

THE ANTHROPOMETRIC LABORATORY.

WHEN shall we have anthropometric laboratories, where a man may from time to time get himself and his children weighed, measured, and rightly photographed, and have each of their bodily faculties tested, by the best methods known to modern science? In the January number of this *Review* I endeavoured to show the advantages of Photographic Chronicles maintained from childhood to age, and how they should be made and preserved; in the present memoir I propose to briefly speak upon the anthropometric and medical facts that might properly be recorded by the side of the photographs in the family records to which I there referred. I shall endeavour to define the scope of what may be effected in this direction, partly by accurate apparatus now extant, and partly in a rougher and less effective way owing to the present want of appropriate apparatus. In doing so the instrumental and other desiderata will be pointed out that seem most easily capable of being supplied if the attention of a few persons interested in the matter could be brought to bear on the subject. Two things are at present needed—a desire among many persons to have themselves and their children accurately appraised, and an effort among a few scientific persons who have the special knowledge required for the purpose to systematise the methods by which this could best be done.

There appears at length to be a somewhat general concurrence of opinion that the possibilities of a child's future career are more narrowly limited than our forefathers were fondly disposed to believe. I shall not endeavour to epitomise the many arguments *pro* and *con* in respect to such views as these, but will merely recall in partial justification of them the results of some inquiries into the life histories of twins¹ that I published a few years ago. I took two categories of twins—those who were closely alike in their infancy and those who were exceedingly unlike—and I traced their histories up to the date of the memoir. It appeared that twins who were closely alike at the first, frequently preserved their resemblance throughout life, subject I may almost say to the accident of a fever or other serious illness altering the constitution of one of them, and laying the first foundation of a gradually widening divergence. I found not a few cases in which twins residing apart and following different professions at home and abroad still continued to live parallel lives, ageing in the same way, and preserving all along the same features, voice, gestures, and ways of thought. I also met with cases in which death had occurred at nearly the same time to the two

(1) *Journal of Anthropological Institute*, 1875. *Fraser's Magazine*, Nov., 1875.

twins, and from the same disease. It further appeared, as regards those twins who were born very unlike, that in no case did their dissimilarity lessen under the influence of identical nurture. They had the same nurses, the same tutors, the same companions, they were reared in every respect alike, yet their characters continued to be as dissimilar, and, I need hardly add, their features remained as different as if they had belonged to totally different families. The conclusion to which I was driven by the results of this inquiry was that a surprisingly small margin seemed to be left to the effects of circumstances and education, and to the exercise of what we are accustomed to call "free-will."

It follows from such opinions as these, which appear to be gaining ground in popular estimation, that it is highly desirable to give more attention than has been customary hitherto to investigate and define the capacities of each individual. They form his stock-in-trade, the amount of which admits of definition, whereby he has to gain his livelihood, and to fulfil the claims upon him as head of a family and as a citizen. So far as we succeed in measuring and expressing them, so far almost in an equal degree should we be able to forecast what the man is really fit for, and what he may undertake with the least risk of disappointment. They would encourage him if unduly timid, or they would warn him from efforts doomed to be wasted.

What I propose to speak of in the present memoir are those measurements of the bodily form and faculties that can, or apparently could be, made with some precision, but the personal data in respect to intellectual and emotional capacities and to special aptitudes and tastes require a separate treatment. The progress of the art of measurement of the more purely bodily faculties has been by no means uniform. It has never been specially directed towards furthering the knowledge of the life-history of individuals, but for the most part towards other theoretical investigations. In some cases elaborate instruments and methods of observation have been devised by which certain faculties have been tested with extreme minuteness; in other cases no well-contrived and approved system of examination exists. If everything should be stated by which anthropometry might profit, the effect would be not unlike the map of some partially settled country drawn on a scale so large as to show the cadastral survey of its principal town lands. A fraction of the whole would thus be minutely engraved, the wide adjacent regions would be represented by a few lines of route, and the remainder would consist of blanks. In order to convey in the best way an idea of what is known about such a country as this, the general map of it should be on a small scale, and then uniformity of treatment becomes possible. Acting on this principle, I shall avoid entering into details on those subjects where there exists very much to speak of, and

shall nowhere go farther than is sufficient to express the simpler requirements of anthropometry.

Let us then consider how we should set to work to define and describe the various bodily faculties of a person whom we had ample means of observing, say one of our own children. Some of the observations could hardly be made except at a properly equipped anthropometric laboratory; others, as it will be seen, could at present be carried on best in the playground. I shall not care to distinguish these in the description, they will be obvious enough when they occur. The tests would define the capacities of the person at the moment when he was observed. They are expected to be renewed at intervals, so as to serve as records of successive periods in his life-history.

