

PLATE XVIII.

GENERATIVE ORGANS OF THE MARSUPIALS.

Figure 1. A female opossum, showing the pouch open, and the young ones attached to the nipple.

Figure 2. The milk apparatus of the female kangaroo, showing its numerous nerves, *c, d, e, g*, and the powerful muscles, *f, b*, by which it is compressed to force out the milk.

Figure 3. Internal generative organs of the female kangaroo. *aa*. The two uteri. *bb*. Where they open into the vagina. *cc*. The uterine tubes. *d*. The left ovary. *ee*. Blood-vessels. *ff*. The principal veins. *g*. One of the tubes open. *hh*. The ureters leading from the bladder. *ii*. The large ligaments of the womb. *jj*. The two vaginas. *k*. The bladder. *l*. The external opening of the vagina. *m*. That of the bladder. *n*. The common cloaca.

Figure 4. A foetus just born. Figure 5. The same.

Figure 4a. The head of a young kangaroo cut through, to show how the nipple is held in the mouth.

Figure 6. The external sexual organs in the male kangaroo. *a*. The testicles placed forward. *b*. The penis drawn back into the body.

Figure 7. The same organs dissected out. *a*. The testicles. *b*. The penis a little protruded. *c*. The spermatic tubes. *e*. The bladder. *f*. The neck of the bladder. *h*. The rectum. *i*. The muscle which draws the penis back into the body. *j*. The gland of the penis. *dd*. The ureters.

Figure 8 shows part of the pouch of a female kangaroo. *b*. One of the nipples pulled out, as when in use by the young. *a*, is one when not in use.

Figure 9. Head of young kangaroo out open, to show how the windpipe and cesophagus are arranged, so that it can swallow and breathe all the time without inconvenience. *a*. The cesophagus. *b*. The windpipe, going to the nostrils.



Generative Organs of the Marsupials.



that when once the teat is in the mouth the hold never relaxes. The milk, therefore, is all the time being absorbed, though slowly, and owing to a peculiar formation of the larynx this occurs without interfering with breathing. It will be seen that this is analogous to the constant absorption of blood by the young of more perfect animals, in a true womb.

The time that these half-formed young remain in the womb is very short, in the opossum only twenty-six days, and in the kangaroo only thirty-nine. When first brought forth they are very imperfect, almost shapeless, and in the smaller animals much resembling earth worms. The earlier observers, who only saw these minute creatures attached to the nipples, thought they grew there, like buds. The subjoined cut shows a young Kangaroo, when first placed in the pouch, natural size; the skin is thin, and almost transparent, in fact almost like that of a worm.



FIGURE 75.—Young Kangaroo, just born.

The mother, it is said, uses her mouth to transfer the young to the nipples, and this is much facilitated by the close connection between the vagina and the pouch. They remain fast to the nipples a long time, in the kangaroo about two months, and suck at intervals after they are detached, like other animals, for some months longer.

It may be supposed that the young marsupial, so imperfect, cannot have muscular strength enough to hold on voluntarily to the nipple. And this is probably true, the hold being very likely spasmodic, or involuntary, and aided by the mutual adaptation of the teat and the mouth. Nor could it draw the milk by its own efforts, at least not at first. The flow is therefore regulated by the action of a special muscle, in the abdomen of the mother, which compresses the mammary gland and squeezes the milk gradually into the mouth. These beings evidently form a link between the egg-bearing and the young-bearing animals, for they possess characteristics common to both, but fully belong to neither.

In past ages they formed one of the links, in the long chain of evolution, by which the more perfect animals of the present day have been developed from the imperfect ones of a more early period.

These particulars will, however, be better understood by reference to the accompanying plates. In some animals of this kind, it should be observed, the pouch is not perfectly developed, the skin being only drawn into deep folds, or wrinkles, which apparently serve the same purpose.



FIGURE 76.—Young Kangaroo in its Mother's Pouch adhering to the Teat.

