GENERATION AND THE INDIVIDUAL
IN DESCARTES, MALEBRANCHE AND LEIBNIZ

by

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This dissertation is an examination of the emergence of the preformation doctrine of generation in three early modern philosophers: Descartes, Malebranche and Leibniz. Received wisdom on this question maintains that the preformation doctrine became so popular in the seventeenth century because it seemed most capable of explaining generation of living beings within the limits of the reigning mechanical philosophy. This dissertation considers another motivation, generally neglected by commentators, for the rise of this doctrine in the early modern period -- namely to account for the individuation, unity and enduring identity of material bodies.

With the clear exception of Leibniz, early modern rationalists rarely developed robust theories of material individuation, but I argue that the living, organic being is a paradigm example of the enduring material unity for all three philosophers under examination. Descartes' theory of generation, however, is unable to account for the unity of this living being, although it is able to account for species-specific complexity even given the nascent mechanism that he embraced. So Malebranche introduces preformation as a way to remedy this failure.

Nonetheless, both Descartes' and Malebranche's forms of mechanism threaten the material unity of organisms on a number of fronts. Leibniz's starting point, I argue, is the problem of individuation very broadly conceived, and his solutions to the various aspects of this problem all dovetail to culminate in his quite unique theory of preformation and in a notably different version of
mechanism than that held by his predecessors.

All three thinkers draw on Aristotelian ideas about substantial unity and organic beings, though they do so in different ways. I thus show that the usual story (much challenged in recent decades) of the early moderns’ radical break from Aristotelianism crumbles under a consideration of the individuation of living individuals. I also argue that teleology enters into all three philosophers’ work more than normally supposed. Finally, I use my findings to suggest new ways of looking at central metaphysical questions of the seventeenth century (Malebranche’s theory of causation is paramount here) and new ways of reading the historiography of generation in the early modern period.
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Abbreviations

The following abbreviations are used for primary sources frequently cited in this dissertation. Secondary sources and primary sources cited infrequently are listed at the end under the reference list.

Works by Aristotle


All other works by Aristotle are listed by work name and numbers corresponding to Bekker’s 1831 texts by page and line number, and are found in: A New Aristotle Reader. Various translators and edited by J.L. Ackrill. Princeton: Princeton University Press.

Works by Descartes


Works by Malebranche

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Th  *Theodicy.* Translated by E.M. Huggard. La Salle, IL: Open Court Publishing Company, 1996. Cited by page number for the preface and by section number for the rest of the text, with “pd” indicating sections from the Preliminary Discourse.

Chapter One

Introduction: generation and the individual in the early modern period

The sketch by this philosopher [Descartes] can help us understand how the laws of motion suffice to cause the parts of animals to grow little by little. But that these laws are able to form them and connect them all together, is something no one will ever prove (OC XII, 264/DMR XI, 205).

I. Introductory comments

In this passage from his Dialogues on Metaphysics and on Religion, Nicholas Malebranche has seized upon one of the problems in natural history (and later, biology) which has proven, historically, to be among the most difficult -- the question of the origin of organic forms. In E.S. Russell’s evaluation, it is the problem of explaining the development of a living individual from something seemingly simple and uniform to a complex and organized creature. Further, the problem is to explain how a creature is able to be unified at a time and identical through times despite its evident material diversity and mutability (Russell 1930, 1).

Malebranche ‘solves’ the problem by denying it altogether. Generation of new lives does not occur. Each animal, plant and human body is preformed, fully created by God at the Creation as a miniature of the eventual adult it will become, awaiting only its appropriate moment to grow to its adult size. This process of growth or augmentation, a sort of swelling, is entirely possible by mechanical means. What we observe as and even call generation is simply the becoming visible of what was previously invisible, but it is not a new becoming, a new formation, and there is no development in any meaningful sense of the idea of development. That is, there is no coming-into-being of the completed organic form itself -- that complex, organized and unified living being. Nor is there a problem of accounting for the simplicity or identity of a creature; it was created so as to be intrinsically unified. This theory, termed “preformation” by some of its adherents,1 dominated the study of generation in natural philosophy for about a century, from the 1670s when Malebranche first
clearly sketched it in its modern form. Preformation is often contrasted with epigenesis, the theory which maintains that each new organism is formed anew, the parts emerging successively, and often due to a *self*-generative capacity. Many believe that epigenesis finally triumphed near the end of the eighteenth century putting an end to the reign (or tyranny) of preformation.

Preformation was (and to some, still is) regarded as a quaint and quirky aberration in the history of natural philosophy, surpassed in oddity perhaps only by the fact that it was so widely accepted by so many natural historians and philosophers alike for one hundred years or more. The case for preformation as an historically and philosophically (and perhaps scientifically) important doctrine was not helped by diagrams such as these:
The first of these diagrams was presented as an hypothesis by Nicholas Hartsoeker and depicts a small human crouched in the foetal-position within a sperm cell (Hartsoeker 1694). The second — sent as a jest to Antoni van Leeuwenhoek by François de Plantade, though not dismissed as such by Leeuwenhoek (Cole 1930, 71) — depicts a little man, complete with fez-like hat and baggy pants, as he would become visible when the animalcule in the male sperm (the spermatozoa discovered, but misinterpreted, by Leeuwenhoek) shed its skin (Plantade 1699).

Four of the most well-known historians of biology writing earlier in the twentieth century all reflect the attitude that preformation was an unfortunate blight on the history of embryology. They believe it is best forgotten, should be studied only if we find in it something of value to the forward march of this branch of science, or is to be understood as the costly result of philosophy encroaching improperly into the terrain of science. "The preformationists contributed nothing of value to the understanding of our problems", writes Russell. "It is unnecessary for us to consider them in detail; the fascinations of the doctrines of emboîtement shall not tempt us, nor the battles of the ovists and spermists" (Russell 1930, 29; see the section on definitions below for an explication of the terms used by Russell). Arthur William Meyer attributes the unfortunate, two-century life of the preformation doctrine to "meager... knowledge of [embryonic] development and... [the] confident... attitude of that day", and suggests that it is "somewhat disturbing" that prominent biologists of his own day suggest that the embryo is "in a certain sense, preformed in the ovum" (Meyer 1939, 84). Joseph Needham writes that the "preformation doctrine was what was holding up further progress" in the mid-eighteenth century (Needham 1959, 223), and the preformationists "took embryology on to a plane where observation became superfluous" (Needham 1959, 238). And F.J. Cole, though generous in space in his discussion of preformation is not generous in judgment, concluding that the "contributions of the early naturalists to the doctrine of generation [are]... too brief.... That this meagre record is the direct consequence of the paralysing influence of the Preformation Doctrine is beyond question.... A speculation which makes a picturesque or academic appeal to the imagination... is assured of the warmest reception. The Preformation Doctrine is an excellent illustration of this
Preformation was rescued from ignominy in the 1960s by a series of historical studies which demonstrated its deep roots in the metaphysics and natural history of the early modern period. This was part of a general transition to more sympathetic, contextualized approaches to the history of science. Paramount among these is Jacques Roger’s monumental study, Les Sciences de la vie dans la pensée française du XVIIIe siècle: la génération des animaux de Descartes à l’Encyclopédie, recently translated into English under the title The Life Sciences in Eighteenth-Century French Thought. The title is a bit of a misnomer. Roger covers much of the seventeenth-century history and even dabbles in the earlier history of Aristotle and Galen, and he ranges far outside of France. He builds a convincing and historically rich case for the reasons why preformation, bizarre as it may seem to the modern mind, was the most amenable theory of generation to thinkers of the late seventeenth and early eighteenth centuries given the sorts of concerns in natural philosophy and theology which occupied them. Most specifically, Roger builds the case that, faced with the limitations of the nascent and unsophisticated brand of mechanism to which many seventeenth- and eighteenth-century philosophers and natural historians were committed, preformation was the most sensible answer to the problem of generation -- the apparent new creation of a living being from parents of the same kind. Indeed, in lieu of abandoning strict mechanism by positing some active and purposeful or intelligent agent in nature, preformation seemed the only solution to the problem. Stephen Jay Gould picks up this theme when explaining his own abandonment of the “silly student’s view” that preformation was a “nonsensical doctrine”: “I came to understand that the leading preformationists had been, ironically, defenders of the general mechanistic attitude that modern science now honors, whereas the epigeneticists had tended to favor the vitalistic views now anathematized” (Gould 1997, xiv-xv).

In the years since Roger and others first brought respectability to the concept of preformation as advocated by the early moderns, the trickle of material on this theme has been steady. Shirley Roe’s 1981 book on the mid-eighteenth century debate between Albrecht von Haller and Caspar
Friedrich Wolff examines the philosophical roots of the twenty-year controversy between the preformationist Haller and the epigenecist Wolff. Among the most recent studies, Helmut Müller-Sievers’ *Self-Generation: Biology, Philosophy, and Literature around 1800* examines why epigenesis eclipsed preformation at the end of the eighteenth and beginning of the nineteenth century, and ventures to show how this triumph is bound up with revolutions in philosophy and literature in the same period. Clara Pinto-Correia’s *The Ovary of Eve: Egg, Sperm and Preformation* focuses primarily on the debate within preformation between the ovists and the spermists, consciously treating preformation in its own right and refusing to frame a discussion of preformation in terms of its rival, epigenesis.

