The Welsh language is still that of the peasantry and middle class, and the members of the Church of England are largely out-numbered by the Baptists, Calvinistic Methodists, and Independents.

Brecknockshire formed part of the territory of the Silures, and its occupation by the Romans could never have been very complete. After their expulsion the district (*Brycheiniog*) was ruled by native princes and was the scene of many a border struggle. Many of the castles which are scattered over its eastern border had their origin at this period; and some of them may be regarded as advanced posts erected by the English during the wars which preceded the formation of Offa's Dyke. Subsequently, when Bernard de Newmarch and his Norman followers obtained possession of the country, they were converted into regular fortresses, by which the neighbourhood was kept in awe, and the mountain passes defended. The district between Brecon and Builth was the scene of the last struggle between the English and Llewelyn in 1282, when the Welsh chieftain was defeated and slain. Since that date Breconshire has not been associated with any important historical events, unless we include among them the raids of Owen Glyndwr. It formed part of the Welsh Marches until their union with England in 1532. Among the eminent natives of the county may be mentioned Sir David Gam (Shakspeare's Fluellen), who lost his life at Agincourt while defending Henry V.; the ill-fated Henry Stafford, duke of Buckingham; John Penry ("Martin Marprelate"); Henry Vaughan, the poet; Dr Hugh Price, founder of Jesus College, Oxford; Thomas Howel, bishop of Bristol (less known than his brother, the letter writer); Théo. Jones, historian of the county; and Mrs Siddons.

BRECON, or BRECKNOCK, the capital of the county of the same name, a market and borough town, 145 miles N. by W. from London, picturesquely situated in a fine open valley, at the confluence of the Honddu and Tarell with the Usk, and nearly in the centre of the county. It is supposed to occupy the site of the Roman station *Bannium*, but it is more probable that it was partly constructed with materials drawn from that spot, which lies to the W. of the present town, on the Via Julia Montana. There are three main streets, with several smaller ones. The houses are for the most part constructed of stone, and are generally well built. Brecon has a fine cruciform church (Early English in style), which has been restored by Sir Gilbert Scott. There are two other churches, and two Independent, two Baptist, and one Calvinistic Methodist chapel. The corporation consists of a mayor, recorder, four aldermen, and twelve councillors. The borough has returned one member to parliament since 1536. Constituency in 1875, 813. The assessed taxes yield annually £1259, and the annual value of real property paying income-tax is £24,941. There are weekly markets, and several fairs in the course of the year. The quarter sessions and assizes are held here. Brecon has a foundation called the College of Christ Church, of which the bishop of St David's is *ex officio* dean, but after the death of its present officers its revenues will devolve to the ecclesiastical commissioners and be appropriated to ecclesiastical uses. The ruins of the ancient castle are enclosed in the beautiful grounds of the Castle Hotel, and though unimportant in themselves, derive an interest from their connection with the Fitzwalters, de Braoses, de Bohuns, and Staffords, successive lords of Brecon. The principal fragment now remaining is Ely Tower, so called from its having formed the prison of Morton, bishop of Ely, where he concerted with his custodian, Henry Stafford, duke of Buckingham, the dethronement of Richard III., and the union of the houses of York and Lancaster. There are some fine Roman and other remains in the immediate vicinity. Population of municipality in 1871, 5845; inhabited houses, 1172.

BREDA, a town of Holland in the province of North Brabant, and capital of a circle, is situated in a marshy plain on the Merck, 24 miles S.W. of Bois-le-Duc, and 30 N.N.E. of Antwerp. It is strongly fortified and defended by a citadel (rebuilt by William III. of England), and the surrounding district may be laid under water when required. The town is well built, with wide and well-paved streets, is intersected by several canals, and has a fine quay, a town-hall, an arsenal, an observatory, an orphan asylum, a cathedral, and several Roman Catholic and Protestant churches, one of the latter having a spire 362 feet in height. It has also a Latin school and a military academy, and manufactures of linen and woollen goods, carpets, hats, beer, and musical instruments. Population (1869), 14,172.

