CHAPTER VI.

DATA.

Records of Family Faculties, or R. F. F. data.—Special Data.—Measures at my Anthropometric Laboratory.—Experiments on Sweet Peas.

I HAD to collect all my data for myself, as nothing existed, so far as I know, that would satisfy even my primary requirement. This was to obtain records of at least two successive generations of some population of considerable size. They must have lived under conditions that were of a usual kind, and in which no great varieties of nurture were to be found. Natural selection must have had little influence on the characteristics that were to be examined. These must be measurable, variable, and fairly constant in the same individual. The result of numerous inquiries, made of the most competent persons, was that I began my experiments many years ago on the seeds of sweet peas, and that at the present time I am breeding moths, as will be explained in a later chapter, but this book refers to a human population, which, take it all in all, is the easiest to work with when the data are once obtained,

to say nothing of its being more interesting by far than one of sweet peas or of moths.

Record of Family Faculties, or R.F.F. Data.—The source from which the larger part of my data is derived consists of a valuable collection of "Records of Family Faculties," obtained through the offer of prizes. They have been much tested and cross-tested, and have borne the ordeal very fairly, so far as it has been applied. It is well to reprint the terms of the published offer, in order to give a just idea of the conditions under which they were compiled. It was as follows:

"Mr. Francis Galton offers 500*l.* in prizes to those British Subjects resident in the United Kingdom who shall furnish him before May 15, 1884, with the best Extracts from their own Family Records.

"These Extracts will be treated as confidential documents, to be used for statistical purposes only, the insertion of names of persons and places being required solely as a guarantee of authenticity and to enable Mr. Galton to communicate with the writers in cases where further question may be necessary.

"The value of the Extracts will be estimated by the degree in which they seem likely to facilitate the scientific investigations described in the preface to the 'Record of Family Faculties.'

"More especially:

"(*a*) By including every direct ancestor who stands within the limits of kinship there specified.

"(*b*) By including brief notices of the brothers and

sisters (if any) of each of those ancestors. (Importance will be attached both to the completeness with which each family of brothers and sisters is described, and also to the number of persons so described.)

"(*c*) By the character of the evidence upon which the information is based.

"(*d*) By the clearness and conciseness with which the statements and remarks are made.

"The Extracts must be legibly entered either in the tabular forms contained in the copy of the 'Record of Family Faculties' (into which, if more space is wanted, additional pages may be stitched), or they may be written in any other book with pages of the same size as those of the Record, provided that the information be arranged in the same tabular form and order. (It will be obvious that uniformity in the arrangement of documents is of primary importance to those who examine and collate a large number of them.)

"Each competitor must furnish the name and address of a referee of good social standing (magistrate, clergyman, lawyer, medical practitioner, &c.), who is personally acquainted with his family, and of whom inquiry may be made, if desired, as to the general trustworthiness of the competitor.

"The Extracts must be sent prepaid and by post, addressed to Francis Galton, 42 Rutland Gate, London, S.W. It will be convenient if the letters 'R.F.F.' (Record of Family Faculties) be written in the left-hand corner of the parcel, below the address.

"The examination will be conducted by the donor of the prizes, aided by competent examiners.

"The value of the individual prizes cannot be fixed beforehand. No prize will, however, exceed 50*l.*, nor be less than 5*l.*, and 500*l.* will on the whole be awarded.

"A list of the gainers of the prizes will be posted to each of them. It will be published in one or more of the daily newspapers, also in at least one clerical, and one medical Journal."

The number of Family Records sent in reply to this offer, that deserved to be seriously considered before adjudging the prizes, barely reached 150; 70 of these being contributed by males, 80 by females. The remainder were imperfect, or they were marked "not for competition," but at least 10 of these have been to some degree utilised. The 150 Records were contributed by persons of very various ranks. After classing the female writers according to the profession of their husbands, if they were married, or according to that of their fathers, if they were unmarried, I found that each of the following 7 classes had 20 or somewhat fewer representatives: (1) Titled persons and landed gentry; (2) Army and Navy; (3) Church (various denominations); (4) Law; (5) Medicine; (6) Commerce, higher class; (7) Commerce, lower class. This accounts for nearly 130 of the writers of the Records; the remainder are land agents, farmers, artisans, literary men, schoolmasters, clerks, students, and one domestic servant in a family of position.

Three cases occurred in which the Records sent by different contributors overlapped. The details are complicated, and need not be described here, but the result is that five persons have been adjudged smaller prizes than they individually deserved.

