

ROYAL COMMISSION ON HORSE BREEDING:

APPENDIX G.

By *Francis Galton*, D.C.L., F.R.S., on the PHOTOGRAPHY of the PREMIUM HORSES.

In consequence of a memoir communicated by me to the British Association (Report British Association 1898, p. 697) a Committee was appointed, with myself as Chairman (p. xcvi) "to promote the systematic collection of Photographic and other Records of Pedigree Stock." It is desired to encourage the gradual accumulation of trustworthy material, now neglected, that shall hereafter be of extreme value in the study of Heredity and of the Art of Breeding.

The field of operations is so wide that after some tentative efforts it seemed best to concentrate the earliest attempts of the Committee upon the thoroughbred horses that are selected by the Royal Commissioners on Horse Breeding. They have the advantage of being only 29 in number, they are of national importance as the future sires of some 800 foals during the coming year, a great prestige is properly attached to the initiative of a Government body, and lastly, the Show is held at the Royal Agricultural Hall, which is largely used for other exhibitions of Pedigree stock. These were strong reasons for applying to the Royal Commissioners to allow me to make a trial. Permission was cordially granted, and I proceed to report the principal results.

The aim of the desired Records is to place in a permanent form as good a presentment as is feasible of the form and gait of Stallions and Brood Mares, by Photographs taken under standard conditions, by direct Measurements of the animal, and by Descriptive terms whose meanings are strictly defined.

It is not for a moment maintained that the idea of a horse which can be conveyed by those means is as full and just as that gained by the Judges and Spectators who see him in the ring and put through his paces, nevertheless, photographs of the specified kind, measurements, and descriptions suffice to preserve from oblivion much that is of sterling value.

The science of Heredity, like other sciences, must be based on recorded facts; these may be meagre, but if they refer to the same points, and are numerous and exact, they will supply a solid foundation.

Photographs being the most popular as well as the most important of the above Records, and being by far the most difficult to obtain under such conditions as will enable them to be compared on equal terms, will be almost exclusively the subject of the following remarks. They are offered in answer to the primary question, whether it be practicable to photograph a considerable number of horses under standard conditions amid the bustle of a Show held at the Agricultural Hall. By a "Standard Photograph" is meant a nearly accurate side view, taken at a distance of about 30 feet from the camera, whose plate holder must be strictly parallel to the screen, and whose height above the ground is known. The photograph itself must bear evidence of and contain means of measuring any small deviation of the animal from an exact side view, and it must contain marks by which the precise distance of the animal from the camera, and the vertical and horizontal scales of its portrait may be determined, and the parallelism of the plate to the screen be verified. These conditions give a scientific value to the portrait. They enable trustworthy measurements of the animal to be deduced from those made between any desired points in his photographed outline, as well as the heights of those points above the ground, according to methods described in the Additional Notes. In addition to this, it may be thought desirable to mark the position of certain bony prominences in the body and in the limbs, which are of anatomical importance, useful as points of reference, and easily felt by the hand, though indistinguishable by the unassisted eye, therefore an experiment was made which will be described in the Additional Notes.

There is a large backyard adjacent to the place where the veterinary inspection is performed. A temporary shed which had been built at one end of this for other purposes, was utilised to support a cloth to serve as a background. A cartload or more of sand was spread and levelled along the side of the shed, and three rows of flagstones were laid along the sand to form a level platform, 6½ by 17 feet, for the horses to stand upon in their turns. The camera was placed in a fixed position opposite to the middle of the screen, and approximately 30 feet from it. The focal length of its lens was 13 inches, so the image of the horse in the camera fell easily into a rectangle of 3½ by 2½ inches. Sensitive plates, measuring 6½ by 4½ inches, were used; consequently, wherever the horse might stand on the platform within reasonable limits, his image was sure to fall somewhere on the plate. The photographer was Mr. Charles Reid, of the Studio, Wishaw, N.B.; he was accompanied by his son, who made the exposures.

