

ones, and they are brought together in many different and curious ways, very much like the same acts in animals. There is, however, this difference, the organs of reproduction in the plant are not permanent, as they are in the animal, but fall off, or decay, as soon as impregnation is effected and the seed developed.

The pollen of the plant, however, never exists in a fluid form, like the animal sperm, but always in the form of little grains, often very minute. These grains have two coats, an outer and an inner, or perhaps it would be more correct to say the pollen grain is a cell, with two investing membranes. When one of these sperm cells, or pollen grains, comes in contact with the stigma, or top of the pistil, which is the tube leading down to the female germ, it undergoes a curious change. The inner membrane separates from the outer one and rolls itself out into a thread, or filament, which is pushed down the hollow female pistil till it reaches the germ cell, or rudiment of the seed, which lies at the base of the pistil, and so impregnates it. This, as will be better seen farther on, is exactly the same act as the impregnation of a female animal by the male. Very often the pollen is carried from the male plant to the female for many miles, by the wind, or by insects, and if anything prevents the female plant from receiving the pollen at the proper time, no fruitful seeds are formed. As a rule, the male pollen and the female germ must belong to the same species, or they cannot unite to form a new plant, the same as the male and female animal must be of the same species to breed together. This rule, however, is often deviated from to a certain extent, so that animals not of the same species, but nearly related, will breed; as the horse and ass, for instance. The progeny of two different kinds of animals is called a mule, or hybrid, and they may be either male or female, but can never breed together. This is because the semen of the male mule, as before stated, seldom contains animalcules. The female mule occasionally develops perfect ova, and may be impregnated by the male ass, or horse.

It is exactly the same with the plant; different kinds may be crossed within certain limits, and the product is a hybrid, or mule, which usually is unable to fertilize itself, but may be often impregnated by either of the parents.

Plants may be fertilized artificially, by taking the pollen from one plant and dusting it on the pistils of others. Gardeners and horticulturists in this way mix different kinds, and so produce numerous varieties of flowers and fruits. When the male and female principles are on different plants, as is the case with some fruit trees, it often happens that they may not be near enough to intermix, and then the female is always barren.

Even with many of those that have the male and female organs on the same plant, self-impregnation does not take place, the flowers being so constructed that their own pollen cannot reach the pistil. In these cases, pollen is conveyed by some outside agency, from other plants, so that there is constant cross fertilization. Insects are the great impregnators of plants, by passing continually from one flower to another; in doing so they get dusted with pollen from one which they convey to another, and in this way they often make crosses. Some plants depend entirely upon insects for their fertilization, and would die out if all those which visit them should become extinct. There are even particular insects which live on certain flowers, and which alone are capable of fertilizing them. This is the case with the *Tipula pennicornis*, a small insect which lives on the plant called the *Aristolochia clematis*. This little creature, in its ramblings about the flower of the *Aristolochia*, carries the pollen upon the pistil, and so effects impregnation. It seems, in fact, to live on that

particular plant for this very purpose, so that they are necessary to each other. There are many other similar instances known to botanists, and some even more remarkable. Usually the insect is after the nectar, or honey, when he thus acts as fertilizer to the plant, but sometimes it almost appears as if the fertilization was its special purpose in nature. There are some plants so entirely dependent upon particular insects for their fertilization, that if they were taken to new countries it would be necessary to take those insects with them, for they would soon die out, because the insect is necessary for the fertilization of their seeds.

The common Indian corn is a good example of self-impregnation in plants. The blossom at the top is the male portion, which produces the pollen grains, or dust; the cob is the female portion, and contains the germs of the future seeds. From the cob, when young, there is protruded a number of threads, usually called the silk, which hang down, and on which the pollen from the blossom above falls. These threads are tubes, and they convey the pollen grains down to the germs, which are thus impregnated. As soon as impregnation is effected both the blossom and the silk wither and die, while the seeds begin to perfect themselves. If the blossom be cut off one of these plants before the pollen is ripened, and care be taken that none is brought from other sources, that plant will not produce perfect seeds, that will grow into other plants, but will be barren. It is well known how easily different kinds of Indian corn intermix, when grown near one another, owing to the pollen of different kinds reaching the same cobs.

This plant also shows how readily the different parts may change from one to another. It is quite common to see grains of corn growing on the blossom, and blossom being produced at the end of the cob. In the one case the male pollen grain has changed into a female germ, and in the other the germ has changed into pollen.

