THE

VARIATION OF ANIMALS AND PLANTS

UNDER DOMESTICATION.

CHAPTER XII.

INHERITANCE.

WONDERFUL NATURE OF INHERITANCE — PEDIGREES OF OUR DOMESTICATED ANIMALS — INHERITANCE NOT DUE TO CHANCE — TRIFLING CHARACTERS INHERITED — DISEASES INHERITED — PECULIARITIES IN THE EYE INHERITED — DISEASES IN THE HORSE — LONGEVITY AND VIGOUR — ASYMMETRICAL DEVIATIONS OF STRUCTURE — POLYDACTYLISM AND REGROWTH OF SUPERNUMERARY DIGITS AFTER AMPUTATION — CASES OF SEVERAL CHILDREN SIMILARLY AFFECTED FROM NON-AFFECTED PARENTS — WEAK AND FLUCTUATING INHERITANCE: IN WEEPING TREES, IN DWARFNESS, COLOUR OF FRUIT AND FLOWERS, COLOUR OF HORSES — NON-INHERITANCE IN CERTAIN CASES — INHERITANCE OF STRUCTURE AND HABITS OVERBORNE BY HOSTILE CONDITIONS OF LIFE, BY INCESSANTLY RECURRING VARIABILITY, AND BY REVERSION — CONCLUSION.

THE subject of inheritance is an immense one, and has been treated by many authors. One work alone, 'De l'Hérédité Naturelle,' by Dr. Prosper Lucas, runs to the length of 1562 pages. We must confine ourselves to certain points which have an important bearing on the general subject of variation, both with domestic and natural productions. It is obvious that a variation which is not inherited throws no light on the derivation of species, nor is of any service to man, except in the case of perennial plants, which can be propagated by buds.

If animals and plants had never been domesticated, and wild ones alone had been observed, we should probably never have heard the saying, that "like begets like." The proposition would have been as self-evident, as that all the buds on the same tree are alike, though neither proposition is strictly true. For, as has often been remarked, probably no two individuals are

identically the same. All wild animals recognise each other, which shows that there is some difference between them; and when the eye is well practised, the shepherd knows each sheep, and man can distinguish a fellow-man out of millions on millions of other men. Some authors have gone so far as to maintain that the production of slight differences is as much a necessary function of the powers of generation, as the production of offspring like their parents. This view, as we shall see in a future chapter, is not theoretically probable, though practically it holds good. The saying that "like begets like" has in fact arisen from the perfect confidence felt by breeders, that a superior or inferior animal will generally reproduce its kind; but this very superiority or inferiority shows that the individual in question has departed slightly from its type.

The whole subject of inheritance is wonderful. When a new character arises, whatever its nature may be, it generally tends to be inherited, at least in a temporary and sometimes in a most persistent manner. What can be more wonderful than that some trifling peculiarity, not primordially attached to the species, should be transmitted through the male or female sexual cells, which are so minute as not to be visible to the naked eye, and afterwards through the incessant changes of a long course of development, undergone either in the womb or in the egg, and ultimately appear in the offspring when mature, or even when quite old, as in the case of certain diseases? Or again, what can be more wonderful than the well-ascertained fact that the minute ovule of a good milking cow will produce a male, from whom a cell, in union with an ovule, will produce a female, and she, when mature, will have large mammary glands, yielding an abundant supply of milk, and even milk of a particular quality? Nevertheless, the real subject of surprise is, as Sir H. Holland has well remarked,[1] not that a character should be inherited, but that any should ever fail to be inherited. In a future chapter, devoted to an hypothesis which I have termed pangenesis, an attempt will be made to show the means by which characters of all kinds are transmitted from generation to generation.

[1] 'Medical Notes and Reflections,' 3rd edit., 1855, p. 267.