**II. The primary thesis of this work: generation and the individual**

What more, then, is to be said about generation, and this strange theory of preformation, in the early moderns? One theme in particular has not received adequate study, and will form the central thesis of this work. This thesis starts from the fact that there are several motivations which compelled early moderns to support preformation. These different motivations lead to quite distinct renditions of the theory. As noted above, the motivation most often cited for the re-emergence of the doctrine in the mid-seventeenth century is the fact that early seventeenth-century mechanism, specifically the idea of inherently inert matter externally moved in accordance with a few simple laws, could not explain the generation of organic forms, the proof for which was produced by Descartes when he attempted to provide such an explanation and, many believed, failed abjectly. Descartes’ explanation for the phenomenon of organic generation runs roughly as follows. The seminal fluid from the female and male mix in the uterus. They begin a rapid vortical motion due to extreme heat caused by a sort of fermentation upon the mixing, and from this mechanically moving liquid, the heart, then brain, then other body parts emerge one by one until a living being is formed. Virtually all those who came after Descartes found this explanation entirely improbable. It is unlikely that a complex and well-organized being could develop this way just once let alone with the frequency and respect for natural kinds that
we regularly observe. Generation, probably more than any other natural phenomenon, threatens early modern mechanism. Yet most of these thinkers are unwilling to give up mechanism and so adopt the belief that God -- and not something in the natural world -- is responsible for the creation of these forms (e.g. Roger [1963] 1997, 128-29). I shall call this explanation for the emergence of the preformation doctrine the "received" view because it is so prevalent in the literature. There are, however, other overly-neglected reasons why early moderns turn to preformation.

My main concern is with one of these neglected reasons which compelled early modern preformationists. This reason, found in Malebranche, Leibniz, Haller and Charles Bonnet to name just a few prominent figures, starts from the belief that the organic being is a truly unified individual.

Perhaps the clearest expression is found in Bonnet:

One needs no Morgagni, no Haller, no Albinus [experimentalists who believed they had provided empirical proof for preformation] to see that all constituent parts of the body are so directly, so variously, so manifoldly, intertwined as regards their function, that their relationship is so tight and so indivisible, that they must have originated all together at one and the same time. The artery implies the vein, their operation implies the nerves, which in their turn imply the brain and that by consequence the heart, and every single condition a whole row of other conditions (Bonnet [1769] 1964, 377).

A living being cannot exist and function as a living being without a heart or a brain or any of a number of other essential parts, and so an organism must come into being with all these parts together, a premise denied by epigenesis given that it postulates a successive development of parts.

My primary goal in this work, then, is to show how closely bound together are the natural problem of generation and the metaphysical problem of individual unity. Recall Russell's evaluation of the three aspects of a living being which a theory of generation must explain: complexity, organization and unity in space and time. Most studies of preformation in the early moderns which focus on the problem of generation on a mechanical model of natural philosophy have focussed on the facts of complexity and organization to explain why preformationists advocate the theory. These studies have concentrated largely on the problem of chance. Early modern mechanism is too unsophisticated to explain the formation of the incredible complexity that marks the living being.
Should such a being be brought into existence through the movement of matter according to a few simple laws, this would be a matter of sheer chance. But the process of foetal formation happens all the time, quite regularly and in a highly deterministic fashion. One cannot base such a process on something as chance-laden as matter in lawful motion. I am interested in examining the third, overly neglected, problem which generation must explain: the enduring unity of an organic individual. I shall do this by tracing the changing solutions to the two problems of generation and individual unity -- and the emergence of the preformation doctrine -- through three key figures of the early modern period -- Descartes, Malebranche and Leibniz.

It could be argued that these two motivations for the emergence of the preformation doctrine -- the motivation from mechanism and the motivation from individual unity -- are really two different ways of expressing a single motivation. I think this could be shown in at least three important ways. First, as Kenneth Barber suggests in the introduction to his edited volume on the problems of individuation and identity in the early moderns, the problem of accounting for the individual is really a “cluster of related problems” (Barber 1994, 1). Barber’s own formulation of the relevant problems is as follows:

... ordinary objects [in a perceptual field] have four very general features that, in turn, generate four corresponding philosophical problems. (1) Such objects are, as one would say, individuals possessing a variety of qualities and, hence, complex. (2) Yet despite the observed complexity each individual is one thing, a unity, since the qualities in question are all attributed to the same individual.... (3) Furthermore, an individual is different or distinct from all other individuals appearing with it in the visual field. (4) Some of these individuals may also appear to endure through time, to have continued existence as the same individuals even though undergoing various kinds of change, including change of quality and change of relation with respect to other objects (Barber 1994, 3).

The first argument that the received explanation for the emergence of the preformation doctrine is the same as the explanation I propose, turns on the fact that both explanations are driven by the problem of individuation in the early moderns. They are driven, however, by a different aspect of that problem. The received explanation for the birth of early modern preformation (that it was motivated by the limits of mechanism) concentrates on the first of Barber’s problems of
individuation. Early modern mechanism seems unable to realistically explain the immense complexity of organisms. More precisely, early modern mechanism seems unable to realistically explain specific complexities of organisms of particular natural kinds. The explanation for the birth of early modern preformation which I shall consider concentrates primarily on the second of Barber’s problems of individuation and secondarily on the fourth problem of temporal endurance. Early modern preformation is best able to account for the oneness or unity of an organism. Nonetheless, it could be argued that the motivation from the limits of mechanism and the motivation from the problem of unity are both expressions of the problem of individuation broadly conceived.

There is a second argument that the two motivations for preformation under consideration can be understood as expressions of just one motivation. The usual explanation for the emergence of preformation is not simply that mechanism cannot explain complexity, but also that mechanism cannot explain organization. Mechanism, that is, seems unable to explain a very precise (indeed, species-specific) configuration of organs and parts of the living body. But, it could be argued, it is precisely this organization which explains the unity of a living organism. In fact, I shall argue in chapter three below that unity through functional organization is one of two prime motivations for Malebranche’s embrace of the preformation doctrine. And in chapter four, this functional organization impacts Leibniz’s theory of preformation as well, although in significantly different ways than it impacts in Malebranche. So this second argument which maintains that the motivation from the limits of mechanism and the motivation from individual unity are really the same motivation, shows that the received interpretation of why preformation emerged as an explanation for generation in the early modern period is expansive enough to account for the interpretation I put forward in this dissertation. That is, the claim that mechanism cannot account for the generation of complexity and organization of living beings, also encompasses the claim that unity cannot be accounted for through a mechanical, natural generation but only through generation by God -- preformation.

The final argument for the claim that the two motivations really represent a single motivation
for the early modern embrace of preformation also relies on the belief that the received explanation is expansive enough to include the explanation from the need to explain individual unity of the organism. This depends on a specific interpretation of “mechanism”, the interpretation with which I have been working. This interpretation maintains that mechanism is a theory of explanation of natural change which relies on the idea of matter in lawful contact motion. All natural phenomena can be explained by the motion of often sub-visible matter, its collision, breaking apart and clumping together according to a few simple laws. It could be argued that this definition of mechanism is unable to account for the complexity, organization and unity of organic beings. My concern with the unity of living beings, therefore, is a derivative of the more basic concern with mechanism.

To flesh this claim out: just as the simplicity, small number and uniformity of the laws of motion make the generation of species-specific and complex organic bodies highly unlikely, the collision and breaking apart upon impact of extended matter makes the enduring unity of a given living body highly unlikely. Emily Grosholz captures this problem with specific reference to Descartes and the individuation of physical objects (assuming, for now, that organic beings are just physical objects for Descartes). According to Grosholz, “Descartes uses his laws of impact [one aspect of mechanism] in two incompatible ways. He uses them to organize and conserve the furniture of the world.... But impact, as the only form of interaction among material bits, is also the sole physical means for breaking up physical individuals” (Grosholz 1994, 50). Thus, trying to explain “unity in virtue of common motion [of a parcel of matter] does not seem strong enough to keep matter from being pulverized into the dust of subtle matter, if shattering is allowed as a possible outcome of impact.... Otherwise put, the unity of physical bodies so conceived cannot maintain itself against the disruptive effects of the sole form of physical interaction” (Grosholz 1994, 51). The difficulty of explaining generation on a mechanical natural philosophy is thus the foundation of the concern to explain organic unity through the process of generation. The received view is adequate to capture my concern.

There may be some limited truth to this conclusion, but the received view certainly gives
priority to the question of the development of structural complexity, leaving individuation as a derivative problem. I shall show that the problem of individuation is of equal concern; after all, as the arguments above indicate, it is the other side of the coin to mechanism. I believe, therefore, that it is fruitful to frame the problem of generation (and the more particular problem of the emergence of preformation in the early moderns) explicitly in terms of the problem of individual unity. I think the strength of Descartes’ theory of generation has been badly under-estimated, and the real reason why his theory fails has been overlooked, because the very specific problem of individual unity has not been clearly articulated. Further, I think a strong strand of naturalism at the core of Malebranche’s natural philosophy comes to the fore if we read his theory of preformation against the concern to explain individual unity -- a naturalism unexpected in the advocate of such a strong theory of occasionalism. More significantly, it is clear that Leibniz’s starting point is individuation, not mechanism. Consequently, with Leibniz, it is not the case that mechanism poses problems for explaining individual unity but conversely, solving the problem of individual unity leads Leibniz to establish a particular brand of mechanism in his natural philosophy. By clearly articulating the problem of individual unity as a paramount, even if not explicitly stated, concern in the changing explanations for generation and in the emergence of the preformation doctrine, I am able to put the natural philosophies and metaphysics of various early modern thinkers in a new light.

There is a second reason for focussing on the close relation between the problem of generation and the problem of the individual. As indicated above through reference to Barber, the problem of individual unity is one of a cluster of problems that emerge when discussing the issue of the individual. Barber also notes that these problem received very little attention in the early modern period, as if the problem had already been solved by the abundance of attention paid to it by the Medievals (Barber 1994, 1-2). Nonetheless, as Barber himself suggests, “one can ask how within their [the early moderns’] systems the problem of individuation could or should have been resolved even where explicit discussion of the issue is minimal” (Barber 1994, 2). Not only, I contend, does the problem of individual unity enter into the question of generation and especially preformation, but
it is also the case that one problem of individuation (that of unity) in the systems of the early moderns finds a solution in appeal to the wholeness or unity of living beings. Leibniz, for example, just does solve the problem of physical individuation by reference to the organism and its preformation, but seeds of this solution are already present in the work of Descartes and even more so in the work of Malebranche. Tracing the development of this particular solution to the problem of individuation through these three thinkers forms the central theme of this work.

