PREFACE

[By Joseph McCabe]

The work which we now place within the reach of every reader of the English tongue is one of the finest productions of its distinguished author. The first edition appeared in 1874. At that time the conviction of man's natural evolution was even less advanced in Germany than in England, and the work raised a storm of controversy. Theologians—forgetting the commonest facts of our individual development—spoke with the most profound disdain of the theory that a Luther or a Goethe could be the outcome of development from a tiny speck of protoplasm. The work, one of the most distinguished of them said, was "a fleck of shame on the escutcheon of Germany." To-day its conclusion is accepted by influential clergies, such as the Dean of Westminster, and by almost every biologist and anthropologist of distinction in Europe. Evolution is not a laboriously reached conclusion, but a guiding truth, in biological literature to-day.

There was ample evidence to substantiate the conclusion even in the first edition of the book. But fresh facts have come to light in each decade, always enforcing the general truth of man's evolution, and at times making clearer the line of development. Professor Haeckel embodied these in successive editions of his work. In the fifth edition, of which this is a translation, reference will be found to the very latest facts bearing on the evolution of man, such as the discovery of the remarkable effect of mixing human blood with that of the anthropoid ape. Moreover, the ample series of illustrations has been considerably improved and enlarged; there is no scientific work published, at a price remotely approaching that of the present edition, with so abundant and excellent a supply of illustrations. When it was issued in Germany, a few years ago, a distinguished biologist wrote in the Frankfurter Zeitung that it would secure immortality for its author, the most notable critic of the idea of immortality. And the Daily Telegraph reviewer described the English version as a "handsome edition of Haeckel's monumental work," and "an issue worthy of the subject and the author."

The influence of such a work, one of the most constructive that Haeckel has ever written, should extend to more than the few hundred readers who are able to purchase the expensive volumes of the original issue. Few pages in the story of science are more arresting and generally instructive than this great picture of "mankind in the making." The horizon of the mind is healthily expanded as we follow the search-light of science down the vast avenues of past time, and gaze on the uncouth forms that enter
into, or illustrate, the line of our ancestry. And if the imagination recoils from the strange and remote figures that are lit up by our search-light, and hesitates to accept them as ancestral forms, science draws aside another veil and reveals another picture to us. It shows us that each of us passes, in our embryonic development, through a series of forms hardly less uncouth and unfamiliar. Nay, it traces a parallel between the two series of forms. It shows us man beginning his existence, in the ovary of the female infant, as a minute and simple speck of jelly-like plasm. It shows us (from analogy) the fertilised ovum breaking into a cluster of cohering cells, and folding and curving, until the limb-less, head-less, long-tailed foetus looks like a worm-shaped body. It then points out how gill-slits and corresponding blood-vessels appear, as in a lowly fish, and the fin-like extremities bud out and grow into limbs, and so on; until, after a very clear ape-stage, the definite human form emerges from the series of transformations.

It is with this embryological evidence for our evolution that the present volume is concerned. There are illustrations in the work that will make the point clear at a glance. Possibly too clear; for the simplicity of the idea and the eagerness to apply it at every point have carried many, who borrow hastily from Haeckel, out of their scientific depth. Haeckel has never shared their errors, nor encouraged their superficiality. He insists from the outset that a complete parallel could not possibly be expected. Embryonic life itself is subject to evolution. Though there is a general and substantial law — as most of our English and American authorities admit — that the embryonic series of forms recalls the ancestral series of forms, the parallel is blurred throughout and often distorted. It is not the obvious resemblance of the embryos of different animals, and their general similarity to our extinct ancestors in this or that organ, on which we must rest our case. A careful study must be made of the various stages through which all embryos pass, and an effort made to prove their real identity and therefore genealogical relation.

This is a task of great subtlety and delicacy. Many scientists have worked at it together with Professor Haeckel—I need only name our own Professor Balfour and Professor Ray Lankester—and the scheme is fairly complete. But the general reader must not expect that even so clear a writer as Haeckel can describe these intricate processes without demanding his very careful attention. Most of the chapters in the present volume (and the second volume will be less difficult) are easily intelligible to all; but there are points at which the line of argument is necessarily subtle and complex. In the hope that most readers will be induced to master even these more difficult chapters, I will give an outline of the characteristic argument of the work. Haeckel's distinctive services in regard to man's evolution have been: (1) The construction of a complete ancestral tree, though, of course, some of the stages in it are purely conjectural, and not final; (2) The tracing of the remarkable reproduction of ancestral forms in
the embryonic development of the individual. Naturally, he has not worked alone in either department. The second volume of this work will embody the first of these two achievements; the present one is mainly concerned with the latter. It will be useful for the reader to have a synopsis of the argument and an explanation of some of the chief terms invented or employed by the author.

