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Darwin's *Questions about the Breeding of Animals*, with a Note on *Queries about Expression*

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The Society, through its Sherborn Fund, has recently published an offset facsimile of Charles Darwin's *Questions about the Breeding of Animals* (Darwin, 1968), with an introduction by Sir Gavin de Beer. This facsimile was based on the only copy known at the time, that in the Zoological Library of the British Museum (Natural History). The original is number 82 in the Darwin *Handlist* (Freeman, 1965). It has been bound so that the sewing cannot be seen, and has been slightly cut by the binder, giving a page height of 280 mm to the nearest 2·5 mm.

Another copy was found in September 1968 in the Darwin archive in the University Library, Cambridge. This one is in its original state, uncut and with the sewing intact. Of the twenty-one numbered items nineteen have been answered in manuscript in the wide outer margins, and the copy is dated 10 May 1839 in Darwin's hand. Also in the Darwin archive is a second set of answers to five of the items. These are not on a copy of the questionnaire itself, but on a half sheet of paper folded once, making four pages, the last of which is dated 6 May 1839. Between them, these two documents make it possible to give a more accurate bibliographical description of the *Questions* than was previously available. This new material was discovered just too late to be incorporated in de Beer's introduction to the facsimile, and does not entirely support his conclusions.

Because the facsimile exists, there is no need to give a detailed description of the original. It will be sufficient to add that the uncut Cambridge copy is 290 mm high by 230 mm wide, and consists of a single wove medium sheet. It is folded in quarto, forming four leaves of eight pages, and sewn through the fold. Neither surviving copy has any wrappers and it is probable that it was issued without. Its date of earliest circulation can now be narrowed down to between 1 January 1839, the day that Darwin moved into 12 Upper Gower Street, and 6 May 1839, the earlier date on the answers. Other copies may of course have been circulated later. The date of composition and printing could have been during the last quarter of 1838, because Darwin then knew that he would be moving to Upper Gower Street, the address given on the questionnaire, on 1 January. Early in 1839 is, however, more probable.

A date "?1840" is given in the printed *Catalogue of the Books, Manuscripts, Maps and Drawings in the British Museum (Natural History)*, Vol. VI, Supplement A–I, 1922. The date [1840] is printed on the title page of the facsimile, but de Beer is cautious in his text. He concludes that: "A search through Darwin's letters during this period tends to confirm this date." He refers to a letter from Darwin to his second cousin William Darwin Fox, dated June, which is printed in *Life and Letters* (Darwin, F., 1887) under a date heading of 1838. This letter mentions "my questions about the crossing of animals", probably in

reference to the printed pamphlet. He shows that a date of 1838 must be wrong and implies one of 1840; the present evidence would suggest 1839 as more probable.

On page ix de Beer states: "... whatever replies he may have received to his questions about the breeding of animals (which will never be known, except, perhaps, for some references in his books, because all letters received by him before 1862 were destroyed by him), they failed to provide him with any valid theory". The evidence for this destruction is Francis Darwin's statement in the preface to *Life and Letters*: "This process [of burning letters], carried on for years, destroyed nearly all letters received before 1862." Although de Beer was wrong to include documents with letters, the two sets of answers do exactly illustrate the point that he makes on page x in quoting a passage from Darwin's *Essay of 1844* (in Darwin, F., 1909): "This passage serves to show the impenetrability of the fog which the theory of blending inheritance imposed on biologists before Mendel's demonstration of particulate inheritance." The fog was made deeper because such characters as configuration, hardiness, fat content, speed or even coat colour are not suitable for the demonstration of particulate inheritance. All depend on the interaction of numerous genes, and the breeders do not seem to have recognized any of the few characters, such as hornlessness in cattle, which may be due to single factors. These breeders were highly successful, and the improvement of British livestock during this period was great, but the methods and results could not contribute towards what Darwin needed.

