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FOUNDED BY EDWARD C. HEGELER

MAY, 1931

VOLUME XLV NUMBER 900

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EDITED BY

FRANK THILLY
and G. WATTS CUNNINGHAM
OF THE SAGE SCHOOL OF PHILOSOPHY, CORNELL UNIVERSITY
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JUPITER OPENING THE COSMIC EGG

The frontispiece from the first edition (1651) of William Harvey's *Generatione Animalium.*

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THE INFLUENCE OF THE THEORY OF PREFORMATION ON LEIBNIZ' METAPHYSICS

BY SALVATORE RUSSO

HOW Leibniz, the eclectic philosopher, solved his dual problem of substance has not been adequately explained and still requires attention. His metaphysics is a curiously colored tapestry in which we can trace the varied threads of his predecessors; we know that he inherited the problem of substance from the atomists on the one hand, and from Descartes and Spinoza on the other. But there is something in his philosophy which has hitherto defied genesis; something which was new in philosophy and not to be found in the mathematics and mechanics of his age. By virtue of an internal principle he maintained the reality both of the part and the whole, the many and the one. How, then are we to account for this notion of immanence which harmoniously combined the two? Preformation, a biological theory prevalent in the seventeenth and eighteenth centuries, offers the solution: by the application of this theory Leibniz evolved his Monadology. The obvious rôle that mathematics and physics played in his system has often been rehearsed, but somehow this biological influence has not been adequately acknowledged, and the relation of the one to the other has been strikingly misunderstood.

Of course it has long been known that Leibniz accepted the theory of preformation, but historians in general and commentators such as Latta, Dewey, and Russell have not clearly understood this direct influence. They have maintained that the sole function of this theory in his philosophy was to explain the problem of generation.

Even Leibniz himself does not admit how significant it is in his thought. The only commentator who has understood, in part, the relation, is Professor Carr, who contends that if the microscope did not suggest, it certainly confirmed Leibniz' principle of Pre-established Harmony.[1]

More erroneous still is the belief, current at the close of the last century, that the theory of preformation was original with Leibniz. Mr. Russell seems to suggest this when he writes, "Leibniz supported his theory of preformation by reference to the microscopic embryology of his day."[2] No less a commentator than Professor Cassirer makes the same historical error; evidently he believed that Leibniz created the theory, and that it was later applied to biology. Thus he declares:

"The most decisive empirical result which arises from the application of the concept of the monad to biological problems lies in the idea of preformation."[3]

This unfortunate and misleading error was, in part, fostered by the biologists themselves, who were careless in their references. Mr. Osborn, for example, in his *From the Greeks to Darwin,* makes a statement to this effect, though other references show that he was aware of the time sequence. Speaking of preformation, he writes that Charles Bonnet "derived it from *e-volvo* to express his remarkable theory of life, which was an adaptation of Leibniz' philosophy to embryology." It is true that Leibniz influenced a host of men, Robinet, Bonnet, Réamur, Diderôt, Maupertuis, Linnaeus, Cuvier, and others, but he received his inspiration from the embryology of his contemporaries. This obvious mis-conception has been corrected by Locy:

Although it was a product of the seventeenth century, from several printed accounts one is likely to gather the impression that it arose in the eighteenth century and that Bonnet, Haller, and Leibniz were among its founders. This implication is in part fostered by the circumstances that Swammerdam's *Biblia Naturae*, which contains the germ of this theory, was not published until 1737—more than half a century after his death—although the observations for it were complete before Malpighi's first paper on embryology was published in 1672.

We have, likewise, been so much concerned with Leibniz' rela-

[1] *Leibniz,* by H. W. Carr
[2] *The Philosophy of Leibniz,* page 154
[3] *Leibniz' System,* by Ernest Cassirer, page 410.

tion to the physicists and mathematicians of his time, Kepler, Newton, Huygens, Pascal, Bernouilli, and Robert Boyle, that we have considerably underestimated this other influence. His interest in scientific discoveries, and his immortal contribution to mathematics are well known, but his relation to the biologists of his day, William Harvey, Marcello Malpighi, Robert Hooke, Jeremiah Grew, John Swammerdam, Francesco Redi, and Authony van Leeuwenhoek, from whose work he took much, should not be undervalued. These men laid a foundation that made biology as great an influence in philosophy as were mathematics and the physical sciences. Its vital presence in the philosophies of such men as Hegel, Schelling, Spencer, Schopenhauer, Nietzsche, Bergson, and S. Alexander, give evidence of this. The philosophical importance of the sciences was at its height in the times of Bacon, Descartes, and Spinoza; the decline of the mathematical influence began with Kant, who contended that the method of mathematics was not applicable to philosophical problems. Leibniz was the first modern philosopher to give biology a prominent place in his system; thus biology is doubly important in a study of Leibniz. Our purpose is to show especially the influence that the theory of preformation had on his metaphysics.