#### MONOTREMATA.

There is another order of animals, containing only two kinds, which are still lower than the marsupials, and which, in their generative organs, approach very



closely to birds. This is the order monotremata, which is found nowhere else but in Australia, and consists only of the *ornithorhynchus*, or duck mole, and the *echidna*, or porcupine ant-eater. In both of them the intestine, the urinary passage and the seminal duct, all open into a common *cloaca*, as described in birds. The females have no marsupial pouch, like that of the kangaroo, although there are the marsupial bones. The testicles of the male remain always in the body, there being no scrotum, and the vas deferens discharges the semen into the cloaca. There are no nipples on the females' breasts, the milk ducts opening, in the echidna, into a kind of small pouch, and in the ornithorhynchus on a flat surface. So far as observed, the young appear to have no direct connection with the mother by a placenta, and the way in which they are carried and nourished is not known. They are born quite blind, and almost skinless, so that they are evidently not retained long in the body. From the peculiar formation of their mouths, and the absence of nipples in the mother, their manner of nursing is a mystery.

The manner in which these very exceptional animals copulate, and other particulars as to their generation, have not been ascertained. I have been assured, however, by a gentleman long resident in Australia, that in the act of sexual union, the female duck mole lies on her back, and that the act is very prolonged.

The ornithorhynchus is perhaps the most remarkable animal known. It has a body like an otter, covered with fur, the tail is broad and flat, like a beaver's, the feet have claws and are webbed, and it has a bill like a duck's. It has no teeth, and its food consists mainly of insects, and it burrows in the ground like a mole.

The echidna resembles somewhat a hedgehog, having spines, and stiff bristles on the back. The feet are not webbed; it burrows in the ground, and lives on insects, which it catches by means of a long sticky tongue. Its snout is long and pointed, and like the duck mole, it has no teeth. Its principal food is ants, from which it is called the porcupine ant-eater.

No doubt these singular animals are as exceptional in their generative processes, in many ways not now known, as they are in other respects.

The following table will give a synopsis of all the different modes of reproduction, as above described:



*Duck-billed Platypus, or Ornithorhynchus.*



*Wallabee Kangaroo, with Young in Pouch.*





*Crab-eating Opossum, with Young in its Pouch.*



*Female Opossum carrying its Young.*



## I.

## NON-SEXUAL GENERATION.

## VARIETIES.

*Fissiparous.*

When the parent simply divides into two or more parts, each becoming a new being.

*Gemmiparous.*

When the parent gives off buds, which grow into new beings, either attached to the parent or separate.

## II.

## SEXUAL GENERATION.

## VARIETIES.

*Hermaphrodite.*

Where both sexual organs, male and female, are found in the same individual, some being capable of self-impregnation, others needing the concurrence of two, or more, to mutually impregnate each other.

*Diœcious.*

When the male and female organs are placed in separate individuals; the male and female principles being united within the body in some, and without the body in others.

## MANNER OF DEVELOPMENT.

## OVI PAROUS.

The eggs laid and hatched outside the body. As in birds and insects.

## OVOVIVIPAROUS.

The eggs partly developed within the mother's body, but the young being in no way connected with her.

## VIVIPAROUS.

The eggs developed in the mother's body; the new being nourished from her blood, and brought forth alive, and capable of living independently.

## MARSUPIAL.

The eggs developed in the mother's body, but the young only half formed, and then placed in an outside pouch to be completed.

## MONOTREMATOUS.

Development mainly external—no placenta, and no marsupial pouch.



CHAPTER XXIII.

THEORIES OF GENERATION.

HAVING thus stated the provisions which have been made by nature for the fecundation of the ovulum, by the concurrent offices of the two sexes, we may here examine various speculations and opinions which, from time to time, have been entertained relative to the nature of this marvellous and mysterious process; speculations which, although for the most part exceedingly hypothetical, and often completely visionary, have been dignified with the appellation of *theories of generation*. This it is our intention to do very briefly, and to notice only the more important of these theories; for the total number of hypotheses which have been advanced on this subject is so great, that their mere enumeration might occupy many pages. Drelincourt, who lived in the latter part of the seventeenth century, collected from the writings of his predecessors as many as two hundred and sixty-two "groundless hypotheses" concerning generation; "and nothing is more certain," observes Blumenbach, "than that Drelincourt's own theory formed the two hundred and sixty-third."

