefully tested, and found to weigh easily to quarters of a pound when loaded (fig. 1, pl. x). 2. A simple appliance for taking heights quickly, consisting of a vertical board, A (fig. 2) graduated between 4 ft. and 6 ft. 6 in., and provided with a sliding square board B, at right angles to it.* This board on being brought

* A bracket sliding between vertical guides, and balanced by a counterpoise acting over two pullies as in fig. 3, will be found easy, quick, and sure in action. The vertical board and foot piece may be dispensed with, if the guides can be nailed to a wall.—F. GALTON.

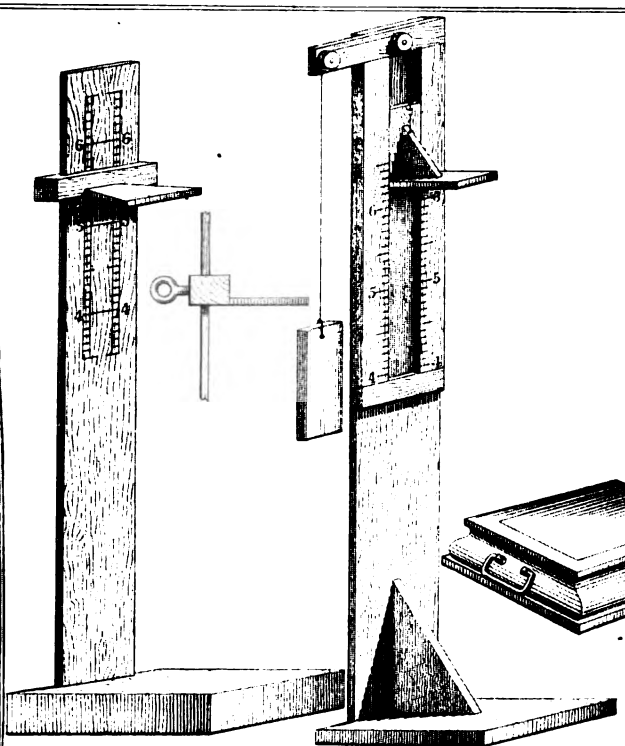


Fig. 2.

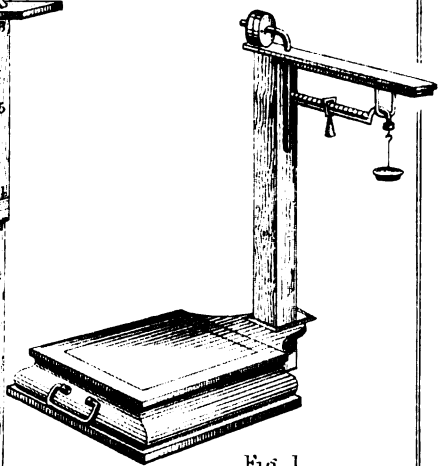
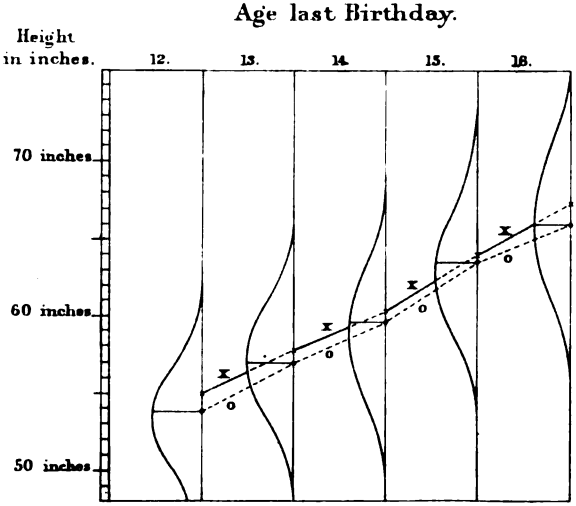


Fig. 1.

Fig. 3.




C.F. Kell, Litho London, E.C.

down upon the head of the person to be measured, insures a level surface, and at the same time acts as an index to the scale. The board moves with just sufficient friction to enable it to remain wherever it may be placed without sliding.

3. About 4 feet of tailors' measuring tape, divided into inches and eighths.

The boys were weighed with their boots on; then the height without boots was measured; the chest measurement was taken over the shirt and waistcoat, but without the coat; the arm and leg were bared before measurement.