The arrangements for the first day of the Show are that the Judges commence their work by making a provisional selection of about twice the required number of horses, which are then subjected in turns to veterinary examination. Those who pass are led back to their stalls, and at an hour fixed in the programme are paraded together before the Judges and compared; the final selection of the 29 premium horses is then made. The only opportunity for photographing each horse was in the short interval between his passing the veterinary examination and being led back to his stall, and it was, of course, necessary to photograph all of those who passed the examination, because the final selection of the premium horses had not then been made. After each provisionally selected horse had been passed by the Veterinaries, he was led to the platform, and at once measured by two students deputed for the purpose from the Royal Veterinary College (subsequent measures being made in their stalls), then the attention of the horse was momentarily arrested and the photograph was taken. The skill and readiness with which the groomers coaxed and hustled refractory horses into the proper place was truly remarkable, but the difficulty of arresting the attention of the animals proved greater than might have been anticipated. They were so excited by the neighbourhood of other horses and their unusual surroundings that they often wholly refused to notice waived handkerchiefs, antic gestures, or sounds. The quickness with which the photographer caught momentary opportunities was clearly the result of long experience with horses. I subsequently learnt that nearly all of his plates proved successes, but in the hands of an ordinary photographer the result would have been very different.

When the time arrived for beginning operations there was so dense a fog that photography was impossible, but it cleared a little after 9 a.m., and no want of light was afterwards felt. The photography lasted 3½ hours, from about 9h. to 1h. 30m., during which time 35 horses were photographed, including 28 out of the 29 who were subsequently awarded premiums, the measuring and photographing being thus done at the average rate of six minutes for each horse. Occasionally one of them was very troublesome and occupied so much time that the slow stream of horses going to the platform and passing away from it became blocked, and horses had to be sent to their stalls to be led out again later.

Herewith, I enclose a set of the 28 prints to show the degree of artistic skill and definition that was attained. They are unquestionably of a high order of merit, but presumably not so high as might be reached after more experience under like circumstances. The background is somewhat too dark, a fault easily to be remedied on a future occasion.

Again, the camera was not raised high enough; the ground sloped awkwardly downwards from the platform, and it was not possible under the hurried conditions to arrange a suitable stage. The result is that the width of the platform is so foreshortened in the photograph that the position of the horse's feet cannot be located as exactly as is desirable upon it. An error of half a foot (or one quarter of the breadth of a flag-stone) might occasionally be made. Now at a distance of 30 feet an error of half a foot is that of 1-60th, which would make the calculated height or length of the horse differ to that amount. As the height of one of these horses at the withers, and as also the length of his body, is about 64 inches (16 hands), it follows that the measures in that case would be fully 1 inch wrong. Had the object glass of the camera been raised to the level of the horse's back, the error would have been reduced by nearly one-half, and would have become insignificant. A comparison between certain measures made by the Veterinaries and those derived from the photographs is given in the Additional Notes. It proves conclusively that whenever the standard conditions are observed, the measures of heights, length, diameter of limbs and curves of outline may be made more trustworthily by means of photographs than by direct measurements on the living animal.

The main result of this experiment has been to prove the feasibility of taking photographs of horses at a Show, that shall be acceptable as ordinary portraits, and will at the same time be of sterling scientific value. I beg in consequence to express a hope that the Royal Commissioners may think fit to arrange that photography under standard conditions shall become a permanent feature of their annual Shows, it being impossible to ensure that those conditions shall be strictly attended to when animals are photographed at their homes, though easy to do so at a public exhibition. The experience gained by this trial (as will be described directly more in detail) proves how inexpensive, and at the same time how necessary, it is to have an appropriate installation, one that might be removed and replaced when desired. It also shows that the total annual cost need not exceed 20*l.*, or say 25*l.*, the whole of which, as I have reason to think, might ultimately be borne by the photographer, if he were permitted to sell authorised copies for his own profit, under such restrictions as the Royal Commissioners might properly exact. If the Royal Commissioners feel in any way, other societies who exhibit at the Royal Agricultural Hall would doubtless be glad to follow their example and to avail themselves of their installation. The managers of local exhibitions would in time pursue a like practice, until the custom of utilising exhibitions for the purpose of photographing prize winners under standard conditions became general, and probably more or less self-supporting, and the principal object of the Committee of the British Association, as set forth in the first paragraph of this Report, would be attained. Horses and other pedigree animals are usually exhibited more than once, so occasional failures due to bad weather admit of being subsequently rectified.

42, Rutland Gate, June 1899.

Francis Galton.

ADDITIONAL NOTES.

1. COST OF THE EXPERIMENT.
2. DISCUSSION OF THE RESULTS.
3. SUGGESTION AS TO FUTURE ARRANGEMENTS in respect to—
 - a. Installation.
 - b. Conduct of Operations.