Some writers,[2] who have not attended to natural history, have attempted to show that the force of inheritance has been much exaggerated. The breeders of animals would smile at such simplicity; and if they condescended to make any answer, might ask what would be the chance of winning a prize if two inferior animals were paired together? They might ask whether the half-wild Arabs were led by theoretical notions to keep pedigrees of their horses? Why have pedigrees been scrupulously kept and published of the Shorthorn cattle, and more recently of the Hereford breed? Is it an illusion that these recently improved animals safely transmit their excellent qualities even when crossed with other breeds? have the Shorthorns, without good reason, been purchased at immense prices and exported to almost every quarter of the globe, a thousand guineas having been given for a bull? With greyhounds pedigrees have likewise been kept, and the names of such dogs, as Snowball, Major, &c., are as well known to coursers as those of Eclipse and Herod on the turf. Even with the Game-cock pedigrees of famous strains were formerly kept, and extended back for a century. With pigs, the Yorkshire and Cumberland breeders "preserve and print pedigrees;" and to show how such highly-bred animals are valued, I may mention that Mr. Brown, who won all the first prizes for small breeds at Birmingham in 1850, sold a young sow and boar of his breed to Lord Ducie for 43 guineas; the sow alone was afterwards sold to the Rev. F. Thursby for 65 guineas; who writes, "she paid me very well, having sold her produce for 300*l.*, and having now four breeding sows from her."[3] Hard cash paid down, over and over again, is an excellent test of inherited superiority. In fact, the whole art of breeding, from which such great results have been attained during the present century, depends on the inheritance of each small

[2] Mr. Buckle, in his grand work on 'Civilisation,' expresses doubts on the subject owing to the want of statistics. *See* also Mr. Bowen, Professor of Moral Philosophy, in 'Proc. American Acad. of Sciences,' vol. v. p. 102.

[3] For greyhounds, *see* Low's 'Domest. Animals of the British Islands,' 1845, p. 721. For game-fowls, *see* 'The Poultry Book,' by Mr. Tegetmeier, 1866, p. 123. For pigs, *see* Mr. Sidney's edit. of 'Youatt on the Pig,' 1860, pp. 11, 22.

detail of structure. But inheritance is not certain; for if it were, the breeder's art[4] would be reduced to a certainty, and there would be little scope left for all that skill and perseverance shown by the men who have left an enduring monument of their success in the present state of our domesticated animals.

It is hardly possible, within a moderate compass, to impress on the mind of those who have not attended to the subject, the full conviction of the force of inheritance which is slowly acquired by rearing animals, by studying the many treatises which have been published on the various domestic animals, and by conversing with breeders. I will select a few facts of the kind, which, as far as I can judge, have most influenced my own mind. With man and the domestic animals, certain peculiarities have appeared in an individual, at rare intervals, or only once or twice in the history of the world, but have reappeared in several of the children and grandchildren. Thus Lambert, "the porcupine-man," whose skin was thickly covered with warty projections, which were periodically moulted, had all his six children and two grandsons similarly affected.[5] The face and body being covered with long hair, accompanied by deficient teeth (to which I shall hereafter refer), occurred in three successive generations in a Siamese family; but this case is not unique, as a woman[6] with a completely hairy face was exhibited in London in 1663, and another instance has recently occurred. Colonel Hallam[7] has described a race of two-legged pigs, "the hinder extremities being entirely wanting;" and this deficiency was transmitted through three generations. In fact, all races presenting any remarkable peculiarity, such as solid-hoofed swine, Mauchamp sheep, niata cattle, &c., are instances of the long-continued inheritance of rare deviations of structure.

When we reflect that certain extraordinary peculiarities have

[4] 'The Stud Farm,' by Cecil, p. 39.

[5] 'Philosophical Transactions,' 1755, p. 23. I have seen only second-hand accounts of the two grandsons. Mr. Sedgwick, in a paper to which I shall hereafter often refer, states that *four* generations were affected, and in each the males alone.

[6] Barbara Van Beck, figured, as I am informed by the Rev. W. D. Fox, in Woodburn's 'Gallery of Rare Portraits.' 1816, vol. ii.

[7] 'Proc. Zoolog. Soc.,' 1833, p. 16.

thus appeared in a single individual out of many millions, all exposed in the same country to the same general conditions of life, and, again, that the same extraordinary peculiarity has sometimes appeared in individuals living under widely different conditions of life, we are driven to conclude that such peculiarities are not directly due to the action of the surrounding conditions, but to unknown laws acting on the organisation or constitution of the individual;—that their production stands in hardly closer relation to the conditions than does life itself. If this be so, and the occurrence of the same unusual character in the child and parent cannot be attributed to both having been exposed to the same unusual conditions, then the following problem is worth consideration, as showing that the result cannot be due, as some authors have supposed, to mere coincidence, but must be consequent on the members of the same family inheriting something in common in their constitution. Let it be assumed that, in a large population, a particular affection occurs on an average in one out of a million, so that the *à priori* chance that an individual taken at random will be so affected is only one in a million. Let the population consist of sixty millions, composed, we will assume, of ten million families, each containing six members. On these data, Professor Stokes has calculated for me that the odds will be no less than 8333 millions to 1 that in the ten million families there will not be even a single family in which one parent and two children will be affected by the peculiarity in question. But numerous cases could be given, in which several children have been affected by the same rare peculiarity with one of their parents; and in this case, more especially if the grandchildren be included in the calculation, the odds against mere coincidence become something prodigious, almost beyond enumeration.