The first, and more complete, set of answers is headed in pencil in Darwin's hand: "Mr George Tollet, Betley Hall, 10th of May 1839". George Tollet, or Tollett as it is sometimes spelled, was born George Embury on 3 August 1767, and assumed the name of Tollet on inheriting estates at Betley from Charles Tollet, a cousin. He was a Justice of the Peace, Deputy Lieutenant for Staffordshire, and Recorder of Newcastle-under-Lyme 1792–1800 (Simms, 1894). "Mr Tollet was long before the public as an active magistrate and devoted agriculturist; one of the promoters of that agricultural movement which has produced such great and beneficial results to the Kingdom at large" (Hinchliffe, 1856). He was a member of the group of agricultural reformers whose meetings were originated by Thomas William Coke, later Earl of Leicester, the first being held at the latter's house Holkham Hall, in Norfolk. Another member was Sir John Sebright, who is mentioned in the answers. George Tollet died in 1855. He is not to be confused with George Tollet the Shakespearean scholar, and elder brother of Charles. He also lived at Betley Hall, but belonged to the previous generation.

Betley is a small village in Staffordshire, only a few miles from Maer, the home of Josiah Wedgwood (1769–1843), Darwin's uncle and father-in-law. It is known (Darwin, F., 1887) that Charles and Emma his wife were at Maer and at Shrewsbury, Charles's family home, between 26 April and 13 May 1839, and it is possible that the questionnaire may have been given or sent to Tollet at that time. This may answer in part de Beer's query as to how Darwin distributed it.

George Tollet's answers are as follows:

> 1. It will not I think keep constant; it will tend in appearance to one parent or the other but will more commonly shew in individuals an evident admixture of both—In pigs some would be more like the Chinese others more like the common breed but all would shew the cross in some degree. The Chinese character being probably the older race would prevail. As before stated the progeny will shew the admixture for some generations even under the greatest care taken in matching them.

2. There is little doubt but by great care in selecting for several generations the character would become more permanent, but for a long time the characters of the different varieties of the first cross would frequently occur—but it must have been by a long perseverance that the different varieties or races have been formed—Thirty years ago in order to get a large breed of fowls I crossed *once* with the large long-leg'd *Malay-breed*. Having endeavoured to breed fowls with compact bodies and short legs from the time of the first cross yet the long-leg'd character of the Malay fowl together with a tenderness of the feet *from cold* is frequently breaking out. This year a hen of my sort was crossed with a particularly handsome short leg'd Dutch fowl belonging to my son. But the Malay blood shewd itself most pointedly in two young cocks the produce of this cross: So that it is difficult to say how many generations would be requisite [to] form a mixed race into a permanent variety.

3. I think a new character appearing in a male & female of an established race would probably be made permanent after successive generations by carefully selecting and breeding from those which happen to possess the character in question. To affect this after a certain time the choice out of a considerable number would be desirable.

4. If the Australian Dingo is an older or aboriginal breed the cross from the spaniel bitches would I think more resemble the Australian than the pug: and would be most persistent under similar circumstances in successive generations.
What has been said of the Malay fowl—I think shews it to be much nearer the aboriginal breed—probably from proximity to the jungles of India.

5. If you can suppose such a cross to be fertile I think the character of the fox would prevail for a great length of time.

6. I should be inclined to think they would be more apt to take after the father than the mother but it would be by no means certain.

8. I think every cross has a tendency to make the offspring prolific. But if the Chinese pig were crossed with a race less prolific the offspring would most likely not be so prolific as the original Chinese tho more prolific than the race with which it was crossed.

* *Breeding in and in as it is called* has a manifest tendency to decrease the prolifickness of animals.

* Sir John Sebright many years ago published an interesting little book on this subject [see Seebright, 1809]. I have mislaid it or I would have referred to it.

9. No experience.

10. No experience.

11. I should suppose by means of the male. This I understand is generally the case in breeding hybrid Canary birds.

13. No experience.

14. No experience but I should think it would be a mere chance.

15. No experience.

16. In bulls it has a tendency to weaken the masculine form and I suspect also the virility. I have seen very high bred bulls that had lost many of the characteristics of the males. It was thought an improvement but it was found to be an imperfection, and the more masculine appearance was again preferred—The same circumstances happened in the breed of sheep—*Breeding in and in* or *closely* in an improved stock greatly lessens the fertility of cattle. Mr Mason of Chilton sold a high bred Durham heifer for 1000 guineas upon a warranty that she was to produce 3 calves or the bargain was to be off—She was too high bred to do this—Some of the defects of interbreeding might be lessened in a large stock by judicious selection.

