ANTHROPOMETRY IN ELEMENTARY SCHOOLS.*

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ANTHROPOMETRY is the art of measuring man—the corresponding science, anthropometrics, deals with the establishment of correlations between the physique and the various factors of human inheritance and environment.

While it is probable that valuable information, even from the hygienic standpoint, might be derived from a detailed study of the changing dimensions of the growing child, considerations of time render it advisable, in all investigations on a large scale, to confine the preliminary enquiry to those features which, while capable of being rapidly recorded, serve most completely as tests of the general health and state of nutrition. The measurements required by the Board of Education are those of stature and weight, which amply conform with the foregoing postulates. Both measurements can be made rapidly with simple apparatus; neither demands special training.

The only apparatus required to ascertain the stature is a graduated rod, a plummet, and a set square. The plummet is necessary to ensure the rod being held vertically; if the rod is attached to a wall the alignment can be made once and for all, but it must not be overlooked, as many walls are not truly vertical. The subject must stand erect, barefooted or in socks, with his back to the scale, his eyes directed to the horizon, his heels firmly planted, and the pads of his feet only lightly in contact with the ground. The latter is a precaution to avoid any apparent increase due to standing partially on tip-toes. The set square is applied to the rod and moved from above downwards until it is in contact with the head of the subject, when the stature is read from the scale. The various forms of apparatus with sliding indicators present no additional advantages, while some forms in general use in which the measurement is made on a short graduated rod which does not reach the ground may yield inaccurate readings owing to their not being fixed at an absolutely correct height. The subject should

not be measured while wearing boots or shoes, since all attempts to make allowance for the height of the heel introduce considerable error besides wasting time.

The record should be accurate to the nearest centimetre or half-inch. Greater refinement than this is quite unnecessary, as the extra decimal places will almost certainly be ignored in making up averages for groups of several hundreds of children. Greater accuracy would also involve the necessity of taking into consideration the diurnal variation in stature and ensuring that the measurements were always taken at the same time of day and after similar conditions of posture and occupation. Of course this might be advisable if any special investigation were being carried out on a limited number of subjects. Scales accurate and graduated only to half-inches or centimetres are naturally less expensive than those with finer sub-divisions and the risk of making errors in reading are proportionately reduced. When the attention is concentrated on reading to millimetres, errors in centimetres are more likely to creep in.

Three types of weighing machines—balance scales, spring machines and steelyards—are in general use.

Machines of the first type are the simplest and the least liable to get out of order, but present a great disadvantage in the time and labour involved in shifting the actual weights for each subject. In small country schools such a form might be available or easily borrowed which would save trouble in transport. Spring weighing machines present the advantage of rapid manipulation, and are easily carried and hooked to any convenient beam or branch of a tree. It is, however, necessary to note that the pointer returns to zero after each observation, and advisable to test the accuracy of the scale record from time to time by means of standard weights. There are several forms of steelyard machine varying in the form of the platform and the manner of estimating the weight. In some the larger part of the weight on the platform is counterbalanced by loose weights suspended from the long arm of the steelyard, while the finer adjustment is made by a small sliding weight. This takes up a good deal of time if changes in the larger weights are often necessary. The form in which there are two parallel bars on one of which slides a heavy weight to record

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the larger units, and on the other a smaller weight for the final adjustment of balance is more convenient.

Both forms need testing from time to time.

The subjects should be weighed as far as possible under uniform conditions. The ideal method would be to weigh each when clothed in a dressing gown of known weight which can be deducted from that observed, or which could be previously counterpoised. This is quite impracticable in schools. If gymnastic costume is worn for physical exercises it would be the best for these observations, but generally all that can be done is to record the average weight of the clothing of each group of children. This varies considerably; the range in a series of hospital patients aged ten to fourteen years was from five to twelve pounds, the greatest difference being in the footwear, which varied between three-and-a-quarter pounds and six ounces.

It is therefore desirable that the children should be weighed without coats or overcoats and without boots.

In any case every report should state the conditions under which the measurements were made.

It is sufficient to record the weight to the nearest pound or half-kilogramme, the metric system being preferable. Greater accuracy is useless since no two observations will be made under precisely similar physiological conditions; and the weight of an adult presents a daily variation of some two to three pounds, and there is a proportional change in children.

A uniform system of recording ages is essential if groups of children in different districts are to be compared. In making up averages it is usual to deal with groups of each year of life, reckoning from the last birthday, but on the actual record card it is better to make a complete statement of age in years and months so that it could be available for any further data that might be sought.