After the work of Hippocrates and Aristotle, the most important problem of biology, that of generation, remained untouched until Fabricius published his *De Formato Foetu* in 1600. His beloved pupil, William Harvey, whose work in embryology is often considered as important as his physiological discovery, continued the experimental work of his teacher, and with the aid of a simple lens brought it up to a point from which little departure has been possible. In his *Exercitationes de Generatione Animalium*, he advanced a theory of epigenesis which described development as a process of gradual differentiation of the primordium of the parents. He maintained that all the characteristics are produced in the embryological development; that they were not there before. This radical theory, anticipated by Aristotle, was little entertained until revived by Wolf in 1759, who later abandoned it for the preformation theory of his contemporaries. The theory of epigenesis was not accepted again until 1827.

Our interest here is not in Harvey's theory of epigenesis but rather in the biogenetic aphorism, *omne vivum ex ovo*, which he made popular. The belief that the egg is the common beginning of all ani-

mals (*Ovum esse primordium commune omnibus animalium*) became basal to biology. Curiously enough, the first edition of Harvey's *Generatione Animalium* is provided with an allegorical frontispiece embodying this idea of the origin of life from the ovum.[4] It represents Jupiter opening a round box or egg bearing the inscription "ex ovo omnia": from the box issue all forms of life, including man.

In direct opposition to Harvey, Swammerdam and Malpighi expounded a theory of "evolution" which was later called the theory of preformation or encasement (*emboîtement*). This use of the word evolution in its true etymological meaning of unrolling or unfolding to describe a supposed method of organic development must not be confused with the later biological and metaphysical usage of the word. Preformation taught that the pre-existence and predelineation of the organs of the chick, for example, are present in the egg before incubation: there is no differentiation during the embryonic stage, but only an unfolding of what was already there.[5] The phenomenon of growth is simply an expansion and enlargement by continuous development of the enfolded embryo. The homunculus was thought to have been discovered at last, with its head bowed and its limbs flexed. Each ovum contained an animalcule, a miniature of the adult, complete in every detail, and requiring only nourishment to reach maturity. It was the old problem of being and becoming, and Heraclitus was denied. "There is no such thing as becoming," wrote Haller in his *Elements of Physiology*. "No part was formed before another; all were created at the same time . . . The caterpillar, for instance, contained in itself the pupa, and the pupa the butterfly, therefore the butterfly was already present, as such, in the caterpillar."

But there was another aspect to Preformation which was des-

[4]It must be remembered that the ovum studied and referred to was chiefly that of a chick. The mammalian ovum was not discovered until 1827 by Ernst von Baer. For a long time it was believed that the female sexual organ secreted a fluid called "testes muliebres"; the term ovarian was invented by Stensen in 1667. In the same year Regaier de Graff published a description of the follicles which bear his name (Graffian follicles) and thought that these follicles were the ova. Von Baer showed that the Graffian follicles were not the ova, and that the ovum was a minute body imbedded in the follicular epithelium.

[5]Malpighi's belief in this matter, which materially affected the theory of preformation, was founded upon an unfortunate error. Apparently some of the eggs that he studied were incubated, for he thought he saw slight traces of the future organism in the egg.

tined to be even more significant. This was the theory of *emboîtement,* which maintained that the germs of all coming generations were accounted for on the supposition that the human ovum contained numberless other ova, each containing an individual in miniatures, and within these others, like a nest of Chinese boxes. "In the extension of this box-within-box doctrine (*Einschachtelungslehre*) the distinguished physiologist Haller calculated that God created together, 6,000 years ago, on the sixth day of his creatorial labors, the germs of 200,000,000,000 men, and ingeniously packed them in the ovaries of our venerable Mother Eve."[6]

Humorous as this may seem, it was one of the first expressions of the theory of the continuity of germ plasm that had in Arthur Weismann its latest exponent. In answer to the doctrine of acquired characteristics advanced by Darwin and Lamarck, Weismann said that the germ plasm alone is inherited. This is accomplished by the reproduction of germ tissue from generation to generation, everything being present at conception. This sounds like a modern theory of preformation, and the continuity of the human race from the seed of Adam has its counterpart in the study of the heredity of such families as the Jukes, Kallicacks, and the Edwards.