1. COST:

The cost of the trial was as follows:—

Paid for the photographs of 35 horses (including travelling expenses of the photographer and assistance)	£.	s.	d.
		15	12
Paid for laying down the stone platform		4	1
			4
Total	£.	19	13
			4

The prints were about 1*s.* each, so the cost of each set of prints of the 20 premium horses would be 1*l.* 10*s.*

I do not reckon here, the fees (4*l.* 4*s.*) to the veterinary measurers, because if the standard conditions are strictly followed in making the photographs, the measures would be, for the most part, superfluous.

2. DISCUSSION OF THE RESULTS:

Fig. 1 is a rough tracing from one of the photographs; it shows their size and the method with which it was dealt, so far as concerns the determinations of the height of the horse at its withers, back, and croup, and of its length. The principle of the calculation is further illustrated by Figs. 2 and 3. Fig. 2 is a side view of the installation in its true proportions, *C* being the object glass of the camera, *CD* its height above the ground, *Q* the edge of the platform on which the horse stands (that is the line *qq* in Fig. 1, now seen sideways), and *qdy* the section of the screen. Fig. 3 shows the same thing but in greatly changed proportions to give distinctness to the additional details introduced in it. *J* is the object to be measured; it is analogous to a horse, inasmuch as it stands symmetrically upon four legs, of which two appear in the figure. The intention is to show how the height of *P* above the ground, which is expressed by *PM*, is to be measured; *P* corresponds to either II, III, or IV in Fig. 1. It will be observed that the position of *q* is determined by drawing a line from *C*, through *Q*, until it cuts the line *Pa*, produced. *hq* is obtained by measuring on the photograph the dotted lines at 1 and 5, in Fig. 2, and multiplying those values by the proper factor. In the present case the factor was 1.5, which changed

the measures made in millimetres on the photograph to inches on the screen. [I speak of the unmounted set with which I worked; the mounted ones are slightly stretched]. HQ is determined by hq . M is an ideal point, half way between H and K , and may be taken as six inches from H , an inch or two of error here making no sensible difference in the results. Thus MQ becomes known. The point q corresponds to some specified point on the back of the horse, such as one of those marked II, III, or IV in Fig. 1. The value of qp is found from its measure on the photograph, multiplied by the same factor as before; then the intersection of pC with the vertical from M , gives P ; PM is the desired height.

This somewhat involved operation becomes exceedingly simple when performed mechanically. The method I used may prove useful in other ways, so there is all the more reason for describing it now. A drawing board, four feet long, was marked as in Fig. 2, on the scale of one-tenth of the natural size, this being $dQ=90^\circ$, $QD=270^\circ$, $DC=37^\circ$. A drawing-pin was fixed at C , and the loop at one end of a long thread was thrown over it. A scale of tenths of an inch, with its zero at q , was drawn along qY . A piece of paper ruled crossways with lines one-tenth of an inch apart, had its corner fixed at Q , which served as zero for the horizontal lines, the lowest of which coincided with Qd , and also as zero for the vertical lines. Measurements were then made in millimetres of the five vertical and the one horizontal line, that are dotted in Fig. 1. By the aid of a simple table calculated for the purpose, the photographic values in millimetres of qh were at once converted into the real values of QM in inches (by pure accident, the figures of these values are here closely alike). Then by rough interpolation or extrapolation, as the case may be, the values of QM for the lines 1, 2, and 3 were found and noted. The thread was then stretched from C through p , and the value of P was read off at once.

The following is an example of the work:—

TABLE 1.—Measurements of the Horse "Marioni."

	Withers.	Back.	Croup.	Length.
$q'h$ on photo. in millimetres	3.5	3.6	3.75	3.6
$q'p'$ " " "	54½	51.0	5.40	51.0
QM (by Table) real values in inches	34	37	38	37
$q'p' \times 1.5 = qp'$ " " "	81.75	76.5	81.0	76.5
Calculated PM " " "	65.1	60.7	64.0	60.5
Observed PM " " "	65½	61.0	64½	62.5
Differences to nearest ½ inch			0	2.0

The differences are small both here and elsewhere in the first three columns; so the Withers, Back, and Croup will be considered together, and the Length afterwards.

TABLE 2.

SUMS OF THE DIFFERENCES (1) WITH, AND (2) WITHOUT REGARD TO THEIR - OR + SIGNS.

	Number of Cases.	-	+	TOTALS.
Withers.	26	7½	13½	20½
Back	26	15	8½	23½
Croup	26	8	15½	20½
TOTALS	78	30½	34	64½

Mean Error, 0.82.

