SEX DEVELOPMENT

or SEX EVOLUTION

By

BERNARD BERNARD

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LOVE, BIRTH AND DEVELOPMENT

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Phys. B., M. P. C. (Lond.)

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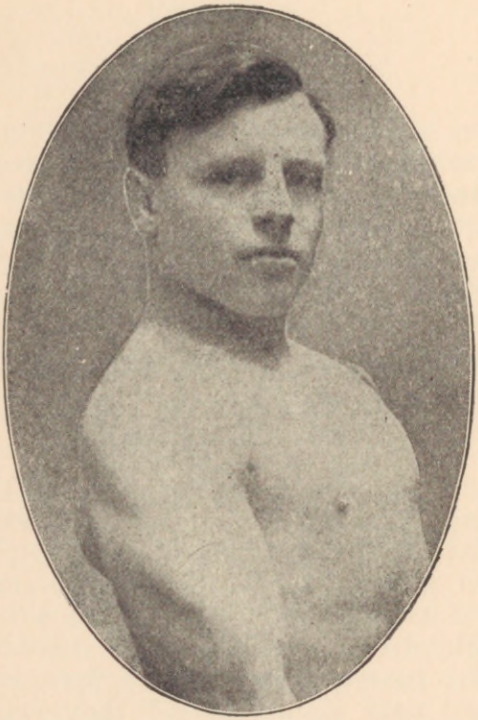

BERNARD BERNARD
Phys. B., M. S. P., M. P. C. (Lond.)
Editor of "Health and Life"

DEDICATED

TO

one who never really knew that she was the inspiration that kept my soul pure and spotless for her love, and to whom I owe any ability I have to do good for others.

PREFACE

In the following pages I have endeavored to outline the evolutionary development of the organs by whose functioning we human beings are immortal. The most sacred part of human life is the expression of sex. All the virtues and the finer qualities exist in intimate association with the sexual emotions, and to maintain purity is, therefore, the absolute essential for full human development.

It has been my experience, in many years spent in trying to appreciate and sympathize with young people in their emotional difficulties, that the most effective means by which troubles are overcome is to possess a scientific knowledge of sex development and functioning. Sound morals must rest on a firm foundation. I have found that where only negative information has been given, the difficulties in resisting the natural temptations of adolescence have been overpowering; whereas, when the exact nature of these things can be

shown plainly, by resort to physiological and biological argument, the temptations disappear of their own accord.

Every person's greatest fight in life is against the animal passions inherited from pre-human ancestors. If he succumbs he passes his life among the mediocre ones of the world. If he triumphs he achieves success and becomes numbered among the great ones.

The noblest work we can do, therefore, is to point out the pitfalls of life to our children and give them a firm scientific basis for their understanding of these matters. The average person picks up his information from indecent sources, so can it be wondered that there are so many tragedies? I believe that if in every school we could teach the simple facts of sex evolution I have tried to outline in this book we should rapidly become a race of truly great men and women.

Unfortunately today the sex forces engage the major portion of mankind's energies. Although sex questions are only dealt with in hushed voices, popular literature, art, and amusement are just saturated in a suggestive, subtle sexual appeal. Bad practices in youth,

and overindulgence in adulthood rob men and women of a full appreciation of the true beauties of life.

The best way to counteract all this is to come honestly to study the subject, realize its importance in human life and conduct, be familiar with functional details, and then let it take its correct place and be dominated instead of being allowed to dominate.

Thus, quite naturally, will the sex emotions develop, and, later on, in matrimony, they will bring exceeding joy and happiness. The tragedies in marriage are, almost without exception, set up by either an exaggeration of the sex factor or by its subjection. Women who have made themselves believe that sex is something wicked can never truly appreciate the love of a good man, and a man who seeks merely sexual gratification can never love a good woman.

In order that a man and woman may come together and be dissolved in each other spiritually and physiologically, and reproduce the highest of their qualities, it is essential that the function which enables them to do this is recognized in its sacredness, and kept spotlessly clean in youth.

The sexual weaknesses and diseases of adulthood always originate in the indiscretions of youth. Let there be no mistake about it; the purity of each person's body is a sacred trust, not only to himself and his future life partner, but to the whole of mankind and posterity.

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CHAPTER I.

Introduction.

Every endeavor should be made to simplify the understanding of sex and all that it means in life. Our children must know the facts of their existence if they are to fight successfully against the animal sex instincts which are aroused in them at the time of maturity. They must know, too, the source of their idealism and the nobleness of the right use of sex. They will strive, then, to obliterate the bad and will succeed because of the domination of beautiful and pure thoughts and ideals; for the good, when stimulated, always easily obliterates the bad. I have had a great deal of experience with boys approaching maturity, and I have found that once they know that the temptations with which they are faced are merely a stage in their development which all have had to face—the successful members of society being those who have been successful in combating these temptations—and that sex is base only

when abused, they feel that they have the *secret* which will carry them through the battle of life securely. Consequently they can fight and win.

The subject of Sex has been sadly neglected by parents and teachers, who were themselves brought up on the system of secrecy in regard to all sex matters, and continued the process when dealing with the young people entrusted to their care. They lived without realizing the deep significance of the subject and the important part played by it in all our thoughts and acts; they eyed it askance; their knowledge of the processes involved was superficial because of the lack of direct teaching, and the veil thrown over it made it difficult to approach the question openly, sanely and purely.

Children are given instruction in many things; they learn to read and write and use money correctly; they are taught "manners" and Latin and Greek and quadratic equations and French verbs; but of that which would number them among the great ones of the earth or fling them into the great abyss of mediocrity or hurl them as flotsam upon the sea of life, no one has said a word.

In all other matters use can be made of the experience of ancestors and contemporaries; in this—the most important subject of all, when one false step may lead to destruction—blindfolded youth has to begin at the beginning of things and toil slowly and painfully among the pitfalls which threaten to engulf him. No danger signals point the way, no guide books help the traveler upon his lonely journey; but if he stumbles along the unfamiliar road, or becomes lost in treacherous bogs and morasses, he is execrated and blamed for that which he could not foresee.

Fortunately, "the old order changeth, yielding place to new." Today people are beginning to realize the great importance of direct instruction regarding sex, and that to be "forewarned is to be forearmed." Enlightened parents and teachers know that, in order to give young people a reliable weapon with which to fight their early temptations, secrecy in matters of sex must be eradicated. When a child is old enough to ask a question, it is old enough to have a *truthful* answer, although the answer will necessarily vary according to the age and development of the child. Many

books have of late been published on this subject, but I feel that there is a need for one on sex evolution, having a distinct modern scientific bias and a moral standpoint, and yet an exposition simply written and therefore easily understood by the average youth. It is with this purpose that I am writing this little book.

I do not wish to trouble my readers with scientific names, but if it is necessary to use them, I shall explain them.

I propose to deal with specimens of the different forms of life, from the lowest, the most simple organisms, to the highest, the most complex. In so doing I shall touch briefly upon their general and sexual physiology, showing the relationship between the various organisms.

The subject deeply affects the meaning of Life and its problems. To quote Warrington Dawson, the famous novelist and historian:

"Every human being has fine depths, since his soul, however little developed, is a link between him and infinity. Evolution does not create this link, but brings consciousness of it, teaching its utility and revealing its splendors."

Nothing I could add could express more accurately my reasons for dealing with sex problems from the evolutionary standpoint. It is not that the biological processes matter so much, but it is the fact that they show us—make conscious to us—our connection to all that is; that we are actually the result of all that has been and are responsible to all that will be. We owe all we have to past generations; this, plus the results of our own lives, we shall pass on to be the foundation of all life to come.

In this little talk, then, my purpose is to show the connection of man with the past and his responsibility to the future. Man has a control over certain forces of nature. He also has, or should have, control over certain forces within himself. Depending upon the development of this control is the inheritance of future mankind. Every act echoes and re-echoes throughout the universe; a rash action due to ignorance, will have its evil effect not only upon the individual but upon posterity as a whole. Ignorance must have its terrible consequences—consequences, too, about which our youth is not informed. The majority of young people who have written to me for help

because of their condition have stated that they were unaware of the harm they were doing themselves. Many, it grieves me to say, were led into evil practices by the example of some older person.

If, by writing this book, I can help parents to make themselves more familiar with the scientific facts of life, so that they may prepare their children, by friendly counsel, to meet the difficulties of the world; if young people themselves will read it, and, remembering what they owe to others, resolve that they will leave to posterity a legacy of health and strength and purity, then my words will not be wasted or my labor have been in vain.

CHAPTER II.

THE AMŒBA.

All living organisms are composed of cells. A cell is a unit of living substance containing a nucleus, or a thickening. The simplest living organism is composed of merely one cell. The *Amoeba* is such an organism, and you shall see how simple it is.

If we take a little slime from a stagnant pool and examine it with a pocket lens, we shall in all probability notice a little jelly-like substance. Let us put this under a microscope, for it is too small for complete examination, even with a pocket lens. We behold an organism which has no settled shape; as we observe it, one part of its body is thrust out on one side, and then on another side. It is continually changing its shape and is therefore known as *Amoeba.*

The thrusting out of various portions of itself is its method of enveloping its food, which is then digested by the various acids which help to compose the *Amoeba.* (Fig. 1.)