III. The general problem of individuation

It will be helpful at this juncture to clearly delineate exactly what the "problem of individuation" is, or rather, what aspects of that problem I am interested in and what falls outside the scope of this discussion. Much of this should be implicit in my clear focus on individual unity, but there is sufficient complexity in the issue of individuation to warrant a clear explication of my concerns. Barber is not the only commentator who has identified a number of problems which comprise this larger question, and so I shall define the problem more closely through reference to a few of these others.

Perhaps the reason for some of the complexity surrounding the issue is the fact that the word "individual" is equivocal and different meanings vie with one another as the proper definition for the term during the early modern period. Raymond Williams, in his Keywords: A Vocabulary of Culture and Society, traces the meanings attached to this word and emphasizes that our modern meaning is quite different from its original meaning, and that the transition occurred in the early seventeenth century. "Individual" initially meant "indivisible", and only later was the word used to refer primarily to "distinct from others" (Williams 1983, 161ff). The difference is profound and especially significant for my purposes for it is the former meaning and not the latter which is of central concern in this dissertation.

Let me start with the latter meaning -- the idea of the individual as distinct, distinguishable or different (Barber's third problem in his cluster of problems). This requires reference to something
external to the individual. The individual must be compared against something else, often something that is considered to be of the same kind or species and therefore somehow the same yet nonetheless different. Williams notes that in the seventeenth century this meaning tended to be framed in logical terms but in the eighteenth century, it was increasingly framed in biological terms (Williams 1983, 163). He makes the contrast between this meaning, and the meaning of the individual as indivisible, clear by distinguishing between "... ‘an individual’ -- a single example of a group... [and] ‘the individual’: a fundamental order of being" (Williams 1983, 163).

Jorge Gracia captures this contrast in a different way by distinguishing between the concepts of singularity and particularity, and he argues that it is a mistake to equate the individual with both singularity and particularity as if they are one and the same thing. "For particularity has to do with an individual’s ‘participation in’ or ‘partaking of’ a universal. In this sense the individual is considered as being a part of something else, or as partaking of it... An individual is called singular... or is said to have singularity because it is not many" (Gracia 1984, 256). Thus, singularity captures the idea of oneness or unity in a way that particularity does not. It is the problem of the individual as singular, and not the individual as particular -- it is the problem of the individual as a fundamental order of being, and not as an example of a group -- that is central to my concerns.

There is an important reason why this discussion is relevant. Many who write about the problem of the individual claim that the nominalist does not need to grapple with the problem of individuation since it is solved by the very premise of the nominalist position -- the only things that are real are individuals (Gracia 1984, 32-3; Thiel 1998, 233). It is true that the nominalist does not have a problem with individuation as long as the problem is understood as one of explaining the individual’s particularity or difference from others which partake in the same species. This is because the nominalist denies the reality of universals, of species. The only things that are real are particulars. But the nominalist, no less than any other, does still have the problem of individuation if this is understood not as the problem of having to explain what distinguished members of universal classes but rather as the problem of having to explain what constitutes the fundamental order of being. It is
true that for the nominalist, the only real things are individuals, but what those real beings are, or what makes them into single beings, is a question that still needs to be answered. This will become especially acute in the case of Leibniz who has been called a nominalist (Mates 1986, 10), but who is nonetheless deeply concerned with the problem of individuation in the sense of having to explain the singularity of individuals. It is, I shall argue, precisely this preoccupation with the individual which provides the foundation for Leibniz’s theory of generation.

So this brings me back to the earlier meaning of “individual” according to Williams -- the individual as indivisible. It is this meaning that interests me in the present work. What is this individual, this indivisible substantial entity? What is this singular whole, this fundamental order of being? I shall look primarily at one answer to this question: the living organism is a paradigm of the indivisible individual, at least in the material world. And I choose this answer for obvious reasons: to show the connection between this aspect of the problem of individuation (indivisibility) and the emergence of the preformation doctrine as a solution to generation. Although I frame this solution to material individuation in terms of the organism, we shall see that this solution to the problem cannot be disengaged from the problem of individuation at the levels of metaphysics and physics too. So the relations among what constitutes an individual at the metaphysical, physical and organic levels will enter into this work too.

IV. Some remarks on Aristotle, generation and the individual

At this point, it would be fruitful to make a few comments about Aristotle’s role in the history of the two problems of individuation and of generation. Udo Thiel, among others, claims that the rejection of Aristotle’s basic form-matter ontology of substance (which had been embraced in a variety of forms through until the rise of the New Science) resulted in the loss of one solution to the problem of individuation. In Thiel’s words, “as substantial forms were denied, it did not seem possible to pick out any constituent in the things themselves that could in all cases be regarded as that which is essential for securing identity over time” (Thiel 1998, 235), and this ontology is also used to explain
both unity and differentiation as well. Barber believes this was lost by the early moderns, especially by Descartes, because of the changed relationship between ontology and epistemology: only what could be clearly known could be counted among the ontologically real beings of the world, and thus Aristotle’s proposed metaphysics of substance was dropped (Barber 1994, 6-7).  

Aristotle himself puts forward the idea that a true, primary individual substance is a unity or whole, a being in some sense indivisible. There are, however, different senses of “unity” that Aristotle proposes, and here is one especially relevant to my concerns. Individual substances are unities in the sense that they are intrinsic unities — they are a complex of features essential to each other, none of which can be considered a mere predicate of the others, and none of which can therefore exist apart from the rest (Metaphysics, 1030a3-6). Further, all individuals with the exception of the Prime Mover must be a combination of form and matter since neither pure form nor pure (prime) matter can exist apart from the other. This ontology can be used to explain both differentiation of the individual (through different parcels of matter that distinguish individuals of the same universal form), and unity of the individual through its unifying form.  

This basic ontology applies to all existents, natural and artificial, living and non-living. In the case of non-living artifacts, the form is usually conceived of in terms of shape or structure. The form of a statue is the shape of that artifact. In addition, artifacts can be made out of a variety of materials, though not just any matter will do. A statue can be made of bronze or wax, but it cannot be made out of water, for example. My primary interest is not with artifacts but with natural, living beings. In fact, Aristotle takes such beings as the paradigm example of natural substances. And natural, as opposed to artificial, substances are the best examples of individuals truly unified by form. If anything can be counted among true substances, it is the living being, “a man or a plant or one of the things of this kind” (Metaphysics 1032a19-20), a being marked in part by its ability to produce another of its kind (Metaphysics 1033a29ff). This is largely because the living being is distinctive from others in that these ensouled individuals carry their own source of motion (defined broadly as change, including locomotion) and rest within themselves while artifacts do not. Artifacts must be moved (changed)
from without, most notably by the artificer (GA 735a2ff). Animals, plants, their parts and the elements (earth, fire, air, water) are beings by nature — they have their own source of change within. Beds and other artifacts are not beings by nature (Physics 192b9ff).

In De Anima, Aristotle gives us his definition of life, or the living being: "... that which has soul is distinguished from that which has not, by life. But life is so spoken of in many ways, and we say that a thing lives if but one of the following is present -- intellect, perception, movement and rest in respect of place, and furthermore the movement involved in nutrition, and both decay and growth" (413a21ff). The minimum requirements for life are merely the activities of self-nourishment, growth and decay, and Aristotle calls these activities the nutritive soul (412a13). In Generation of Animals, Aristotle adds the activity of generation to this list, and equates the nutritive with the generative faculty (GA 735a15ff). These activities indicate the presence of soul. In the special case of living individuals, then, the basic form-matter ontology is manifest as soul-matter. Thus, the form of living beings is not manifest merely or even primarily as the shape or structure of those beings: "... when the soul is gone, it is no longer a living creature, and none its parts remain the same, except only in shape, just like the animals in the story that were turned into stone" (PA 641a20ff; see also GA 734b25ff). A living body is defined by its functions and capacities, and can only count as a body of its type if it is able to perform the functions which define its type (Meteorology 390a10ff).

It is not only function that defines a living individual, however, because the living body and body parts of an individual of a given species also require specific matter. Just as a statue cannot be made of water, so too a living animal cannot be made of stone or wood. Further, certain essential and essentially structured material parts or instruments (organs) must be in place for the living functions to occur. "[T]he body... is an instrument; as well the whole body as each of its parts has a purpose, for the sake of which it is; the body must therefore, of necessity, be such and such, and made of such and such materials, if that purpose is to be realized" (PA 642a11ff; see also de Anima 412a28, 415b18ff). So more accurately, perhaps, in the case of living individuals, the basic form-and-matter ontology is manifest as soul-and-organic body.
Not only does this hylomorphic ontology serve to explain the ontology of individuals (including their unity, identity through time, and distinction from one another), but this ontology is key in Aristotle’s theory of generation as well, and in his attempts to avoid the problems he finds in his predecessors (Preus 1970, 5ff; Whiting 1990, 38ff). Essentially, Aristotle uses this ontology to distinguish between generation and mere alteration (something his materialist predecessors could not adequately do) while at the same time not falling prey to a theory of generation ex nihilo (Whiting 1990, 37, 57).

His distinction between generation and alteration as metaphysical concepts is as follows. Generation (and corruption) occur “whenever a whole changes, there remaining nothing perceptible as the same subject”, while alteration occurs “whenever the subject remaining, something perceptible changes in its affections” (On Generation and Corruption, 319b6-21). That is, generation (or corruption) occurs whenever some individual substance comes into (or goes out of) existence, while alteration occurs when the existing substance persists but undergoes some sort of change. Aristotle has to explain how a new subject or substance comes into being where there was no such substance before while at the same time avoiding the conclusion that this substance is generated from nothing at all.