The close equality between the totals of the - and + differences is a proof of the general correctness both of the method and of the data, while that between the separate results for the withers, back, and croup shows that each of these has been determined with an equal degree of exactness. These three sets may therefore be combined in order to obtain enough cases for trustworthy statistics of the amounts of difference; this has been done in Table 3.

TABLE 3.

Comparison of the Values calculated from 26 Photographs, with the Measures of the Horses themselves. (They refer to the heights of Withers, Back, and Croup, combined indiscriminately.)

Distribution of the Differences without regard to their Signs.

Inches of Difference.	Number of Cases.	Sums from beginning.	
			Per Cent.
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

Note.—Twenty-eight of the 29 premium horses were photographed, but two of these were not measured. In one case the observed height of back was recorded as 14 hands (56 inches), the height of the withers being 15 hands and $3\frac{1}{4}$ inches (63 $\frac{1}{4}$ inches), and that of the croup 15 hands and 3 inches (63 inches). If the record of 14 be correct, the back would be conspicuously hollow, which is not the case in the photograph. The calculated value was 14 hands and $3\frac{3}{4}$ inches (69 $\frac{3}{4}$ inches), so there can be no doubt that the 14 was miswritten for 15. I have corrected and treated it accordingly.

It appears from Table 3 that in 52 per cent., or in a full half of the cases, the greatest difference between calculation and observation was only half-an-inch, and that in three-quarters of the cases it was only one inch. In the remaining quarter, the differences ranged upwards to a solitary case of $2\frac{1}{4}$ inches. These cannot be ascribed wholly to photographic misreadings, or other errors, because the photographs were measured at least twice, and the coarsest measurements could not err to that amount. Considering the difficulties in the way of an exact measurement of human stature (with which I have had large experience), and the serious augmentation of those difficulties when measuring a restless horse, and bearing in mind that one important error has already been detected in the records of the veterinary measurers, I should limit the maximum amount of liability to error in the photographic method to $1\frac{1}{4}$ inches, and to $\frac{1}{4}$ inch when the line *gg* in Fig. 1 is sharp and clean, and the standard conditions are strictly observed. There can, I think, be no reasonable doubt that the photographic method under those conditions is practically more exact than that of direct measurement of the animal itself.

A direct and trustworthy measurement of the length of a vicious or timid horse is extremely difficult, perhaps impracticable. It was attempted, in this case, in a rude way, but with results that were not self-consistent; they differed from the calculated values, nearly always in excess, up to $7\frac{1}{2}$ inches. The calculated values were perfectly self-consistent, forming a pure curve when protracted in the usual way. At the distance of about 30 feet the apparent profile of a horse is almost exactly the same as it would appear at any greater distance, and the effect of a slight obliquity in his position is insensible, on account of the roundness of his chest and buttocks. The errors in excess, alluded to above, were errors in the wrong direction, due doubtless to faultiness in the rough method employed, for which I was responsible. For determination of length of body, the photographic method is the only one to be depended on, and it seems to be as trustworthy as that of height.

3. SUGGESTIONS ON FUTURE ARRANGEMENTS:

a. Standard Installation:

1. If no appropriate wall be available, a vertical frame of wood should be provided, about 17 feet wide and 8 feet high, which can be taken to pieces and stored away when not wanted. It should fit into sockets let permanently into the ground.
2. A light-coloured hanging to be attached to the frame.
3. Studs to be fixed both in the vertical and in the horizontal bars of the frame, 3 feet apart, to project through button-holes in the hanging, as indicated rather coarsely by the small crosses in Fig. 1. They are to afford a scale to the photograph, and means of verifying the parallelism of the plate in the camera, to the screen, and would be of some use in securing the hanging in its place.
4. A level platform of stone, concrete, brick, or other hard material to be laid down in front of the screen; its edge that fronts the camera to be 6 feet from the screen. That edge, which is also the top of the face of the curbstone (if any), must be sharp and kept clean during photography, being a most important line of reference.
5. The platform to be marked in a way clearly visible to the groom, but not of a character to frighten the horse. The simplest method, perhaps, is to have a broad, longitudinal pathway, and two cross-lines, say 2 feet apart; the horse's fore feet to be always between the cross lines, and all his feet, so far as feasible, to be on the pathway.
6. Three sockets to be let permanently into the ground, 30 feet from the screen, and opposite to its middle, to receive the feet of a solid tripod for the camera.