These theories may be arranged according as they relate to the action of the parent organs, or to the changes in the egg occurring during the formation of the new animal; and Haller divided the first of these classes into three divisions, according as the offspring is supposed to proceed; first, exclusively from the organs of the male parent, which is the theory of the *Spermatist*; or, secondly, entirely from those of the female, which is that of the *Ovists*; or, thirdly, from the union of the male and female products, which is the theory of *Syngenesis*. The second class, again, may be arranged under two heads, according as the new animal is supposed, first, to have its parts rendered visible, by their being expanded, unfolded, or evolved from a previously existing though imperceptible condition of the germ, which is the theory of *evolution*; or, secondly, to be newly formed from amorphous materials at the time when it makes its appearance in the ovum, which constitutes the theory of *Epigenesis*.

The theory of the *Spermatists* regarded the male semen as furnishing all the vital parts of the new animal, the female organs merely affording the offspring a fit receptacle and suitable materials for its nourishment, until it could exist by the independent exercise of its own functions. One of the earliest supporters of this hypothesis was Galen; but its modern revival dates from the period of the discovery of the seminal animalcules, which were regarded by Leewenhoek as the proper rudiments of the foetus. They were even considered by some to be miniature representations of men, and were styled *homunculi*; one author going so far as to delineate in each, the body, limbs, features, and all the parts of the grown human body. Even Leewenhoek describes minutely the manner in which they gain the interior of the ovum, and are retained after their entrance by a valvular apparatus.

The *Ovists*, comprising some of the older philosophers, such as Pythagoras and

Aristotle, maintained that the female parent affords all the materials necessary for the formation of the offspring, the office of the male being merely to awaken the dormant formative powers residing in the female products. Malpighi and Harvey asserted that the rudiments of the foetus are derived principally from the female ovum; an opinion which was also elaborately defended by Vallisneri (*Della Generazione*, part 2).

The theory of *Syngenesis*, or of the simultaneous combination of products derived from both sexes, which after sexual intercourse, are supposed to unite together to form the germ, is also of very ancient date. In connection with this theory may be mentioned that modification of it which may be termed the theory of *metamorphosis*, according to which a formative substance is held to exist, but is allowed to change its form, in order to be converted into the new being; as also the hypothesis of Buffon, which was eagerly adopted by Needham, who conceived that certain molecules, which they termed *organic*, and which they believed universally to pervade plants and animals, were all endowed with productive powers, which enabled them, when placed in suitable situations, to attract one another, and to compose by their union living organized bodies. They imagined, that in the process of generation the superabundant portion of these organic molecules were accumulated in the generative organs, and there constituted the rudiments of the offspring.

The hypothesis of *evolution*, or of pre-existing germs, coincides with that of the *Ovists*, in considering the foetus as solely the production of the female; but it farther assumes that it already exists, with all its organs, in some part of the female system previous to the sexual intercourse; and that it receives no proper addition from the male semen, the action of which is merely that of exciting the powers of the foetus, and of endowing it with vitality. The observations of Haller with respect to the gradual enlargement or evolution of the chick during the process of incubation, were conceived to lend great support to the advocates of this theory, of whom the most strenuous and enthusiastic was Bonnet. This naturalist, so celebrated for the boldness of his speculations, contended, not only that the whole of the parts of the foetus pre-exist in the ovum, before they actually make their appearance, but that the germs of all the animals which are in future to be born, also pre-exist in the female parent; so that the ovaries of the first parents of any species of animal contained the germs of all their posterity, included the one within the other, like a nest of boxes; from which comparison he termed his theory that of "*emboitement*." This extravagant notion was adopted by many physiologists, principally from its affording some kind of explanation of what no other theory seemed in the least adequate to solve. Spallanzani, in particular, was a zealous defender of the hypothesis of pre-existing germs. It appears, however, to be totally irreconcilable with the phenomena of hybrid productions, and of the resemblance which, in so many instances, the offspring bears to its male parent.