TABLE I.—HEIGHT.

| Height without Boots. | | Age last Birthday. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Above. | Under. | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 |
| feet. in. | feet. in. | | | | | | | | | | |
| 4 ..... 3 | 4 ..... 4 | ... | ... | ... | ... | ... | 1 | ... | ... | ... | ... |
| 4 ..... 4 | 4 ..... 5 | ... | ... | ... | ... | ... | ... | ... | 3 | 1 | ... |
| 4 ..... 5 | 4 ..... 6 | ... | ... | ... | ... | ... | 1 | ... | 2 | ... | 1 |
| 4 ..... 6 | 4 ..... 7 | ... | ... | ... | ... | ... | 3 | 6 | 1 | 2 | 1 |
| 4 ..... 7 | 4 ..... 8 | ... | ... | ... | ... | ... | 3 | 8 | 8 | 4 | 1 |
| 4 ..... 8 | 4 ..... 9 | ... | ... | 1 | ... | 1 | 2 | 11 | 5 | 1 | ... |
| 4 ..... 9 | 4 .....10 | ... | .. | ... | 2 | 3 | 7 | 6 | 7 | 5 | ... |
| 4 .....10 | 4 .....11 | ... | ... | ... | ... | 5 | 9 | 12 | 3 | 1 | ... |
| 4 .....11 | 5 ..... 0 | ... | ... | ... | 3 | 6 | 11 | 18 | 1 | ... | ... |
| 5 ..... 0 | 5 ..... 1 | ... | ... | 3 | ... | 17 | 11 | 19 | 3 | ... | ... |
| 5 ..... 1 | 5 ..... 2 | ... | 1 | ... | 2 | 13 | 9 | 10 | ... | ... | ... |
| 5 ..... 2 | 5 ..... 3 | ... | ... | 3 | 6 | 13 | 11 | 5 | 1 | ... | ... |
| 5 ..... 3 | 5 ..... 4 | ... | 2 | 1 | 6 | 18 | 8 | ... | ... | ... | ... |
| 5 ..... 4 | 5 ..... 5 | 1 | 2 | 2 | 15 | 22 | 5 | ... | ... | ... | ... |
| 5 ..... 5 | 5 ..... 6 | 1 | 2 | 4 | 15 | 10 | 6 | ... | ... | ... | ... |
| 5 ..... 6 | 5 ..... 7 | ... | 3 | 6 | 10 | 14 | 3 | ... | ... | ... | ... |
| 5 ..... 7 | 5 ..... 8 | 1 | 1 | 9 | 19 | 11 | ... | 1 | ... | ... | ... |
| 5 ..... 8 | 5 ..... 9 | 1 | 1 | 5 | 11 | 5 | ... | ... | ... | ... | ... |
| 5 ..... 9 | 5 .....10 | ... | 3 | 6 | 5 | 1 | ... | ... | ... | ... | ... |
| 5 .....10 | 5 .....11 | ... | 1 | 4 | 4 | 1 | ... | ... | ... | ... | .. |
| 5 .....11 | 6 ..... 0 | ... | 2 | 1 | 2 | ... | ... | ... | ... | ... | ... |
| 6 feet and | above..... | ... | 1 | 2 | 3 | ... | ... | ... | ... | ... | ... |
| Total number..... | | 4 | 19 | 47 | 103 | 140 | 90 | 96 | 34 | 14 | 3 |

The extreme limits were found, on the one hand, in the case of a boy of sixteen years and ten months, who measured 6 feet 3½ inches; and, on the other hand, of a boy fourteen years and nine months, who measured 4 feet 3¼ inches. The complete measurements of these boys are as follows:

| | Weight. | Height. | Head. | Chest. | Arm. | Leg. | Age. |
|---|---|---|---|---|---|---|---|
| A... | 11 st. 2¾ lbs | 6 ft. 3½ in | 22¾ in | 32 in | 9½ in | 13½ in | 16 yrs. 10 mths. |
| B... | 4 „ 8 „ | 4 „ 3¼ „ | 21 „ | 26½ „ | 6½ „ | 10 „ | 14 „ 9 „ |

TABLE II.—WEIGHT.