Every one of the replies refers to a very large number of persons, as will easily be understood if the fact is borne in mind that each individual has 2 parents, 4 grandparents, and 8 great parents; also that he and each of those 14 progenitors had usually brothers and sisters, who were included in the inquiry. The replies were unequal in merit, as might have been expected, but many were of so high an order that I could not justly select a few as recipients of large prizes to the exclusion of the rest. Therefore I divided the sum into two considerable groups of small prizes, all of which were well deserved, regretting much that I had none left to award to a few others of nearly equal merit to some of those who had been successful. The list of winners is reproduced below, the four years that have elapsed have of course made not a few changes in the addresses, which are not noticed here.

LIST OF AWARDS.

A PRIZE OF £7 WAS AWARDED TO EACH OF THE 40 FOLLOWING CONTRIBUTORS.

Amphlett, John, Clent, Stourbridge; Batchelor, Mrs. Jacobstow Rectory, Stratton, N. Devon; Bathurst, Miss K., Vicarage, Biggleswade, Bedfordshire; Beane, Mrs. C. F., 3 Portland Place, Venner Road, Sydenham; Berisford, Samuel, Park Villas, Park Lane, Macclesfield; Carruthers, Mrs., Brightside, North Finchley; Carter, Miss Jessie E., Hazelwood, The Park, Cheltenham; Cay, Mrs., Eden House, Holyhead; Clark, J. Edmund,

Feversham Terrace, York; Cust, Lady Elizabeth, 13 Eccleston Square, S.W.; Fry, Edward, Portsmouth, 5 The Grove, Highgate, N.; Gibson, G. A., M.D., 1 Randolph Cliff, Edinburgh; Gidley, B. Courtenay, 17 Ribblesdale Road, Hornsey, N.; Gillespie, Franklin, M.D., 1 The Grove, Aldershot; Griffith-Boscawen, Mrs., Trevalyn Hall, Wrexham; Hardcastle, Henry, 38 Eaton Square, S.W.; Harrison, Miss Edith, 68 Gloucester Place, Portman Square, W.; Hobhouse, Mrs. 4 Kensington Square, W.; Holland, Miss, Ivymeath, Snodland, Kent; Hollis, George, Dartmouth House, Dartmouth Park Hill, N.; *Ingram, Mrs. Ades, Chailey, Lewis, Sussex; Johnstone, Miss C. L.*, 3 Clarendon Place, Leamington; Lane-Poole, Stanley, 6 Park Villas East, Richmond, Middlesex; Leathley, D. W. B., 59 Lincoln's Inn Fields (in trust for a competitor who desires her name not to be published); Lewin, Lieutenant-Colonel T. H., Colway Lodge, Lyme Regis; Lipscomb, R. H., East Budleigh, Budleigh Salterton, Devon; Malden, Henry C., Windlesham House, Brighton; Malden, Henry Elliot, Kitland, Holmwood, Surrey; McCall, Hardy Bertram, 5 St. Augustine's Road, Edgbaston, Birmingham; Moore, Miss Georgina M., 45 Chepstow Place, Bayswater, W.; Newlands, Mrs., Raeden, near Aberdeen; Pearson, David R., M.D., 23 Upper Philimore Place, Kensington, W.; Pearson, Mrs., The Garth, Woodside Park, North Finchley: Pechell, Hervey Charles, 6 West Chapel Street, Curzon Street, W.; Roberts, Samuel, 21 Roland Gardens, S.W.; Smith, Mrs. Archibald, Riverbank, Putney, S.W.; Strachey, Mrs. Fowey Lodge, Clapham Common, S.W.; Sturge, Miss Mary C., Chilliswood, Tyndall's Park, Bristol; Sturge, Mrs. R. F., 101 Pembroke Road, Clifton; Wilson, Edward T., M.D., Westall, Cheltenham.

A PRIZE OF £5 WAS AWARDED TO EACH OF THE 44 FOLLOWING CONTRIBUTORS.

Allan, Francis J., M.D., 1 Dock Street, E.; Atkinson, Mrs., Clare College Lodge, Cambridge; Bevan, Mrs., Plumpton House, Bury St. Edmunds; Browne, Miss, Maidenwell House, Louth, Lincolnshire; Cash, Frederick Goodall, Gloucester; Chisholm, Mrs., Church Lane House, Haslemere, Surrey; Collier, Mrs. R., 7 Thames Embankment, Chelsea; Croft, Sir Herbert G. D., Lugwardine Court, Hereford; Davis, Mrs. (care of Israel Davis, 6 King's Bench Walk, Temple, E.C.); Drake, Henry H., The Firs, Lee, Kent; Ercke, J. J. G., 13, Brownhill Road, Catford, S.E.; Flint, Fenner Ludd, 83 Brecknock Road, N.; Ford, William, 4 South Square, Gray's Inn, W.C.; Foster, Rev. A. J., The Vicarage, Wootton, Bedford; Glanville-Richards, W. V. S., 23 Endsleigh Place, Plymouth; Hale, C. D. Bowditch, 8 Sussex Gardens, Hyde Park, W.; Horder, Mrs. Mark, Rothenwood, Ellen Grove, Salisbury; Jackson, Edwin, 79 Withington Road, Whalley Range, Manchester; Jackson, George, 1 St. George's Terrace, Plymouth; Kesteven, W. H., 401 Holloway Road, N.; Lawrence, Mrs.