In some respects the evidence of inheritance is more striking when we consider the reappearance of trifling peculiarities. Dr. Hodgkin formerly told me of an English family in which, for many generations, some members had a single lock differently coloured from the rest of the hair. I knew an Irish gentleman, who, on the right side of his head, had a small white lock in the midst of his dark hair: he assured me that his grandmother had

a similar lock on the same side, and his mother on the opposite side. But it is superfluous to give instances; every shade of expression, which may often be seen alike in parents and children, tells the same story. On what a curious combination of corporeal structure, mental character, and training, must handwriting depend! yet every one must have noted the occasional close similarity of the handwriting in father and son, although the father had not taught his son. A great collector of franks assured me that in his collection there were several franks of father and son hardly distinguishable except by their dates. Hofacker, in Germany, remarks on the inheritance of handwriting; and it has even been asserted that English boys when taught to write in France naturally cling to their English manner of writing.[8] Gait, gestures, voice, and general bearing are all inherited, as the illustrious Hunter and Sir A. Carlisle have insisted.[9] My father communicated to me two or three striking instances, in one of which a man died during the early infancy of his son, and my father, who did not see this son until grown up and out of health, declared that it seemed to him as if his old friend had risen from the grave, with all his highly peculiar habits and manners. Peculiar manners pass into tricks, and several instances could be given of their inheritance; as in the case, often quoted, of the father who generally slept on his back, with his right leg crossed over the left, and whose daughter, whilst an infant in the cradle, followed exactly the same habit, though an attempt was made to cure her.[10] I will give one instance which has fallen under my own observation, and which is curious from being a trick associated with a peculiar state of mind, namely, pleasurable emotion. A boy had the singular habit, when pleased, of rapidly moving his fingers parallel to each other, and, when much excited, of raising both hands, with the fingers still moving, to the sides of his face on a level with the eyes; this boy, when almost an old man, could still hardly resist this trick when much pleased, but from its absurdity concealed it. He had eight children. Of these, a girl, when

[8] Hofacker, 'Ueber die Eigenschaften,' &c., 1828, s. 34. Report by Pariset in 'Comptes Rendus,' 1847, p. 592.

[9] Hunter, as quoted in Harlan's 'Med. Researches,' p. 530. Sir A. Carlisle, 'Phil. Transact.,' 1814, p. 94.

[10] Girou de Buzareignues, 'De la Génération,' p. 282.

pleased, at the age of four and a half years, moved her fingers in exactly the same way, and what is still odder, when much excited, she raised both her hands, with her fingers still moving, to the sides of her face, in exactly the same manner as her father had done, and sometimes even still continued to do when alone. I never heard of any one excepting this one man and his little daughter who had this strange habit; and certainly imitation was in this instance out of the question.

Some writers have doubted whether those complex mental attributes, on which genius and talent depend, are inherited, even when both parents are thus endowed. But he who will read Mr. Galton's able paper[11] on hereditary talent will have his doubts allayed.

Unfortunately it matters not, as far as inheritance is concerned, how injurious a quality or structure may be if compatible with life. No one can read the many treatises[12] on hereditary disease and doubt this. The ancients were strongly of this opinion, or, as Ranchin expresses it, *Omnes Græci, Arabes, et Latini in eo consentiunt.* A long catalogue could be given of all sorts of inherited malformations and of predisposition to various diseases. With gout, fifty per cent. of the cases observed in hospital practice are, according to Dr. Garrod, inherited, and a greater percentage in private practice. Every one knows how often insanity runs in families, and some of the cases given by Mr. Sedgwick are awful,—as of a surgeon, whose brother, father, and four paternal uncles were all insane, the latter dying by suicide; of a Jew, whose father, mother, and six brothers and sisters were all mad; and in some other cases several members of the same family, during three or four successive generations, have committed suicide. Striking instances

[11] 'Macmillan's Magazine,' July and August, 1865.