Form allows Aristotle to make the distinction between generation and mere alteration in a way his material predecessors could not. For those predecessors, there is only matter (in some form or another), and any change must be a change in the relations among parts of that matter. But “[b]ecause they took everything to come to be from (and to perish into) a single underlying matter, Aristotle concludes that they were committed to treating all changes -- including those we call ‘generation and destructions simpliciter’ -- simply as alterations of this underlying matter.... Aristotle’s own view is that we can give an adequate account of the distinction between generation simpliciter and mere alteration only if we appeal to what he calls ‘form’” (Whiting 1990, 38-9). An individual is generated or destroyed when its form changes, while an individual merely changes when its form remains the same through any changes the individual undergoes. An obvious example of this is found in the
living being. It remains the same even while some of its constitutive matter comes and goes because it retains its own form or soul. Once that form is lost, so too is the individual lost.

So this use of the hylomorphic ontology clearly applies not only to metaphysical generation and corruption, but to biological generation and death as well. The crudest sketch of Aristotle’s theory of biological generation runs as follows (this is found mainly in his *Generation of Animals*, Book I). The male provides the form (together with final and efficient causes) of the future new individual while the female provides the matter. The matter is simply the menstrual fluid, the excess product of nutrition, especially well-prepared because extremely well-concocted by the heat of the female. This matter is particularly appropriate to become the future foetus and eventual living individual because it is such a being potentially, needing only the form passed on by the male to bring it to actuality. Indeed, in the case of some animals where the matter of generation is an egg rather than menstrual fluid, an unfertilized egg (a wind egg) is almost an individual already. In the case of higher animals, however, the matter of generation is less informed and consequently less actualized as an individual.

During sexual generation, the form is passed on to the female by the male. Aristotle is explicit that the semen does not become part of the future individual, and in fact, sometimes it seems that the male contributes no matter whatsoever to the final product. Aristotle sometimes struggles in determining the role of the semen. It probably serves as the material vehicle for the soul, though elsewhere, Aristotle postulates that it is the *pneuma* which serves this purpose. The *pneuma* is a mysterious principle indeed. It is a “physical substance which is different from the so-called ‘elements’ [fire, water, earth and air] and more divine than they are.... [T]his substance is analogous to the element which belongs to the stars...” (GA 736b32ff). Although it is mysterious, there is a clear and important role for the *pneuma* in generation (Peck 1975). Serving as an active, but non-intelligent, instrument for the fully developed form of the male parent, the *pneuma* carries out the predetermined plan implicit in the form which it carries, and it builds a living, functioning individual substance out of the matter provided by the female. “[I]n fact it is probable that nature makes the
majority of her productions by means of *pneuma* used as an instrument” (GA 789b10ff). Thus, when the menstrual fluid becomes informed with the form passed on by the male, a true generation, rather than merely an alteration, occurs. The coming-into-being of a new substantial individual is realized.10

Aristotle contrasts his own theory with the theory of Hippocrates, one of his materialist forerunners, noting the latter’s flaws. According to Hippocrates’ theory, the male and female both contribute semen which is drawn from all body parts and which thus provides the body parts needed to make the offspring. Aristotle has a number of objections to the theory. One objection notes that this theory does not really explain the generation of resembling offspring since generation is not merely the presence of all the body parts. Generation is

the *assemblage* of them.... [W]ithout this assemblage, the parts would not have the resemblance [to the parents or to a given species]; so if there is something which sets to work later on to bring this assemblage about, then surely this something, and not the drawing of the semen from the whole of the body, will be the cause of resemblance. Further, if the parts of the body are scattered about within the semen, how do they live? If on the other hand, they are connected with each other, then surely they would be a tiny animal (GA 722a35ff).

Aristotle does not entertain this final possibility, mainly because empirical evidence shows that such tiny animals do not pre-exist and that the parts of animals are formed successively, some clearly visible before others (GA 734a17-26).11 This final suggestion can be pushed one step further to the conclusion that any materialist theory such as Hippocrates’ that posits actual, and fully-formed, material parts must posit that these *always* come connected in order for the parts to live. But since they must always be so connected, because otherwise they would be dead parts incapable of coming together into a living whole, preformation on the early modern model (God creates all living beings at Creation — they enter nature as full-fledged living animals) is a small step away.12

However, preformation on the early modern model is not, for a myriad of reasons, an option in Aristotle’s philosophy. For example, organic unities or individuals, for Aristotle, are indivisible only in the sense that they cease to be the living beings that they are if they lose their essential structure such that the soul can no longer perform the appropriate living functions. They are not strictly indivisible in the sense that they simply cannot be divided. Some preformationists share this
conception of indivisibility (although Leibniz does not, and he consequently has a particularly quirky form of preformation). But this conception of indivisibility manifests itself quite differently in the preformationists than it does in Aristotle. According to Aristotle, before birth the form and matter of a given organism do, in fact, start off separately from each other, and after death the corpse is matter of a specific shape only; it is not joined with a functioning form (the soul). This accords with our intuitive understanding of living beings -- they are individuals that endure, but they endure for a limited period of time, namely a lifetime. This intuitive understanding is not fully carried over into the preformation doctrine which posits the endurance of the organic individual from the Creation through until they grow to visible size and then die (again, Leibniz is an interesting exception here).

Nonetheless, this divergence between Aristotle and most preformationists starts from a shared intuitive understanding that living beings cease to be living beings if they lose their essential structure, or some part of it (a heart, for example). I shall argue, in fact, that both Descartes and Malebranche embrace the very Aristotelian idea of form as functional holism of the sort best exemplified by living organic bodies, though they would not associate this form with a soul. The old wisdom that the early moderns reject Aristotelian forms has been widely challenged in recent scholarship, and here we see one case in which this supposed rejection is not actually true. If Barber is right that epistemology limits what is ontologically possible for some early moderns (most notably Descartes), then the possibility that the form of a living being is simply its functioning, organic body need not be a rejected ontology because this is something that can be known with a fair degree of certainty. In fact, though many early moderns do not call this a "form", many do recognize the living being as a whole structural unit that functions in a particular way even if its material bits come and go from that structure.

It is still true, however, that most early moderns, including Descartes, Malebranche and Leibniz, would reject some crucial aspects of the explanation that Aristotle gives for the generation of that essential structure. Most obvious here would be the idea of the otherworldly, almost divine, *pneuma* -- the instrument by which nature builds her machines. Barber's strictures about the limits of
ontology are certainly relevant here. Further, since many early moderns do reject concepts like the pneuma, and since many accept the functional holism of living beings, the need for the theory of preformation comes quite clear. Since the pneuma carries with it (somehow) the whole plan of the eventual organism, the whole always exists, in some sense at least. Without this pre-existing formal whole, a pre-existing material whole must be posited. Descartes, of course, does not take this step, but it is precisely this lack and the resulting negative impact on the unity of the organic whole that prompts Malebranche to embrace preformation.

This only serves to underscore the central thesis of this dissertation. The early modern rejection of the notion of an actively building agent in nature supports the received interpretation of why preformation emerged when it did. That is, by rejecting these sorts of entities and accepting instead mechanism as the proper explanation for natural phenomena, the early moderns are left needing a different explanation for how the complex form comes into being in the first place. God is a clear choice for filling this lacuna. But the early modern acceptance of the very Aristotelian notion of a functioning organic body supports the motivation for preformation I wish to examine more closely in this work: the need to explain the functional unity of the organic individual.

A second, closely related, conclusion I wish to emphasize derives from Aristotle’s criticism of Hippocrates’ theory of generation and also underscores the central thesis of this dissertation. There are two distinct criticisms in the passage from Aristotle quoted above. First, the problem of generation is primarily a problem of assemblage, or efficient cause. It is not enough that all the body parts are represented in the parental semen. These parts need to be properly arranged, and there must be an efficient cause up to the task of doing so. This is, broadly, the same point made by the received view of the emergence of preformation: the laws of nature alone are not up to the task of assembling bits of matter into their proper arrangement. The second criticism is that Hippocrates’ theory of generation cannot explain how the body parts, which supposedly exist in the semen, live unconnected to each other. This is, broadly, the same point that forms the basis of my argument for the emergence of preformation. When Aristotle suggests that the materialist ought to posit the whole tiny animal
with all the parts already connected so as to explain how the animal lives, he helps make clear that preformation in the seventeenth and eighteenth centuries can be motivated by a need to account for the whole organism on a materialist ontology (or dualistic ontology where the soul is not active in manipulating material nature). Preformation is not just a fall-back position for the mechanist who finds it difficult to explain the generation of a complex structure by appeal only to matter in motion.

A third conclusion that will received considerable attention in the chapters that follow is the fact that Aristotle takes living organisms (along with the elements) as the truest examples of individual substances, substances marked in part by their intrinsic unity. Atomists of the seventeenth century will take atoms to be among these true, indivisible unities at least as far as material nature is concerned. But many early moderns will also, like Aristotle, take the living organism to be a paradigm example of the unified, material individual. The living being considered as an organic body cannot be divided and still retain its essential character. Some early moderns, Leibniz most notably, will have difficulty getting a conception of an indivisible being at the level of brute matter — at the level of metaphysics. One of the goals of this dissertation is to show how the model of the organism provides a solution, at least metaphoric if not actual, to the problems of metaphysical and material individual unity. At least in the case of Leibniz, this will impact his metaphysics of substance profoundly, but it will be of considerable import in the philosophies of both Descartes and Malebranche too. This interplay among the conceptions of the material individual at the metaphysical, physical and organic levels will weave throughout the chapters that follow.