Alfred, 16 Suffolk Square, Cheltenham ; Lawrie, Mrs., 1 Chesham Place, S.W. ; Leveson-Gower, G. W. G., Titsey Place, Limpsfield, Surrey ; Lobb, H. W., 66 Russell Square, W. ; McConnell, Miss M. A. Brooklands, Prestwich, Manchester ; Marshall, Mrs., Fenton Hall, Stoke-upon-Trent ; Meyer, Mrs., 1 Rodney Place, Clifton, Bristol; Milman, Mrs., The Governor's House, H.M. Prison, Camden Road ; Olding, Mrs. W. 4 Brunswick Road, Brighton, Sussex ; Passingham, Mrs., Milton, Cambridge ; Pringle, Mrs. Fairnalie, Fox Grove Road, Beckenham, Kent; Reeve, Miss, Foxholes, Christchurch, Hants ; Scarlett, Mrs., Boscomb Manor, Bournemouth ; Shand, William, 57 Caledonian Road, N. ; Shaw, Cecil E., Wellington Park, Belfast ; Sizer, Miss Kate T., Moorlands, Great Huntley, Colchester ; Smith, Miss A. M. Carter, Thistleworth, Stevenage ; Smith, Rev. Edward S., Viney Hall Vicarage, Blakeney, Gloucestershire ; Smith, Mrs. F. P., Cliffe House, Sheffield ; Staveley, Edw. S. R., Mill Hill School, N.W. ; Sturge, Miss Mary W., 17 Frederick Road, Edgbaston, Birmingham ; Terry, Mrs., Tostock, Bury St. Edmunds, Suffolk; Utley, W. H. Alliance Hotel, Cathedral Gates, Manchester ; Weston, Mrs. Ensleigh, Lansdown, Bath ; Wodehouse, Mrs. E. R. 56 Chester Square, S.W.

The material in these Records is sufficiently varied to be of service in many inquiries. The chief subjects to which allusion will be made in this book concern Stature, Eye-Colour, Temper, the Artistic Faculty, and some forms of Disease, but others are utilized that refer to Marriage Selection and Fertility.

The following remarks in this Chapter refer almost wholly to the data of Stature.

The data derived from the Records of Family Faculties will be hereafter distinguished by the letters R.F.F. I was able to extract from them the statures of 205 couples of parents, with those of an aggregate of 930 of their adult children of both sexes. I must repeat that when dealing with the female statures, I transmuted them to their male equivalents ; and treated them when thus transmuted, on equal terms with the measures of males,

except where otherwise expressed. The factor I used was 1·08, which is equivalent to adding a little less than one-twelfth to each female height. It differs slightly from the factors employed by other anthropologists, who, moreover, differ a trifle between themselves; anyhow, it suits my data better than 1·07 or 1·09. I can say confidently that the final result is not of a kind to be sensibly affected by these minute details, because it happened that owing to a mistaken direction, the computer to whom I first entrusted the figures used a somewhat different factor, yet the final results came out closely the same. These R.F.F. data have by no means the precision of the observations to be spoken of in the next paragraph. In many cases there remains considerable doubt whether the measurement refers to the height with the shoes on or off; not a few of the entries are, I fear, only estimates, and the heights are commonly given only to the nearest inch. Still, speaking from a knowledge of many of the contributors, I am satisfied that a fair share of these returns are undoubtedly careful and thoroughly trustworthy, and as there is no sign or suspicion of bias, I have reason to place confidence in the values of the Means that are derived from them. They bear the internal tests that have been applied better than might have been expected, and when checked by the data described in the next paragraph, and cautiously treated, they are very valuable.