[12] The works which I have read and found most useful are Dr. Prosper Lucas's great work, 'Traité de l'Hérédité Naturelle,' 1847. Mr. W. Sedgwick, in 'British and Foreign Medico-Chirurg. Review,' April and July, 1861, and April and July, 1863: Dr. Garrod on Gout is quoted in these articles. Sir Henry Holland, 'Medical Notes and Reflections,' 3rd edit., 1855. Piorry, 'De l'Hérédité dans les Maladies,' 1840. Adams, 'A Philosophical Treatise on Hereditary Peculiarities,' 2nd edit., 1815. Essay on 'Hereditary Diseases,' by Dr. J. Steinan, 1843. *See* Paget, in 'Medical Times,' 1857, p. 192, on the Inheritance of Cancer; Dr. Gould, in 'Proc. of American Acad. of Sciences,' Nov. 8, 1853, gives a curious case of hereditary bleeding in four generations. Harlan, 'Medical Researches,' p. 593.

have been recorded of epilepsy, consumption, asthma, stone in the bladder, cancer, profuse bleeding from the slightest injuries, of the mother not giving milk, and of bad parturition being inherited. In this latter respect I may mention an odd case given by a good observer,[13] in which the fault lay in the offspring, and not in the mother: in a part of Yorkshire the farmers continued to select cattle with large hind-quarters, until they made a strain called "Dutch-buttocked," and "the monstrous size of the buttocks of the calf was frequently fatal to the cow, and numbers of cows were annually lost in calving."

Instead of giving numerous details on various inherited malformations and diseases, I will confine myself to one organ, that which is the most complex, delicate, and probably best-known in the human frame, namely, the eye, with its accessory parts. To begin with the latter: I have heard of a family in which parents and children were affected by drooping eyelids, in so peculiar a manner, that they could not see without throwing their heads backwards; and Sir A. Carlisle[14] specifies a pendulous fold to the eyelids as inherited. "In a family," says Sir H. Holland,[15] "where the father had a singular elongation of the upper eyelid, seven or eight children were born with the same deformity; two or three other children having it not." Many persons, as I hear from Mr. Paget, have two or three of the hairs in their eyebrows (apparently corresponding with the vibrissæ of the lower animals) much longer than the others; and even so trifling a peculiarity as this certainly runs in families.

With respect to the eye itself, the highest authority in England, Mr. Bowman, has been so kind as to give me the following remarks on certain inherited imperfections. First, hypermetropia, or morbidly long sight: in this affection, the organ, instead of being spherical, is too flat from front to back, and is often altogether too small, so that the retina is brought too forward for the focus of the humours; consequently a convex glass is required for clear vision of near objects, and frequently even of distant ones. This state occurs congenitally, or at a very early age, often in several children of the same family, where one of the parents has presented it.[16] Secondly, myopia, or short-sight, in which the eye is egg-shaped, and too long from front to back; the retina in this case lies behind the focus, and is therefore fitted to see distinctly only very near objects. This condition is not commonly congenital, but comes on in youth, the liability to it being well known to be transmissible from parent to child. The change from the spherical to the ovoidal shape seems the immediate con-

[13] Marshall, quoted by Youatt in his work on Cattle, p. 284.

[14] 'Philosoph. Transact.,' 1814, p. 94.

[15] 'Medical Notes and Reflections,' 3rd edit., p. 33.

[16] This affection, as I hear from Mr. Bowman, has been ably described and spoken of as hereditary by Dr. Donders, of Utrecht, whose work was published in English by the Sydenham Society in 1864.

sequence of something like inflammation of the coats, under which they yield, and there is ground for believing that it may often originate in causes acting directly on the individual affected, and may thenceforward become transmissible. When both parents are myopic Mr. Bowman has observed the hereditary tendency in this direction to be heightened, and some of the children to be myopic at an earlier age or in a higher degree than their parents. Thirdly, squinting is a familiar example of hereditary transmission: it is frequently a result of such optical defects as have been above mentioned; but the more primary and uncomplicated forms of it are also sometimes in a marked degree transmitted in a family. Fourthly, *Cataract*, or opacity of the crystalline lens, is commonly observed in persons whose parents have been similarly affected, and often at an earlier age in the children than in the parents. Occasionally more than one child in a family is thus afflicted, one of whose parents or other relation presents the senile form of the complaint. When cataract affects several members of a family in the same generation, it is often seen to commence at about the same age in each; *e.g.*, in one family several infants or young persons may suffer from it; in another, several persons of middle age. Mr. Bowman also informs me that he has occasionally seen, in several members of the same family, various defects in either the right or left eye; and Mr. White Cooper has often seen peculiarities of vision confined to one eye reappearing in the same eye in the offspring.[17]