| Weight (in usual indoor dress, with boots on) 1 stone = 14 lbs. | | AGE LAST BIRTHDAY. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Above. | Under. | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 |
| 4½ stone ..... | 5 stone..... | ... | ... | ... | ... | ... | 1 | ... | 4 | ... | 1 |
| 5 „ ..... | 5½ „ ..... | ... | ... | ... | 1 | ... | 2 | 4 | 5 | 6 | 1 |
| 5½ „ ..... | 6 „ ..... | ... | ... | ... | ... | 2 | 5 | 17 | 12 | 2 | 1 |
| 6 „ ..... | 6½ „ ..... | ... | .. | 1 | 1 | 7 | 19 | 32 | 7 | 6 | ... |
| 6½ „ ..... | 7 „ ..... | ... | ... | 1 | 1 | 13 | 14 | 24 | 4 | ... | ... |
| 7 „ ..... | 7½ „ ..... | ... | ... | 3 | 2 | 25 | 22 | 13 | 1 | ... | ... |
| 7½ „ ..... | 8 „ ..... | ... | ... | 4 | 9 | 20 | 8 | 4 | 1 | ... | ... |
| 8 „ ..... | 8½ „ ..... | ... | 1 | 3 | 7 | 18 | 11 | 1 | ... | ... | ... |
| 8½ „ ..... | 9 „ ..... | ... | 2 | 2 | 20 | 22 | 5 | 1 | ... | ... | ... |
| 9 „ ... .. | 9½ „ ..... | ... | 4 | 8 | 21 | 15 | 2 | ... | ... | ... | ... |
| 9½ „ ..... | 10 „ ..... | ... | 2 | 6 | 11 | 14 | ... | ... | ... | ... | ... |
| 10 „ ..... | 10½ „ ..... | 3 | 4 | 7 | 12 | 3 | 1 | .. | ... | ... | ... |
| 10½ „ ..... | 11 „ ..... | 1 | 2 | 6 | 9 | ... | ... | ... | ... | ... | ... |
| 11 „ and | above ..... | ... | 4 | 6 | 9 | 1 | ... | ... | ... | ... | ... |
| Total number ..... | | 4 | 19 | 47 | 103 | 140 | 90 | 96 | 34 | 14 | 3 |

The extreme limits were found, on the one hand, in the case of a boy of 16 years and 355 days, who weighed 12 stone 5¼ lbs., and, on the other hand, of a boy 14 years and 9 months (*vide* B. above, in connection with height), who weighed 4 stone 8 lbs.

TABLE III.—HEAD MEASUREMENTS.

| Head measurement in inches. | AGE LAST BIRTHDAY. | | | | | | | | | | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | |
| 20 ..... | ... | ... | .. | 1 | ... | ... | 3 | 3 | ... | ... | 7 |
| 20¼ ..... | ... | ... | ... | 1 | 1 | ... | 4 | 2 | ... | ... | 8 |
| 20½ ..... | ... | ... | ... | 1 | 4 | 3 | 8 | 4 | 2 | ... | 22 |
| 20¾ ..... | ... | ... | ... | 1 | 5 | 8 | 7 | 1 | 1 | 1 | 24 |
| 21 ..... | ... | ... | 4 | 5 | 15 | 12 | 13 | 9 | 3 | 1 | 62 |
| 21¼ ..... | ... | 2 | 3 | 6 | 9 | 6 | 7 | 3 | ... | ... | 36 |
| 21½ ..... | ... | 1 | 1 | 17 | 37 | 24 | 20 | 6 | 4 | ... | 110 |
| 21¾ ..... | ... | 5 | 5 | 12 | 19 | 10 | 14 | 5 | 1 | ... | 71 |
| 22 ..... | 1 | 3 | 9 | 21 | 18 | 15 | 14 | 1 | 2 | 1 | 85 |
| 22¼ ..... | ... | 1 | 10 | 9 | 13 | 5 | 3 | ... | ... | ... | 41 |
| 22½ ..... | 3 | 2 | 4 | 19 | 13 | 6 | 3 | ... | 1 | ... | 51 |
| 22¾ ..... | ... | 2 | 7 | 5 | 4 | 1 | ... | ... | ... | ... | 19 |
| 23 ..... | ... | 1 | 2 | 1 | 1 | ... | ... | ... | ... | ... | 5 |
| 23¼ ..... | ... | 1 | ... | ... | 1 | ... | ... | ... | ... | ... | 2 |
| 23½ ..... | ... | 1 | ... | 3 | ... | ... | ... | ... | ... | ... | 4 |
| 23¾ ..... | ... | ... | 1 | ... | ... | ... | ... | ... | ... | ... | 1 |
| 24 ..... | ... | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... |
| 24¼ ..... | ... | ... | 1 | ... | ... | ... | ... | ... | ... | ... | 1 |
| 24½ ..... | ... | ... | ... | 1 | ... | ... | ... | ... | .. | ... | 1 |
| Total number measured..... | 4 | 19 | 47 | 103 | 140 | 90 | 96 | 34 | 14 | 3 | 550 |

