

*Pedigree Stock Records.*—*Report of the Committee, consisting of FRANCIS GALTON, D.C.L., F.R.S. (Chairman), Professor E. B. POULTON, F.R.S., and Professor W. F. R. WELDON, F.R.S. (Secretary), appointed to promote the Systematic Collection of Photographic and other Records of Pedigree Stock. (Drawn up by the Chairman.)*

INQUIRIES made on behalf of the Committee have fully justified the belief that led to its appointment, namely, that few exact records exist of even the nearer ancestry of the members of any description of Pedigree Stock. The *names* of all their ancestry for many past generations are published in Stud-books, Herd-books, and other similar works, but, in other respects those works afford scant means for obtaining that distinct presentment of each of the nearer ancestry which is needed for an exact study of the Art of Breeding. The information as to feature and form in the books mentioned above is almost wholly confined to colour, and, in the case of horses only, to height at the withers. Many details relating to appearance and action are, however, scattered over the pages of various volumes and periodicals, but these would require an excessive amount of labour in research before any complete families could be properly worked through for even three generations. As regards photographs, those of the more celebrated animals are now published in one form or another; nevertheless, it has been found very difficult to obtain the photographs of even a few of those genealogical *triads*, consisting of an adult subject, its sire, and its dam, which form the primary molecules of every pedigree. The authorities who were consulted on thoroughbred horses and on purely bred shorthorn cattle, were hardly able to indicate a single case in which photographs exist of all the seven individuals—the adult subject, its two parents, and its four grandparents—which form the secondary molecules of a pedigree. Thus the admirable opportunities enjoyed by breeders for making systematic records that would afford a solid basis for the advancement of the art of breeding, have been hitherto most inadequately utilised. The reason is not far to seek. Heredity is a comparatively new science, and few persons are as yet acquainted with the character of the records most suitable for its study, or are sufficiently impressed with the need for their exactness and persistence. The most important of those records which it seems feasible to obtain are photographs, not merely pretty and well worked-up productions satisfactory to an artistic eye, but rather such as are analogous to the portraits made of criminals, for storage at the central police office, to serve as future means of identification. The desired photographs need to be taken under such conditions as shall ensure their being comparable under equal terms, and shall admit of the accurate translation of measurements made upon them into corresponding measurements made on the animals themselves. There are a variety of ways by which the latter process may be performed, but it was only after many trials that a method was found capable of being used with extreme facility. It will be described later on; in the mean time, its existence may be taken for granted. The problem was thenceforward reduced to that of devising a self-working system by which the more important pedigree animals, say the prize-winners at great Shows, should be habitually photographed under standard conditions. Before this could be done certain doubtful questions had to be solved by an adequate experiment.

(1) Is it possible to make satisfactory photographs under standard conditions amid the hurry and under the necessary restrictions of a great Show? (2) If so, could they be made at a reasonable cost? (3) Is there any likelihood of such a system being self-supporting?

The desired experiment was permitted to be made, in response to a request of the Committee, by the Royal Commissioners on Horse-breeding at their Show held last March at the Royal Agricultural Hall. On this occasion 29 premium stallions were selected for service throughout England during the current season, who will become the sires of some 800 foals within the present twelvemonth. The Committee desire to express their grateful thanks to the Royal Commissioners for the assistance thus cordially given to them. The results were most satisfactory; they will be found in an Appendix to the Blue Book (C.—9487. Price 2½d.) just issued by the Royal Commission. Reference should be made to this by those persons who desire fuller information than is given in this Report. Twenty-eight out of the 29 premium horses were photographed at the average rate of six minutes to each horse. Considered merely as portraits, they were very satisfactory, and they were of a size that gave, roughly, 2 inches or 50 millimetres for the height at the withers, being a little less than 1 millimetre to 1 inch of real height. Measurements made on them gave results that, in three-quarters of the cases, did not differ more than  $\frac{3}{4}$  inch from those made by two veterinaries on the animals themselves. In the remaining quarter of the cases in which the differences ranged up to a single instance of  $2\frac{1}{2}$  inches, it seemed from internal evidences and other considerations that the photographic method was the more trustworthy of the two. The experiment further showed that the cost of photography did not exceed what might be wholly or in part recouped by the sale of prints, and there was reason to believe that a highly skilled photographer might consent to take the photographs under standard conditions, at his sole charge, if he were permitted to sell authorised copies to newspapers and to private persons under such reasonable restrictions as might be thought proper by the authorities.