We have already mentioned that Harvey and Malpighi ascribed the formation of the foetus principally to the powers of the female. This opinion gave origin to the modern theory of *Epigenesis*, first clearly promulgated by Casper Frederick Wolff, who not only described a successive production of organs, of the previous formation of which there existed no trace; but showed, also, that after parts are first formed, they undergo many important changes in their shape and structure, before arriving at their finished state. The more recent researches, aided by delicate microscopical observation, of Meckel, Pander, Baer, Bathké, Oken, Purkinje, and Valentine; Ser-



res, Kolando, Dutrochet, Prévost and Dumas, Coste, and others, have demonstrated that the theory of Epigenesis, or superformation of parts, is much more consistent with the observed phenomena than that of evolution. The facts which have thus been brought to light are of peculiar interest with reference to the plans of nature, into which they give us a more extended insight, by exhibiting new and unexpected affinities between remote families and classes of animals; by showing that at one period the type of their formation is nearly the same, and by explaining the seeming caprice of nature in instances of monstrous and defective formation.

The fact that the new being is often a perfect mixture of *both* parents, would seem sufficient to prove that it is not formed exclusively from either the egg or the semen, but from a union of the two. And further, the fact that it is not in any particular part that it always resembles, either the one or the other, would show that the union is not effected on any strict plan. The fact that a child may resemble either father or mother, in many different ways, is well known. In a large family some of the children will resemble the mother in features, and dispositions, while others will resemble the father in the same way.

In the lower animals, when the new beings are formed from only one parent, they resemble that parent. It is only when sexual difference comes in, and the two parents are concerned in reproduction that we find great differences in offspring.

In those cases, among the higher animals, where a new organism is formed from the female egg alone, it is never perfect, as already explained, which alone would seem to prove the need, among them, for the concurrence of both egg and semen.

In their primary condition the egg and seminal animalcule are probably the same kind of simple cell, but they become afterwards differently specialized. The seminal germ is apparently further developed than the ovum, and assumes a different character in consequence. They both probably contain the same fundamental organization, but the seminal germ becomes more *vitalized*, or capable of motion, as we see in the animalcule, while the egg remaining more inactive is but little else than a mass of protoplasm, with a small amount of motive energy; when they unite, therefore, the male germ gives the *life*, or motive energy—in the animalcule—while the female germ gives the nutrient material by which the new being is formed. In this way both concur, and the union of the two results in the perfect new being.

Still even in the female the egg may, in some cases, have much more vital force, or motive energy than ordinary, while the sperm may have less, in which case the female would influence the formative process more than the male, and impress her likeness upon the offspring more than he would. That there are these differences in the *vigor*—if the term may be used—of the male and female principles is undoubted. Usually they are tolerably well balanced, but cases are not unfrequently met with in which the female completely neutralizes the male, and her children resemble her alone.

In other cases it is the reverse, and the family represents the father alone.

Breeders of animals often understand this important fact very well, and by proper pairing, and attending to the relative condition of the two parents, at the time of connection, they will produce offspring resembling one or the other. Negro women, it is well known, will bear much lighter colored children to some white men than to others, and some mules will resemble the ass much more than they do the horse.

The most probable theory would seem to be that the male germ, and the female germ, both have within them the formative rudiments of a similar new being, and

that the corresponding elements unite, part to part, and thus produce a more perfect organism than either could alone.

The one that gives the preponderating portion of any part stamps its impress on that part, and thus transmits its own resemblance.

The actual commencement of development is probably due to the male germ, because it is already, at the time of impregnation, endowed with motion, or life, owing to its having further progressed.

The reason we do not find the male germ alone forming a new being (beyond the animalcule) like the female germ, is simply because it has no stored up stock of nutriment, such as we find in the female egg; and there is therefore nothing by which further development can be effected. But the animalcule itself is, in reality, the male germ alone, developed to that extent, and it is in fact a more perfect development than the female egg ever reaches alone.

The animalcule is really a new human being, produced by the male germ only, as far as the formative material in that germ could effect its development; but when the nutrient matter of the female egg, and its formative power, is added, then the development becomes complete.