The complete measurements of these boys are as follows:

| | Weight. | Height. | Head. | Chest. | Arm. | Leg. | Age. |
|---|---|---|---|---|---|---|---|
| A .. | 12 st. 5¼ lbs | 5 ft. 11½ in | 22¾ in | 35½ in | 11¾ in | 14½ in | 16 yrs. 355 d. |
| B... | 4 8 | 4 3½ | 21 | 26½ | 6½ | 10 | 14 „ 9 mts. |

We gather from these results that 89 per cent. of the boys have a head measurement of, or exceeding, 21 inches, while 11 per cent. have a head measurement of less than 21 inches. Of these latter, half the number are between twelve and fourteen years of age, and no one had attained his seventeenth birthday. Again, 2½ per cent. have heads which measure 23 inches and upwards; their ages being between fifteen and nineteen. 38 per cent. of the heads measure 22 inches and upwards; while 20 per cent. measure 21½ inches. The greatest range of measurement is seen to occur in the case of the 103 boys who were sixteen last birthday. Here we find two boys whose ages differ by less than a month, while the girth of their heads differ by 4½ inches—the extreme limits of the entire series of measurements, viz., 20 and 24½ inches.

The complete measurements of these boys are as follows:

| | Weight. | Height. | Head. | Chest. | Arm. | Leg. | Age. |
|---|---|---|---|---|---|---|---|
| D... .. | 11 st. 8½lbs | 5 ft. 7 in | 24½ in | 37½ in | 11½ in | 15¾ in | 16 yrs. 9 mts. |
| E..... | 5 „ 6¼ „ | 4 „ 9¼ „ | 20 „ | 27 „ | 6¾ „ | 10¾ „ | 16 „ 9 „ |

We are unable to trace any distinct connection between intellectual vigour, and head measurement; for although many of those who possess the higher girths of head are intelligent boys of considerable ability, it must be confessed that many boys whose heads measure less than 22 inches, are in ability, perseverance, and general culture, quite equal to those who possess the higher measurement. Let it, however, be borne in mind, that a simple measurement at the base of the brain, does not of necessity give any true indication of brain-capacity, because skulls differ in height, as well as in length and breadth, and until measurements of the head embrace space of three dimensions, they can afford us but little information.

## IV.—CHEST MEASUREMENT.

The extremes were 37½ inches and 26 inches. The larger measurement was given by the possessor of the largest head circumference (D. above). The following are the complete measurements of the three possessors of the smallest chests:

| | Weight. | Height. | Head. | Chest. | Arm. | Leg. | Age. |
|---|---|---|---|---|---|---|---|
| F..... | 6 st. 0¼ lbs. | 4 ft. 9¾ in | 20¼ in | 26 in | 7¾ in | 11½ in | 13¼ ye ars. |
| G..... | 6 „ 0¼ „ | 4 „ 9 „ | 21¼ „ | 26 „ | 8¼ „ | 11½ „ | 13 „ |
| H ..... | 4 „ 12 „ | 4 „ 6¼ „ | 20 „ | 26 „ | 6¾ „ | 9¾ „ | 12¼ „ |

### V.—ARM MEASUREMENT.

The extremes were $11\frac{7}{8}$ inches and $16\frac{1}{2}$ inches. The smaller measurement belonged to the possessor of the least weight and height (B. above, pp. 127, 129). The other gave the following measurements:

| | Weight. | Height. | Head. | Chest. | Arm. | Leg. | Age. |
|---|---|---|---|---|---|---|---|
| I..... | 10 st. 7½ lbs | 5 ft. 4¼ in | 22½ in | 34 in | 11¾ in | 14¾ in | 19 years. |

He is one of the strongest and most muscular boys in the school.