Photography was the subject of my last memoir. I showed that the features should be taken in full face and in exact profile, and on not too small a scale—that of about one-seventh of the natural size being perhaps the most convenient. I also spoke of other photographs in less formal attitudes, to show the whole figure and gesture. In some of these the limbs might be more or less bared to exhibit the muscular development.

I need not dwell upon the usual anthropometric measurements. They should of course be made, and probably no better rules can be followed in making them than those of the present Anthropometric Committee of the British Association. These measurements refer to height, to weight, to chest girth (but only if taken by skilled observers on a uniform plan), to capacity of lungs (also under those conditions), and to colour of hair and eyes. Other data are asked for in the instructions issued by the committee which would also require to be recorded, and which may as well be mentioned now—such as birthplace and residence, whether in town or country, both of the person and of his parents; also their race, whether English, Scotch, or Irish, &c.

We now proceed to the measurements and records that are more especially the subject of this memoir.

Energy may be defined as the length of time during which a person is wont to work at full stretch, day by day, without harm to himself, in obedience to an instinctive craving for work, and Endurance may be tested by the same observation if an adequate motive for work be supplied. Some persons seem almost indefatigable; they are never happy or well except when in constant action; and they fidget, fret, and worry themselves under enforced idleness. Others, whose vitality is low, break down under a small amount of strain, and their happiness lies mainly in repose. The true tests would undoubtedly be physiological and of considerable delicacy, but they have yet to be discovered, or at least to be systematised for anthropometric purposes. They would measure the excess of waste

over repair consequent upon any given effort, and would furnish the indications of a loss of capital which, if persevered in, must infallibly lead to vital bankruptcy. Now, when a haberdasher examines a piece of cloth to learn its strength, he handles and pulls it gently in different directions, but he does not care to tear it to pieces or to strain it. He learns by the way it behaves under a moderate tension how it would support a great deal more of it. So it may prove to be with physiological tests as applied to the determination of the amount of endurance. The balance of the living system might be artificially disturbed by a definite small force, and its stability under the influence of greater forces might thereby be inferred. Unfortunately the only convenient tests of a person's endurance that are now available are records of such feats of sustained bodily or mental work as he may have recently performed, that were not succeeded next day by feverish excitement or by fatigue, but whose effects were entirely dissipated by a single night's rest.

The faculties about which I have next to speak admit of being developed in a high degree by exercise, and some difficulty will always arise in knowing how far their development may be due to nature and how far to practice. This difficulty is, however, of less importance than it might appear to be. All our faculties are somewhat exercised in the ordinary course of life, and when we begin to practise any special test, though our skill increases rather quickly at first, its rate of progress soon materially lessens, and we are able to judge with sufficient precision of the highest point which we can hope to attain. When recording the results of any test it would be sufficient to append a brief note concerning the amount of previous practice.

The strength is best measured by a spring dynamometer, of which the framework is held in the left hand with the arm extended, while the spring is drawn back by the right hand in the attitude of an archer. This is the test used by the Anthropometric Committee; it only refers to the strength of the arms, but that is in most cases sufficient to express the general muscular power, and it has the advantage of not causing injurious straining to weakly persons. Trials of lifting heavy weights are positively dangerous. If a multitude of persons were tested in that way, some instances of broken blood-vessels and of abdominal ruptures would be almost sure to occur.

Agility may be defined in terms say of the number of seconds required to run a hundred yards, of the greatest horizontal distance that can be covered by a leap, of the distance to which a cricket-ball can be thrown, and by means of various gymnastic feats. The several merits of the latter, however, require to be carefully considered, and those that can be performed indoors and in a confined space should be selected as standards.

The co-ordination of muscles and eye is another faculty that varies

widely in different persons, while it is also greatly increased by education. Some persons are gifted with a high power of accurate movement, while others are as notoriously clumsy. In all cases, however, this faculty may be largely developed in special directions, as is shown by the superior dexterity of artisans to that of amateurs. It seems a most simple faculty to be tested, nevertheless I know of no recognised methods of doing so; and in default of one, the best plan of defining its amount might be, in the case of youths, by their measured skill in well-known games, as racquets, cricket, rifle-shooting, billiards, and wherever else a good eye and steady hand are required.

The faculty of sense discrimination has in many respects been the subject of most elaborate experiments, chiefly in regard to the relation between the amounts of stimuli, as measured by objective standards (such as weight in pounds, as brightness in units of intensity, &c.), and the corresponding amount of evoked sensations, measured by subjective standards, namely, by the feelings of the several persons operated on. Out of all the contrivances that have been devised for these experiments, some of which are extremely delicate, we want a battery of the most simple ones that are sufficiently effective for ordinary anthropometric purposes. I find it difficult, in obedience to the programme already laid down, to enter as much as I should like to do into particulars concerning this wide and important part of the subject before us. The sources of error to be guarded against, the principles that have to be attended to, and the instruments already in use cannot be properly explained in a few paragraphs. The reader must take it for granted that all this is a familiar subject to many writers and experimenters, such as Fechner and Delbœuf, and that the work remaining to be done is to select out of extant instruments those that are sufficiently inexpensive and quick in manipulation to be appropriately placed in an anthropometric laboratory. Under these circumstances I will refrain from doing more than specifying the more important measurements among the many that admit of being made.