17. I think timidity—ill temper etc are hereditary—and I should not choose to breed from animals that had those or similar defects.

18. No experience.

19. No exp[erience].

20. No experience.

21. In crossing cattle which may be very advantageous under certain circumstances, the agriculturist would never by choice go on breeding from mongrels. In dairy cattle crossing may be generally advantageous and the choice would be of breeds yielding either in quality or quantity or both the best return of milk butter & cheese. The *Holstein*, *Dutch* or *Holderness* cow is large & gives a large quantity of milk but not of rich quality. The Ayrshire cow is smaller and gives a good return of milk of better quality. If from circumstances a smaller animal with better milk were desirable the dairy farmer would put *an Ayrshire** bull to his Yorkshire short horned cows. But to carry on the breed he would not use a bull of the mixed breed but would go on with an Ayrshire bull till his object was attained. If he afterwards wished for larger size he would use a Yorkshire bull & so keep changing to suit his purpose. The Alderney cow is still smaller than the Ayrshire & the milk is still richer. From one or other of these crosses, which may all be reckoned *short horned varieties* the best sort of milking cow may be obtained. N.B. The first cross generally gives so much vigour that the produce is apt to be superior to either of the parent breeds.

* N.B. Where the choice can be had it is always better to have the cows of the larger and the bull of the smaller breed.

The second set of answers is signed at the end "R. S. Ford, Swynnerton May 6th 1839." Richard Sutton Ford was baptized in February 1785 and died about 1850. At the time of his marriage in 1807 he was described as a farmer of Newstead near Trentham, and he was for many years Agent to the Fitzherbert Estate at Swynnerton. Swynnerton and Trentham are both Staffordshire villages close to Maer.

R. S. Ford's answers are as follows:

1. In crossing varieties of cattle & sheep, I have observed generally, that although the first cross has usually produced a satisfactory result—such in fact as might have been expected—a remarkable inconstancy has often attended subsequent crossings between this progeny and either of the parent stocks, as well as the breeding from the produce of the cross exclusively.

4. In crossing between an old established variety, and a new, or mixed breed, the progeny will usually take more after the former than the latter. I may instance the effect produced by crossing our variously bred mares with an Arabian stallion, in which the peculiarities of the sire have been remarkably impressed on the offspring, and continued through many generations, though of course becoming gradually weaker in each. Nor am I inclined to attribute this to the power of the sex, although not aware that we have any examples of Arabian mares having been put to our native stallions. But in breeding sheep, which I have crossed *both ways*, between several of our old varieties and the new Leicestershire breed, I have not been able to determine, on the whole, that there was any preponderance of character in favour of either sire or dam, though in numerous cases the offspring has taken much more after the one parent than the other. [Marginal note in C.D.'s hand—C. Did they take more after old breed than new??] The colours of the progeny of domestic animals are extremely capricious. In crossing a black-sided long-horned cow, with a red and white mottled bull, of the short-horned Durham breed, the produce in one year was a calf almost entirely red, and in the following year a white one. And I have now in my possession a brown horse, the sire and dam of which were both grey: nor do I mention these as being at all rare instances of the kind.

12. The sexual passion of the males, in cattle and sheep at least, appears to be wholly indiscriminate, without regard to age, symmetry, or colour—the females, if not in almost perfect health, are never in season for the male—It may be remarked however, that a bull or ram, having served one female, will commonly prefer a fresh one to the same again; and sometimes

when he has such choice, after having served the whole, he will continue to follow a particular one, though I think this is wholly incidental, and not the effect of partiality or design. Whether or not any preference of a more marked kind is shewn by these male animals in their wild state, I am unable to say.