Twenty years after Harvey had published his book, Ludwig Ham, a medical student in Leyden, discovered the spermatozoon,[7] and thereby divided the preformationists into two groups. Ham showed these little bodies to his teacher, Leeuwenhoek, who began to study them with such zeal and enthusiasm that he postponed the further study of eggs for a long time, declaring that the spermatozoa were the essential germs, and that in them were the beginnings of future souls. Carried on by his fancy, he thought he saw the complete outline of both the maternal and paternal individuals in the spermatozoa, and went so far as to make sketches of them. They

[6]*Biology, General and Medical.* By McFarland. Erasmus Darwin ridiculed his scholastic element in his *Zoonomia.* "These embryons . . . must possess a greater degree of minuteness than that which was ascribed to the devils who tempted St. Anthony, of whom 20,000 were said to have been able to dance a saraband on the point of a needle without in the least incommoding each other.

[7]Most books written about the beginning of the twentieth century state that it was Leeuwenhoek who discovered the spermatozoon instead of Ham (also spelled Hamm, Hamen, and Hammen.) Latta makes this error and so does Osborn in his book *From the Greeks to Darwin.* He also credits Degraff with the discovery of the ovum in 1678. This misunderstanding may be due to the fact that it was Leeuwenhoek who announced the discovery of the spermatozoon to the Royal Society in London in a letter dated November 1677.

were made out to be minute animals of both sexes, capable of coition. Thus Leeuwenhoek, together with Hartsoeker,[8] who maintained that the ovum was merely a nidus in which the sperm developed, began a movement contending that the sperm rather than the ovum was the miniature of the human foetus.

The Ovists took the matter with comparative indifference. Some believed that the spermatozoon was a parasitical animalcule,[9] others believed that it possessed simply a stimulating force which helped the growth of the egg. Both factions agreed, however, that the whole race was contained in a seed, and that there was some contact between the sperm and the ovum.[10]

It now became a contest between the Spermatists and the Ovists to prove whether the future was contained in the ovum or in the sperm, whether the human race was originally put in Adam or in Eve. Leibniz, who was at first an Ovist, now sided with their opponents in believing that the origin of the human race lay in the sperm. He was as impressed with the idea of continuity as he was with the idea of uninterrupted development within the germ. But he did not agree with Swammerdam who predicted that the end of the human race would take place when the last germ of this miraculous series had been unfolded; he believed that the germ was immortal because it did not contain within it the seeds of destruction. Only an act of God could destroy it.

In summing up the theory of preformation, which was accepted as the biological dogma of Leibniz' time, we find that it consisted of five main points:

1. That all life is biogenetic and all generation comes from pre-existing germs.
2. That all life was created and predelineated by God in the beginning.
3. That encasement (*emboîtement*) gave continuity to life.

[8]Hartsoeker, qui voyait dans l'animalcule la larve humaine, plaça tout l'homme dans sa tête; il réserva la queue pour la cordon ombilical. Sa métamorphose s'opérait dans la cicatricule, qui, selon lui, n'était qu'une cellule unique de la capacité du zoosperme. *Archives du Museum d'Histoire Naturelle* Paris 1839. Tome IV, p. 250.

[9]The name spermatozoa itself (seed plus animal) was chosen to indicate that it was an internal parasite of the sperm.

[10]Long before Aristotle, the principle of syngenesis, or formation of the embryo by the union of elements from both the parents, was rightly understood by Empedocles.

4. That development was from within, precluding all influence or change from without.
5. That these germs were immortal.

Let us now see how this theory influenced Leibniz.

In the *Monadology* we are told that the monad is a simple substance which enters into compounds. By simple he means indivisible and without parts; by compounds he means bodies. The entire universe is composed of monads, either simple or in compounds. Determined in no way from without, the monad experiences all its changes from its own inner necessity, which is one of unfoldment or evolution.