Breda obtained municipal rights in 1252 from Henry, but was not surrounded with walls till 1534. The old castle, which had been built in 1350 by Jan Van Polanen, was restored about the same time. In 1696 William Prince of Orange and king of England caused the erection of the new castle, which was regarded as one of the finest buildings of the period. It was afterwards the residence of Charles II. in his exile, and is now the seat of the military academy. The town was captured by the Spaniards in 1581, by Maurice of Orange in 1590; again by the Spaniards, under Spinola, in 1625; and by Henry of Orange in 1637. It was finally ceded to Holland by the treaty of Westphalia in 1648. During the wars of the French Revolution it was taken by Dumouriez in 1793, and again by Pichegru in 1795. Much of its celebrity is due to the various political congresses of which it has been the scene. In 1566 the nobles of the Netherlands formed there the league known as the Compromise; in 1575 a conference was held between the ambassadors of Spain and those of the United Provinces; in 1667 a peace was signed between England, Holland, France, and Denmark; and in 1746–7 the representatives of the same powers met in the town to discuss the terms of another treaty.

BREDA, JAN VAN, a Dutch painter, was the son of Alexander Van Breda, an artist of considerable merit, and was born at Antwerp in 1683. He imitated the style of Wouvermans and Breughel with such dexterity, that even connoisseurs are often unable to distinguish his copies of their pictures from the originals. He visited England, where he was so well employed, that in a few years he was able to retire to his native country with a competency. The earl of Derwentwater was one of his chief patrons. He died at Antwerp in 1750.

BREDOW, GABRIEL GOTTFRIED, a German historian and professor in the university of Breslau, was born at Berlin in 1773. He is known in England by his *Manual of Ancient History*, which was translated into English in 1827; *Researches on History, Geography, and Chronology*; and his valuable *Historical Tables*, which come down to 1811. This last work was translated into English by Major J. Bell, who continued the tables down to 1820, and produced a popular and very useful work. Bredow died in 1814.

BREEDS AND BREEDING.[1] The word breeds is usually applied to the varieties of domesticated *animals* only, but since the phenomena presented under cultivation by all classes of organisms are entirely similar in character, and since, moreover, much of our knowledge on the subject has been gained from botany and horticulture, we shall include, under the one term breeds, the varieties of domestic animals and of cultivated plants. The natural and simple definition of breeding would be the art by which breeds are produced. But here the objection arises, that in this definition too much is assumed. It may be argued that our domesticated animals and plants are each

[1] Many of the facts and arguments contained in the present article are taken from Mr Darwin's work, *The Variation of Animals and Plants under Domestication*, 1868, and 2d. ed. 1876; and in most instances it has not been considered necessary to give the references.

identical with a wild prototype either living or extinct, and that man has merely deprived them of liberty and regulated their environment and propagation in the manner most advantageous to each kind. At the present day, when the whole range of biological thought is so largely permeated by the principles of the doctrine of evolution, this objection will probably not be advanced. Yet, when it is remembered that such an authority as Col. Hamilton Smith held the belief that each breed of dog had its wild prototype, it appears necessary to modify the definition above given. Let it be said that the art of breeding consists in changing the conditions of life and regulating the reproduction of animals and plants.

Since a breed is a domestic variety, it implies the existence of a group of individuals marked off from their congeners by the possession of certain characters which are transmitted to their offspring. It is this *transmission* of peculiarities which is the essential characteristic of a breed; for any collection of domesticated organisms could be divided into groups of individuals distinguished by certain points, but such groups would not necessarily form breeds. It is evident, then, that the law of heredity which asserts that "like begets like" must hold good, or the existence of breeds will be an impossibility. Again, if it were absolutely true that like begets like, that is, if the offspring were in all cases identical with the parent, it is evident that neither by man's interference, nor by the operation of nature, could a breed or race arise. It seems, then, that were it not in the nature of all organic beings to reproduce their kind in the manner formulated in the principle of heredity, and were it not for the continuous slight infringement of it expressed by the principle of variability, breeds could not have arisen. It is therefore necessary to examine these two principles as part of the subject under consideration.