This, however, is only what we constantly see taking place in other parts. Thus thorns will develop into branches or leaves, leaves into flowers, and flowers again into leaves. They are all fundamentally the same, having the same cell origin, and there is, therefore, nothing surprising in their transformation from one to another. An apple can be traced back and shown to be a modified leaf, and so with the flower and other parts.

The male pollen and the female germ are only cells, originally alike, but more or less differentiated, and capable of interchanging one with another.

The quantity of pollen produced by some plants is something astonishing. In the coal beds, whole seams of coal are formed of nothing else but the pollen of plants, which grew during the carboniferous era. Even now, the pine forests near Lake Michigan often send forth such immense quantities that it thickens the waters of the lake for many miles. In many parts of the world, at particular seasons, the air is filled with clouds of pollen dust, from certain plants, so that the light of the sun, even, is obscured by it.

At a meeting of the Linnaean Society, Mr. W. G. Smith exhibited some sections of a *boletus*, or common *puff-ball* fungus, to show the arrangement and number of the spores. He stated that in a specimen five inches in diameter, there were seventeen thousand pores, or tubes, each one of which, when cut across, showed two thousand cells upon the surface. The cells in the entire plant, he estimated, were at least five thousand millions, and the number of spores contained in them, at least sixty thousand millions! With such a superabundance of these spores, of all kinds of



funguses, floating in the air, it is no wonder they spring up everywhere, when the conditions are favorable. It is quite probable, also, that the same spores, under different conditions, may develop into different kinds of organisms.

In nearly all plants, in fact, nature produces immensely more pollen than is needed for fertilization, even after every possible contingency of failure is provided for, and it becomes a question what is the purpose of this apparently useless superabundance? In all probability it serves some other purpose than that of reproduction, but we have not yet learnt what that is. It is the same with the semen of many animals, especially man, which is always secreted in much greater quantity than can possibly be expended in propagation alone. The question may therefore be asked here the same, for what purpose is it? To this we can give no answer at present, but doubtless it will be found, at some future time, that it serves some other necessary purpose.

When the pollen grains of plants form themselves into filaments, in the way already described, to enable them to penetrate the female tube, they resemble the seminal animalcules of animals so closely that the two can scarcely be distinguished. They also penetrate the germ of the plant in the same way that the animalcule penetrates the female egg, which shows the strict similarity between the two.

The precise way in which the sperm and the germ are brought together, with the organs concerned in the process, both in plants and animals, will be described farther on, in the article on Copulation.

## CHAPTER XX.

### SEXUAL UNION, OR COPULATION.

WHEN the male principle is added to the ovum, so that foetal development commences, the egg is said to be *impregnated*, or in other words the female *conceives*. Conception, therefore, is the union of the two principles, and foetal development is the result of that union.

In different beings, as already explained, impregnation is effected in many different ways, being sometimes internal, by the act of copulation, and at other times *external*, without any kind of association whatever. In many of the lowest beings there is no copulation whatever, and frequently even no difference of sex, each individual being hermaphrodite, or possessing both principles, but in all the higher beings a personal union, in some form or other, always takes place. This union, or copulation, is practiced, however, in many different ways, some of them exceedingly curious, and in all cases the beings are impelled to it by a peculiar and powerful instinct, the gratification of which constitutes perhaps the highest of all physical enjoyments, and leads also to other enjoyments of a superior order.

It is a remarkable circumstance, and one which shows how careful Nature has been to insure *reproduction*, that the young of all beings, at the proper age, not only experience sexual desires, but are also led, unconsciously at first, to practice those peculiar positions and modes of bodily union by which alone those desires can be properly gratified. In no instance do young animals fail in this particular, though they may have been kept carefully secluded from all others of their kind from the moment of birth. Immediately that the eggs are ripened in the female ovary, and the animalcules fully developed in the male testes, the sexual impulse is mutually experienced, and each is impelled to seek the society of the other.

The immediate causes which lead to actual personal union, between two young beings of opposite sexes in a state of nature, when neither has seen nor in any way known the manner of the act, have frequently been discussed by philosophers, and some curious experiments have been made for the purpose of ascertaining them. A careful study of the actual process of sexual union, and of the form and condition of the body at that time will, however, solve the mystery to a great extent, and will show that certain physical wants and adaptations inevitably lead to certain peculiar maneuvers. The infant will seize the breast to nurse immediately it is born, and has even been known to suck the finger of the accoucheur before birth, when the hand has been in the womb during some operation. This is evidently owing to a peculiar sensitive condition of the nerves of the lips and tongue, which impel to the act of *suction*, and in like manner the peculiar sensibility of the nerves of the genital organs, at puberty, impels to those peculiar acts by which it is similarly relieved.