V. The limits and architectonic of the work

This is an admittedly large topic, and so I shall draw some limits to the discussion as follows. First, I shall not make any important distinction between animal and plant bodies. Although some interesting distinctions can be made between these two kingdoms, even in the way they were theorized by early modern naturalists and natural philosophers (Delaporte [1979] 1982), I shall not investigate these distinctions here. Second, I shall for the most part consider the generation of the organic body only,
and not the generation of the human as a being which also includes soul. This bracketing will not be perfectly attainable — indeed, it cannot be since part of the solution to the problem of individual unity at the metaphysical level relies on an appeal to soul (this is most especially true of Leibniz), and this impacts the solution to the problem at the organic level. Nonetheless, as Daniel Fouke has pointed out, the generation of rational as opposed to merely organic beings presents a special problem for the theology of the early moderns. This is because the human soul, if believed to carry some mark of the divine, cannot be naturally generated without attributing some divine power to the natural world. Alternatively, if God brings rational souls into existence throughout time, then this amounts to numerous miraculous acts (Fouke 1991). Thus, my main focus will be the generation of organic bodies, and discussions of the rational soul will enter into this dissertation only where unavoidable in dealing this the problem of the organism. Third, in the main discussion of this work (chapters two through four), I shall confine my discussion to sexual, and not spontaneous, generation as the latter case presents unique issues (I shall touch on spontaneous generation briefly in the concluding chapter, however). Fourth, I shall impose the following outline and architectonic structure on the discussion.

Chapters two through four will trace the joint problems of generation and individuation (as unity) through Descartes, Malebranche, and Leibniz. I choose these three because of the mix of natural philosophy and metaphysics in their works, and because tracing the development of the theory of organic generation through these three shows very clearly the connection of this problem with the problem of material unity. This starts from four distinct ideas of body found in Descartes' work (textual evidence for the following claims will be presented when these ideas are dealt with in the following chapters):

1. body as extended matter;
2. body as non-living machine;
3. body as living machine; and
4. body as a hylomorphic union of a human organism coupled with a soul.
Each of these ideas comes with a distinct theory of material individuation:

(1) body as extended matter takes material individuation to depend upon the common motion of parts of extended matter at rest relative to each other;\textsuperscript{14}

(2) body as non-living machine takes material individuation to depend more or less upon the same matter, but it depends primarily on the functioning structure that maintains its ability to realize its purpose;

(3) body as living machine takes material individuation to depend upon a functioning structure which diverges from the sort of structure found in non-living machines in at least two ways: living machines seem to have their own internal and enduring source of change and development, and part of the change these sorts of bodies go through regularly is a gain and loss of constitutive matter; and

(4) body as a hylomorphic human takes material individuation to depend upon the union of the human body with a soul.

Four problems of material unity emerge from these ideas of body and of individuation.

**The Problem of Material Existence:** This problem plagues the first three ideas of body, and it arises because extended matter, or anything made out of extended matter, cannot actually have any ontological reality. Such matter can be divided without end, and consequently, there are no ultimate material units from which the material aggregates of the world can be composed.

**The Problem of Material Independence:** This, too, plagues the first three conceptions of body, and it arises because extended matter, or anything made out of extended matter, is passive and cannot move or act on its own. Consequently, it must be moved by something active, and this is usually conceived of as God. This makes material beings dependant upon God and not really independently substantial in and of themselves.

**The Problem of Reconciliation:** This is the problem of reconciling two of the conceptions of body. Extended matter and living machines are at odds with each other because they are individuated in incompatible ways. Extended matter is individuated only so long as each of its parts remains while a living machine is considered the same individual even though it never has the same parts of matter found together for very long at all. Consequently, the organism considered as an organism is the same individual as long as it maintains a structure that functions according to living purposes, but the organism considered as a system of extended matter is never the same individual for long.

**The Problem of Organic Endurance:** This problem also emerges as a result of a tension in the first and third concepts of body. This is the problem noted by Grosholz which I cited above. The organic structure of a living machine endures as an individual, and yet it would seem to be in threat of disintegrating at every moment due to the disassembling activity of extended matter moving and colliding in every one of its parts according to the strictures of the laws of motion.

In chapter two, I begin with Descartes, and I concentrate on the first, the most fundamental, conception of body in his work. This is because this conception of body as extended matter is the one
that Descartes relies upon in his theory of generation. I examine the “received” view of Descartes’ theory of generation and argue that this view does not do justice to what Descartes actually says about generation in that it accuses him of ignoring the issue of why reproduction leads to a creature of the same species as its parents. Rather, drawing on a more subtle understanding of Descartes’ approach to natural investigations (an understanding that has been developed by commentators in recent decades), I argue for a more charitable depiction of Descartes’ approach to generation, contending that he probably can account for organic complexity and generation of like kinds by like kinds. What Descartes’ theory of generation cannot account for, however, is organic unity. That is, while his theory of generation depends upon body as extended matter, the outcome of this theory is supposed to be body as a unified living machine, and he is unable to explain this result.

In chapter three, I turn to a consideration of Malebranche, and look specifically at the next two conceptions of body in Descartes (which surface in Malebranche as well) -- body as machine and body as living machine. I argue that Malebranche opts for preformation of organic, living bodies because no other theory of generation can, in his view, account for the clear functional unity of such bodies. I show two distinct arguments for this. One argument turns on the infinite complexity of living machines (as opposed to the finite complexity of non-living machines), and maintains that only God could have created living machines, and he must have done so at the Creation to avoid positing a huge number of miracles throughout the duration of the universe. The second argument turns on the recognition of the integrated wholeness of organisms, and maintains that such organisms have to exist with all essential parts intact to be able to function as a whole. This consideration of Malebranche, however, makes clear that the four problems of material unity are left unsolved by both Descartes and Malebranche, and that Leibniz must solve these to account for material individuation.

So in chapter four, I turn to Leibniz who solves all these problems of the material individual. Strikingly, his theory of organic preformation is bound up with these solutions. In this chapter, I focus the discussion around Descartes’ fourth conception of body -- the ‘body’ as a hylomorphic union of mind and body. I argue that any hylomorphism found in Descartes is of an extremely weak
variety, aimed solely at explaining mind-body unity. Leibniz, to the contrary, supports a far more robust theory of hylomorphism, and this is because he wishes to use this ontology to account for bodily unity. Leibniz takes these hylomorphic unities to be living and animated beings, or organisms. I argue why he does so, what the living being or organism actually amounts to for Leibniz, and how his concern to avoid positing huge numbers of miracles leads him to posit preformation. I also note the difference between his approach and Malebranche's approach to preformation, miracles and laws. I end by arguing that Leibniz's very strict definition of the individual as indivisible requires a different form of hylomorphism than that found in Aristotle. This strictness derives from Leibniz's very modern concerns with problems of the unity of material substance, and it leads him to preformation rather than a theory of generation more in line with Aristotle's own.

In chapter five, I shift away from tracing the historical development of the preformation doctrine to account for organic and material unity. In this chapter, I use the new insights into preformation garnered from the previous chapters to challenge some standard beliefs about the problem of generation in the early modern period and its connection with natural philosophy in general. Drawing on conclusions reached in the previous chapters, I show the difficulty of aligning preformation with mechanism and epigenesis with vitalism as so many commentators tend to do. I also argue that the two theories of generation are not always clearly distinct, and that the two tend to blur into each other. Perhaps in no other thinker is this more obvious than in Leibniz. I also suggest that this new reading of generation — generation understood against the background of the problem of individual material unity — can be helpful in re-reading related questions in the history of philosophy of science, and here I show how this is the case in the way the problem of spontaneous generation was handled by early modern thinkers.

VI. Definitions
In this section, I shall provide a few working definitions of terms used in discussions of generation in the early modern period. These terms include "preformation" and "epigenesis". As should be evident

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from my comments above on the blurring of the line between these two theories these will be provisional definitions only. Frederick B. Churchill notes that in discussing the “awkward dichotomy” of preformation and epigenesis, “a thorough analysis must tangle with those intractable questions about the meaning of ‘novelty,’ ‘emergence,’ ‘coming-to-be,’ and ‘form’” (Churchill 1970, 171). Some of this work will be done in the following chapters, and complexities in these definitions will emerge as we proceed.

Nonetheless, let me start with the following. Preformation and epigenesis are two theories meant to answer the question of how new living organisms are generated -- how organic form comes into being from apparent non-being. Broadly, preformation maintains that the organic form exists as a preformed germ before coitus, and that coitus merely starts the process of growth. This process represents no true development of form in any meaningful sense of the term “development”. It is a simple enlargement of what existed before -- a sort of swelling. Preformation, in short, denies the coming-into-being of organic form. Epigenesis, by contrast, posits true new development of form. Upon coitus, what was previously seemingly homogenous, undifferentiated, non-complex, unorganized, and non-unified becomes heterogeneous, differentiated, complex, organized, and unified into a living, functional individual. The form not only develops anew, but it is actually brought into existence as this process continues, and it is often considered a process of self-development, even self-creation.

Even if we bracket the suggestion that these theories are actually fairly complex and that these definitions will need to be reconsidered as we proceed, it is still the case that “preformation” is an ambiguous term in early modern theories of generation. As Roger and Peter Bowler have both noted, it denotes two distinct theories which answer the key question of generation in importantly different ways (Roger 1963 [1997], 259-60; Bowler 1971, 221-22). One theory, which I shall call “natural preformation”, postulates that the form of the living organism is generated sometime before coitus, and by some natural agent, usually by the parental soul (either maternal or paternal depending on where the germ is believed to be formed). Coitus starts the process merely of growth and not of
organization or unity. The second theory, which I shall call "divine preformation", also postulates that the form of living organisms is generated before copulation and also maintains that copulation starts the process merely of growth and not of development of organic form. But unlike natural preformation, on this theory, the generation of form occurs not at just anytime before copulation and not by a natural agent. Rather, God created each organism, all at once, at Creation. Unlike natural preformation, that is, divine preformation provides a final and foolproof explanation for the problem of organic origins because it equates generation with supernatural creation. As Georges Buffon would charge in the eighteenth century, this 'explanation' is an admission of utter impotence in the face of a difficult question, and in identifying God as the immediate cause of each organic life, divine preformationists failed as scientists (though obviously not as theologians) because they placed the problem securely beyond any further human investigation (Buffon [1749] 1780, 26-27).