By means of staining we are enabled to see the full structure of the primitive organism. We shall observe a kind of bubble which becomes larger after a time. Watching it closely we notice that this travels toward the side of the body and suddenly contracts, and that

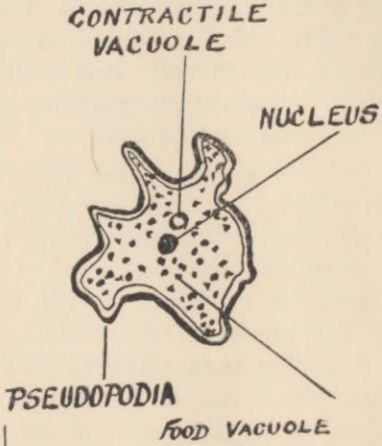

Fig 1. Amoeba

in so doing an oily substance has been squeezed out. The latter comprises the waste products of the organism and the "bubble" is the representative of an excretory system, and is known as the contractile vacuole, because of its power of contraction.

How Amoeba Gives Birth to New Life

Let us look at the *Amoeba* still under the microscope. We shall see a thickening of the jelly-like mass. This is the nucleus. If we watch it closely and patiently we shall see a constriction develop in the middle of it. This becomes

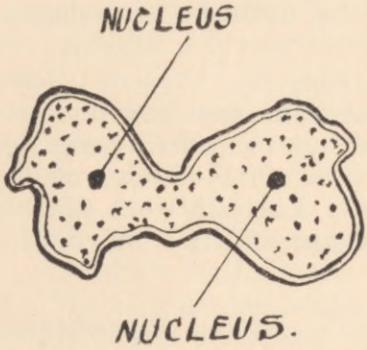

Fig. 2. Amoeba about to become TWO individuals.

more and more pronounced, until at last it divides into two nuclei. (See Fig. 2). Then the outer body of the organism begins to develop a constriction which increases and finally two new individuals are the result of the one. This is the *Amoeba's* method of reproduction.

Is the mother dead? No, the parent lives again in the two daughters. Here is, indeed, an actual expression of the immortality of life. Death means Life. The two daughters are carrying on the life previously expressed by the mother *Amoeba*. We shall see later that the same principle applies to all Life, including that of the higher animals, even of man.

Sometimes it happens that two *Amoebae* meet and fuse one into the other. The two nuclei become one and each becomes thoroughly mixed with the other. Later this one nucleus will divide again and two individuals will result.

The Principle of Reproduction.

This is the principle of all reproduction. In all forms of Life the initial stage consists of the coming together, union or fusion, of two simple cells into one, which later divides again into two. We shall find when we discuss the higher forms of Life, that this immortality is the fundamental fact of Life. All future Life depends upon the past, and the present, and from this may be deduced our responsibility for all future

mankind. By the abuse of sex the whole of Life in the future consequently suffers. Not only does the abuser suffer, but his children and his children's children "unto the third and fourth generation" and later still. As in the simple *Amoeba,* so in the highest—human—organisms, are the offspring an actual part of the parent; in other words, the parent is reproduced in new form in his children.

Professor Weismann observed that these life products do not die, and this led him to establish his well-known theory, "The Immortality of the Germ Plasm." The germ plasm composes the sexual cells which make the new individuals. We certainly understand that if the life-products are immortal, so is Life itself. The life we see around us is the result of, and the continuation of, all previous existence. It depends upon what use we make of sex, how even we *think* of it, what the future of the world will be. For not only are we as individuals related to our parents, but to the whole world—in short, to All.

We call *Amoeba* one of the lowest organisms, and one of the most primitive, because it is one of the simplest.

It is called a Protozoon, because it is composed of but one cell of protoplasm. There are very many forms of one-celled animals, but *Amoeba* serves as a good illustration of this form of life. All animals go through a stage similar to *Amoeba;* every human being starts life as a single cell.

CHAPTER III.

VOLVOX.

In *Amoeba,* the one-celled organism, we saw that all the functions of Life were carried on in the one cell, and by the organism generally. We will next study *Volvox,* an organism fairly common in ponds.

Volvox is composed merely of a group or sphere of simple cells all working in harmony. If we can imagine a single cell with a pair of flagella or lashes, then several of these all joined up to make a sphere, we have *Volvox.* *Volvox* lives in fresh water and swims about by means of the lashing of its flagella. Because of this the zoologists group it with the animals. It contains in its plasm a substance known as chlorophyll, which is a typical constituent of plants. Because of this the botanists group it with plants.

Volvox, as I have stated, is simply a group of cells which have clubbed together for the general good of the or-

ganism. We should thus expect to find a "division of labor" between the cells, and this is what we do find. Certain cells are set apart for nutrition, others for reproduction. Substance is passed from cell to cell by a process known as osmosis. It stands to reason that as soon as cells—which have hitherto been individual organisms—work together socially in this way, they gain great advantages over the individuals still working singly. In the "struggle for existence" they would emerge triumphant. Each part being able to perform a different function, a greater adaptation can be secured between the organism and its external conditions. This is the essence of evolution—continued harmony, or adaptation, between organism and environment. The organism, if it is to live, must develop parts suitable to the ever-changing conditions of its environment.

The evidences that this has been the case are exhaustive. It was undoubtedly by means of socialization that man himself was enabled to emerge from the lower animals. He grouped himself in communities and in this way became far too powerful for the gigantic and fero-

cious beasts which lived side by side with him. The development of man is now the development of his social relations. These are continually becoming more complex and the time is not far distant when the whole of mankind will realize the full advantage of complete social organization.

How Volvox Reproduces.

Volvox has two methods of reproduction. In one we find its reproduction interestingly similar to, and yet vastly differing from that of *Amoeba*. Certain cells of *Volvox* fall into the center of the sphere, where each begins to divide into two cells. These two divide and make four; the four divide to make eight, and so on; but all these new cells remain together to form one organism. This continues until the interior of the mother *Volvox* becomes too large for her, and finally she bursts, sending into the world her new and multiplied form. In so doing she dies, yet she lives again in her progeny. How similar to *Amoeba*, which lost its own individuality in its two daughters!

In the other form of reproduction *Volvox* gives off special sexual cells.

They are liberated from one individual *Volvox* and swim off until they meet those given off by another *Volvox*. When two cells of different *Volvox* meet, they fuse together in the same way as did the two *Amoebae*. In fact, exactly the same process takes place, except that in the case of *Volvox all the cells remain together* as one organism, until the complete *Volvox* is produced.

Comparison With Man.

In this method of reproduction also we find the offspring to be part of the parents, as is the case in man, for here again are special cells set apart for the purpose of reproduction. In fact, man goes through a stage embryologically similar to that of *Volvox*. There is a stage in the human embryo when it merely consists of a sphere of simple cells—a stage known to scientists as the Blastula. All animals which are composed of many cells have to pass through such a stage, which represents that passed through by their ancestors in the process of evolution.

The Function of Sex.

In the first form of reproduction of *Volvox* that we discussed, we saw that

the mother *Volvox* lost her individuality in her offspring. We saw also that *Amoeba,* in order to continue her life, gave birth to two daughters, thus losing her individuality. Man has reproduced his species in exactly the same way. It is true that his individuality may cease, but he, as Man, still lives.

This in itself should make us realize the true responsibility of sex, when recognized as the means of man's immortality. It should bring home to us the iniquity of an improper use of a function which is for the maintenance of the race and not for the pleasure of the individual.

If the real meaning of sex is properly appreciated, the mystic inquisitiveness which is responsible for much loose thinking and unhealthy inquiry through wrong sources, will disappear. A physician who studies certain parts of the human anatomy becomes so familiar with their correct uses that he can see them without being overcome as a layman would be. Similarly, if we approach the question of sex in a pure manner, if we strip off the conventional covering of the whole problem and let light fall upon it, sex teaching in schools and col-

leges will be regarded in as natural and rational a way as the teaching of history or mathematics.

CHAPTER IV.

FRESH WATER HYDRA.

It is surprising what a number of interesting forms of life can be found in a fresh water pool. An ordinary duck-pond generally contains specimens ranging from the lowly *Amoeba* to the highly organized vertebrate or backboned animal, the lizard. We shall find it thoroughly worth while to take a pocket lens and a few test tubes and wend our way to the despised duck pond to examine the life to be found therein. Those organisms which are too small to be seen either with the naked eye or by the aid of a pocket lens can be taken home in a test tube, to be examined later under the microscope.

Amongst the many beautifully colored organisms which can be discovered in a test tube of water taken at random from a pond is *Hydra,* a very small fresh water organism. Like *Volvox*, it is not definitely animal or vegetable, but has characteristics of both. It is composed of two simple layers of cells, which have a layer of protoplasm be-

tween them. During the first part of its life it swims about freely, but when it becomes adult it fixes its base to some object and thus becomes stationary. Situated at the other end of its body is its "mouth," around which there are tentacles. *Hydra* simply bends its body about and thus secures its food, with the assistance of its tentacles.