Should this hope be hereafter realised, it seems difficult to imagine that any serious difficulty would stand in the way of causing the photography of prize-winners to become a permanent feature in the larger Shows of Pedigree Stock. Of course, the uncertainties of weather have to be reckoned with, and the Shows held during the darker period of the year, in the smoky atmosphere of large towns, should be left out of consideration, unless artificial light could be used. But the more valuable animals are usually exhibited more than once, so that an occasional photographic mishap might be subsequently remedied.

Details relating to what has been said will now be given; they will be found stated at greater length in the Appendix to the Blue Book mentioned above.

*Standard Conditions.*—The arrangements now suggested are slight improvements on those under which the experiment was conducted. A wall, or solid vertical screen, is required for a background, and a hard and level pathway of 6 feet in width running alongside the wall for the horse to stand on. Two lines are to be made across the pathway at 2 feet apart, between which the fore-feet of the horse must stand while he is being photographed, his body being at the same time as nearly in the line of the pathway as possible, both of his hind feet being, at all events, upon it. The pathway should be rather light in colour, to show the feet

clearly ; it may be of flag-stones, concrete, or light-coloured bricks. Its curb, or edge, towards the camera must be sharp and clearly visible, because it is an important line of reference in the photograph. The wall should be painted of a light colour—bluish, not yellow. Fifteen small marks, each the size of a sixpence, arranged in three horizontal and five vertical rows, at the exact distance of 3 feet apart, should be made upon the wall, to give a scale to the photograph. They are indicated in fig. 1 by small crosses. The lowermost row should be well clear of the pathway, say 1 foot above its level. Some of these marks will be sure to be visible in the photograph, though most of them will be hidden by the body of the horse. Simple screens or hangings should shield the horse from distracting sights. An aperture in a screen will enable a person who is stationed for the purpose on the other side of it to momentarily arrest the attention of the animal when the photograph is about to be taken. The camera is to be firmly clamped to a solid stand opposite to where the horse is to be placed, and to remain undisturbed during the whole operation. Its object-glass is to be 5 feet above the ground, that the view from it of the pathway may not be too much foreshortened, and it is to be 30 feet from the wall. The equivalent focus of the lens should not be less than 9 inches, otherwise the photograph will be too small for convenient measurement ; the lens used in the experiment was of 13 inches focus, with plates of  $6\frac{1}{2} \times 4\frac{3}{4}$  inches, and proved exactly suitable. The most important point of all is that the plate-holder of the camera should be *strictly* parallel to the wall, as tested by the images of the marks on the wall forming squares of exactly equal sizes on its ground-glass focussing screen. As many of them as are visible in the photograph will, of course, do the same. A label should be fixed to the wall, well above the back of the horse, but within the field of the camera, on which the permanent data of the instalment should appear in bold letters, easily legible in the photograph. Lastly, the horse should wear a distinguishing number for after-identification. The photograph will thus bear internal evidence of the standard conditions having been observed, and will carry its own scale. An experiment succeeded perfectly of indicating the position of the prominence at the hip, which is easily to be felt but is not distinctly seen, by labelling it with a wafer of thin white paper the size of a shilling ; *thick* paste which penetrated between the hairs was needed to make the wafer adhere. The mark was, however, unnecessarily large and conspicuous ; one of the size of a sixpence would have been ample. It might, perhaps, be printed on the horse with water-colour. The question whether any, or what, points of anatomical interest might be treated advantageously in this way has not yet been fully considered.

*Calculation from measurements on the Photograph.*—Fig. 1 represents, on a scale of about one-third the actual size, the appearance of one of the photographs and of the measurements made upon it. SS is the line of junction between the pathway and the wall ; the little crosses indicate the positions of the marks already described ; qq is the curb, or edge, of the pathway opposite to the camera ; p is any desired point on the ridge of the back of the horse, whose height above the ground it is desired to find. A measurement is made of the line that falls perpendicularly from p to qq ; also of that from h to qq, h being the point where the perpendicular from p cuts a line so drawn on the pathway as to touch the sides of the shoes of the fore and of the hind foot that are nearest to the camera, and which may be called the *hoof line*. [Practically, the simplest