Natural preformation as a theory of post-coitus growth may have more in common with divine preformation than with epigenesis (as characterized above), but as a theory of origin of form -- the key problem of generation -- it has, or can have, much in common with epigenesis. The critical common element is the fact that both theories posit natural, and not supernatural, generation of organic form. Further, according to the working definition of epigenesis offered above, living beings are newly produced each time from initially homogenous and unorganized material through a series of successive, rigidly deterministic organic developments -- through a progressive differentiation, organization and unification of parts. But natural preformation need not deny any of this. The natural agent could fashion the foetus in a number of ways, including by successive development of parts as in epigenesis, and the fact that this happens before sexual contact is irrelevant to the question which remains: what exactly is the natural agent which performs this work, and by what means does it accomplish the task? By refusing to turn to God as the direct agent or efficient cause, both natural preformation and epigenesis are left to answer this, a critical question. In his discussion of the preformation-epigenesis debate, Needham clearly interprets preformation in its natural, not supernatural, form, and concludes with good reason that if organic differentiation for the epigenecist
was pushed back far enough in time, the distinction between the theories tends to disappear (Needham 1959, 184). Throughout this work, I shall use the term “preformation” to indicate divine preformation, because it is this theory and not its natural counterpart which most clearly diverges from epigenesis on the issue of generation of organic form, primarily on the question of the agent.

Even in its divine form, there is variation in the theory of preformation. The main way in which such preformationists differ among themselves is in their beliefs about where the preformed germs have been stored since Creation and prior to their first moments of growth. Preformationists entertain one of three options: panspermism, animalculism (spermism) or ovism. Least popular among the three preformationist options is panspermism, the theory that the preformed germs are found scattered throughout nature -- floating in the air, settled in soil, in food and so on. Claude Perrault is perhaps the earliest, strongest and most unwavering of its advocates (Roger 1963 [1997], 279-80), but panspermism endures at least until the mid-eighteenth century with La Mettrie’s endorsement of the theory (Roger 1963 [1997], 397-98). The one major advantage of panspermism over animalculism and ovism is that it is able to provide an explanation for spontaneous generation, widely accepted to be true generation simply because it appears to happen so often. Both panspermism and spontaneous generation find support in the microscopic discoveries of apparently live, minute and moving beings found throughout nature -- in food, puddles of water and so on (Jacob [1970] 1993, 55). This topic shall be dealt with in greater depth in the concluding chapter.

Animalculism (or spermism) and ovism both maintain that the germs are nested within the reproductive organs of their parent, the father in the case of animalculism (spermism) and the mother in the case of ovism. That parent is nested within his or her mother’s or father’s reproductive organs and so on, all the way back to Creation and all the way forward to the end of the universe. God organized the germs in this manner and thus guaranteed the regularity of specific births. This is the theory of emboîtement. Animalculism, though encouraged by Leeuwenhoek’s discovery of the spermatozoa which were often erroneously believed to be minute animals, enjoyed far less popularity than did ovism (Roger [1963] 1997, 249-50). Leeuwenhoek himself, Hartsoeker and Leibniz
(usually) are among its most famous adherents (Roger [1963] 1997, 281). Ovism, the theory which reigned throughout the early modern history of preformation, had a much longer list of adherents including Swammerdam, Régnier de Graaf, Malebranche, John Ray, Pierre-Sylvain Régis, Bernard Le Boyer de Fontanelle and Haller (Roger [1963] 1997, 216). Much of the debate between animalculist and ovists centres more on theological or societal concerns than on natural concerns. The apparent wastage of huge numbers of lives on the animalculist's theory lends support to the ovists. The unlikelihood that God would choose the inferior host (as the female was deemed to be) for all future lives lends support to the animalculists.16 These cultural and societal concerns are extremely interesting, but have garnered a fair amount of attention in the secondary literature. I shall confine the discussion of generation, in its various forms, to questions of natural philosophy and metaphysics, and it is to these that we shall now turn.
Endnotes

1. For definitions, including equivocations in the meaning of the word “preformation”, see the section on definitions later in this chapter.

2. Other prominent studies in this early wave which dealt seriously with preformation include books by Howard B. Adelmann (1966), Elizabeth Gasking (1967), Jane Oppenheimer (1967) and François Jacob (1973), and articles by Charles W. Bodemer (1968), Peter Bowler (1971), François Duchesneau (1979) and Shirley Roe (1975 and 1979).

3. I shall provisionally define mechanism as the belief that all changes at the phenomenal level — that is, all changes we experience — are due to the lawful motion and contact of sub-visible matter which is quantitatively and not qualitatively defined. Equivocations in the concept of mechanism will become a key issue in a proper evaluation of preformation.

4. See chapter two, section III for a more complete analysis of the received view, especially as it is found in Roger.

5. Edward Ruestow argues for yet a third motivation which he attributes to the microscopist, Jan Swammerdam. This reason starts not from a metaphysical idea of nature and its capabilities (and incapacities) but from an ideal about God’s way of working in the world. Ruestow argues that as an experimentalist, Swammerdam builds his theories about nature from his experiments and observations, not from an hypothesis about the nature of matter and motion. But he is also a deeply religious man and finds the work of God in each intricate and well-formed living being. The brute fact of insects, and the fact that living beings produce only like kinds, reflect such design, order and harmony in nature that only God could have been responsible for it. Thus piety, not mechanism, is Swammerdam’s primary motivation (Ruestow 1985, 231ff).

6. Other thinkers who have noted the role played by unity in some form or another in various early modern preformationists (primarily Leibniz, and we shall see why in chapter four below) are Roger (1969), Asma (1996, 64ff), Duchesneau (1976) and Smith (1998).

7. The term “organization” includes the word “organ” which had, even into the early modern period, the meaning of “instrument” (Williams 1983). The organs of an animal are the instruments of the whole animal needed and used to achieve various living functions. Implicit in “organization”, then is the idea of the whole or unity. Georges Canguilhem notes that although the early moderns recognized the need for organized complexity, and for structural differentiation and functional specialization, the problem of unity and individualisation became increasingly important only later in the early 1800’s and beyond, thus indicating that organization need not be linked with unity (Canguilhem 1994, 84).

8. This does not mean that the idea of difference or distinctness was foreign to earlier eras. Indeed, Williams quotes Boethius on the meaning of individual to show that both concepts (indivisible and different) were present then. His point is merely that the former meaning dominated in the Medievals while the second began to rise in importance only later. Williams, of course, may be challenged on this historical point but the philosophical point — that there are different concepts captured by the idea of the individual and that these were both relevant in the seventeenth and eighteenth centuries — remains and is all that I require here.

9. I shall bracket, for now, the possibility that this ontology was not actually lost by the early moderns, though this will surface with regularity in the chapters that follow. I shall also bracket the fact that among Aristotle and his various Medieval followers, there are a myriad of ontologies under
the basic form-matter hylomorphism, and these differ significantly from one another.


11. Later preformation theorist would either downplay the empirical evidence, noting the inability of the senses to determine conclusively what the empirical facts of the matter actually are in the case of very tiny, forming foetuses, or select aspects of the empirical evidence that suggest that a fully-formed foetus actually does pre-exist. The dispute between Albrecht von Haller and Caspar Friedrich Wolff is particularly instructive. Both experimentalists had access to precisely the same data, and yet interpreted what they saw entirely differently (Haller was a preformationist and Wolff was an epigeneticist). Shirley Roe argues that with various legitimate ways of interpreting visual data, choices will be made on the basis of theoretical commitments, and she shows how each of these two thinkers justifies his conclusion regarding the data by appealing to such commitments (see Roe 1975, 1979, 1981).

12. This form of preformation is one that Aristotle could never have conceived of given his cosmology of an eternally enduring natural world. There is no creation, and nor is there a Christian God who intentionally builds artifacts that we call natural. This does not mean that Aristotle’s system could not accommodate a different form of preformation. See the final section of this chapter for the various renditions of preformation, especially the distinction between “divine” and “natural” preformation which is especially relevant here.

13. In fact, Descartes’ most fundamental idea of ‘body’ is material substance as extension, but this is a wholly geometrical conception with, as Leibniz would argue, no substantial reality at all. The supposition that Descartes is actually an idealist with regard to matter is not one I shall entertain here. I simply assume some substantial reality to his metaphysical idea of matter and work with this definition -- extended matter -- as the first idea of body in Descartes.

14. In the Synopsis to the Meditations, Descartes claims that all arrangements and ‘unions’ of particular portions of matter are accidental, suggesting that there is really just one material substance -- all of extension (AT VII, 13-14/CSM II, 10). I shall bracket this austere idea of material unity in this discussion.

15. One reason why Needham’s evaluation does not always hold is that the epigenecist often sides with Galen over Aristotle by conceiving of generation on the two-semen model (both male and female contribute the material of the eventual foetus) while natural preformation cannot maintain this theory.

16. For an extensive discussion of various advantages and disadvantages of each of the two enboîtement theories, see Pinto-Correia (1997, chpt 7).
Chapter Two

Body as extended matter: Descartes’ “inchoate preformation”

I. Introductory comments

Descartes’ theory of generation cannot account for the experienced facts of the living being. This belief has been at the core of criticisms of Descartes’ theory since shortly after the 1662 posthumous publication of his Description of the Human Body (hereafter Description). Malebranche is among the first to reject Descartes’ position on the problem of generation and replace it with preformation, and virtually every early modern naturalist and philosopher who came after Descartes, and who is interested in the question of how living beings form, takes issue with his theory. Even those who praise Descartes’ method of investigation as uniquely outstanding among those of his contemporaries (Caspar Friedrich Wolff, most notably1) are critical of the actual theory which this method spawns.