The organization of the different cells of *Hydra* is more harmonious than that of *Volvox,* although individually, embryologically, *Hydra* goes through a similar stage to that of *Volvox.* As stated above, it swims about freely in early life, simply as a sphere of cells like *Volvox,* afterward settling down in a definite spot and developing mouth, gut and tentacles.

But a far higher, though similar, "division of labor" takes place among the different cells of *Hydra.* The inner ones digest the food, and pass on nutriment through the inner layers of protoplasm to the other parts of the organism. This is similar to the method of nutrition which is carried on in the human being, but is necessarily much simpler. Again, *Hydra* contains cells which are distinctly set apart for defense;

they are stinging cells, which thrust out a tiny process when provoked by any foreign body.

Sex in Hydra.

In *Hydra,* both the male and the female elements are produced in the same individual. Later on, in "higher" animals, we shall find a still further "division of labor," where each sex is carried by different individuals. But our specimen, *Hydra,* does not belong to so high a stage.

As in *Volvox,* so in *Hydra,* there are two methods of reproduction. In one method some of the outside cells will commence to develop until a new *Hydra* is budded off. Leaving the parent, this new *Hydra* swims away to live its own independent life.

In the other form of reproduction in *Hydra,* one of the cells of the outside layer begins to enlarge and the surrounding cells nourish and care for it. This enlarging cell is the ovum, or female egg cell. Above the ovum another swelling, from the outer layer of cells, is developed, earlier than the ovum itself. Special cells, known as interstitial cells in *Hydra,* divide up into

many cells and are enclosed in this swelling. These are the male sexual cells, or sperm cells. Several are produced and look like very minute tadpoles, with their comparatively large heads and motile tails. When they are ripe they rupture the swelling and are set free. One finds its way to a female cell, or ovum, generally of another *Hydra*, and uniting with it, fertilizes it.

What Is Birth?

The process known as fertilization means that the male sperm comes in contact with the female ovum. The two cells fuse together and become one cell. This is, as far as we can make out, the actual birth of the new individual. This cell has been called the stem cell. It contains, potentially, all the characteristics of both male and female parents.

Love.

Man's method of carrying on the race is exactly the same process as the one described above. Thus can be seen the importance and responsibility of the choice of a mate. The greatest honor a woman can bestow upon a man is to select him to be the father of her chil-

dren; the greatest honor a man can bestow upon a woman is to select her to be the mother of his children. Each is willing to be reproduced of the other, so that bodily and spiritually they may be blended into one. Man and wife are not two, but one—he is part of her and she of him. This is Love. Can Love have a higher object?

This should make all young men and women realize the responsibility of sex, the purity of which they must regard as the most beautiful thing in life. It should lead them to understand that sex must be kept pure and clean and untainted, not only for humanity at large, but for the time when it will find its deepest meaning in the sacredness of love between man and wife.

Development.

The one stem cell which is the result of the union of male and female cells, does not remain one cell for long. It soon divides into two cells in exactly the same way as did *Amoeba*. Then these two become four, these four eight, and so on, until the cluster, like *Volvox*, is formed and the young *Hydra* swims merrily away.

Afterward, however, another development takes place. One end of this sphere of cells becomes invaginated, i.e., pushed in, forming the shape of an indiarubber ball which has been pushed in. This process forms two layers of cells, the gut internally, with a "mouth" or common opening, for the substances which *Hydra* cannot digest are also exuded through this "mouth."

All animals above *Hydra*, including man himself, go through this stage embryologically. It is called the Gastrula, or Gut, stage. *Hydra* stops here, but we shall see in later chapters how the higher animals have passed from this to more complex stages.

CHAPTER V.

THE EARTHWORM.

As practically everybody is familiar with the earthworm, I think it will be our best plan to take it as our next specimen for brief examination. It makes an exceedingly interesting study on account of the very high specialization of its various parts compared with the simple specimens already studied; although, in comparison with the higher forms of life yet to be studied, it is extremely simple.

The earthworm has no heart such as we have, but has several expanded blood vessels which run across the body, and these act as hearts. It has a simple food channel from front to rear. The "worm" passes earth through this food channel as it burrows its way through the ground. We have all noticed the worm casts, having the appearance of earth which has been passed through a sausage machine. This earth has all been through the worm, nourishment having been extracted from it by the

worm during its passage. This is the way the whole surface of the earth is broken up and kept so. If it were not for this habit of the earthworm, vegetation would not be possible, for the earth would be too hard and compact to allow the tender shoots of the plants to push their way through.

The earthworm has no lungs, but its blood is aerated by means of its skin.

The Sex Apparatus.

The earthworm has both male and female sex organs. It is thus hermaphrodite (Fig. 3). The body of the worm is divided into segments, as we have all probably noticed. The thirteenth, internally, carries a pair of small ovaries, for the production of the female ova, or egg cells. Just below these are the oviducts—funnel-shaped tubes—which catch the eggs when ripe and convey them down to an opening on the fifteenth segment (see Fig. 3).

Nearer to the mouth end, in the tenth and eleventh segments, are the testes, for the production of the male sperm cells—the cells which form the male fertilizing element for the egg.

Copulation.

When the cells engaged in the work of reproduction are all matured, two worms will lie alongside each other, the head of one next to the tail of the other. When this happens, the ripe spermato-

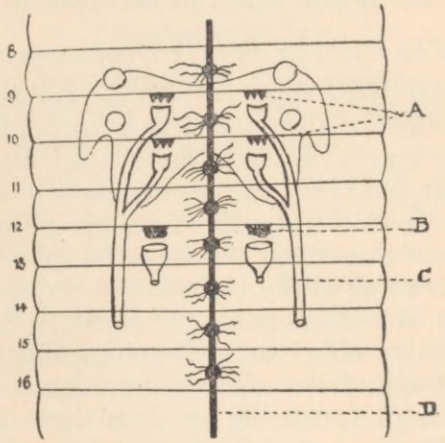

FIG. 3.

A diagram showing the position of the organs of reproduction in the Earthworm. The numbers at the sides indicate the segments, commencing from the head. A—*Testes (male).* B—*Ovaries (female).* C—*Sperm ducts.* D—*Nervous System.*

zoa, or male cells, of one worm pass into the sperm receptacle of the other. This is for the fertilization of the eggs, but that does not take place immediately.

The spermatozoa are stored, and later, when the eggs are extruded by the worm, the spermatozoa ooze out, and find their way to the ova, which then form cocoons. These are laid beneath a leaf or similar object, and from each cocoon is developed an earthworm.

The Embryo and Its Development.

All living things which are composed of more than one cell pass through all the stages beneath their own during their embryological development. Thus the earthworm passes through the stage of the one-celled *Amoeba,* the sphere of cells stage of the *Volvox* and the double bag of cells stage of the *Hydra.* Similarly we ourselves, embryologically, pass through these succeeding stages, and through forms higher than these until at last we reach the highest—mankind.

The *Amoeba* completes its state with one cell; the *Volvox* with a sphere of cells; the *Hydra* with the simple double bag of cells; but the earthworm continues its development. In the simple animals, uniform similar cells carried on the different functions of nutrition and reproduction; in the earthworm parts, or cells, have become so specialized that

definite organs have been developed for the different functions. We can no longer speak of specialized cells, but we must term them specialized *organs*. In the higher animals these develop to a still greater complexity.

Comparative Sex.

Let us return for a moment to the forms of life that we have discussed and revise their sexual habits. Sometimes two one-celled *Amoebae* will fuse to form one individual, and later divide again to form two. *Hydra* gives off male and female cells, which sometimes fertilize from the same individual and sometimes from another. There is no actual coming together of two individuals for their reproduction; i.e., there is no *copulation*.

In the earthworm, however, though male and female cells are produced in the same individual, two individuals come together for the fertilization of the ova. Thus in our study of the earthworm we have made a great step forward, and are approaching the highest organisms. In the worm we see a very primitive stage of what, in the highest

organisms, proves to be that which leads to the basis of love.

The Development of Altruism.

We have no time at present to inquire into the love making of the various insects. This is beautifully recorded in Darwin's "Descent of Man," and I would advise you all to read this work.

It is remarkable that as soon as it becomes necessary for two individuals of the same species of animals to copulate together to reproduce their kind, altruism becomes pronounced. The development of higher powers and faculties also results. A study of some of the greatest works of human art will soon convince us of the great part which has been played by the sexual factor in the development of the best that is in us. Inspiration is derived from the struggle for the attainment of that which is ideal.

One Set of Ancestors.

In this chapter I have taken the earthworm as a specimen because we are all more or less familiar with it; but it is not in the direct line of development with the higher animals. It dif-

fers from these in that its central nervous system runs along the ventral (underneath) side of its body.

There are many excellent types of animals which could be taken to show the direct line of development with the higher animals, including man; but the earthworm gives a very interesting phase in regard to its mode of reproduction, and in this respect can be said to be the best illustration of the group of animals to which it belongs. There are better forms existing showing the general development of the higher animals from the lower forms; for some groups of animals during their life history have diverged from the beaten track into lines of their own. The earthworm is one of these; yet we have every evidence to support our statement that originally all these groups, including the earthworm, had the same common set of ancestors.