The plan most often adopted in publishing results is to record the average dimensions of each age group for boys and girls separately. The average may be somewhat misleading owing to the influence of a few individuals presenting unusual traits, so that, when possible, all observations should be recorded in full. The dimensions of the individual members of any population show a wide range of variation, even when all are of the same racial stock, and live under uniform conditions

of environment. This range increases with age until all growth has ceased. Thus in the middle-class schools of Boston, Massachusetts, Bowditch showed that while at the age of five the tallest boy exceeded the shortest by eleven inches, at the age of nine the corresponding difference in stature amounted to nineteen inches. It is therefore advisable to append to the table of averages a statement of the range of variation, and of the number of individuals in each group. The quantitative estimate of the variation or degree of dispersion is known as the *standard deviation*. The methods of ascertaining this quantity would occupy too long a time to be dealt with in this lecture, but those interested may be referred to the Report of the Medical Officer (Education) to the L.C.C. for 1907, pp. 10-16, while for a discussion of the general methods they may refer to Karl Pearson's "Grammar of Science."

The records having been made, it is necessary to endeavour to explain the meaning of any considerable divergencies between the averages of different groups. The chief points to which attention may be drawn are:—Age, heredity and environment.

If one group contained many children just past a birthday, and another many a large proportion just approaching the next, the averages for that year of life in the two groups might differ considerably without indicating the action of any cause other than age. This is not likely to occur in dealing with large groups of children whose ages would be fairly uniformly distributed, but must be remembered if a small group is under consideration. Beside actual age it is necessary, especially in dealing with individual children, to remember that the physiological and temporal ages may not coincide. Thus, if the physiological age be estimated by such factors as the number of teeth cut, it will be found that the average dimensions of those who have cut many teeth are greater than the average of those who have cut a smaller number. This difference is subsequently made up. A similar relation has been shown by Ward Crampton to exist between physiological age and scholastic attainments. This is of importance in view of the system of superannuation in force in certain public schools since, obviously, it is the physiological rather than the temporal age which should receive attention.

The hereditary factors are usually referred

to as racial. Thus, the average dimensions of children living in the East of Scotland are greater than of those in North Wales, from whom they differ in other characters, such as the pigmentation of the hair and eyes. In referring to the peoples of Western Europe, it is usual to distinguish three races who present characteristic associations of physical characters. These are:—

The *Nordic*, or Teutonic, long-headed, tall and fair, who occupy the countries bordering the Baltic Sea and the Eastern portions of the British Isles.

The *Mediterranean*, long-headed, short and very dark, who inhabit the South of Europe, but have outliers in the Western portions of the British Isles.

The *Alpine*, broad-headed, but intermediate between the others in stature and colouration. This race derives its name from the central mountainous region in which it is found in greatest purity, but sends outliers across Auvergne into Brittany, and is possibly slightly represented in our population.

In the British Isles, hair and eye colours form the easiest available test of race. The hair colours are classified as fair, red, light brown, dark brown, and black; the eyes as light (blue and grey), neutral, and dark (brown).

For further details, "Beddow's Races of Britain" may be consulted.

The problem of finding suitable standards for comparison is complicated by the phenomenon that the distribution of racial types is not the same in urban and rural districts. In Great Britain, the Continent, and in the United States, it has been shown that there is a tendency for the short, dark-haired element to collect in the great towns. In London, the darkest population, excluding alien immigrants, is to be found in the poorer and overcrowded central districts, while the suburban areas present a far greater proportion of fair-haired children.

It therefore seems necessary at present for each district to form its own standards, checking the possible influence of race by noting the colouration of each individual measured, and recording the averages and variations for each colour-type when a sufficient amount of material has been collected. The numbers at present available are far too small to allow of the publication of standards for the stature of children of different ages classified according to their colour-type, even if reference

to the action of environment were omitted. So far as they go, they point to fair and light brown-haired children being distinctly taller than the dark brown, black, and red haired. Also that light eyes are more often found in taller, and dark eyes in shorter children, but this only applies to large groups; in small areas the combinations are liable to wide variations.

The racial factor is worthy of attention, the absence of any record having spoilt many otherwise valuable contributions to anthropological literature on the influence of environment and social status.

The influence of environment on the rate of growth and on the standard of physique begins in pre-natal life when hardships or ill-health of the mother check the development of the child, though the effect on the child of partial starvation of the mother are much less than the subsequent effects of diminished nutrition in post-natal life.

The suitability and sufficiency of the food supply in early infancy exerts long lasting, if not a permanent influence. Russow detected the superiority in physique of the naturally fed child as late as the twelfth year.

In later life the physique appears to vary almost directly with the social status of the group under investigation. Several factors are concerned in the production of this phenomenon. Initially there is an hereditary element; the upper classes being nearly everywhere the descendants of the dominant race. Where two races come into contact, all the advantages of environment and power of selection of mates are in favour of the superior. Under modern conditions, the upper classes are able to choose their abode at will, and to spend a part of the year in the country, thus escaping the dangers of a continuous urban environment. They are exposed to no privations, and can avoid all influences tending to stunt growth.