Whatever views we may entertain respecting the origin of our domestic animals and plants, there can be no doubt as to the matter of fact that breeders have always proceeded on one principle,—*select the best individuals in each generation and pair them.* Now we have found that the qualities of organic beings (forming in a certain sense the material on which the breeder has to work) can be generalized under two principles—heredity and variability. And in the same way the art of breeding is itself capable of a kind of generalization under the principle of selection. There are thus three great principles or laws—heredity, variability, and selection,—the last relating to the art of man, the other two to those qualities of organic beings which render the art practicable.

Heredity.—The simplest form of heredity is found amongst those organisms which reproduce their kind by division into two parts similar to each other. This process is illustrated by the fission of a Moneron. The next advance in complexity of reproduction occurs when the two portions into which the organism divides are dissimilar to one another; here the process by which both portions ultimately assume the form of the parent is not one of simple nutrition, *i.e.*, of formation of tissue like that already formed. The process by which man propagates some of his cultivated plants is one of artificial reproduction by fission. For instance, a cutting or part of a shoot, or even a leaf (as with Begonia), if placed in suitable soil, will reproduce the original plant in all its minute details. We are here face to face with the mystery of reproduction; for we have the ever wonderful fact that in a few cells lies dormant the vital impetus which enables them to produce from inorganic pabulum a most complicated structure, which in its totality is utterly unlike themselves. And this example shows us, moreover, how essentially the same are sexual and asexual reproduction; for there is no intrinsic difference between reproduction from a small part artificially separated from a simple foliar organ (a leaf) and the same sequence of growth originating in a small portion naturally segregated from a transformed foliar organ (the ovary). The conditions of growth are not the same in the two cases, and there all essential difference ends; for the broad distinction which the congress of two individuals in one case appears to make is swept away by the facts of Parthenogenesis. In the lowest of living things we have seen that growth and reproduction are almost identical aspects of life. And this connection is not less close among higher organisms; as Mr Herbert Spencer observes,—"When in place of its lost claw a lobster puts forth from the same spot a cellular mass, which, while increasing in bulk, assumes the form and structure of the original claw, we can have no hesitation in ascribing this result to a play of forces like that which moulds the materials contained in a piece of Begonia leaf into the shape of a young Begonia. In the one case as in the other the vitalized molecules composing the tissues show their proclivity towards a particular arrangement; and whether such proclivity is exhibited in reproducing the entire form or in completing it when rendered imperfect matters not."[1] The main fact of inheritance is so obvious that it is apt to be forgotten. Mr Darwin remarks,—"It is hardly possible, within a moderate compass, to impress on 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 various treatises which have been published on the various domestic animals, and by conversing with breeders."[2] Certain peculiarities have appeared only once or twice in the history of the world, but have reappeared in children or grandchildren of the individuals so characterized. Thus Lambert "the porcupine man," whose skin was covered with warty projections, which were periodically moulted, had all his six children and two grandsons similarly affected. The most striking cases of inheritance have, as in this instance, been observed in man; but the very existence of the numerous breeds of domestic animals is clear evidence of the possibility of the transmission of every kind of peculiarity. For instance, it is believed that the varieties of the domestic pigeon amount to at least 150, and these races differ from each other in many ways, and all breed true to their kind. Some very curious peculiarities have been perpetuated. A race of cattle called "Dutch buttocked" was formed in Yorkshire by selecting in each generation the animals with the largest hinder-quarters. When the breed began to be established it was found that the large size of the calves' hind-quarters increased the dangers of parturition to a considerable extent. This case is interesting as showing that hurtful peculiarities may be inherited just as readily as those which are beneficial, and as bearing witness to the improbability of the view that there is an innate tendency to vary in the right direction. The terrible strength of inheritance exhibited by disease is a fact which is only too well established in the case of man; and in the maladies of domestic animals the same law holds good. It appears that nearly all the diseases to which the horse is subject are hereditary,—for instance, contracted feet, curbs, splints, spavin, founder, and weakness of the fore legs, roaring or broken and thick wind, melanosis, specific ophthalmia, and blindness, and even such habits as crib-biting and jibbing, are all plainly hereditary. The fact that any, even the most complex combinations of qualities are capable of hereditary transmission, is, perhaps, more forcibly brought home by considering the monetary aspect of the art of breeding, than by the fullest collection of special instances. As Mr Herbert Spencer remarks:—"Excluding those inductions