This chapter aims to investigate the claim that Descartes’ theory of generation -- his theory of the formation of living beings -- is unequal to the task of explaining the final product. While I think this belief is true, Descartes’ theory is much more subtle and interesting than has thus far been recognized. Many of those working in the immediate post-Descartes years of the seventeenth and eighteenth centuries and most of the more distant commentators of the twentieth century studying the history of early modern generation and Descartes’ role in that history, have underestimated the complexity of Descartes’ theory. They have consequently failed to note the real reason why it fails. This reason is the fact that Descartes’ theory of generation cannot account for the unity of the completed organism. The reason is not, as most commentators have claimed, that Descartes’1 metaphysical mechanism is unable to account for the structural complexity2 of the living being, and the fact that animals generate only like (structurally resembling) kinds.

Let me begin this discussion by examining Barber’s claims surrounding Descartes and the problem of individuation. Recall that Barber believes that the “epistemological turn” of the seventeenth century, as best exemplified in the work of Descartes, had a profound impact on the
problem of individuation. Specifically, the relationship between epistemology and metaphysics changed quite notably such that ontology became limited by epistemology -- only what could be known with certainty was taken as ontologically real. This resulted in the loss of Aristotle's solution to the various aspects of the problem of individuation (Barber 1994, 6). For Descartes,

[w]hat can be known about substance is furnished solely by reason, or the understanding, and what can be known by reason is restricted to just one aspect of the formerly complex entity, namely, the essence or nature of substance (extension in the case of material substance). The other aspect, matter, which had been the principle of individuation for material objects, disappears, leaving Descartes with the twin difficulties of having no principle of individuation and of having to equate, untenantly, substance with essence (Barber 1994, 7).

Barber's discussion of the loss of matter as the principle of individuation refers to an aspect of individuation that, as I noted in the introduction, falls outside the scope of this work. That is, matter serves as the principle of individuation of individuals within a species. Matter is that which distinguishes or differentiates individuals from all others with which they share a universal form. Barber further notes, however, that the form (or nature) is also lost and with it, the principle of continuity or identity is lost as well. Form is the principle that "accounts for... identity through time... [which in turn] requires that the individual in question at each moment of its existence be distinct from all other individuals" (Barber 1994, 6). It is the loss of that universal form, or nature, which is more germane to my interests. Form, suggests Barber, is that which makes an individual a single thing and therefore allows us to separate it off from other individuals as ontologically distinct. Form picks out distinct examples of the "fundamental order of being". Still, the reference to matter is key in a consideration of Descartes and the problem of individual unity.

Barber claims that the only thing that can be known with certainty of material substance is that it is extended. As I noted above, I will bracket for now the concern that Descartes' theory of the essence of material substance is a theory that is basically geometrical and not substantial -- what is essential is mere extension not extended matter as I am treating this notion of body. I am, therefore, sidestepping Barber's central worry. Nonetheless, let me proceed on the picture of body as extended matter because even this raises problems for individuation, especially in Descartes' theory of
generation. Besides being extended, matter is also indefinitely divisible into indefinitely small pieces. Further still, it is actually divided as a consequence of the movement of this extension, and the collision of parcels of this extension with other parcels. This presents a serious obstacle to deriving ultimate, indivisible and enduring individuals in the material realm. This is well-expressed by Grosholz, whom I quoted on this issue above (chapter one, section II): “unity in virtue of common motion [of a parcel of matter] does not seem strong enough to keep matter from being pulverized into the dust of subtle matter, if shattering is allowed as a possible outcome of impact.... Otherwise put, the unity of physical bodies so conceived cannot maintain itself against the disruptive effects of the sole form of physical interaction” (Grosholz 1994, 51). Eventually, I shall challenge Barber’s claim that, according to Descartes, the only thing that can be known of matter is that it is extended. Some of that work will be done in the current chapter. But for now, let me grant Barber this claim since it is especially valuable in the investigation of Descartes’ theory of generation. The reason for this is simple. The first and most fundamental concept of body -- extended matter -- and the attendant concept of mechanism as such matter in lawful contact motion, are precisely the metaphysical and physical concepts which Descartes uses in his theory of generation.

Obviously, the inability of matter and mechanism, thus understood, to support a theory of individual unity will explain exactly why Descartes’ theory of generation is likewise challenged. So the conclusion that Descartes’ theory of generation fails to account for individual unity because of the underlying theory of matter and mechanism is easily drawn. Nonetheless, it is useful to delve into the particularities of Descartes’ theory in order to understand the points on which it actually succeeds, just how his critics have underestimated Descartes’ work in this area, and the theory which set the tone for subsequent early modern investigations into generation.

In section II, I outline the principal tenets of Descartes’ various ideas about generation as found in the three anatomical texts in which he addresses this problem. In section III, I sketch the usual story, or “received view”, of Descartes’ position in the history of early modern generation, emphasizing the prominent belief seized upon by commentators: Descartes’ own mechanical
commitments are inadequate to explain generation, and preformation is the mechanical answer to that failure. Three issues, not appropriately accounted for in the standard history, arise from this examination. The first issue (Section IV) concerns Descartes’ methodological approach to the study of generation. Far from the standard account in which Descartes is portrayed as speculating from a priori principles while failing to properly account for empirical evidence of how foetuses actually form, Descartes’ evolving ideas in the area of generation attest to an interesting blend of intuited innate first principles, some of which are natural causes, and positing other potential causes to explain effects garnered from extensive empirical investigation. The second and third issues (Section V) are, first, the positive role played in these investigation by teleology, a greater and much more important role than has been thus far acknowledged, and second, the role that God plays in generation. Taken together, these three issues, and the more accurate reading of Descartes’ theory of generation which they allow, expose a weak sort of preformation at the core of Descartes’ theory, often neglected by students of Descartes. This budding preformation posits a God-given initial arrangement of the matter of generation such that the laws of motion alone can bring into existence, from that initial arrangement, a being structured exactly like an animal of the appropriate species.

This is important because the obvious question that arises is the following: why would Descartes’ followers reject this offered solution to the problem? That is, why substitute the supposedly mechanical preformation when a mechanical model of generation more in line with Descartes’ own mechanical metaphysics is already in the offing? This question is at the heart of the two following chapters where I shall argue that both Malebranche and Leibniz are dissatisfied with Descartes’ theory of generation, not primarily because it fails to account for complexity, structural design or even the uniformity of like kinds always producing like kinds. Descartes’ theory has the power to explain all this without recourse to fully formed little animals. Rather, Malebranche and Leibniz posit full-fledged preformation because Descartes’ theory is incapable of accounting for individual unity in a number of ways.
II. Body as extended matter in lawful motion: Descartes’ theory of generation

Descartes’ interest in questions concerning the living body — that is, questions in the discipline then called medicine — surfaces with regularity in his work. He writes to the Marquess of Newcastle in October 1645, that the “preservation of health has always been the principal end of my studies, and I do not doubt that it is possible to acquire much information about medicine which has hitherto been unknown” (AT IV, 329/CSMK 275). Part of this attempt to gather more and new information in the field of medicine is his attempt to understand how living beings form. As he claims in the *Principles of Philosophy* (hereafter *Principles*), “if we want to understand the nature of plants or of men, it is much better to consider how they can gradually grow from seeds than to consider how they were created by God at the very beginning of the world” (AT VIIIa, 100/CSM I, 256). Yet Descartes, no less than his contemporaries (and many others for generations to come), seems to find the problem of generation especially intractable. Charles Adam notes in his preface to the *Primae cogitationes circa Generationem Animalium* (hereafter *Generationem*) that Descartes approaches the problem again and again in more than half the years between his first written mention of generation in 1629 and his last in 1649 (AT XI, 503), and it is not until two years before his death that he sets out some systematic thoughts on the subject. Even so, he himself never published these thoughts.

Sometimes Descartes simply mentions the problem of generation noting his intention to deal with it in future (letter to Mersenne of June 1632: AT I, 254/CSMK 39). Sometimes his comments on generation centre around his need to do more experiments and dissections before he will be able to approach the issue properly. This quest for more experimental data is found even as late as this letter of 1648 or 1649: “In meditating on this [the formation of animal], I have discovered so much new territory that I have almost no doubt that I will be able to complete my physics according to my wishes, provided I have the leisure and the facilities to perform some experiments” (AT V, 261). Still, about a decade earlier, he had already been confident of his ability to deal with the problem:

I have spent much time on dissection during the last eleven years, and I doubt whether there is any doctor who has made such detailed observations as I. But I have found nothing whose formation seems inexplicable by natural causes. I can explain it
all in detail, just as in my *Meteors* I explained the origin of a grain of salt or a crystal of snow. In my *World* I supposed the body of an animal already formed, and merely exhibited its functions; if I were to start it again I should undertake to include also the causes of its formation and birth (letter to Mersenne, 20 February 1639: AT II, 525/CSMK 134-5).

This undertaking would seemingly wait until shortly before his death, however, for according to a letter to Elisabeth of 25 January 1648, he has “ventured (but only in the last eight or ten days) to attempt to explain the way in which the animal is formed from the beginning of its origins” (AT V, 112). Even in this attempt (his *Description*) he proceeds tentatively:

We may acquire an even more perfect knowledge of the way in which all the parts of the body are nourished if we consider how they were originally formed from the seminal material. Hitherto I have been unwilling to put my views on this topic in writing because I have not yet been able to make enough observations to verify all the ideas I have had on the subject. Nevertheless, I cannot forbear, in passing, to give some indication of the most general points; I hope I shall run the least risk of having to retract these later, in light of fresh observations (AT XI, 252/CSM I, 321).