CHAPTER VI.

THE DOGFISH.

Our next group for study is the fishes. I have chosen the dogfish as the representative of this class because it is held to be in the main line of development with the highest animals, although it is a low type of fish. All mammals pass through a fish-like stage embryologically. Gills, a typical fish-like characteristic, develop in the human embryo —other important organs being later on developed from them.

The dogfish is grouped with, and related to the shark, and to the skate. Those who have indulged in the latter luxury will know that there are no bones, but simply cartilage or gristle, which, in higher animals, becomes displaced by bone.

The dogfish has a properly centralized heart, which is, however, composed of but two chambers. The used blood is pumped to the gills, where, coming in contact with the water, it is purified; or, to be more accurate, it is oxydized

by the air dissolved in the water. The purified blood then passes to the various parts of the body through arteries, and back to the heart again by veins.

Evolution of the Brain and Nervous System.

The dogfish has a highly organized brain and nervous system compared with that of the lower specimens of life which we have discussed. We saw that *Amoeba, Volvox* and *Hydra* carry on their nervous functions simply by means of outside parts. In the earthworm, certainly, we found that a definite nervous system has been developed, but of a very primitive nature, being merely a pair of nerve cords, with a center, or ganglion, in each segment. There is the definite organ of centralization—brain—such as is developed in the dogfish. In the latter, the brain is very lowly organized, compared with that in the highest forms of life, and many stages of development exist between the brain of the dogfish and that of man. In *Amphioxus,* a fish-like animal placed almost at the bottom of the vertebrate scale, a thickening at the front end denotes the rudimentary brain.

Students of psychology — and I expect there will be many who will read this book — will do well to study the physiological evolutionary development of the organs by which expression is given to the mind. The development arose by the invagination of external cells, and the evolution was due to interaction with external stimuli. Response in external stimuli is the first function of living substance; *individual* development of mind can only take place by means of such interaction; thus we have every reason to believe that its development in a group, *i. e.*, its *evolution* in mankind, has been due to the same cause.

The Food Canal.

The dogfish has a highly complex food canal. The mouth leads by a channel — the oesophagus — or gullet — to the stomach, which in turn leads to the intestine. Special auxiliary organs such as the pancreas, liver, bile and spleen, serve to help in the digestion of food, and in the purifying of the blood. When we remember *Amoeba's* primitive method of carrying on these functions, and trace the development of those simple cells to groups of cells, and then to

organs more and more highly complex, we are bound to acknowledge that all Life is One. All these stages are but periods also in man's evolution throughout the ages.

Urinogenital System.

The sexual or germ plasm is developed in the general body cavity,

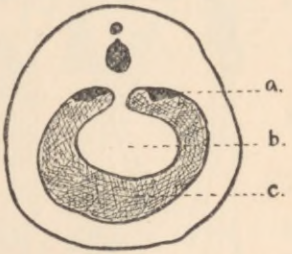

FIG. 4.
Transverse section of a Dogfish. A—*Germ Plasm.* B—*Intestine.* C—*Coelom.*

known as the coelom (see Fig. 4). Each sex is carried by a separate individual, although there is a fish *(Seranus)* which is hermaphrodite.

From the fishes to the highest organisms the reproductive organs are always intimately connected with the urinary ones; thus we speak of the urinogenital system.

In the male dogfish, the testes (the organs containing the male sexual element) are connected with the kidneys (whose function is to excrete waste matter and urine) by fine tubules.

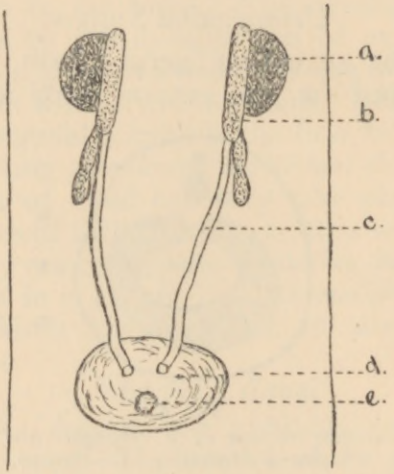

FIG. 5.

Male Organs of Dogfish. A—*Testis.* B—*Kidney.* C—*Tube Conveying Urinogenital Products to* D—*Common Opening.* E—*Anus.*

From thence the spermatozoa (the male sex cells) travel by the same tube which carries the urine down to the common opening or cloaca (see Fig. 5). Thus the fishes have but one opening for sexual and excretory products.

In the female dogfish the ova are carried from the ovaries independently of the kidneys. The ripe ova are received in funnels, and are thence carried down to the common opening by a duct (see

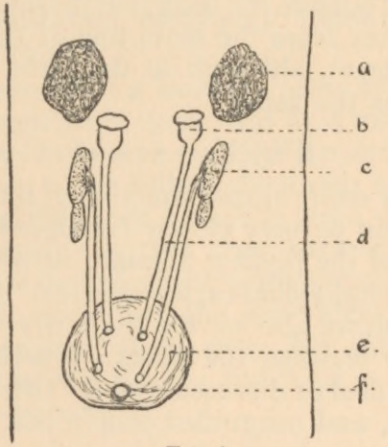

FIG. 6.
Female Organs of Dogfish. A—*Ovary.* B—*Funnel to catch Ova.* C—*Kidney.* D—*Tube conveying Ova to* E—*Common Opening* F—*Anus.*

Fig. 6). (The above figures are purely diagrammatic; they must not be taken as exact drawings.)

Fertilization.

The male dogfish has two claspers on its underside, for clasping the female in

copulation for the fertilization of the eggs. In the dogfish the eggs are fertilized within the body and they develop to an immature stage before being extruded. In most fish the eggs are fertilized outside the body; but these are departures from the main line of sex development, although in them the principle is the same.

Why Two Sexes?

The entire sexual function of the dogfish can be very closely compared with that of the highest animals, in which a single individual carries one sex. In the dogfish we also see the similarity which exists between the sexes. There is a great deal of discussion of the two sexes today, and misguided people talk as if members of opposite sexes are almost different species of beings. Morphologically, *i. e.*, in form, or anatomically, there is a corresponding organ in each sex. They are necessarily different because they have to carry on a different work, but they have both developed in the same way, from corresponding parts and organs.

The carrying of one sex by one individual is a "division of labor" which is

necessary for the higher development of those groups of organisms in which it occurs, just as the socialization of the one-celled organisms led to higher, more complex organisms, and consequently "division of labor" between the parts. Specialization invariably follows centralization.

Necessarily a woman's ideas are very different from those held by a man. It is not illogical to say that a member of one sex never fully understands a member of the other. Each is but a part of one unit; together they harmonize in what is termed scientifically—man. Ultimately both have the same ideal — the maintenance of the race; they share the greatest and noblest ambition — to become parents.

CHAPTER VII.

THE FROG.

In the frog we find a most interesting link between land and water animals. All know that the frog in early life is a fish (a tadpole), and not until it is adult does it develop air breathing apparatus and jump about on the land. It then becomes amphibious, living in the water or on the land.

This is a very important development in evolution; for all the highest organisms were fishes at one time, and in emerging from water into land animals had to pass through an amphibian stage, such as occurs in the frog. Various organs in the frog, especially those relating to sex, explain to us most peculiar structures in higher organisms, through which we are able to trace the development of our own.

In comparing the adult frog with the specimens discussed in the previous chapters, we shall notice a much greater complexity of the parts. For instance, the heart in the dogfish was merely a

tube doubled on itself to make an "S" shape. In the frog this doubling is developed much farther, giving a heart which is divided into three chambers—two auricles and one ventricle; although the embryo frog's heart is identical with that of the adult dogfish, in the respect that it comprises one auricle and one ventricle. In the mammals, the mechanism of the heart becomes still more complex, and we find two auricles and two ventricles.

Male Sexual Organs.

In the frog the sexual organs, too, show more complexity than those of the dogfish, although essentially the principle is the same. In the male, the testes are in the body cavity against the back, and are connected by fine tubules to the anterior, *i. e.*, front portion of each kidney. The spermatozoa pass through these tubules, and down the same tube which carries the urinary products to the cloaca. They are then stored in a seminal vesicle.

When we come to study the mammals we shall find that the testes and the portion of the kidney to which they are attached in embryo life and youth become

detached, and pass down the body to the lower part of the abdomen, and finally through the abdominal wall into a scrotal sack or bag. The part of the kidney which has been detached is known as the epididymus, and this maintains its tubules from the testes. I will refer to this matter when discussing the rabbit, so I would like you to remember it. As a matter of fact, it simplifies what would otherwise prove an insoluble enigma: the development of the vas deferens (the tube which conveys sperm) from the mesonephric duct (the duct used to convey urinary products).

That is to say, the duct which in the frog is used for conveying both sexual and urinary products, becomes adapted in the mammals for conveying spermatozoa only.

Female Sexual Organs.

The female sexual organs of the frog are also essentially on the same principle as those of the dogfish. The kidneys are situated at the back of the abdomen, and have their own urinary tubes (ureters) as in the dogfish.