Sight.—Its keenness; the appreciation of different shades; that of different colours.

Sound.—Its keenness; the appreciation of different grades of loudness; that of different notes.

Touch.—Discrimination of different roughnesses, such as wire-work of differently sized mesh.

Muscular Sense.—Discrimination of weights externally alike, but differing slightly in specific gravity.

Another class of delicate apparatus refers to the rate of response to stimuli. A signal is given to one of the senses, as by the sight of a suddenly lifted finger, by an exclamation, or by a touch, to

which response is made by pressing a stop. The interval between the signal and the response is measurable, and it differs in different persons.

Another well-known arrangement tests the time lost in forming a simple judgment. Arrangement is made for two possible and different signals, which are severally to be responded to by different forms of response. The subject of the experiment is ignorant which of the two signals will appear. After he perceives it, there is an appreciable time of hesitation before he is able to make the appropriate response, and this time is easily measured, and is found to differ in different persons.

The persistence of impressions, especially if visual ones, is exceedingly various. Some persons are strongly affected by after-images and others are not. For example, after gazing at a red wafer for a short definite time and then rapidly withdrawing the eye, the appearance of a green after-image will be present to some and not to others. There can be little doubt that the liability to after-images is an important factor of the artistic temperament, being the base of the enhanced susceptibility to conditions of contrast and harmony of colours. Numerous experiments exist bearing on various kinds of after-images, but they want systematising for anthropometric purposes.

The memory, in its dependence on the relative impressions of eye, ear, and other senses, whether severally or in combination, admits of being tested, and here again numerous scattered experiences have been gained, and ingenious experiments have been devised which require consolidating and systematising.

This is perhaps as much as need be said in a very brief general glance over a large division of a large subject. My object is to point out that means already exist for the appraisalment of many of the principal bodily faculties, but that they require to be systematised, and that others have to be contrived, and that they cannot be properly utilised for ordinary anthropometric purposes without such apparatus as would require to be kept in a laboratory and used under the guidance of an intelligent operator.

I will say a few words, and a few only, upon another large branch to which I alluded in my previous article, namely the medical life-history of each individual. There seems to be a need for medicometric laboratories where certificates of observed facts should be furnished to any applicant for stated fees. These would contain as exact and complete a report of the physiological status of a person as is feasible in the present state of science, by the help of the microscope, chemical tests, and physiological apparatus. Laboratories of this description ought to be welcome to practising physicians, who, being unable to keep the necessary apparatus in their consulting

rooms, could send their patients to be examined in any way they wished, whenever they thought it desirable to do so. The laboratories would be of the same convenience to them that the Kew Observatory is to physicists, who can send their delicate instruments there to have their errors ascertained.

The data for the medical history of a man's life are the observations made by his physician in his successive illnesses, and I would dwell on the importance of gradually establishing a custom that the medical attendant of each patient should as a matter of course write down such clinical notes of his case as are written at the bedsides of public patients at hospitals. These papers would be for the private and future use of the patient, and would be preserved by him together with the prescriptions. They would accumulate as the years went by, and would form the materials for a medical life-history of very great value to the patient himself in the illnesses of his later life. The records might be epitomised by his physician from time to time, and they would in that form be an heir-loom to the children of the patient, warning their medical attendants in future years by throwing light on hereditary peculiarities.

The popular object of this and the previous memoir is to further the accumulation of materials for life-histories in the form of adequate photographs, anthropometric measurements, and medical facts. No doubt it would be contrary to the inclinations of most people to take much trouble of the kind about themselves, but I would urge them do so for their children so far as they have opportunities, and to establish a family register for the purpose, filling it up periodically as well as they can. It will have been seen that much may be effected without special apparatus, and on the other hand that much more could be effected and with increased ease and precision if anthropometric laboratories existed. Should a demand arise for such establishments it would not be difficult to form them in connection with various existing scientific institutions. A few shelves would hold the necessary apparatus. Something useful of the kind could be set on foot at a moment's notice, but it would require much practice and consideration by capable men before a standard outfit could be decided on.

The motives that might induce a person to take the trouble of getting himself accurately measured and appraised from time to time and of recording the results are briefly as follows:—(1) Their biographical interest to the person himself, to his family, and descendants. (2) Their utility, especially from a medical point of view, to himself in after life. (3) The information they might give of hereditary dangers and vital probabilities to his descendants. (4) Their value as future materials for much-needed investigations into the statistics of life-histories.

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