The main theme of the work is that, in the course of their embryonic development, all animals, including man, pass roughly and rapidly through a series of forms which represents the succession of their ancestors in the past. After a severe and extensive study of embryonic phenomena, Haeckel has drawn up a "law" (in the ordinary scientific sense) to this effect, and has called it "the biogenetic law," or the chief law relating to the evolution (genesis) of life (bios). This law is widely and increasingly accepted by embryologists and zoologists. It is enough to quote a recent declaration of the great American zoologist, President D. Starr Jordan: "It is, of course, true that the life-history of the individual is an epitome of the life-history of the race"; while a distinguished German zoologist (Sarasin) has described it as being of the same use to the biologist as spectrum analysis is to the astronomer.

But the reproduction of ancestral forms in the course of the embryonic development is by no means always clear, or even always present. Many of the embryonic phases do not recall ancestral stages at all. They may have done so originally, but we must remember that the embryonic life itself has been subject to adaptive changes for millions of years. All this is clearly explained by Professor Haeckel. For the moment, I would impress on the reader the vital importance of fixing the distinction from the start. He must thoroughly familiarise himself with the meaning of five terms. Biogeny is the development of life in general (both in the individual and the species), or the sciences describing it. Ontogeny is the development (embryonic and post-embryonic) of the individual (on), or the science describing it. Phylogeny is the development of the race or stem (phulon), or the science describing it. Roughly, ontogeny may be taken to mean embryology, and phylogeny what we generally call evolution. Further, the embryonic phenomena sometimes reproduce ancestral forms, and they are then called palingenetic (from palin = again): sometimes they do not recall ancestral forms, but are later modifications due to adaptation, and they are then called cenogenetic (from kenos = new or foreign). These terms are now widely used, but the reader of Haeckel must understand them thoroughly.

The first five chapters are an easy account of the history of embryology and evolution. The sixth and seventh give an equally clear account of the sexual elements and the process of conception. But some of the succeeding chapters must deal with embryonic processes so unfamiliar, and pursue them through so wide a range of animals in a brief space,
that, in spite of the 200 illustrations, they will offer difficulty to many a reader. As our aim is to secure, not a superficial acquiescence in conclusions, but a fair comprehension of the truths of science, we have retained these chapters. However, I will give a brief and clear outline of the argument, so that the reader with little leisure may realise their value.

When the animal ovum (egg-cell) has been fertilised, it divides and sub-divides until we have a cluster of cohering cells, externally not unlike a raspberry or mulberry. This is the morula (= mulberry) stage. The cluster becomes hollow, or filled with fluid in the centre, all the cells rising to the surface. This is the blastula (hollow ball) stage. One half of the cluster then bends or folds in upon the other, as one might do with a thin indiarubber ball, and we get a vase-shaped body with hollow interior (the first stomach, or “primitive gut”), an open mouth (the first or “primitive mouth”), and a wall composed of two layers of cells (two “germinal layers”). This is the gastrula (stomach) stage, and the process of its formation is called gastrulation. A glance at the illustration on p. 61 will make this perfectly clear.

So much for the embryonic process in itself. The application to evolution has been a long and laborious task. Briefly, it was necessary to show that all the multicellular animals passed through these three stages, so that our biogenetic law would enable us to recognise them as reminiscences of ancestral forms. This is the work of Chaps. VIII, and IX. The difficulty can be realised in this way: As we reach the higher animals the ovum has to take up a large quantity of yolk, on which it may feed in developing. Think of the bird’s “egg.” The effect of this was to flatten the germ (the morula and blastula) from the first, and so give, at first sight, a totally different complexion to what it has in the lowest animals. When we pass the reptile and bird stage, the large yolk almost disappears (the germ now being supplied with blood by the mother), but the germ has been permanently altered in shape, and there are now a number of new embryonic processes (membranes, blood-vessel connections, etc.). Thus it was no light task to trace the identity of this process of gastrulation in all the animals. It has been done, however; and with this introduction the reader will be able to follow the proof. The conclusion is important. If all animals pass through the curious gastrula stage, it must be because they all had a common ancestor of that nature. To this conjectural ancestor (it lived before the period of fossilisation begins) Haeckel gives the name of the Gastraea, and in the second volume we shall see a number of living animals of this type (“gastraeads”).