16. Most of our fine breeds of cattle and sheep (or what is termed by Breeders, "High Blood") have been raised by breeding "in and in"; and when this has been pursued to a great extent—that is, through many generations—the result has been, feeble virility with effeminate appearance in the males; weak passion in the females, which even in sheep rarely produce twins; and diminutive size and great delicacy in the offspring during the first month; to which may be added, that a deficient supply of milk is usually a consequence of this high breeding. But whether these habits arise altogether from breeding in and in, or are more or less occasioned by the finest-boned and smallest-headed males being selected to breed from—such animals being more disposed to take on fat—I do not undertake to determine. [Marginal note in C.D's hand—No because of dogs and pidgeons]. Certain it is however, that in these extreme cases, the procreative powers of the stock have been in a great measure sacrificed in order to attain the greatest possible tendency to fatten. I will here notice one curious and well established fact, which so far as I am aware is peculiar to cattle: if a cow produce at one birth, two male calves, or two females, in either case both animals will be fertile; but if she produce a male and a female calf at the same birth, though the male will possess the power of propagating his species, the female is invariably barren.

18. That the dispositions of animals are not altogether the effect of training, but in some degree at least hereditary, may be gathered from the circumstance, that if the eggs of wild fowl—as of the wild-duck for example—be hatched under a tame duck, or dunghill hen, the produce will shew in a striking manner their wild habits: on the approach of intruders which would scarcely attract the notice of ducklings regularly descended from any of our tame breeds, they will endeavour to escape, or hide themselves; and on arriving at maturity, unless previously pinioned, and well guarded, they will desert their foster friends, and rejoin their original kindred, if such there be in the neighbourhood.

The maxim, "Like produces like", is generally true; and I think this applies equally to temper, disposition, constitution and habits, as to form and size, though all these may be varied by incidental or artificial means. With respect to colour—we find that most animals in their wild, or native state, are true to that of their respective breeds; or if their colours vary, the variations are, with rare exceptions, very slight; and there may be a few species which even domestication does not appear to have altered in this respect—the Guinea fowl for example. But in general, tame animals are of an almost infinite variety of colours: whether this is to be accounted for on the principle laid down in Genesis Ch. XXX v. 37 and following*, or by the admixture of breeds which is continually taking place amongst them, I do not presume to decide: though I am of opinion that the latter cause must operate very powerfully; whilst I do not mean to deny the influence of the former.

On the subjects of most of these questions, many opinions are current which I believe to be

* Footnote added by us—R.B.F. & P.J.G. 37 And Jacob took him rods of green poplar, and of the hasel and chesnut tree, and pilled white strakes in them, and made the white appear which *was* in the rods. 38 And he set the rods which he had pilled before the flocks in the gutters in the watering-troughs, when the flocks came to drink; that they should conceive when they came to drink. 39 And the flocks conceived before the rods, and brought forth cattle ring-straked, speckled, and spotted. 40 And Jacob did separate the lambs, and set the faces of the flocks toward the ring-straked, and all the brown in the flock of Laban: and he put his own flocks by themselves; and put them not unto Labans cattle. 41 And it came to pass, whensoever the stronger cattle did conceive, that Jacob laid the rods before the eyes of the cattle in the gutters, that they might conceive among the rods. 42 But when the cattle were feeble, he put *them* not in: so the feebler were Labans and the stronger Jacobs.—*Authorized Version*, 18c Edition.

> vulgar errors. I have therefore not asserted above any thing as fact but what I think I have proved by my own experience.

de Beer, pages viii–ix, refers to two other sets of questions by Darwin. The first of these, on how human males select their females, is conjectural, and, from the date of the letter which he prints in support of its existence, we would suggest that this letter refers to the second set. The second is *Queries about Expression*. de Beer says: "It does not appear that this questionnaire, or that on the expression of the emotions, has been found." This is number 231 in the *Handlist*, and in 1965, when that list was published, no copy of the original printing was known. One copy of it was discovered in the Darwin archive in the University Library, Cambridge, in October 1967, and another and a corrected proof have been found there since. The description of it given in the *Handlist*, which was conjectural, is correct except that the title is as given above and not as in the Smithsonian Institution printing of 1868 (Darwin, 1868). The text is not that of the Smithsonian printing, nor the same as that which appears in all editions of *Expression of the Emotions* (Darwin, 1872). There is also at Cambridge a consolidated list of the replies received, with the correspondents' names. We intend to publish some notes on this material, with a facsimile of the original printing, at a later date.

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