The ovaries are found in the body cavity or coelom, and are very large be-

cause of the enormous number of ova which they produce. It has been estimated that a single frog will lay several thousand eggs. When ripe these will leave the side of the ovary and occupy the body cavity, until they find their way to a funnel-shaped opening to a much-coiled oviduct. This entrance is right in the anterior part of the frog's body cavity. In the oviduct the eggs become enclosed in an albuminous coat, and, when they leave the body, are about ¼ of an inch in diameter, although the actual size of the egg itself — without the surrounding albumin—is about one-fourteenth of an inch in diameter.

Comparative Copulation.

Copulation takes place in the frog. If we examined a male frog we should find a pad arrangement on each of its fore-limbs; with this it clasps the female and remains thus for several days. As the female lays the eggs, which it does in the water, the sperm from the male are exuded and fertilize the eggs, which develop outside the mother in the water.

Let us pause here for a moment, in order to compare the form of copulation in the frog with that in the fishes, and

also that in the higher land animals. We saw that copulation took place in the dogfish; the male had claspers and fertilized the egg, which developed to a certain stage within the female. Such a process, however, is not entirely typical of fishes—it only applies to the dogfish type. Most female fish exude their ova into the water, the male later spreading the sperm over them, which results in fertilization. During this process *there is no bodily connection* between the male and female.

Traveling from the copulation thus seen in the fish, to that of the frog, we have a direct transition from a lower to a higher form of copulation; in higher animals the transition is still greater, though the principle of fertilization in fish is maintained. In the frog the development in the method of copulation is in the clasping of the female by the male during the fertilization of the eggs, but this fertilization takes place *outside* the female. In the higher land animals copulation is so much more developed that the male not only clasps the female but fertilization takes place *within* her body.

Development of the Spawn.

We have all seen frog's spawn floating on the top of a duck pond in early spring. It forms a jelly-like mass of colorless substance, which is divided into sections, each of the latter having for its nucleus a dark speck. This nucleus is a frog's egg, and the surrounding jelly is albumin, which is the food for the embryo. The egg is exactly the same as all other eggs; it is a single cell, which, combining with a spermatozoon, fuses into a single cell again. Then comes the process of division into two cells, until a simple cluster, or sphere, is formed. This sphere invaginates and other developments, such as have been observed in the dogfish, continue, until a little tadpole, having external gills, is the result. This attaches itself to a stick or other object in the water, and later the external gills are absorbed, and ordinary fish gills, leading to the pharynx, are formed. Still later, the tadpole gets bigger, hind limbs make their appearance, followed by the fore limbs. The tail slowly becomes absorbed, for it serves to supply nourishment and to aid in the aeration of the blood. In the

meantime the gills are undergoing changes, developing into what will eventually become organs for various purposes. All this time the tadpole is a fish, and fulfills all the characteristics of one; but finally, it inquisitively pokes its head out of the water and begins to explore "fresh fields and pastures new." It breathes the air with its lungs, it jumps about on its four legs, it catches flies with its mouth, and shows itself to be a real land animal.

CHAPTER VIII.

THE BIRD.

The bird has been a subject for poets and writers since civilization began. The song of the bird, the ease and grace of its flight, and its wonderfully beautiful attire, all serve to inspire the coldest of us. A careful study of this chapter should not only show us how and why these beauties have developed but should lead us to see our own relation to the birds, as well as to the rest of nature. The gulf that separates us is but relatively wide.

All organisms start life in the same way — as a simple cell; but, as in the human family itself, each has his allotted path. Each organism develops those organs which are most suitable for its particular life in the family to which it belongs.

The bird, being a flying animal, has organs fitted for this purpose. Very powerful and big chest muscles (pectorals) govern the wings. If examined closely, the wings will be found to have

the bones corresponding to those of the fore-limbs of the ordinary mammal (cat, dog, ape).

It has been estimated that it took two million years of struggle for birds to develop wings for flying; from this we get a rough idea as to the time it must have taken to develop other organs necessary for the expression of higher powers, especially in the case of man.

We see specialization of a very high order in the birds. The heart and circulatory system generally are as complex as in the mammals (the group which includes man); but there is one great difference. In the reptiles (snakes) and amphibia (frogs) there are two aortic arches (the big blood vessels leading from the heart). These arches curve round from the top of the heart, and so conduct the blood from the heart to the rear of the body. In the bird the *left* arch disappears, leaving the right; but in the mammal the *right* arch disappears, leaving the left; this becomes the aorta. Thus birds and mammals have taken separate paths, having started from a common ancestor similar to the reptile.

Organs of Reproduction in the Pigeon.

Let us take for our specimen the ordinary domestic pigeon, with which we are all familiar. The organs of reproduction are here very highly developed, and can be compared favorably with those of the highest mammal. As the reproductory organs are always so closely connected with the urinary system we must refer to the latter for a moment. The two kidneys have each three lobes. In the male (see Fig. 7) each kidney has a tube—the ureter—leading to the urinogenital and alimentary opening called the cloaca. The testes, the organs in which the life-producing spermatozoa are formed, lie underneath and anterior to the kidneys. (The diagrams are sketched from the specimen when it is laid open with its underneath side upward. That is why in Fig. 7 the testes appear above the kidneys. If you imagine this turned into the normal position of the live pigeon, you will have a correct idea of the relative positions of the organs.) Each testes has a tube by which the spermatozoa are carried down to the cloaca.

In the female pigeon (Fig. 8) there is really but one ovary, the left; the right one is almost atrophied through lack of use. The life-producing ova are formed

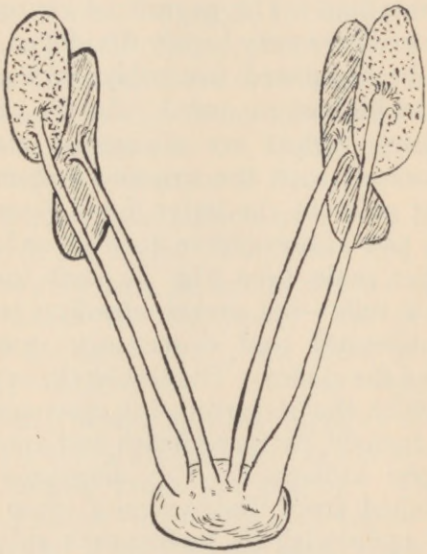

FIG. 7.

Male Urinogenital Organs of Common Pigeon. The outside superior lobes are the Testes, with tubes leading to the Cloaca. The inside elongated lobes are the kidneys, also with tubes leading to the exterior.

in the left ovary. A tube, funnel-shaped at the beginning, leads down to the cloaca. It is in this tube, the

oviduct, that a fertilizing spermatozoon from the male finds its way to an ovum, or egg. There are various glands investing the oviduct, which give

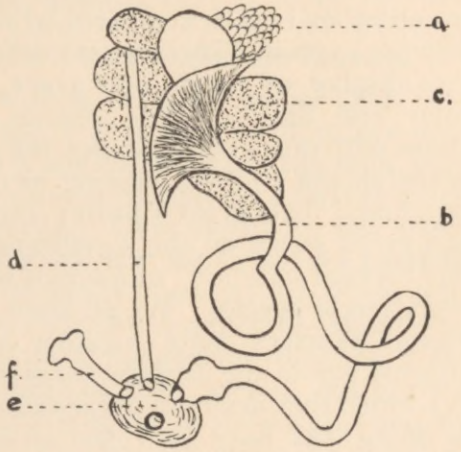

FIG. 8.

Female Urinogenital Organs of Common Pigeon. A—*Ovary.* B—*Tube carrying ova to exterior.* C—*Kidney.* D—*Ureter.* E—*Cloaca.* F—*Remains of atrophied right ovary and oviduct.*

off secretions in the form of albumin (the white) and calcin (for the shell).

Sexual Selection.

How many of us have not walked along a country lane on a spring morn-

ing and felt the glory and oneness of nature? The birds sing their sweetest songs, their plumage is of the richest; they circle around us, and halt in their flight to hop in front of us, as if to call our attention to their treasures, of which they are so proud. There is reason for all this display of form, and grace, and color and beauty. The female bird mates with the most handsome, the most graceful, the sweetest singing bird she can find. The great Charles Darwin laid much stress on the significance of this "sexual selection" of animals in the evolution of species. We all know that pigeon fanciers mate together those pigeons possessing certain characteristics which they desire to perpetuate. By so doing they have bred ever so many new kinds of pigeons. All domestic pigeons are the descendants of the Common Rock Pigeon—a very plain bird; but by this special "selection" all other forms have been developed. Thus we have every reason to believe that the choice of a partner, or "sexual selection" may have had a great influence on the development of life, as exhibited in all living forms. Those animals which are weakly, or show no attractive or useful

signs, ultimately die out, while those possessing good points are chosen, and perpetuate their species in the offspring to which the character of the parents is handed down.

Sex Teaches Another Lesson.