[1] *Principles of Biology*, London, 1863, p. 181.
[2] *Op. cit.*, vol. ii. p. 4.

that have been so fully verified as to rank with exact science, there are no inductions so trustworthy as those which have undergone the mercantile test. When we have thousands of men whose profit or loss depends on the truth of the inferences they draw from simple and perpetually repeated observations; and when we find that the inferences arrived at and handed down from generation to generation of these deeply interested observers has become an unshakeable conviction, we may accept it without hesitation. In breeders of animals we have such a class, led by such experiences and entertaining such a conviction—the conviction that minor peculiarities are inherited as well as major peculiarities. Hence the immense prices paid for successful racers, bulls of superior form, sheep that have certain desired peculiarities."[1] Not only are slight and gradual changes inherited, but in some cases sudden and well-marked variations are strongly transmitted. The case of the Niata cattle is now well known; a similar case is recorded of a rabbit born with only one ear, from which a breed was formed which steadily produced one-eared rabbits. These remarkable cases of sudden and large variation being inherited are closely allied to the still more curious phenomenon of the inheritance of mutilations. The most striking cases on record are those of Brown-Séquard.[2] In his experiments on the inheritance of artificially produced epilepsy he found that guinea pigs, after having undergone section of the sciatic nerve, often nibbled off portions of their hind legs in consequence of the anæsthesia of those parts. Now the offspring of these self-mutilated animals were in thirteen cases born without toes. To appreciate the true value of this case it must be noted that Dr Brown-Séquard has for thirty years kept guinea pigs, and has had many thousands under observation, and *not a single case* of congenitally toeless animals has occurred excepting among the offspring of mutilated parents. In spite of the universal tendency towards the transmission of the form and qualities of the parents to the offspring, there occur capricious and inexplicable lapses in inheritance. It is not possible logically to distinguish a want of inheritance from a case of variation; but when the difference between the offspring and the parent consists merely in the absence in the former of a quality possessed by the parent, it may be more conveniently classed as a want of inheritance than as an instance of variation. Although a weeping or pendulous habit in trees is in some cases strongly inherited, in other instances the want of inheritance is equally well marked. Mr Rivers sowed above 20,000 seeds of the weeping ash, and not a single seedling was in the least degree pendulous. M. Borchmeyer has also observed the same fact in Germany. In all cases it must be remembered that the form and qualities which the offspring of an animal or plant will assume when fully developed are not solely dependent on the nature of the hereditary impetus with which it starts; the initial tendency is as it were calculated so as to impart under certain conditions a certain form to the organism. If the conditions change, the initial tendency will not lead to the proper result; and it is to be noted that the apparent amount of alteration in the conditions is no measure of the amount of effect produced on the organism. For instance, none of the English breeds of sheep can be kept pure in France, the lambs of even the first generation lose vigour as the heat of the summer comes on, and the breed becomes absolutely degenerate. It is extremely curious that the force of inheritance which seems all powerful in England should give way so utterly under such a slight change of circumstances.

The method by which a breed was formed, combining the valuable qualities of the English sheep with a constitution fitted for the French conditions of life, is most instructive, and is a triumph of thoughtful and scientific breeding. The successful attainment of this end is due to M. Malingié-Nouel. He found that the offspring of a cross between a pure English ram and a French ewe inherit the desirable form of the sire, but, unfortunately, also his undesirable constitution. He accordingly paired a ewe taken from a border district, and therefore intermediate between two breeds, with a similar intermediate ram. He thus produced a sheep "combining the four races—Berry, Sologne, Merino, and Touraine . . . without decided character, without fixity, . . . but possessing the merit of being used to our climate and management."[3] It was now found that the lambs born of this mongrel ewe by purely-bred New Kent rams combined the English form with the French constitution, and transmitted this desirable combination to their offspring, and in this way the "Charmoise" breed was produced.