There are many circumstances connected with each sex which make them attractive to the other, and which tend to draw them together. Some of these consist in



obvious excitants of the senses, while others are more mysterious in their action, though their influence is equally perceptible. Among most of the lower animals, the female always emits a peculiar *odor*, at the time of heat, which when scented by the male immediately causes in him the sexual excitement, and draws him towards her by an irresistible impulse. Without this peculiar odor he experiences no excitement, and will not attempt to copulate, but that alone will excite him *even when the female is not present*, as experiment has proved. The *olfactory sense*, therefore, is an important agent in this process, at least among the lower beings, and perhaps it operates even in others, in some instances, more than is suspected. In those beings that are capable of reasoning and comparing, the sense of *sight* may also assist, by making differences in organization obvious, and suggesting adaptations. Besides these, however, there are certain other influences which, for want of a more *explicit* term, we will call *attractive*, the nature of which cannot be ascertained, though their power is obvious. These are evidently connected with the action of the sexual organs, being experienced only when they are in perfect action, and only operating in relation to the opposite sex. It has been suggested that this mutual attraction is a species of real *animal magnetism*, the male being *positive* and the female *negative*, so that they are drawn irresistibly together, like the needle and the loadstone.

In the human being there are also, at that time of life, peculiar moral sympathies, and intellectual requirements, which lead to mutual caresses and endearing embraces, even before the actual sexual impulse is fully awakened, and these bring about the mode by which the novel desires may be gratified, and the peculiar sensibility of the parts relieved. It is probable that in the human being the act of sexual union always results, in cultivated people, more from moral sympathy and intellect than from the mere senses, though these undoubtedly operate, especially *sight* and *touch*. Experiment has shown that the generative organs of each sex, when they are both in a proper state, exercise a mutual influence one upon the other, so that their contact can be distinguished from that of any other part, however similar. This has been proved by bringing various parts of the body in contact with the genitals, while the individual was blindfolded, and in every instance the touch of the corresponding parts of the other sex was known instantly. This arises in all probability from their possessing a peculiar power of exciting each other, which causes a species of *shock*, like that of electricity. It is easy to see from this how an accidental contact of these parts, during a mere caress, would suggest their mutual adaptation, and would lead to actual association.

Besides these provisions there are also others, equally necessary, and equally curious. Thus, the nervous sensibility is placed so that it influences certain muscles, the action of which causes peculiar motions of the body, such as are necessary during actual association. These motions are, in fact, often practiced, by the young, before actual connection is thought of, showing that they originate involuntarily. This is the case with both sexes, and the motions peculiar to each are precisely those best adapted for favoring actual connection with the other. Human beings, however, as society is now constituted, seldom acquire their knowledge of this process by nature's slow and sympathetic teaching, but precociously, by the gross, premature, and lascivious medium of instruction from others. This is perhaps unavoidable, but it is on many accounts to be regretted, and is certainly less conducive to true morality, and to human happiness. As the sexual impulse is now experi-

enced it is usually both forced and exaggerated, and is but seldom brought into play by the natural instincts and requirements alone.

The different organizations of animals make the act of copulation vary very much, both in its manner and duration. In some it is a complicated act requiring intimate internal union, and considerable time, while in others it is merely external and effected in a very brief period. It is impetuous and violent in some, and slow and gentle in others, but is possibly productive of intense enjoyment in all, no matter how brief may be its duration, nor how forcible its consummation. Some part of the process is, however, to the females of many animals, extremely painful, as is evinced by their cries and efforts to escape, and by the exhaustion which they afterwards exhibit.

The long duration of the act of copulation in the dog is well known, but in some other animals it is much longer, especially among insects, with some of whom it continues for days, and always terminates the life of the male, while the female only lives sufficiently long afterwards to deposit the fecundated egg, and then she dies also. The long duration of the act in the dog is owing to two causes; the male organ has a number of knots, or swellings, towards its termination, around which the sphincter muscle of the female vagina closes with such force that the two cannot separate till the parts become flaccid. So powerfully does this muscle act that even if the male be killed, or the organ cut off, the vagina will still retain it, till relaxation takes place. The same phenomenon is often seen in insects also, and the long continuance of the act is undoubtedly owing to the semen being slowly emitted, and very gradually absorbed into the female organs.