The line of argument is the same in the next chapter. After laborious and careful research (though this stage is not generally admitted in the same sense as the previous one), a fourth common stage was discovered, and given the name of the Coelomula. The blastula had one layer of cells, the blastoderm (derma = skin): the gastrula two layers, the ectoderm (“outer skin”) and entoderm (“inner skin”). Now a third layer (mesoderm
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= middle skin) is formed, by the growth inwards of two pouches or folds of the skin. The pouches blend together, and form a single cavity (the body cavity, or caelom), and its two walls are two fresh "germinal layers." Again, the identity of the process has to be proved in all the higher classes of animals, and when this is done we have another ancestral stage, the Caflomac.

The remaining task is to build up the complex frame of the higher animals—always showing the identity of the process (on which the evolutionary argument depends) in enormously different conditions of embryonic life—out of the four "germinal layers." Chap. IX. prepares us for the work by giving us a very clear account of the essential structure of the back-boned (vertebrate) animal, and the probable common ancestor of all the vertebrates (a small fish of the lancelet type). Chaps. XI.–XIV. then carry out the construction step by step. The work is now simpler, in the sense that we leave all the invertebrate animals out of account; but there are so many organs to be fashioned out of the four simple layers that the reader must proceed carefully. In the second volume each of these organs will be dealt with separately, and the parallel will be worked out between its embryonic and its phylogenetic (evolutionary) development. The general reader may wait for this for a full understanding. But in the meantime the wonderful story of the construction of all our organs in the course of a few weeks (the human frame is perfectly formed, though less than two inches in length, by the twelfth week) from so simple a material is full of interest. It would be useless to attempt to summarise the process. The four chapters are themselves but a summary of it, and the eighty fine illustrations of the process will make it sufficiently clear. The last chapter carries the story on to the point where man at last parts company with the anthropoid ape, and gives a full account of the membranes or wrappers that enfold him in the womb, and the connection with the mother.

In conclusion, I would urge the reader to consult, at his free library perhaps, the complete edition of this work, when he has read the present abbreviated edition. Much of the text has had to be condensed in order to bring out the work at our popular price, and the beautiful plates of the complete edition have had to be omitted. The reader will find it an immense assistance if he can consult the library edition.

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HAECKEL'S CLASSIFICATION OF THE ANIMAL WORLD

Unicellular animals (Protozoa)

1. Unnucleated
   - Bacteria
   - Protamææ
   - Monera

2. Nucleated
   - Amœbina
   - Radiolaria
   - Flagellata

3. Cell-colonies
   - Catallacta
   - Blastæada

Multicellular animals (Metazoa)

I. Coelenteria, Coelenterata, or Zoophytes.
   Animals without body-cavity, blood or anus.

   a. Gastræads
      - Gastremaria
      - Cyemaria

   b. Sponges
      - Protospongïæ
      - Metaspongïæ
      - Hydrozoa

   c. Cnidaria
      (stinging animals)
      - Polyps
      - Medusæ

   d. Platodes
      (flat-worms)
      - Platodaria
      - Turbellaria
      - Trematoda
      - Cestoda

   a. Vermalia
      (worm-like)
      - Strongylaria
      - Prosopygia
      - Frontoma
      - Cochlides

   b. Molluses
      - Conchædes
      - Teuthodes

   c. Articulates
      - Annelida
      - Crustacea
      - Trachea

II. Coelomaria or Bilaterals.
    Animals with body-cavity and anus, and generally blood.

   a. Echinoderms
      - Monorchonia
      - Pentorchonia

   b. Articulates
      - Acrania-Lancelet
      - Craniota
      - Tylochæes

   c. Tunicates
      - Ascidæ
      - Thalidæ

   f. Vertebrates
      - Selachii
      - Ganoids
      - Teleosts
      - Dipneusts

   a. Amphibia
   b. Reptiles
   c. Birds

   f. Mammal
      - Monotremes
      - Marsupials
      - Placentals
      - Rodents
      - Edentates
      - Ungulates
      - Cetacea
      - Sirenia
      - Insectivoræ
      - Cheiroptera
      - Carnassia
      - Primates

* This classification is given for the purpose of explaining Haeckel's use of terms in this volume. The general reader should bear in mind that it differs very considerably from more recent schemes of classification. He should compare the scheme framed by Professor E. Ray Lankester.