### VI.—LEG MEASUREMENT.

The extremes were $16\frac{1}{4}$ inches and $9\frac{3}{4}$ inches, and the complete measurements are as follows:

| | Weight. | Height. | Head. | Chest. | Arm. | Leg. | Age. |
|---|---|---|---|---|---|---|---|
| K..... | 11 st. 4 lbs | 5 ft. 6½ in | 22¾ in | 35½ in | 11½ in | 16¼ in | 18½ years. |
| L..... | 5 „ 5 „ | 4 „ 6¾ „ | 21¾ „ | 27½ „ | 7 „ | 9¾ „ | 11 „ |

H. (*vide* Table IV, above), also gave a leg-circumference of $9\frac{3}{4}$ inches.

---

## NOTES *on the* MARLBOROUGH SCHOOL STATISTICS. By FRANCIS GALTON, F.R.S.

IT will be in the recollection of many in this room, that a few months ago I applied with success to the Anthropological Institute, to enlist their co-operation in obtaining statistical information from large schools. I showed that it appeared feasible to obtain in that way information for the purpose of intercomparison, on the growth of Englishmen living under different conditions of town and country, and belonging to different ranks of society. I explained that the boys at each school were of fairly homogeneous origin, and that, being under the control of highly intelligent masters, it would be practicable in many instances to obtain classified returns of large numbers of heights and weights which we might discuss and combine with comparatively little labour into appropriate groups, the publication of which would be found to be exceedingly valuable contributions to anthropological statistics.

Much time was necessarily lost in preparing the blank schedules, and in making other prefatory arrangements; at length a few applications were issued, but only a few, in order that our earlier experience might correct or reassure us before we were finally compromised to a definite form of action. The first reply

that was received came from Marlborough College, a great school of 540 boys, now presided over by a distinguished scholar, Dr. Farrar, honourably known to the scientific world by his early and outspoken advocacy of the introduction of science teaching into schools. The gentlemen who actually carried out the work were Dr. Fergus, Medical Officer of the College, who has had considerable experience in statistics, and Mr. Rodwell, the natural science master. Their returns are additionally valuable from the fact that they include many statistical inquiries besides those of age, height, and weight, which we had confined ourselves to asking for. We have also received a return from Liverpool College, containing 650 boys, promises from other schools, and hopes of co-operation from many. It would be premature to rely on general results derived from the data furnished by either of these two colleges, but I considered it would be well to do two things, at once. The one was, to ask Mr. Rodwell and Dr. Fergus to furnish an account of the way in which they had so successfully conducted their measurements, accompanied by such general remarks as they might think fit to make—this forms the subject of the preceding memoir; and the other was, roughly to work out by myself some of the published Marlborough results, in order to show in a general way how I proposed hereafter to treat the larger map of materials, and thus to invite criticism and helpful suggestions at the outset. It should, however, be repeated here, that in inviting schools to send in returns we do not propose to publish those returns separately but in groups. I will confine what I am about to say to height.

The returns are furnished, as asked for, in a crude shape. They tell us that there were 540 boys at the school, of whom 103 were 16 on their last birthday, 140 were 15, 90 were 14, and 96 were 13; these groups are sufficiently numerous to give approximate results. Again, the returns tell us, in each of these groups, how many boys there were between 5 feet 1 inch and 5 feet 2 inches, between 5 feet 2 inches and 5 feet 3 inches, and so on throughout the whole range of measurement. These are the crude statistics on which I have worked as follows:—

1. I obtained the mean height for each age, and examined the run of those figures. By the law of continuity we have every right to expect the mean growth to be regular, and therefore that a line through the tops of a series of ordinates representing the mean heights should form some regular curve. If it forms a broken line we may be sure that there is error in our way of collecting the facts. In the Marlborough statistics the line is fairly regular, so much so, as to enable us to guess what the curve would have become if we had dealt with more cases. It must be recollected that we are in a much better position

than if we were dealing with isolated groups of 103, 140, 90, and 96 boys respectively, as will be very clearly seen as we proceed.