In other animals, on the contrary, the act of copulation is almost instantaneous, the semen being darted out in a single jet and absorbed immediately. This is the case with most birds, some of whom connect while on the wing. The reason for this quickness will be obvious on inspecting their organs, which are not adapted for continued intercourse. In fact it can scarcely be said that birds copulate at all, except a few species. The male has no true penis, but merely a slight protuberance, like a button, which cannot enter the female organ, but merely ejects the semen upon its mouth. The female also has no vagina, there being but one passage, called the *cloaca*, which is common to the excrement, the urine, and the semen. In some few birds, however, as in the ostrich, the penis is considerably developed, and enters the vagina, so that they really copulate. As a general rule also the clitoris is absent in female birds, which has led some physiologists to conjecture that they have no pleasurable excitement during the act, but this perhaps is erroneous, as some other part may be more than usually sensitive in their case. There are a few kinds, as some of the ducks for instance, that have the clitoris very large, and in the ostrich and cassowary it even has a groove, like a urethra, so that it resembles a penis. Ducks are well known to exhibit great amative excitement, the reason for which is evidently their possessing this large and sensitive clitoris.

In most reptiles also the act is equally imperfect, as in very few do the males have a properly developed penis, but merely a small bulb, or protuberance. The tortoise, and the crocodile, however, have a single penis, and the alligator has a double one. In the lizard and serpent it is also double, and in the rattlesnake each part is also divided again. Excepting at the time of copulation this organ, however, is not visible, being drawn into a sheath, from which it is thrust, at the proper time, by appropriate muscles. Some serpents copulate always at one particular season,



and then great numbers assemble together and twine and interlace themselves into an immense pyramid, with their heads directed outwards. Humboldt tells us of one of these living pyramids which he met with in South America, and which he describes as being the most fearful and horrible sight that ever met his gaze. The whole combined mass moved slowly on over the plain, while each individual writhed its body, darted out its forked tongue, and hissed in the most horrible manner. Very few females among the reptiles have anything like a clitoris, though it is found in some, as in the tortoise, for instance.

The frog exhibits very well the mode of impregnation without copulation, though in all probability not without mutual pleasure. At the time when the female is ready to eject the eggs the male climbs upon her back, embraces her firmly around the body with his long legs, and as the eggs are emitted he covers them with the semen. They are then left in the water by some species, and in others are fastened to the female's back for a while, by a thick mucus, secreted for the purpose. The embrace of the male frog is well known to be so powerful that the female seems nearly cut in two by his limbs, which contract with such force, and are so rigid, that they may even be torn off before letting go their hold. The object of this powerful compression seems to be the forcing out of the eggs, which probably could not be effected by the female herself. It is for this reason that these animals are called *accoucheurs* or *midwives*, because they cause the female to lay their eggs.

In male fishes we seldom find anything like a penis, though sometimes there is an organ which partly answers the purpose of one. It is merely a cartilaginous prolongation, like the spine of a fin, which hangs down from the body. Sometimes, in fact, it forms part of the anal fin, though in other cases it is separate from it. Down this imperfect organ there runs a shallow groove, which serves as a conduit for the semen. In many species there is nothing like copulation, nor do the two sexes ever meet, except accidentally, but in others the male organ is applied against the female parts at the time when the eggs are emitted, and the semen is then ejected upon them. In very few is there even the slightest entrance effected. The whale, it must be remembered, is *not a fish*, though this may seem strange to some, but merely a mammiferous animal that lives in the water. Its organs, therefore, are like those of the other mammifers, and it truly copulates, the male and female standing partly erect, out of the water, when doing so.

The various forms of the sexual organs in different beings of course necessitate different modes of connection, and probably varies much the sensations connected with it, but there is always a powerful instinct, which insures its performance, in all. Perhaps some of the most singular modes of copulation are found among insects, and other inferior beings, and especially among those that are hermaphrodite. In some insects there is but one female to many males, and no actual union ever takes place with any, the merest touch of the female's body being sufficient to satisfy the instinct of each. This is the case with bees, the males of whom will crowd round the queen in hundreds to touch her body. In other species, however, the sexes are always in equal couples, and when they copulate, the connection continues for days together uninterruptedly, the female carrying the male about with her on her back. Some kinds of hermaphrodite snails exhibit a very singular mode of mutual impregnation, each individual being provided with a number of horny darts, or spears, inclosed in a sheath, which they dart at each other in turn, having first assumed a proper position for the amorous

combat, as illustrated in a previous article. The double connection of the common earth-worm, which is hermaphrodite, may be seen on any dewy morning, when they rise out of the ground, and it usually continues till the sun rises, which would seem to intimate that the continued union is productive of pleasure, because it can be terminated at will. In the perfect hermaphrodites, which self-impregnate, it may be a question what kind of feeling is experienced, if any at all, because they are both male and female, but it is certain that they are as strongly impelled to the act as those beings that associate with an opposite sex.