Sex, then, has also another great cosmic significance. In itself it has provided a method whereby the unfit may be exterminated, and the fit left to carry on the race. Over and above this, there is a natural law which applies particularly to human beings; for those individuals who are degenerate—those who do not reach the general standard of development of their species, but remain at previous stages in some way—become sterile; they are not given the power to perpetuate their retrogression in offspring. The reason for this can easily be understood if we but grasp the elementary facts of life. An animal, as we have found, is an organized unit of many parts; the disturbance of any of these will have a correlative influence on the whole organism. The wrong use of sex is perhaps attended with more disastrous results than is the abuse of any other part of the body.

It causes immediate damage to the individual himself, in many cases leading to sterility, with its attendant indignities and pains; but the effects on his offspring, should he have any, are still more serious, involving the degeneracy of the race. It will be shown later on, however, how this takes place.

Properly understood and used, sex is the most important and significant function which makes for the development of higher life; abused, it not only prevents development but embraces retrogression, leading to the loss of life itself.

The New Life.

In the glorious springtime the male and female birds mate. The spermatozoa of the male are introduced in copulation to the oviduct of the female, where spermatozoa find their way to the ova. The embryological stages of the forms of life, discussed in the earlier chapters, are all recapitulated within the shell, until at last, exercising its muscles, the pigeon breaks forth into the world.

CHAPTER IX.

THE RABBIT.

Let us now make a short study of the group of animals known as mammals. Mammals are distinguished from other orders by having glands (mammae) which provide nutriment for their young; any animal having this characteristic being classed with the mammals.

The rabbit may be taken as a fair specimen of this most important and highest order of animals. The observations we make concerning it, however, will apply generally to all other mammals.

Mammals are vastly superior to the other species of which we have made a study, in that they bring forth their young in a living, though somewhat imperfect state. These offspring have extremely complex and delicate organs, because of their immaturity, so that nearly all mammals have to protect and nurse their young. The period during which this is necessary is regulated by the complexity of the organism; in man,

the most highly developed mammal, the period is longest.

When There Were No Mammals.

There was a period in the earth's development when there were no mammals; when the highest form of animal was one similar to the reptiles (snakes and lizards). They laid eggs which they left to hatch in the sun; but there came a time when the temperature was lowered so considerably that only those organisms which looked after their eggs could reproduce their kind. Those orders that did not do this died out in that period, as their eggs could not hatch to produce offspring. Some of the animals went a step farther; they not only looked after their eggs but the female developed organs which made for the protection and nourishment of the embryo within her body. This was the beginning of the group called mammals.

When we think over these facts we find prominent signs of a developing altruism—the highest form of which is the care of parents for their offspring. Being a real father or a mother is much more than the mere begetting of a child. Proper care, education in the vital ques-

tions affecting life, assistance in difficulties and sympathy, all have their place in parenthood, and we can trace their origin to the time when animals began to care for their young.

Sex in the Rabbit.

The kidneys in both sexes are situated on the back wall of the abdominal body cavity; they have each a tube (ureter) which leads to the bladder.

In the adult male the two testes (Fig. 9) containing the life-producing cells sink low into a scrotal sac, but in the young are still in the body cavity. A tube from each of the testes approaches the bladder, where they are joined on to a bigger tube called the Urinogenital duct, because it carries to the exterior the urinary and genital products.

At the end of the testis is a gland known as the epididymis, which has tubules leading from the testes, through which the spermatozoa are passed up to the vas deferens (the duct which carries the spermatozoa to the urinogenital opening).

This may seem curious to those who have made no comparative study of anatomy; but this epididymis is simply

the remains of a part of what was the kidney in the ancestors of the mammals, corresponding to what we saw takes place in the frog, where the testis was

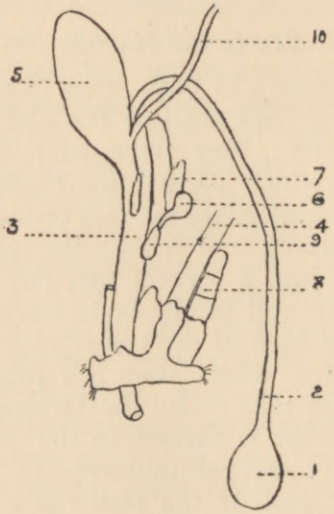

FIG. 9.

Male Urinogenital Organs of a Mammal. 1—*Testis.* 2—*Duct carrying Sperm from Testis.* 3—*Urinogenital Tube.* 4—*Rectum.* 5—*Bladder.* 6, 7, 8, 9—*Glands.* 10—*Tube coming from kidney.*

connected to the kidney by five tubules (see Chapter VII.).

We remember that in the frog there were a number of tubules which took

the sperm through the kidneys and down a duct into the cloaca. In its embryo life the mammal goes through a similar stage, but as it develops into a

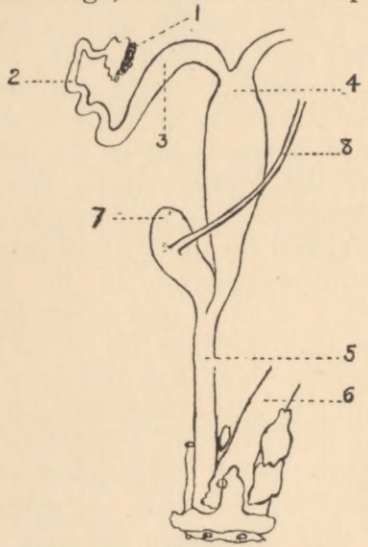

FIG. 10.

Female Urinogenital Organs of a Mammal. 1—Ovary. 2—Duct carrying ova from ovary. 3—Uterus, in which ova are fertilized. 4—Vagina. 5—Urinogenital Tube. 6—Rectum. 7—Bladder. 8—Tube leading from kidney to bladder.

mammal, the testes begin to descend until they reach the lower end of the abdomen, and finally break through into a scrotal sac. During this descension

they take with them that part of the kidneys to which they have been attached anatomically and physiologically. Even in man this development persists. This teaches us that animals have used such parts or organs as they possess to develop more complex organs and functions in their evolution. Still more, it traces for us the development of the higher forms from the lower, demonstrating the common origin of all life, and the unity of all things.

For the completion of the sexual function, a series of glands produce secretions as a medium for the dilution of the sperm—and the necessary muscular force to expel these secretions.

In the adult female (Fig. 10) there are organs which correspond exactly with those of the male, excepting, of course, that they have different functions, and consequently differ in form. As we can trace the development of the organs of the mammal — even to the small secretory glands — to those of a less complex ancestor, so can we find a parallel development of male and female in the same source.

The ovaries, producing the female ovum, or egg cell, correspond to the

testes in the male, but remain throughout life attached to the wall at the back of the abdomen behind the kidneys. A tube (oviduct) leads from each ovary, and becomes larger and thicker as it progresses. At the largest part it becomes the uterus — wherein the young develop.

There is — in the rabbit — a uterus formed from the tube leading from each of the two ovaries—so there are two uteri. This does not apply to man, as we shall see later, for here the two uteri are fused together into one uterus, which becomes pear-shaped in character. In the rabbit the two uteri open into a bigger tube — the vagina. The latter is homologous with, *i. e.*, it develops in the same way and forms the same corresponding organ, in the male, the *uterus masculinus:* the vagina leads downward and meets the urinogenital canal which finally leads to the urinogenital aperture.

Reproduction in the Rabbit.

When an ovum is ripe it is released from the ovary and passes down to the oviduct, where, if copulation has taken place, it meets a sperm cell from the male. Reaching the uterus, having

fused and become one cell, this, like the primitive *Amoeba,* divides into two. Then these two cells divide into four, and so on, until, like *Volvox,* our rabbit embryo becomes a social cluster of cells. Then, like *Hydra,* it becomes indented at one end, having an interior, or gut, with but one opening. As in the earthworm, however, parts become specialized, and gills develop, as seen in the dogfish. From these gills are developed organs of much greater complexity, similar to those of the frog and the pigeon, for, like them, it finally intends to breathe air. Thus a gradual embryological growth results in the birth of a perfect organism, having the characteristics of its own species.

In the rabbit, as in the lower organisms, a cell from the male (an actual part of the organism) meets a cell from the female. This happens in the female genital duct of the rabbit, where, descending to the uterus, development takes place by means of an intercirculation of blood between the mother and its offspring.

The young is attached from the navel, or pit of its stomach, to what is known as the placenta, a large network

of capillaries communicating with the blood system of the mother, by a cord—the umbilical cord or navel string. When born the young passes down the vagina out into the world, and the navel cord has to be broken.

The Correct Use of Functions.

The mammal is an exceedingly delicate organism, and tampering with vital parts may blast the whole of its future life. The life cells contain, potentially, those characters which go to make up the perfect being, and we know, definitely, that the habits of the individual affect these cells, for better or for worse.

There is an intimate connection between the germ plasm (the sexual life-cells) and our external surroundings, and with the general individual characteristics various statistics show, and experiments have been made to prove, that if the whole organism is not kept in clean, healthy surroundings, a distinct deteriorative effect is noted in the offspring. Moreover, an ill-considered use of the sexual functions may produce malformations and weaknesses in the offspring, which may result in disease or premature death.

CHAPTER X.

MAN.