2. I reduced the groups severally to the same proportions, supposing them in each case to have consisted of 100 boys, and examined the run of the figures, and compared them with a series calculated according to the "law of frequency of error", adopting such constants as appeared in each case most conformable to fact. The following table shows the result.

*Number of boys of different degrees of height, at the several years of their ages.*

| Height in inches. Limits. | Mean. | Age last Birthday. 12 | | 13 | | 14 | | 15 | | 16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | obs. | cal. | obs. | cal. | obs. | cal. | obs. | cal. | obs. | cal. |
| Above 71 inches ... | 72½ | ... | ... | ... | ... | ... | ... | 2 | 2 | 3 | 4 |
| 68 to 71 „ ... | 69½ | ... | ... | ... | ... | 3 | 4 | 2 | 2 | 11 | 17 |
| 65 „ 68 „ ... | 66½ | ... | ... | 1 | 6 | 22 | 14 | 22 | 18 | 39 | 32 |
| 62 „ 65 „ ... | 63½ | 12 | 6 | 36 | 32 | 35 | 38 | 35 | 40 | 34 | 31 |
| 59 „ 62 „ ... | 60½ | 32 | 34 | 38 | 46 | 30 | 30 | 30 | 31 | 8 | 12 |
| 56 „ 59 „ ... | 57½ | 41 | 45 | 25 | 15 | 8 | 9 | 10 | 8 | 5 | 4 |
| 53 „ 56 „ ... | 54½ | 15 | 14 | ... | 1 | 2 | 1 | 1 | 1 | ... | ... |

It will be seen that the returns corresponding to the ages of 16, 15, and 14, derived from 103, 140, and 90 cases respectively, conform very fairly to the law, those for 12 happen to do so, but as there are only 37 cases under this head I cannot place much reliance on the result—it may be a mere accident. Those for 13 are irregular, although based on 96 cases (and so were those for 17, but these are only 47 in number). Taking the table as a whole, I think we are justified in saying that the "law of frequency of error" is fairly applicable, and in adopting it, although we do some violence to the figures corresponding to the age of 13.

I have said that in these calculations I adopted the constants that appeared most conformable to fact. The way of proceeding was as follows. First, I treated each group separately in the usual way, as is popularly described in Quetelet's "Letters" and largely illustrated in Gould's "Statistics of the late American War", not to mention other more learned books. This gave a series of constants for each group, each forming continuous curves. Now the *successive groups* ought also, according to what was pointed out in the preceding paragraph, to form a continuous series. The continuity should exist in "file" as well as in "rank", the whole surface should be regular; I,

therefore, slightly corrected the constants until they fulfilled these conditions, and from the constants so revised calculated the series which I have given.

The whole law of growth now starts into life, by giving a small table as below.

TABLE II.

| AGE (actual, not last Birthday) ..... | 12½ | 13½ | 14½ | 15½ | 16½ | etc. |
|---|---|---|---|---|---|---|
| Mean height, in inches ... | 56¼ | 58½ | 60½ | 63¼ | 65½ | etc. |
| Probable error, in inches . | 1¼ | 1½ | 1½ | 1¾ | 2¼ | etc. |

The percentage of boys of any age within the limits of the table, who will be found between any specified degrees of height, can at once be ascertained from these few figures by reference to an ordinary Table of Frequency of Error, and by a simple and immediate arithmetical process. Nay, further, the relation between age, mean height, and probable error, is undoubtedly to be expressed approximately by some empirical formula, so that the whole history of the human growth of men who passed through the stage of Marlborough boyhood could be given by half a dozen letters.

So far as the law of Frequency of Error does not strictly apply, to that degree will the conclusions be faulty; this difficulty is to be removed by seeking for groups of a still more homogeneous character than is afforded by the mere fact of being a Marlborough boy, in order that individual differences should depend, as far as may be, upon different combinations of a multitude of small, variable causes, and as little as possible upon occasional great influences, such as wide differences of race and nurture. Again, so far as the constants are insufficiently exact, to that degree also will the conclusions be faulty. The check to this is afforded by deriving them from a larger collection of facts than we have now before us.

I will give the results in a graphic form, because the eye is a critical judge of truth in outline, and the reasonableness of the results will become the more apparent when they are displayed in a pictorial form; besides, the procedure will be made more intelligible.