A very curious study is afforded also of the various modes by which the two sexes discover each other, at the proper time, in those species in which they do not live together. Some insects, for instance, have a peculiar song, or cry, by which the female attracts her partner, and others are decked out in brilliant colors for the same purpose. Some, which come out only at night, have a lamp provided to light him, as we see in the glow-worm and fire-fly. The peculiar cry of the locust, the ticking of the death-watch, and the chirp of the grasshopper, are intended for this purpose, and probably also the song of the bird has, to a great extent, the same object. In fact, every animal has a peculiar cry, which it utters only when desiring the company of the other sex, and which is mutually understood.

With respect to the feelings which the act of coition produces, and the instincts or desires which lead to it, they probably vary indefinitely. In all the higher beings the desire to cohabit arises from a specific irritation of the genital organs, acting in conjunction with certain moral sympathies and intellectual perceptions. And when the connection occurs in a proper manner and under proper circumstances, it is always productive of intense and peculiar enjoyment to both. This is especially the case with human beings, and with all others similarly organized. The peculiar excitement which first causes coition to be desired, and which also makes it so intensely pleasurable, arises from the development of certain parts, namely, the *clitoris* in the female, and the *glans penis* in the male. The perfection of either of these organs in the one sex is invariably attended by a similar perfection in the corresponding part of the other sex, so that they are mutually excitable, and generally pretty equally so. We never find a well-developed and sensitive glans in the male, but we also find a well-developed and sensitive clitoris in the female, or else there is some other part, as the neck of the womb for instance, which acts in the same manner. In many of the lower beings, who have none of these parts, it is probable that nothing like what we call *sexual feeling* is ever experienced, but that they are impelled to connection simply by the mysterious workings of the *parental instinct*, which, as we well know, leads to many actions in which no direct pleasure is felt. The careful depositing of their eggs by insects, in the most proper places, and the patient sitting of the hen upon hers, may be adduced as instances of these blind promptings of the parental instinct, and, probably, in some beings, actual connection is brought about in the same way.

The more perfect development of the generative organs in the higher order of beings, and their greater sensibility, especially in man, is only in accordance with the greater perfection of every other part of the system, and is doubtless intended as an additional means of increasing their felicity. The higher any being is placed in the scale of creation, the more multiplied are its means of enjoyment, and the more intense those enjoyments become, as we see in regard to true sexual intercourse, by an actual union of the organs of the two sexes, or intromission of the male, which is altogether confined to the most perfectly organized.



In the lower animals, the situation of the organs in the two sexes, and the position which they are necessarily compelled to assume during coition, is calculated merely for the perfect accomplishment of the act, and often causes both inconvenience and pain, but in the higher animals other adaptations are found. The position which *they* naturally assume, is not only adapted for the most perfect and convenient performance of the act, but also for causing enjoyment to each. With human beings this is more obvious than with any other, because their capability for enjoyment is greater. With them the position is such as to call forth mutual endearment and admiration, both during the act and previous to it, and also to excite sympathy and tenderness in the more ardent and less sensitive of the two. No other beings, at this time, can see each other's eyes—those windows of the soul, by whose glances ardor can be aroused and excitement subdued—nor those expressive lineaments of the face, which can call forth pity and forbearance when timidity conquers love. In many cases of attempted violation, the vision of the victim's face, full of intercession and reproach, and compelling deference and admiration, has overcome the fury of amorous lust, and driven the would-be ravisher away in spite of himself. Even in lawful marriage, sanctioned by love and reason both, this circumstance, though it may seem of little moment, prevents many injuries and evils which the peculiar and delicate organization of woman would otherwise subject her to. In fact, there is as much *design* and admirable contrivance exhibited in this particular, as there is in any action connected with the human frame, and with rational beings it is equally worthy of attention. It is also equally proper to be understood, and its study is eminently calculated to subdue those gross and merely animal feelings with which alone everything of the kind is usually approached.

Before this process can be fully understood, however, it will be necessary to describe all the organs employed, in both sexes, more especially in the human being, as these may be considered the most complete, and all the others as deviations from them.

## PART IX.

### THE ORGANS OF GENERATION IN BOTH SEXES, AND IN THE DIFFERENT TYPES OF ANIMALS.