The following cases are taken from an able paper by Mr. W. Sedgwick, and from Dr. Prosper Lucas.[18] Amaurosis, either congenital or coming on late in life, and causing total blindness, is often inherited; it has been observed in three successive generations. Congenital absence of the iris has likewise been transmitted for three generations, a cleft-iris for four generations, being limited in this latter case to the males of the family. Opacity of the cornea and congenital smallness of the eyes have been inherited. Portal records a curious case, in which a father and two sons were rendered blind, whenever the head was bent downwards, apparently owing to the crystalline lens, with its capsule, slipping through an unusually large pupil into the anterior chamber of the eye. Day-blindness, or imperfect vision under a bright light, is inherited, as is night-blindness, or an incapacity to see except under a strong light: a case has been recorded, by M. Cunier, of this latter defect having affected eighty-five members of the same family during six generations. The singular incapacity of distinguishing colours, which has been called *Daltonism*, is notoriously hereditary, and has been traced through five generations, in which it was confined to the female sex.

With respect to the colour of the iris: deficiency of colouring matter is well known to be hereditary in albinoes. The iris of one eye being of a different colour from that of the other, and the iris being spotted, are cases which have been inherited. Mr. Sedgwick gives, in addition, on the

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[17] Quoted by Mr. Herbert Spencer, 'Principles of Biology,' vol. i. p. 244.

[18] 'British and Foreign Medico-Chirurg. Review,' April, 1861, p. 482-6; 'l'Héréd. Nat.,' tom. i. pp. 391-408.

authority of Dr. Osborne,[19] the following curious instance of strong inheritance: a family of sixteen sons and five daughters all had eyes "resembling in miniature the markings on the back of a tortoiseshell cat." The mother of this large family had three sisters and a brother all similarly marked, and they derived this peculiarity from their mother, who belonged to a family notorious for transmitting it to their posterity.

Finally, Dr. Lucas emphatically remarks that there is not one single faculty of the eye which is not subject to anomalies; and not one which is not subjected to the principle of inheritance. Mr. Bowman agrees with the general truth of this proposition; which of course does not imply that all malformations are necessarily inherited; this would not even follow if both parents were affected by an anomaly which in most cases was transmissible.

Even if no single fact had been known with respect to the inheritance of disease and malformations by man, the evidence would have been ample in the case of the horse. And this might have been expected, as horses breed much quicker than man, are matched with care, and are highly valued. I have consulted many works, and the unanimity of the belief by veterinaries of all nations in the transmission of various morbid tendencies is surprising. Authors, who have had wide experience, give in detail many singular cases, and assert that contracted feet, with the numerous contingent evils, of ring-bones, curbs, splints, spavin, founder and weakness of the front legs, roaring or broken and thick wind, melanosis, specific ophthalmia, and blindness (the great French veterinary Huzard going so far as to say that a blind race could soon be formed), crib-biting, jibbing, and ill-temper, are all plainly hereditary. Youatt sums up by saying "there is scarcely a malady to which the horse is subject which is not hereditary;" and M. Bernard adds that the doctrine "that there is scarcely a disease which does not run in the stock, is gaining new advocates every day."[20] So it

[19] Dr. Osborne, Pres. of Royal College of Phys. in Ireland, published this case in the 'Dublin Medical Journal' for 1835.

[20] These various statements are taken from the following works and papers:—Youatt on 'The Horse,' pp. 35, 220. Lawrence, 'The Horse,' p. 30. Karkeek, in an excellent paper in 'Gard. Chronicle,' 1853, p. 92. Mr. Burke, in 'Journal of R. Agricul. Soc. of England,' vol. v. p. 511. 'Encyclop. of Rural Sports,' p. 279. Girou de Buzareignues, 'Philosoph. Phys.,' p. 215. *See* following papers in 'The Veterinary:' Roberts, in vol. ii. p. 144; M. Marrimpoey, vol. ii. p. 387; Mr. Karkeek, vol. iv. p. 5; Youatt on Goître in Dogs, vol. v. p. 483; Youatt, in vol. vi. pp. 66, 348, 412; M. Bernard, vol. xi. p. 539; Dr. Samesreuther, on Cattle, in vol. xii. p. 181; Percivall, in vol. xiii.