Comparative statistics are available from many quarters, all showing the superiority of the children of the upper classes in stature, weight and thoracic perimeter. Often, however, the racial factor, which has been omitted, is such as to render deductions uncertain.

A marked difference in physique has been noted between country-folk and town-folk, the former being the taller and heavier. In Glasgow and Edinburgh this difference

amounts to as much as four inches in stature, and thirty-six pounds in weight; in London to only an inch-and-a-half and ten pounds.

Observations have shown that many great continental cities, in contrast with rural districts and small towns, present an excess of both tall and short individuals; the richer quarters being occupied by a tall, and the poorer by a very short population. This differentiation appears to be progressive. Ammon studied the conscripts of Baden over a series of years, thus obtaining information as to the physique of the entire young adult population during this period. He classified them into four groups—Urban, when both parents and conscripts were of town birth; Semi-urban, when the parents were born in the country but had immigrated into the towns; Semi-rural, when the conscripts, though born in the country, had been transferred to the town in early life; Rural, when the conscripts and their parents had always lived in the country. He found a progressive diminution of stature accompanied city residence.

Similar results have followed an investigation on a much smaller scale into the physique of Londoners.

It is probable that the most physically-fit section of the rural community comes to the towns in search of higher wages.

The physique of the citizen is worst in the central and most crowded areas, best in the suburbs.

Leslie Mackenzie has shown that in Glasgow the average stature and weight of children varies almost directly with the number of rooms occupied by the family, while Thomas, in London, indicated that though the physique undoubtedly varied with the number of rooms occupied, it bore a still closer relation to the number sleeping in a room. Overcrowding is not only accompanied by deficient ventilation and increased exposure to chronic microbial infection, and consequent ill-health, but also involves a smaller and less suitable food-supply, owing to the meagreness of the family exchequer. A change from these surroundings rapidly improves the children, who grow more in a short time than those not previously subjected to depressing influences.

CENTRAL MIDWIVES BOARD. — NEW MEMBER APPOINTED.—The Lord President of the Council has been pleased to appoint the Hon. Mrs. Charles Egerton to be a member of the Central Midwives Board in the place of Miss Jane Wilson, resigned.

POISONING BY FERRO-SILICON ON BOARD SHIP.

ON December 21st, the Grimsby coroner concluded the inquest upon the bodies of the five Russian emigrants who died suddenly on board the steamship *Ashton*, during the voyage from Antwerp to Grimsby on December 13th. The deceased were bound from Russia to America, via Antwerp, Grimsby, and Liverpool, and were all in good health when the vessel left Antwerp on the night of December 12th. Next morning the steward found four of them lying dead in their berths between decks, while the fifth was dying. It was at first suspected that cholera was the cause of death, and the ship was quarantined and portions of the deceased's anatomy were submitted for bacteriological examination.

Captain Millward, the master of the *Ashton*, was the first witness called, and he described in detail the position of the berths of the emigrants, which was situated between decks and directly above the forehold. There was a hatchway communicating between the places amongst the cargo. In that hold witness stated there were nine tons of ferro-silicon in barrels.

He had never heard of ferro-silicon before, but was informed that it was liable to explode if confined, and liable to fire when wet. He did not know that it gave off poisonous gases?

Witness went on to say that all five emigrants died within half an hour, and though he noticed no smell in the emigrants' quarters, he was very ill after visiting them. He concluded that he was suffering from shock.

John Alfred Foster, analytical chemist, of Hull, said he experimented with samples of the ferro-silicate from the *Ashton*. He found it to be composed of iron silicate, carbon, phosphorus, and arsenic. He found that five gases emanated from the mixture—arseniuretted hydrogen, phosphoretted hydrogen, acetylene, pure hydrogen, and sulphuretted hydrogen. Four of the gases were highly poisonous, and the fifth, hydrogen, was of an asphyxiating nature. Arseniuretted hydrogen was so terribly poisonous that its discoverer, Gahlen, died through inhaling one single bubble of the pure gas. Phosphoretted hydrogen was scarcely less deadly. In less than twenty-four hours the nine tons of ferro-silicon would generate 110 cubic feet of extremely deadly gas, assuming it was dry; if the chemical were moist there would be thrice the volume of gas.

He added that Captain Millward's symptoms were those produced by inhaling the gas. The early symptoms of ferro-silicon poisoning were often mistaken for cholera and ptomaine-poisoning. The gas decomposed the blood and produced death.

Dr. William Bulmer Simpson, Medical Officer of Health, said that the bacteriological examinations conducted by the Government expert proved negative in character, showing that the deceased did not die from cholera, ptomaine poisoning, or from consumption of crude poison. The lungs, on the other hand, were congested and full of blood, suggesting asphyxia by noxious fumes.