Special Data.—A second set of data, distinguished by the name of "Special observations," concern the

variations in stature among Brothers. I circulated cards of inquiry among trusted correspondents, stating that I wanted records of the heights of brothers who were more than 24 and less than 60 years of age; that it was not necessary to send the statures of all of the brothers of the same family, but only of as many of them as could be easily and accurately measured, and that the height of even two brothers would be acceptable. The blank forms sent to be filled, were ruled vertically in three parallel columns: (*a*) family name of each set of brothers; (*b*) order of birth in each set; (*c*) height without shoes, in feet and inches. A place was reserved at the bottom for the name and address of the sender. The circle of inquirers widened, but I was satisfied when I had obtained returns of 295 families, containing in the aggregate 783 brothers, some few of whom also appear in the R.F.F. data. Though these two sets of returns overlap to a trifling extent, they are practically independent. I look upon the "Special Observations" as being quite as trustworthy as could be expected in any such returns. They bear every internal test that I can apply to them in a very satisfactory manner. The measures are commonly recorded to quarter or half inches.

Measures at my Anthropometric Laboratory.—A third set of data have been incidentally of service. They are the large lists of measures, nearly 10,000 in number, made at my Anthropometric Laboratory in the International Health Exhibition of 1884.

4. *Experiments on Sweet Peas.*—The last of the data

that I need specify were the very first that I used; they refer to the sizes of seeds, which are equivalent to the Statures of seeds. I both measured and weighed them, but after assuring myself of the equivalence of the two methods (see Appendix C.), confined myself to ascertaining the weights, as they were much more easily ascertained than the measures. It is more than 10 years since I procured these data. They were the result of an extensive series of experiments on the produce of seeds of different sizes, but of the same species, conducted for the following reasons. I had endeavoured to find a population possessed of some measurable characteristic that was suitable for investigating the causes of the statistical similarity between successive generations of a people, as will hereafter be discussed in Chapter VIII. At last I determined to experiment on seeds, and after much inquiry of very competent advisers, selected sweet-peas for the purpose. They do not cross-fertilize, which is a very exceptional condition among plants; they are hardy, prolific, of a convenient size to handle, and nearly spherical; their weight does not alter perceptibly when the air changes from damp to dry, and the little pea at the end of the pod, so characteristic of ordinary peas, is absent in sweet-peas. I began by weighing thousands of them individually, and treating them as a census officer would treat a large population. Then I selected with great pains several sets for planting. Each set contained seven little packets, numbered K, L, M, N, O, P, and Q, each of the seven packets contained ten seeds of almost

exactly the same weight; those in K being the heaviest, L the next heaviest, and so down to Q, which was the lightest. The precise weights are given in Appendix C, together with the corresponding diameters, which I ascertained by laying 100 peas of the same weight in a row. The weights run in an arithmetic series, having a common average difference of 0·172 grain. I do not of course profess to work to thousandths of a grain, though I did work to somewhat less than one hundredth of a grain; therefore the third decimal place represents little more than an arithmetical working value which has to be regarded in multiplications, lest an error of sensible importance should be introduced by its neglect. Curiously enough, the diameters were found also to run approximately in an arithmetic series, owing, I suppose, to the misshape and corrugations of the smaller seeds, which gave them a larger diameter than if they had been plumped out into spheres. All this is shown in the Appendix, where it will be seen that I was justified in sorting the seeds by the convenient method of the balance and weights, and of accepting the weights as directly proportional to the mean diameters.

In each experiment, seven beds were prepared in parallel rows; each was $1\frac{1}{2}$ feet wide and 5 feet long. Ten holes of 1 inch deep were dibbled at equal distances apart along each bed, and a single seed was put into each hole. The beds were then bushed over to keep off the birds. Minute instructions were given to ensure uniformity, which I need not repeat here. The end of all was that the seeds as they became ripe were

collected from time to time and put into bags that I had sent, lettered from K to Q, the same letters having been stuck at the ends of the beds. When the crop was coming to an end, the whole remaining produce of each bed, including the foliage, was torn up, tied together, labelled, and sent to me. Many friends and acquaintances had each undertaken the planting and culture of a complete set, so that I had simultaneous experiments going on in various parts of the United Kingdom from Nairn in the North to Cornwall in the South. Two proved failures, but the final result was that I obtained the more or less complete produce of seven sets; that is to say, the produce of $7 \times 7 \times 10$, or of 490 carefully weighed parent seeds. Some additional account of the results is given in Appendix C.

It would be wholly out of place to enter here into further details of the experiments, or to narrate the numerous little difficulties and imperfections I had to contend with, and how I balanced doubtful cases; how I divided returns into groups to see if they confirmed one another, or how I conducted any other well-known statistical operation. Suffice it to say that I took immense pains, which, if I had understood the general conditions of the problem as clearly as I do now, I should not perhaps have cared to bestow. The results were most satisfactory. They gave me two data, which were all that I wanted in order to understand in its simplest approximate form, the way in which one generation of a people is descended from a previous one; and thus I got at the heart of the problem at once.