7. The tripod to be a rough, substantial construction, not folding up, with a metalled top arranged to have a base-board firmly clamped to it. The tripod is intended to be stored away like lumber, without suffering harm.

8. The base-board to which the camera will be clamped is to be provided with adjusting screws for levelling. The whole arrangement to be such that the height of the object-glass above the level of the platform shall be 5 feet, and that the back-plate of the camera shall be truly vertical and parallel to the screen, as shown by the squares in the screen, whose corners are formed by the studs, appearing as squares in the photograph. The cost of this installation would be small, for although very important, it is, for the most part, rough and simple. The annual cost of putting it up and of taking it down, and of occasional repairs, would be trifling.

b. Conduct of Operations:

Every detail must be considered and provided for in good time, that the operations when once commenced may proceed without a check. A small omission may cause disaster, there being no time for repairing it.

The general supervision and responsibility for the requisite local arrangements and the control of the operations should be vested in some one person of sufficient authority to settle petty difficulties on the spot without reference.

The photographer must be thoroughly experienced in dealing with horses. He will need at least two assistants, and a large number of dark slides to avoid the loss of time in changing plates.

The experiment of marking anatomical points succeeded perfectly, the position of the prominence of the hip bone being indicated by a disc of thin paper, stuck on with thick paste (gummed paper not being sufficiently adhesive to hair); but the discs were unnecessarily large and conspicuous; they were the size of a shilling. A circular mark no larger than the end of a lead pencil would be perfectly distinct in the photograph when looked for, and it would not attract attention; perhaps it might be stamped on the horse with white water-colour. The particular points to be marked require careful consideration.

To guard against after mistakes, the catalogue number on the neck of the horse should be so pushed to its side as to appear in the photograph. A placard should be placed on the screen showing all the permanent details of the installation, as place, date, name of the show, and the standard data, in letters of $1\frac{1}{2}$ inches.

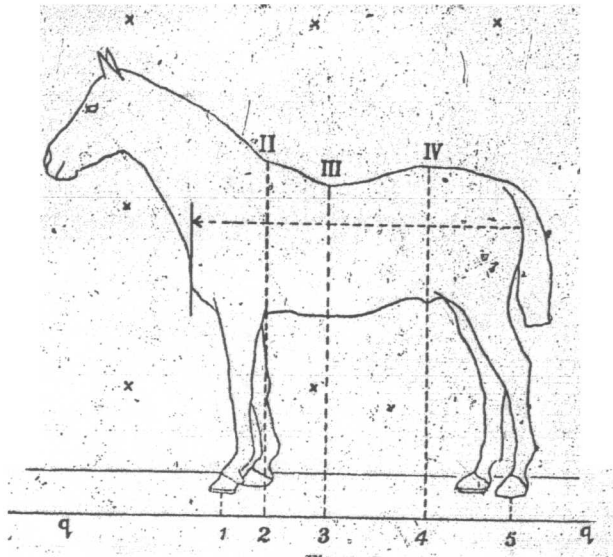


Figure 1.

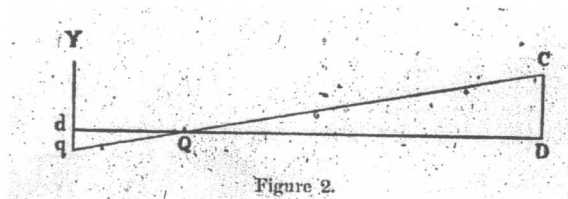


Figure 2.

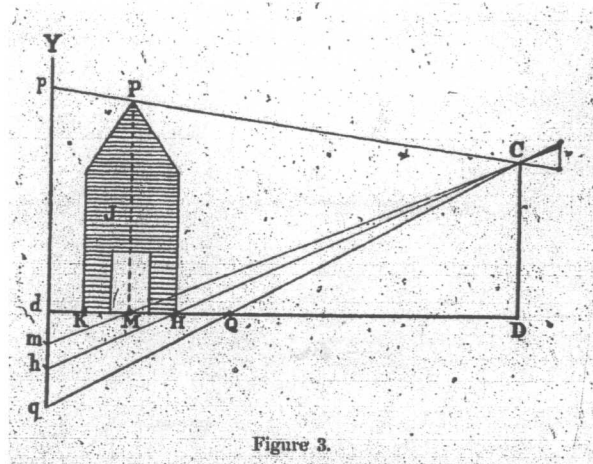


Figure 3.