In the diagram, the curved spaces are supposed to be seen in perspective, and to be imagined as standing out at right angles to the plane of the paper. They are not unlike the partitions in some railway carriages, which separate the head of the occupant of the middle seat from those of his neighbours on either side.

The partition to the left of any one of the columns, say of that under the age of 14, is a record of the heights of all the boys of that age. The principle is as follows:—these boys are supposed to be divided into sets, corresponding to the entries in Table I, namely, one set of boys between 68 and 71 inches in height, whose mean height may be taken as 69½ inches (though this is not strictly correct), and a line is drawn on the partition at 69½ inches from the ground, of a length proportionate to the number of boys in that set, which the table shows to be 4. Similarly, at 66½ inches from the ground, a line representing 18 is drawn; at 63½, 38, and so on. Then the tops of these lines are joined with a free hand, by which the well-known outline of the curve of "frequency of error" becomes apparent, and we obtain a figure which is true for any number of cases, and for any subdivisions of them, however minute. For example, if we wished to know out of 10,000 such boys, how many there were of heights ranging between, say 58¼ and 58¾ inches, then the ratio of the area included between the lines at those heights, as compared to the total area of the figure, taken as 10,000, would give the answer.

I have drawn similar figures in the diagram for each of the 5 years from 12 to 16 inclusive, and the successive ranks of the figures, estimated "in file", shows very distinctly to the eye the character of the law of growth. We see how the variation widens as the age increases, by the outlines being, so to speak, more mountainous in the earlier columns, and forming broader hills in the later, the sectional area in all cases being strictly the same.

It is to be observed that the arithmetical mean of the heights indicated by an X in the diagram, does not strictly correspond with the typical means indicated by an O, but is in all cases somewhat higher. I ascribe this partly to the fact of exceptionally tall boys being not uncommon—in other words to the law of frequency of error not being strictly applicable. Probably the best approximation to the mean value is obtained by drawing a line with a free hand through the X and O of each column, and this is a finally corrected estimate, which I have adopted in Table II.

No one can be more conscious than myself that these Marlborough returns have been thus subjected to more elaborate statistical treatment than the number of cases which they contain would, in ordinary circumstances, warrant. The conclusions are based on a somewhat strained hypothesis, by substituting the figures in the second halves of the columns in Table I for those in the first half, from which they differ in some cases notably. The results are, therefore, to be trusted, only so far as

being near the truth, and certainly nearer the truth than any other result that can be specified. They, however, teach us that it would not require more than the combination of a few schools of the same class to give very excellent results. I believe, judging from the run of the figures, that when we have returns from 4 or 5 schools of equal size to Marlborough, containing boys of the same classes of society, and antecedents generally, that we shall have sufficient material to enable us to establish with certainty the law of growth of the English boys of the present date, who are sons of professional men and clergymen, and who are educated in the country, and reared on the present system of diet and physical and mental work. This will be a standard of comparison for future periods, and also for other countries and to different conditions of life, and is therefore an anthropological constant of sterling value. Liverpool College belongs to another category, namely, to boys educated in towns. The statistics came out very differently, so that it would have been impossible to combine them with those of Marlborough.

I now conclude my remarks, which have been made solely with the view of showing how it appears to me that the school statistics can be dealt with most suitably, and how the trouble to which we ask the school authorities to put themselves will not be labour thrown away.

### DISCUSSION.

Sir DUNCAN GIBB commented upon the great value of the author's investigations, and threw out the suggestion that the spirometer should be used to estimate the chest capacity of the boys, which would add greatly to the importance of the general results. He would also suggest that the colour of the hair and eyes should be mentioned. Some years ago he himself had examined a number of persons amongst the out-patients of Westminster Hospital, to assist his friend, Dr. John Beddoe, in some inquiries into the stature and bulk of the men of the British Islands; and all these points were carefully attended to, thus adding to the importance of the general subject. The value of the spirometer could not be overrated, for it is a more reliable test of strength and chest capacity than any measurements round the body, and no doubt, eventually, the medical officers of the army would find it of great assistance in testing the powers of recruits.

Mr. HYDE CLARKE, Col. FOX, and the PRESIDENT also offered a few remarks.