way is to measure the heights of those two feet above  $qq$  and to roughly interpolate.] Measurements are also made between such marks on the wall as are visible, to furnish the scale of reduction at the distance of the wall from the camera. Fig. 2 represents a section of the installation on the same vertical scale as fig. 1, but the horizontal scale is much smaller and its internal proportions are not preserved, the primary object being to make a clear diagram.  $C$  is the object glass,  $D$  the point on the ground below it,  $q$  is the section of  $qq$ , here seen sideways,  $h$  is the projection of  $H$  upon the wall. Consequently  $CD$  = in reality 5 feet,  $DS$  = 30 feet,  $SQ$  = 5 feet, but the proportions are different in fig. 2 for the reasons just given. A line from  $C$  through  $Q$  determines the position of  $q$ , and  $qh$  being known by measurement, the position of  $h$  on the wall is known; then a line from  $C$  to  $h$  cuts the pathway at  $H$ , which gives the true position of the point where the vertical plane passing through  $C$  and  $p$  cuts the 'hoof line' on the pathway. Now  $M$ , the point on the pathway on which the vertical from  $P$  falls, lies in the same vertical plane as  $H$ , but a little further off from the camera, say 6 inches. This is a near enough

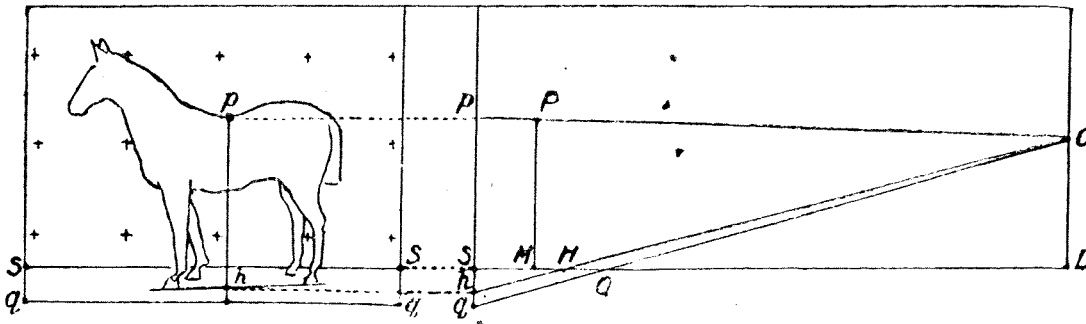


FIG. 1. Photograph. Its scale is about  $\frac{2}{5}$  of that actually used.

FIG. 2. Section of installation on the same vertical scale as fig. 1. The horizontal scale is much smaller.

estimate, as one or two inches of error here have no sensible influence on the result. So the position of  $H$  establishes that of  $M$ , and a line drawn from  $C$  through  $M$  determines that of  $m$  upon the wall as it would be seen in fig. 2, and consequently on the photograph as seen in fig. 1.  $m$  is not shown in the figure, as there is hardly room for it, and as it is not wanted in the simple way of working, which will immediately be explained. The height  $pm$ , as enlarged on the wall, has then to be reduced in the ratio of  $DM$  to  $DS$ , in order to obtain  $PM$ . The whole of this calculation is effected with the utmost ease by drawing the installation in its true proportions to a scale of  $\frac{1}{10}$ th, using paper ruled into squares of  $\frac{1}{10}$ th of an inch in the side, and converting the measurements made on the photographs into their corresponding values as projections upon the wall, reckoned in inches. The position of  $q$  is determined once for all on the paper by drawing a line from  $C$  through  $Q$ . A pin is inserted at  $C$ , and a loop made at one end of a thread is thrown over it.  $Q$  serves as the zero point both horizontally and vertically for all the working part of the diagram up to the line that represents the wall. But the zero point for this line is  $q$ . Then, the thread stretched through  $h$  determines  $H$ .  $M$  is marked off at six divisions further on. The thread is now stretched through  $p$ , and the value of  $MP$  is read off at once. It is unnecessary here to enter more particularly into details. All other measurements in the plane of the

photographic picture can be reduced to the corresponding real values in the same general manner. These are the diameters of the body and of the limbs, the length of the body, and the distances between any points of reference that may have been marked in the way described above, as seen in projection against the medium plane of the body.

*Verification of the Results.*—Numerous experiments have been made to test the exactitude of this photographic method of measuring living animals. The results of those made at the Show of the Royal Commission on Horse-breeding are given in the Appendix to the Blue Book. They are summarised as follows:—Two advanced veterinary students were deputed from the Royal Veterinary College to assist one another in measuring the animals that were photographed, for the purpose of controlling the photographic calculations. Each horse had its height above the ground measured at the withers, at the hollow of the back, and at the croup. Comparisons happened to be available in only twenty-six out of the twenty-nine premium horses, one of the latter having not been photographed, and two out of the remaining twenty-eight having been overlooked by the measurers. The comparison came out as follows:—