I assume also as admitted that every created being, and consequently the created Monad, is subject to change, and, further, that this change is continuous in each.

It follows from what has just been said, that the natural changes of the Monads come from an *internal principle,* since an external cause can have no influence upon their inner being.[11]

The life and individual history of the monad is the result of realizing what is latent and inherent within the monad. The invisible is made visible, and implicit explicit, the potential actual, and the unconscious conscious.

. . . every present state of a simple substance is naturally a consequence of its preceeding state, in such a way that its present is big with its future.[12]

Each monad contains the principle of perfection within itself, and also the degree to which it may achieve.

And this reason can be found only in the *fitness* or in the degree of perfection that these worlds possess, since each possible thing has the right to aspire to existence in proportion to the amount of perfection it contains in germ.[13]

The scale or gradation of monads from the lowest to the highest is characterized by a degree of perception. Both inanimate objects and plant life possess an unconscious perception; the perception of the stone, resembling sleep in human life, is obscure and confused, while that of a plant is such that it reminds us of a comatose state. Animal life is marked by a clearer perception accompanied by memory, which is called conscious perception. In man this perception or reflective knowledge is self-conscious; it is apperception, to use Leibniz' term. These degrees of perception are accompanied by a

[11] *Monadology,* sections 10 and 11.
[12] *Ibid.* section 22.
[13] *Monadology,* section 54.

corresponding degree of appetition, unconscious impulse, instinctive desire, and will.

Concerning the origin of life—and "there is nothing fallow, nothing sterile, nothing dead in the universe"—Leibniz adopts the theory of preformation.

Philosophers have been much perplexed about the origin of forms, entelechies, or souls; but nowadays it has become known, through careful studies of plants, insects, and animals, that the organic bodies of nature are never products of chaos or putrefaction, but always come from seeds, in which there was undoubtedly some preformation; and it is held that not only was the organic body already there before conception, but also a soul in this body, and, in short, the animal itself; and that by means of conception this animal has merely been prepared for the great transformation involved in its becoming an animal of another kind. Something like this is indeed seen apart from birth (*génération*), as when worms become flies and caterpillars become butterflies.[14]

In his *Principles of Nature and Grace,* which is supposed to be something of an earlier version of the *Monadology,* Leibniz says about the same thing:

Modern research has taught us, and reason confirms it, that the living beings whose organs are known to us, that is to say, plants and animals, do not come from putrefaction or chaos, as the ancients thought, but from *preformed* seeds, and consequently from the transformation of pre-existing living beings. In the seed of large animals there are animalcules which by means of conception obtain a new outward form, which they make their own and which enables them to grow and become larger so as to pass to a great theatre and to propagate the large animal. It is true that the souls of human spermatic animals are not rational, and that they become so only when conception gives to these animals human nature.[15]

In the Preface to the *Théodicée,* Leibniz acknowledges this again:

God has *preformed* things, so that new organisms are nothing but a mechanical consequence of a preceding organic constitution: as when butterflies come from silkworms, which M. Swammerdam has shown to be merely a process of development.

Consistent with this theory, Leibniz denies the doctrine of metempsychosis which has been sustained by certain philosophers. He writes:

There is no such passing. And here the transformations noted by MM. Swammerdam, Malpighi, and Leeuwenhoek, who are among the most excellent observers of our time, have come to my aid and

[14] *Monadology,* section 74.
[15] *Principles of Nature and Grace,* pp. 6

have led me the more readily to admit that no animal nor any other organic substance comes into existence at the time at which we think it does, and that its apparent generation is only a development and a kind of growth. I have noticed also that the author of the Recherche de la Verité,[16] M. Regis, M. Hartsoeker, and other able men have not been very far from this opinion.[17]

He repeats this idea in the same essay:

And thus, since an animal has no first birth or entirely new begetting (*génération*) it follows that it will have no final extinction or complete death, in the strict metaphysical sense, and that consequently, in place of the *transmigration* of souls, there is nothing but a *transformation* of one and the same animal, according as its organs are differently enfolded and more or less developed.[18]

Death is only a dissociation of the body, the composite or compound, as Leibniz called it, and not the annihilation of the monad or soul; mirroring the universe, its activity is never completely interrupted: death is merely a slumber, a state in which perceptions become temporarily confused, waiting again to be "re-developed" by another awakening or so-called birth. It is impossible to create monads or destroy those already existing.