In the last chapter we examined a specimen of one of the lowest type of mammal—the rabbit. It differs but little from the highest — man. Embryologically man goes through all the forms and stages of the organisms which we have discussed in the previous chapters. He recapitulates the stage of the one-celled *Amoeba* in the egg cell; the spheric stage of *Volvox* in the blastula; the gastral stage of *Hydra* in the gastrula; the fish-like form with gills in the further advanced foetus. He is actually one with all other living organisms, and, in fact, with the whole of the universe.

The development of man has been far more complex than that of any other animal. This is chiefly in regard to that organ for the generalization of individual sensory impressions—the brain.

The urinogenital organs and their functions are chiefly characterized by the fact that the two uteri in the female

have become one uterus. In the undeveloped human being the two uteri still remain. It is not until maternity is reached that the characteristic pear-shaped uterus comes into existence. A division of the uterus occurs in some adult females, but this is, of course, due to retarded development; in other words, it is an atavism.

Knowing the sexual functions of other animals, you will understand those of man, for the previous chapters show us that the same principle underlies all, and man is no exception.

Sex is the most useful and most important of all the functions of the human race, if used properly. If abused, it is the greatest curse.

The most useful, necessary and noble things create most havoc when used improperly. Thus we must concentrate upon the *noblest* uses of sex, and it is in order that we may do so that we are learning the correct function of sex. Sex is the means of our continuation as a race; it has assisted in the development of the highest gifts and characters; to those who control it is given the means to becoming successful members of society; but those who, through

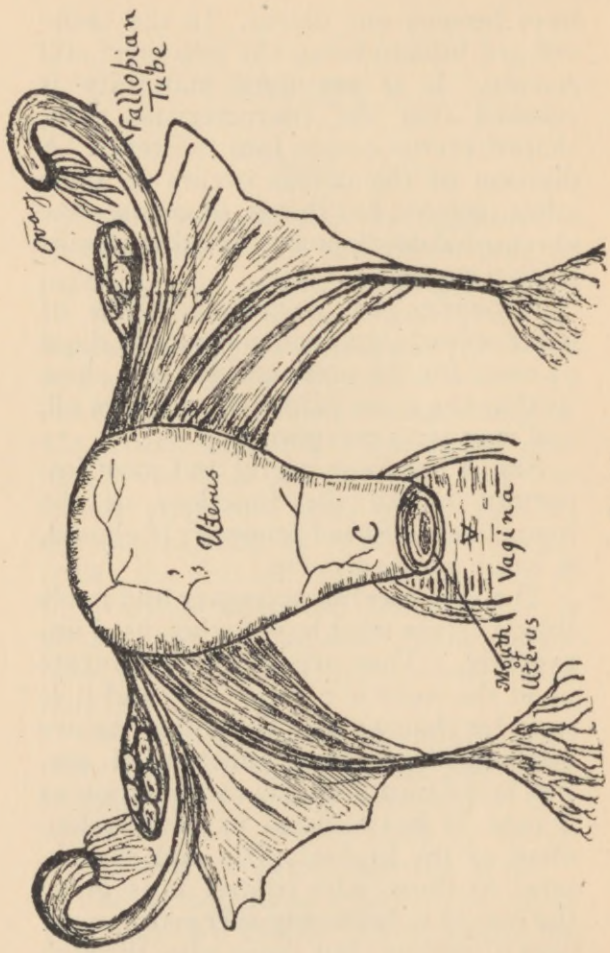

FIG. 12.

EXPLANATION OF FIGURE 12.

Figure 12 illustrates the human female organs. Each month an Ovum from the Ovary is released. This finds its way to the Fallopian Tube and travels thence to the Uterus. If it is not fertilized it will pass down into the Vagina and then out of the body. If the male has placed Spermatozoa in the Vagina, one Spermatozoon will find its way to the Ovum and coalesce with it. This fertilized Ovum will then fasten itself to the wall of the Uterus, and the development of the embryo will take place there. First of all the cell will resemble the protozoon Amoeba; then it will divide into two, and these two will become four until the embryo becomes a cluster of cells, the equivalent of Volvox. One side of this cluster will sink in and it will take a similar form to Hydra. Thus it will progress in complexity, repeating the stages that human ancestors passed in their evolution through the fishes, amphibians and mammals, until nine months from the date of fertilization the human baby descends out of the uterus through the vagina into this great cold world of ours.

ignorance or wilfulness, lose control of sex, drift on to the destruction of those things which make for a beautiful, useful and happy life.

Sex is not a possession of the individual himself; it belongs to man as a whole, and no individual has a right to seek self-gratification at the expense, not only of his own life but of the entire human race.

Heredity.

We have seen that all organisms recapitulate, embryologically, the stages lived by lower species; thus each individual of an order is the result of all its ancestors. The influence of this ancestry is found, not only in the embryo but in the developed adult. This possession, individually, of something which ancestors had, implies a new law — that of heredity. Heredity is the reproduction in offspring of characteristics developed by ancestors; a continuation of the characters of the parents. We all know that rabbits produce rabbits and pigeons produce pigeons; this is because of the law of heredity. In people, bad and good characteristics may be inherited, as also the predisposition to certain

diseases; it is therefore necessary for us to endeavor to eradicate our bad points, so that only strong minds and healthy bodies and good morals are passed on to future generations.

Given favorable conditions, every character will appear at some time or other in offspring; but this does not happen under *unfavorable conditions*.

The conditions have been called environment; and it is the inter-relation of heredity and environment that decides which characteristics of the parents shall develop in the child. For instance, if a disease is "in the family," *i. e.*, if a child inherits a strong predisposition to a disease, the chances for the disease to attack the child lie in the favorability of environment. If conditions are unhygienic the disease will most certainly develop; if, on the other hand, the child's surroundings are clean and healthy, the chances are heavily against the development of the disease.

We have already seen that the first law of living substance is response to an external stimulus; without the ability to respond to their external environment, organisms would not be able to adapt themselves to circumstances and

there would be no development possible. Thus heredity and environment are of equal importance in development of life.

Man must not think that heredity means inevitable strength or weakness; in the struggle for development he has desire, will and strength of character on his side. He must *desire* the right—the progress of humanity and of knowledge; his *will* must enable him to carry out his desires, and so his character will develop. It has been through desiring and *willing* and struggling that man has triumphed over the animals; in the same way an individual triumphs over bodily weaknesses and passions, leaving to his descendants greater strength of will and power to enable them to continue to future still higher stages in evolution.

Cell Development and Reproduction.

We have noticed that the principle of all reproduction is the fusion of male and female cells into one cell. Making man our specimen, let us briefly examine these cells, which are devoted to reproductive purposes.

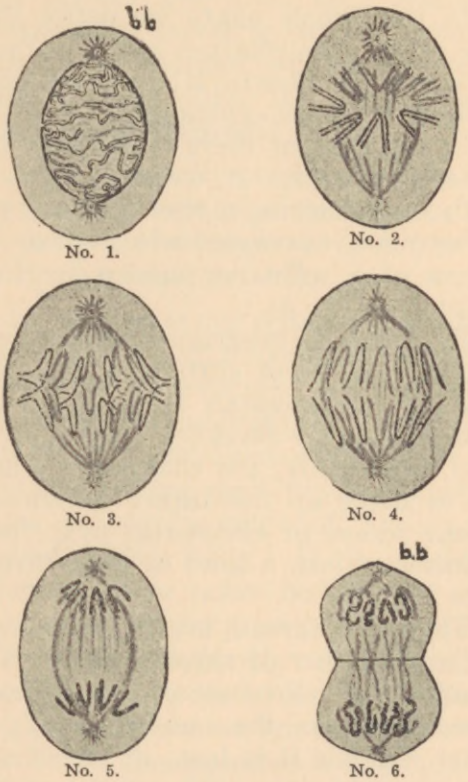

FIG. 11. *Cell Development.*

No. 1 has the Chromatin forming a coil. In No. 2 this coil has broken up into a number of Chromosomes which arrange themselves on spindles which stretch from centrosome to centrosome. Nos. 3, 4 and 5 show further progressive stages, and No. 6 shows the cell about to divide into two cells.

In the female ovary we notice that one of the cells enlarges and the others surround and nourish it; let us see what takes place in the central cell.

In the interior there is a thickening called a nucleus. If we stain the cell with some coloring matter, we shall observe upon examination a number of pieces of a substance known as chromatin.

By means of experiments it has been found that these chromatin elements are the fundamentals from which the future offspring develops; that they contain, potentially, the characters which go to make up the future individual. These pieces of chromatin next form themselves into a kind of long thread (see Fig. 11).

Then the thread breaks up into a definite number of chromosomes. The number of chromosomes is always fixed; in man, the number is 32; in other animals it is less; in plants still less. In some animals the number varies with the sex, the female having one chromosome more than the male.

A small body will be noticed on the outer margin of the nucleus shown in Fig. 11. This is called the centrosome,

and divides into two, each resulting centrosome traveling to an opposite pole. Fine spindles will radiate from each, and on these the chromosomes will arrange themselves.

A chromosome, examined under the very high power of a microscope, will be found to be composed of a number of tiny separate particles.