In this instance it seems as if the tendencies supplied by the ewe formed so discordant a combination that no strong tendency resulted for any of the French forms to appear, so that the form of the English ram was strongly impressed on the offspring. On the other hand, the *constitutional* tendencies coming from the mother's side were not discordant, but united in impressing the French constitution on the offspring. This case is instructive as establishing the possibility of an important kind of acclimatization, and as bearing on a somewhat exceptional phenomenon of heredity, namely, that when *both* parents exhibit a given character strongly, the offspring do not inherit it so surely as when one parent only is especially well characterized. Thus a successful breeder of laced Sebright bantams says,—"I am confident that those that are best laced frequently produce offspring very far from perfect in their markings, whilst those exhibited by myself which have so often proved successful were bred from the union of heavily laced birds with those that were scarcely sufficiently laced."[4] The class of cases just noticed is, moreover, of great interest as bearing on a form of inheritance which has been named "prepotency of transmission." When the offspring, instead of being intermediate between the parents, strongly resemble one of them, the latter is said to be prepotent in transmitting its likeness. The famous bull Favourite is believed to have had a prepotent influence on the short-horn race. It has also been observed with English race horses that certain mares have generally transmitted their own character, while other mares of equally pure blood have allowed the character of the sire to prevail.

In other cases a remarkable weakness of transmission of character is found to exist. A striking instance is given by Mr Brent.[5] It must be premised that the breed of pigeons known as "trumpeters" is characterized by a tuft of feathers over the beak, by a crest on the head, and by a most peculiar coo. Mr Brent crossed a trumpeter with another breed, and then recrossed the mongrels with trumpeters. But it was only at the fourth generation, when the birds had $\frac{15}{16}$ trumpeter blood in their veins, that the characteristic tuft appeared, and even then the peculiar trumpeting coo was absent.

It is frequently asserted that the male is prepotent over the female in transmitting certain characters. It has been shown,[6] however, that such rules do not hold good except

[1] *Principles of Biology*, 1864, No. 10, p. 242.
[2] *Proc. Roy. Soc.*, No. 297; *Brit. Assoc.*, 1870; *Lancet*, Jan. 1875, p. 7.
[3] *Jour. Roy. Agri. Soc.*, xiv. 1853, p. 214, translated by Mr Pusey.
[4] *The Poultry Book*, by W. Tegetmeier, 1866, p. 245.
[5] *The Pigeon Book*, p. 46.
[6] Prosper Lucas, *L'Hérèd. Nat.*, tom. ii. l. ii. ch. i., and Gärtner, *Bastarderzeugung*, s. 264–266.

to a very limited extent, and in certain groups only. It frequently happens that a character existing in one of the parents is transmitted more powerfully to the offspring of the sex to which that parent belongs than to the opposite sex. The large and important subject of secondary sexual characters hinges entirely on this phenomenon. The resemblance between prepotency and sexual limitation becomes clear when we remember that where the offspring are of one sex it may be impossible to distinguish between these forms of heredity. The most interesting point connected with secondary sexual peculiarities in relation to the subject of breeds is, that they are sometimes found in domesticated animals whose nearest wild congeners show no such limitation of character. Thus in the sheep, the males of certain races differ greatly from the females in the shape of their horns, in the development of fat in the tail (in certain fat-tailed breeds), and in the outline of the forehead. These differences are interesting because, so far as we know, similar secondary sexual differences are not found in the nearest allied wild species of sheep. On the other hand, secondary peculiarities which originally distinguished the sexes are in some cases diminished or removed by domestication. Thus our improved breeds of pigs have to a large extent lost the formidable tusks of the wild boar. The existence of secondary sexual characters gives a striking illustration of another important law of inheritance. This law asserts that the age at which any character first shows itself in the offspring is the same as that at which it appeared in the parent. Now, secondary sexual characters—those, for instance, presented by the male sex—have apparently been developed by sexual selection, and this force can only be brought to bear on variations occurring in adult animals. If, then, the male offspring do not develop the selected peculiarities until they arrive at puberty, the age at which it appeared in their male parent, it is clear that they cannot differ from the female until the age of puberty arrives. And this is well known to be the case, for at an early age the sexes are usually undistinguishable by any secondary characters. (See *Descent of Man*, vol. i. chap. viii.)