*Sums of the Differences between Calculated and Observed Values.*

No. of Cases	Heights at	Inches		
		—	+	Totals
26	Withers . . .	7 $\frac{1}{4}$	13 $\frac{1}{4}$	20 $\frac{3}{4}$
26	Back . . . . .	15	8 $\frac{1}{4}$	23 $\frac{1}{4}$
26	Croup . . . . .	8	12 $\frac{1}{4}$	20 $\frac{1}{4}$
78	Totals . . . . .	30 $\frac{1}{4}$	34	64 $\frac{1}{4}$

The approximate equality between the totals of the — and + differences, which are 30 $\frac{1}{4}$  and 34 respectively, testifies to the *average* correctness of the method and of the work. That between the summed results for the withers, back, and croup respectively, which are 20 $\frac{3}{4}$ , 23 $\frac{1}{4}$ , and 20 $\frac{1}{4}$ , shows that each of these has been determined with about the same *degree* of correctness. It is therefore justifiable to treat all the 78 events on equal terms, in order to ascertain what that degree really is. This is done in the following table:—

*Distribution of the Seventy-eight Differences without regard to their — or + signs.*

Inches of Difference to nearest $\frac{1}{4}$ inch	No. of Cases	Sums from beginning	
		Totals	Per cents.
0	10	10	13
$\frac{1}{4}$	11	21	27
$\frac{1}{2}$	20	41	52
$\frac{3}{4}$	9	50	64
1	8	58	74
1 $\frac{1}{4}$	4	62	79
1 $\frac{1}{2}$	5	67	86
1 $\frac{3}{4}$	4	71	91
2	6	77	99
2 $\frac{1}{4}$	1	78	100

It thus appears that in 52 per cent., or in one-half of the cases, the differences, when reckoned to the nearest  $\frac{1}{4}$  inch, do not exceed  $\frac{1}{2}$  inch, and that in 74 per cent., or in three-quarters of the cases, the differences do not exceed  $\frac{3}{4}$  inch. In the remaining quarter of the cases the differences ranged upwards to a solitary instance of  $2\frac{1}{4}$  inches. This summary does not, however, include one case where the veterinaries who entered their measures in 'hands' of 4 inches each, with the extra inches and fractions, obviously wrote down the wrong number of *hands*, 14 for 15. The entry assigned to the animal indicated an exceptionally hollow back, which the photograph showed not to be the case. So the erroneous entry of 'hands' was corrected, and then observation and calculation agreed. Considering the difficulty of measuring a restive, and often vicious, thoroughbred horse, whom it is somewhat dangerous to tickle with measuring apparatus, also that each animal was only measured once, while the photographs were measured at least twice, and again that one blunder of entry was detected as above, it seems reasonable to ascribe the larger differences of from 1 inch to  $2\frac{1}{4}$  inches mainly to faults connected with measurement of the animals, and not to those connected with the photographs. An error in the latter of one millimetre, which corresponds to about  $1\frac{1}{4}$  inch of actual height, is barely credible. This conclusion is confirmed by the more equable run of the statistical curve of photographic measures. It is further confirmed by some experiments made two years ago on behalf of the Chairman of the present Committee, on the degree of consistency between the measurements made (1) by the same veterinary student of the same horses on different occasions, and (2) between the means of the results of the several students. A discussion of these results showed that the probable error of a single measurement was considerable, and therefore that large errors might occasionally occur. Direct measures of the length of the body of a horse are considered by experts to be very untrustworthy, but the photographic method gives them with precision and simplicity. Owing to the roundness of the chest and buttocks, no correction seems necessary for the foreshortening of an animal that stands slightly askew.

Not a few inquiries and experiments have been made in relation to purely bred shorthorn cattle. Thirty-one *triads*, each consisting of one adult subject, its sire, and its dam—the 'subjects' being the offspring of 7 bulls and 26 cows—have been photographed for the Committee by Mr. John Patten, jun., under *quasi* standard conditions. The cattle were, for the most part, of the herd of the Duke of Northumberland, at Alnwick Park. The larger portion of the photographs were received too late to be properly dealt with in this Report. They seem to afford very valuable material for study.

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*Index Animalium.*—Report of a Committee, consisting of Dr. H. WOODWARD (Chairman), Mr. P. L. SCLATER, Rev. T. R. R. STEBBING, Mr. R. MCLACHLAN, Mr. W. E. HOYLE, and Mr. F. A. BATHER (Secretary), appointed to superintend the Compilation of an *Index Animalium*.

THE examination of the literature published from 1758 to 1800 inclusive has been continued by Mr. C. Davies Sherborn, to whom facilities have, as heretofore, been granted by the authorities at the British Museum