In the female egg cell or ovum which we are discussing, half of these chromosomes will be extruded and will form what is called the first polar body. The remaining chromosomes split down the center, doubling their number; half of these are again extruded, forming a second polar body. It is doubtful whether these polar bodies play any part at all in the process of reproduction. When the female cell has reached this stage it is ready for fertilization; it is ripe. We must remember that the number of chromosomes is only half the original full number; the other half is to be obtained from the male life cell. The actual size of the human ovum is 1/250 of an inch in diameter, and generally only one is developed at a time.

The Spermatozoon.

The male sexual cell, or spermatozoon, is developed from the germ plasm in the testes, in much the same way as the ovum in the ovary, except that very many, instead of one, develop. The chromosome development is the same but, instead of half of the chromosomes being expelled, they arrange themselves at the end of the spindles (No. 5). A constriction is formed in the middle of the cell, until finally two cells are formed. Each of these two cells again divides into two and all four are preserved. Half of the number of chromosomes occur in each spermatozoon. A plasmous tail develops, and the resulting spermatozoon has a tadpole appearance.

Fertilization.

The spermatozoa are now ready to fertilize the ovum. They are transferred from the male to the female genital duct from whence one will find its way to the ovum and fertilize it.

The spermatozoon is much smaller than the ovum. The nucleus of the latter is surrounded by a mass of plasm, while that of the spermatozoon has lit-

tle surrounding plasm. It pierces the ovum, and its plasmous tail is left outside. Then the nucleus of the spermatozoon finds its way to the nucleus of the ovum, and a fusion of the chromosomes ensues, the two cells actually becoming one cell. This, the stem cell—the actual beginning of the new individual—follows the ordinary chromosome development as outlined above, until finally it divides into two daughter cells, as in No. 6. The story of the resulting development throughout the stages of embryo life to the full life, we are familiar with already.

The Place of Man in Nature.

We have been able to discuss but very few specimens of other species of organisms, showing their relation to man. They have been taken from groups very widely separated; but were we to consider the subject in detail, amply dealing with all groups of organisms as they present themselves to us, we should be able to trace — even from living specimens—an almost unbroken chain showing the gradual growth—from simplicity to complexity — of the organs by which man continues his life.

Our studies into the comparative sciences of morphology and embryology have shown us that man is actually related to the lower animals; that he has developed in the same way and by the same means, only more so, in fact he has reached the highest stage of development that is at present possible to any organism. We have, therefore, made a comparison between man and specimens of the lower animals, showing not only the differences but the similarities between them.

Man is nature's greatest product; greatest in being the most complex. He has developed to a stage where he can control some of her forces. It has taken nature hundreds of millions of years to produce this human organism, which possesses her most wonderful faculties.

The Place of Science in Illuminating Nature.

In the short talks we have had together we have laid a foundation of thought which should help us in our study of all other sciences. We should now see the *meaning* underlying all development and we should not be content to gorge ourselves with material

facts, but endeavor to look for causes and results, and so study intelligently and with interest. If we have all grasped the theme underlying the observations and deductions we have made in this book, we should be able to place all our studies—especially those of the sciences — in their relative positions to each other and to the universe. Zoology, geology, chemistry, physics, all sciences harmonize in teaching that the universe is a unity, and that all changes and developments in it are merely correlative. Modern scientific research and modern knowledge show us that the whole universe is governed by one set of laws, which act and interact.

"Thou can'st not stir a flower
without troubling a star."

Science illumines for us the fact that all that is has developed from all that has been, and that the present and past merge continually into the future.

The Value of a Wholesome Understanding of Life.

I cannot close this chapter without emphasizing the absolute necessity for a clean and wholesome understanding

of sex problems, which, I feel confident, makes for a clean and wholesome life. The damage done to the individual, mostly through ignorance of matters of sex, is very, very serious, but the results of this ignorance on future mankind can only be grasped by those who can fully appreciate the scientific basis of reproduction.

Actions are preceded by thoughts; therefore do not let your thoughts dwell upon aspects of those subjects which will ruin your moral and physical self. Turn your thoughts to higher things; think of the glorious culture of your body, and *do* those things which make for health. Think yourself a man, and health, strength and prosperity will mark your way. Think purely, talk purely, live purely; always keep your energies engaged; when you are playing cricket or football, when you are doing physical exercises; when your mind is struggling with some great problem, there is no chance for impure thought. If you are tempted to think impurely—and this generally happens when you are idle and alone—go and talk to other people at once, or find some strenuous work to do. Don't let your bad thought

make headway, and each victory will make the next battle easier, until finally you will have conquered yourself and can set out with pure mind and a healthy body to gather the great successes in life that will follow.

CHAPTER XI.

The Law of Recapitulation.

The law of recapitulation has now been definitely established and forms the basis on which the sciences of embryology and psychology are founded. Recapitulation is the repeated development in the individual of the stages traveled through in the evolution of the race.

Embryologically, as we have seen, the human being repeats all the stages of his ancestors. We saw how every individual started life as a simple cell, which is so similar to *Amoeba.* We saw how this simple cell by a process of division formed a cluster of cells similar to *Volvox,* and in precisely the same way. We saw how an indentation was made and the embryo assumed a similar condition to *Hydra.* Later, how he became fish-like and developed gills, which formed the basis of further, more complex, developments. After traversing these and more advanced stages he is finally born a human being. All this is biological recapitulation. It is a rapid

repetition of developments that took millions of years in our ancestors. These few words will, I think, suffice to show the meaning of recapitulation.

But recapitulation does not end with physical repetition in the embryo. After birth a child recapitulates physically, and more especially mentally. The beast-like promptings, in fact, remain throughout life, and life is a perpetual struggle for control of passions and desires that have been inherited by us from our ancestors of millions of years ago. It is the control of these that makes for human advance; it is lack of control that ends in disaster and reversion. Temptation, you see, has its scientific explanation and basis, and, knowing its origin, we shall be better able to counteract it.

Why is there implanted in the young that great and undesired tendency to an abuse of self? Looked at in the light of modern science the answer is simple. It is because he is recapitulating a stage in the evolutionary development of man. Just bear this in mind. As our ancestors struggled above this stage of development, as they had the *will* so to struggle, so have we, and so *must* we

struggle above it. For he who succumbs retards his development; he never matures to express his full human attributes.

Just think for a moment of the sexual processes of the fish and the frog — stages fish-like and amphibian through which undoubtedly everyone travels — and you will see what I mean.

Professor Baldwin has shown us how the mentality of each individual develops along the same lines as those taken in the evolution of man. We need not wonder at the fact of temptation at the age of puberty. But knowing its origin and knowing its part in the development of man, we can triumph over it. The key to success, the key to purity, the key to the attainment of full maturity lies in knowing that this bridge needs fearless walking over —and *must* be walked over. Once you are past this stage you are on the high road to achievement. Hesitate and you are hurled into the abyss of human mediocrity.

How many a young fellow might have steered his course safely had he but known these facts! He feels the inward desire, and thinks himself weak

and wicked. If he but knew that this stage must inevitably be fought through by every human being as the crawling stage had to be fought through in early childhood, he would win.

I want to impress one more point which I feel to be perhaps the most important of all which we have been called upon to consider together.

In discussions of the sexual problem, the majority of people are concerned only with the physical harm done by abuse, and more especially by promiscuous intercourse.

Let me not harass your minds with thoughts of unhappy physical consequences of sexual abuse.

We have seen that Man is at the summit of the world's evolution. He has harnessed many of the great forces of nature. He has produced great works of art. He has changed the face of the earth, and he has changed the order of the struggle for life. He is distinguished from all other forms of life by these characters and achievements. Of what are they the result? They are the result of character and will. They are the result of morale.

The damage done to the physique by an abuse of sex is infinitesimal compared with the damage done to the character—character is the very man himself. Those who are endowed with the greatest human gifts of achievement are those who are often tempted most, who, when they fall, rarely recover from the calamity.

Many people who are battling for the extermination of venereal disease, are inclined to discuss the matter only because of the physical harm done by this dread malady. Moreover, many of them would have no objection to promiscuous indulgence could the physical calamities be abolished. Many people even descend to the argument of how frequently it is possible to indulge without physical weakness resulting. They generally arrive at the most absurd and false conclusions. How do we measure immorality? What is our standard? Is it physical pain resulting from an action? Not by any means. Many of the noblest of human works have had painful physical consequences. The production of many a masterpiece of art, literature or invention has cost its creator health, and in some cases, his life.

The measure of immorality is the damage done to character. A man may suffer no physical disease whatever from some immoral act, but he destroys his character. He loses a great mission in his life. He pays the great price, the price that is greater than physical death. He may have attained to the highest realms in art or science. He may have fought courageously and fearlessly for his mission in life; but he falls, and even the genius of Ibsen has failed to express adequately the moral death he suffers.

So let my parting words sink into each one of you. Never give in. Face bravely and fearlessly the temptations that will inevitably rise before you. *It is but a stage in the evolution of your life as it was a stage in the evolution of the life of the great human race.* Triumph and you will attain the heights of human achievement and become a *man* in the fullest and highest sense of its meaning.

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