The interesting form of inheritance exemplified by the transmission through the female line of diseases necessarily confined to the male sex has been already alluded to. This latency of male characters is clearly illustrated by what frequently occurs to old hens. It is well known that a large number of female birds, when old or diseased, partly assume the secondary male characters of their species. Waterton (*Essays on Nat. Hist.*) gives a curious instance of a hen which had ceased laying, and had assumed the plumage, voice, spurs, and warlike disposition of the cock. The opposite case of the assumption by the male of female characters is illustrated by the fact that capons sometimes acquire the sitting instinct of the hen.

The possibility of characters existing in a latent condition is of the utmost moment to the breeder, since upon it depends the possibility of reversion or atavism. Reversion is a matter of extreme importance to the breeder, for it is one of the serious hindrances to the progress of his art. Since the time of the famous Bakewell during last century, Leicester sheep have been bred with the most scrupulous care, yet grey-faced, black-spotted, or wholly black lambs occasionally appear. In this case the most careful selection has been necessary to battle against the tendency of the original colouring of the sheep to reappear. And in all cases of selection it is this tendency that has to be struggled against by the breeder. On this principle the gardener looks over his beds and weeds out the "rogues." Even from seeds gathered from the finest cultivated varieties of the heart's-ease (*Viola tricolor*), plants perfectly wild both in flowers and foliage are frequently produced. The proximate cause of any particular case of reversion is utterly obscure; but some of the general causes may be set down. It is frequently asserted that domestic animals or cultivated plants, when allowed to run wild, always revert to the original parent form of the species. This assertion appears to rest on insufficient evidence, and to be an exaggerated statement of what is known on the subject. Nevertheless some weight must be allowed to it. Pigs have run wild in various parts of the world, and have everywhere acquired the general characters of the wild pig, and the young have re-acquired the longitudinal stripes. This last character is interesting, since it is not in any way a direct result of the changed conditions of life, as the thicker bristles and increased size of the tusks might be supposed to be. Another well-established cause of reversion is *crossing*. The case is exceedingly striking when the offspring of a cross do not resemble any near progenitor, but throw back to very remote ancestors. In illustration may be mentioned the experiments on pigeons detailed in the *Variation of Animals and Plants under Domestication* (vol. i. p. 200). There can be but little doubt that all our domestic races of pigeons have descended from *Columba livia*, the wild rock pigeon; the common dovecot pigeons exhibit the coloration of the parent form, and the most purely-bred fancy breeds, when of a blue colour, often show these characteristic marks. One of the above-mentioned experiments consisted in pairing a "mongrel female barb fantail with a mongrel male barb spot, neither of which mongrels had the least blue about them." It appears that blue barbs are exceedingly rare, that the spot has been known as a pure breed for nearly 200 years, and that a white fantail throwing any other colour is almost an unknown occurrence; nevertheless the offspring from the above two mongrels were of exactly the same blue tint over the whole back and wings as that of the wild rock pigeon from the Shetland Islands. Moreover, every characteristic mark of the wild pigeon was repeated in their mongrel offspring. This experiment demonstrates in the most striking way the tendency of a cross to produce reversion. The same result was also obtained by pairing black Spanish cocks with hens of various white breeds. In this case the offspring reverted to the red colouring of *Gallus bankiva*, which may be safely ranked as the parent form of our domestic fowls. In these instances the offspring revert to a character originally possessed by the ancestors of both parents, and here the cross is in no way essential to the reversion; it merely acts as a disturbing cause (although, probably, no other equally strong disturbing power could be named). In these cases reversion to a character of any degree of antiquity may occur. In the other class of cases where the character to which the offspring revert is one given by a single cross with a distinct variety, the tendency to reversion becomes weaker in each generation removed from the cross, and may ultimately be obliterated. The length of time requisite to effect obliteration has formed a subject of discussion. The question can hardly be answered, but the fact that it has been asked shows at least that obliteration may in some cases be effected in a practically finite period. In other cases even characters gained in this way by a single cross seem incapable of extermination. Fowls have been known to exhibit a Malay character, due to a cross with that breed forty years previously.

Variability.—When in any case we find the offspring differing from the parent, we set it down at first sight as an instance of variability. But on the discovery being made that the peculiarities characterizing the offspring are derived from a remote ancestor, it can no longer be so considered, and must be attributed to reversion. Many cases of apparent variation are due to this cause. Thus Gärtner declares, and his experience is of the highest value