What surprises me is that, having recognized that the animal can only have its origin with the origin of the world, and that generation only affects change and development, we have not also recognized that the animal must endure while the world endures, and that death is only a diminution, and envelopment, not extinction.[19]

He seeks to support the immortality of the monad by asserting that it is physically impossible even for fire, our most destructive agent, to annihilate completely the monad.

[16]Malebranche also seems to have believed in Preformation: "Theodore. We see quite well, that, if we do not wish to have recourse to an extraordinary Providence, we are bound to believe that the germ of a plant contains in miniature the plant which it engenders, and that the animal contains in its organs the creature that will come out of it. We understand even that it is necessary that every seed should contain the whole species which it can produce, that every grain of corn, for example, contains in miniature the ear which it will eventually produce, every grain of which in turn contains the ear, all the grains of which again can always be just as fruitful as those of the first ear. . . . God was able to preform within a single bee all those bees which were to come out of it, and to adjust the simple laws of the communication of movement in such a wise manner to the design which He had of making them increase insensibly and of producing them each year that their species could never die out." *Dialogues on Metaphysics and on Religion.* Tenth Dialogue.

[17]*New System of the Nature of Substance.* Paragraph 6.

[18]*Ibid.*, paragraph 7.

[19]From a letter to the Electress Sophia of Hanover, dated 6 February, 1706.

As the minuteness of organic bodies may be infinite (which may be seen from the fact that their seeds, enclosed in one another, contain enfolded a continual succession of organized and animate bodies), it is easily seen that even fire, which is the most penetrating and violent agent, will not destroy an animal, since it will at most reduce it to such smallness that fire can no longer act upon it.[20]

In answer to Locke's statement that nothing can exist in the mind which was not first in the senses, Leibniz substitutes the dictum, nothing can exist in the senses which was not first in the mind. Since nothing can be materially gained from without, the monad can neither increase nor diminish its content except in obedience to its preformed arrangement. The principle of Pre-established Harmony accounts for the harmonious relation between the monads, since it was prearranged that a change in one monad would be accompanied by an adjustment in the others. To these death-denied monads commerce and intercourse are impossible, for they have no windows through which anything can come in or go out. The external world can serve only as a stimulus to quicken and awaken what is already immanent in the monad.

The qualitative internal principle which binds the part and the whole to each other, consists of two elements, perception and appetition. The perception of each monad, which is a unity as well as a unit, determines objectively its place in the scale of monads, and internally reflects within itself the whole system, giving us the manifold in unity. The scale itself is not due to an arrangement or design from without, but is due, rather, to the inner development of the procreative monads themselves. The idea of a scale most likely came from Aristotle, yet the inner perception reflecting the whole system came from this theory of generation which insisted that everything was a part of the series of a preformed scheme.

The life of the monad, written as if with invisible ink, on a scroll miraculously wound, a reel that needs but to be unrolled, is expressed by appetition. Appetition accounts for the change within the monad according to a preformed design; its method of producing change entirely from within according to an internal preformed principle is obvious, and shows more clearly than the nature of perception, the direct application of preformation to the monad. The following quotation sums up both influences:

I hold that the souls which are to become some day the souls of men existed already in the seed, that they have existed always in

[20] *Monadology*. Paragraphs 72 and 73, first draft.

organized form in the ancestor, back to Adam, that is to say, to the beginning of things.

Thus we find that the five main points of Leibniz' metaphysics are:

1. That the monad, which is the unit of substance, consists of activity or life.
2. That everything was prearranged by God (expressed by his principle of Pre-established Harmony).
3. That the monads comprise a continuous series graded according to their perception.
4. That all development and expression moves in accordance with an internal principle, which contains the principle of perfection.
5. That the monads are immortal.

The direct relation and indebtness of his metaphysics to the theory of preformation should now be clear: the five main elements of the one corresponding to those of the other to a marked degree. By the judicious application of this embryological concept, by which all possible development was made immanent within the monad, Leibniz was able to solve the baffling problem of substance, preserving both the multiplicity and the unity apparent in the universe.

Moreover, the monads, now completely endowed with both a molecular nature and a cosmic perspective and teeming with a predestined future, enabled Leibniz to evolve an ethics and an original epistemology, as well as to effect a harmonious resolution of the diametrically opposed features of substance, which had thus far been the stumbling stone of metaphysics.