Three texts include detailed material on generation: his *Description*, the *Generationem*, and the *Excerpta anatomica* (hereafter *Excerpta*). Only the first is dated with any certainty. Though written in late 1647 to early 1648, it was not published until 1662, after Descartes’ death, and it was republished by Claude Clerselier two years later along with *Treatise of Man* under the title *On the Formation of the Animal*. Despite Clerselier’s title, however, only the fourth and fifth parts of this treatise concern generation. The *Generationem* and *Excerpta* both consist in fragments and notes, likely written over a span of many years. The *Generationem* includes some contradictions in detail at various points, suggesting that some fragments take account of knowledge from dissections not available when earlier fragments were written. Only three pages in this text are dated, and this only because these pages reiterate virtually word for word a fragment found in the *Excerpta* text which Descartes dated in February 1648. Though not all the fragments in the *Excerpta* are dated, those that are tell us that Descartes was writing these notes by at least 1631 and at least as late as 1648. Victor Cousin, in his 1826 edition of Descartes’ work, claims the *Generationem* is inauthentic (Cousin 1826), though the match between three of its pages and those in the certainly authentic *Excerpta* indicates otherwise. Cousin could not have known about this match, however, because the *Excerpta*
were not published until 1859-60, after Foucher de Careil had discovered Leibniz's transcription of these fragments among Leibniz's own notes in Hannover. The Excerpta are primarily details about Descartes' dissections, including his dissections of chicken embryos through more than thirty stages of foetal formation.

In the preface to the French edition of his Principles, Descartes puts forward his famous metaphor of the tree of philosophy: "(T)he whole of philosophy is like a tree. The roots are metaphysics, the trunk is physics, and the branches emerging from the trunks are all the other sciences, which may be reduced to three principal ones, namely medicine, mechanics and morals" (AT IXb, 14/CSM I, 186). As part of the subject of medicine, Descartes' theory of generation thus arises from, and must accord with, his physical theory of the lawful behaviour of matter, but it is ultimately grounded in his metaphysics, which includes his theory of the essence or nature of matter.

Most broadly, matter is extension, a plenum which extends indefinitely; everywhere is full. There is no vacuum or empty space but rather matter in various stages of density and rarification everywhere. The difference between what we call matter and what we call space is merely conceptual, arising from our inability to sense the extremely rarified matter which fills all of so-called 'empty' space. Matter is brittle and indefinitely divisible. There are no ultimate material atoms which cannot be further divided, and so they can vary widely in their size as well as their shape and the relative speed with which they move. The motion which God injected into the world at Creation, and which he sustains in the same quantity, is the cause of all diversity in the size and shape of parts of matter. In turn, the fact that matter is divisible permits its motion. Motion is to be understood only as local motion, or "the transfer of one piece of matter, or one body, from the vicinity of the other bodies which are in immediate contact with it, and which are regarded as being at rest, to the vicinity of other bodies" (AT VIIIa, 53/CSM I, 233). All matter moves according to three inviolable laws of motion, or laws of nature (see Principles, Part II, articles 37-42), colliding among itself in this lawful fashion, and changing speed or direction, or breaking into smaller pieces, if the relative sizes and speeds of the parts of colliding matter necessitate such change or shattering. Pieces which are moving
at the same speed and in the same direction clump together and stay together and may be regarded as a body unless a collision with other parcels of matter brings about a break.\footnote{6}

This is the matter of generation as it is understood metaphysically, because this is simply what \textit{all} matter is metaphysically and subvisibly. At the physical and visible level, the matter of generation is the spermatic fluid. This is presented in Descartes' most systematic and mature thoughts on generation which are found in the fourth and fifth parts of the \textit{Description}, and I shall start with his account as it is found there. Descartes' is a two-semen theory of generation; both male and female contribute to the matter of generation. This helps to account for the blatant fact that the creation of offspring among animals can occur only with the contribution of both sexes.\footnote{7} It also allows Descartes to provide a theory of generation which, on the face of it, appears to depend on nothing more than material and efficient causes.

Upon coming into contact with one another, the two semens react in a way analogous to the reactions in fermentation because the two semens are slightly different from each other: “This material is apparently just a disorganized mixture of two fluids which act on each other as a kind of yeast, generating mutual heat. Some particles thus acquire as much agitation as fire has, and expand and press on other particles, thereby putting them little by little into the state required for the formation of the parts of the body” (AT XI, 253/CSM I, 322). So the first thing which occurs on the mixing of the semens is the generation of an extreme heat due to a reaction, and this in turn leads to the movement and consequent differentiation of the fluid material, and the beginning of the formation of organs and body parts (AT XI, 254/CSM I, 322). Much depends on this original creation of fairly extreme heat, but Descartes does not \textit{explain} how this heat comes to be, besides simply drawing an analogy between this process and the observed processes of new wine fermenting or wet hay reacting when it is stored. In all three cases, the created heat “causes a number of particles to gather together in some part of the space containing them, and then makes them expand and press upon other surrounding particles” (AT XI, 254/CSM I, 322).

So, the mixed semen is gradually differentiated. The first organ to begin forming is the heart.
The larger particles which eventually make up the finished heart push the smaller, more agitated particles away from themselves. These smaller particles, then, make their way towards what will eventually be the brain stem and brain. More such particles follow, displacing the first ones which are forced back to the forming heart. Heated again in the region of the growing heart, they expand and once again move away from this area. This constant expansion and contraction due to the heating of the particles, and their rapid movement away from the area of the heart when the particles' expansion forces their exodus, is the heart's beat. Particles follow the path of least resistance (AT XI, 256/CSM I, 323): given the flow of hotter, more agitated particles toward the brain from the heart, those flowing in the opposite direction are forced aside and begin to form the spine (AT XI, 257/CSM I, 324). This sort of explanation is typical of Descartes' theory according to which the whole process is dictated by the basic laws of matter in motion and consequent collision and shattering of the matter. For example: “Now I say that the spirits which prepare the path for the nerves in the semen take their course in it towards the outside because they are pressed by the surface of the womb not having any passage free enough to receive them; but they find such passage towards the front of the head...” (AT XI, 265). Other explanations of a similar nature follow: eyes, veins, arteries, lungs all form from semen according to the laws of nature.

This explanation is helped along somewhat by a theory of diversity among the elemental particles which make up the body, a theory which parallels Descartes’ cosmological theory of the “three elements of this visible world” offered in his Principles:

The first element is made up of matter which is so violently agitated that when it meets other bodies it is divided into particles of indefinite smallness... The second is composed of matter divided into spherical particles which are still very minute when compared with those that we can see with our eyes, but which have a definite fixed quantity and can be divided into other much smaller particles. The third element... consists of particles which are much bulkier or have shapes less suited for motion....

The sun and fixed stars are composed of the first element, the heavens from the second, and the earth with the planets and comets from the third... (AT VIIIa, 105/CSM I, 258; see also AT XI, 26/CSM I, 89).

Similarly, in the human body, there is a variety of elements which explains the experienced qualitative variety of body parts. Some elements are very rarified but also very solid and active
(spirits) while others are also rarified but neither very solid nor very active even though they are able to move on their own (airy particles). The lungs, for example, are made up of the airy sort of particles, while the fluid of the nervous system is spiritus. Then there are even coarser particles which make up hard body parts such as bone, or even muscle (AT XI, 259ff and 274ff). Descartes goes into somewhat more detail on this theory of diverse elements than is necessary to recount here, but the point is simply the following. The living body as microcosm mirrors the cosmos in its elemental makeup. Just as the differences we experience as qualitative differences in the bodies that make up the cosmos are due entirely to measurable differences of the particles which make those bodies up, so too the apparently qualitative differences we experience in the body’s organs and parts are due to the different size, shape and amount of motion (all quantities) of their different constituent particles of matter. Importantly, there are three quite specific quantitative combinations of matter at the elemental level. There is not a range along a continuum of various sizes, shapes, densities and speeds.

The other two works in which Descartes deals specifically with generation and anatomy differ from the Description in some details. One fragment in the Generationem posits a different ordering to the formation of parts: brain, lungs, liver, and only then the heart (AT XI, 506-9). In another fragment, however, the order is somewhat different, with the heart among the first organs to form (AT XI, 516), an order comparable with that found in Description as well as in the Excerpta (AT XI, 599). This latter order accords more closely with his own observations of developing chicken foetuses (AT XI, 620-21). The Generationem also adds the claim that should the male semen not mix with the female, it will simply flow out “through the same pathway through which it entered: for there is nothing to keep it there”, while the mixing causes such rapid expansion that the uterus entrance is forced closed and the process of generation can continue (AT XI, 507). This work, like the Description, notes the difference among various sort of body parts based on the different relative coarseness or rareness, shape and motion among their constituent particles (AT XI, 506-7).

In all three works, there are crucial details that I have not explicated here. I shall bracket these until the end of the next section. In that section, I shall outline what I believe is the most
developed and well-argued interpretation of Descartes’ theory and his position in the history of early modern generation. The crucial points in Descartes’ texts are so crucial precisely because of the challenge they mount against this interpretation of Descartes’ role in that history.

III. The received view of Descartes’ role in the history of early modern theories of generation

According to the usual story of early modern generation, and especially the emergence of the doctrine of preformation, most natural philosophers working after Descartes find his mechanical theory of generation far too speculative. More critically, they find it far too improbable. Malebranche thinks that it is entirely possible for the cosmos to form by the chance breaking apart and collecting together of matter moving and colliding according to the laws of nature. In this, he is in line with Descartes. But Malebranche also thinks that such a formation is impossible in the case of something as densely complex as a living being (OC II, 343-4/ST 465). The full reasons for Malebranche’s stance are interesting in themselves and will be addressed in the next chapter. Suffice it to say here that he, along with many others who are theorizing about generation in the immediate post-Descartes years, believe that Descartes’ theory cannot reasonably account for the complexity and clearly designed structure seen in living bodies. More importantly, this theory cannot explain the uniformity with which this complexity and structure forms. Though extremely unlikely, perhaps a living body could form in this chance manner once as did the cosmos. But it is impossible that this should happen with the frequency and sort of regularity and respect for natural kinds that we experience. Descartes’ theory is too chance-laden to explain a phenomenon as clearly regulated and determined as is generation. Further, the persistent creation of something more perfect (a complex animal) from something less so (seemingly non-complex semen) is unreasonable to expect of nature as defined by Descartes.

Thus, according to the standard history of early modern generation, those committed to Descartes’ metaphysical principles of the nature of matter, and to Descartes’ physical principles of the lawful behaviour of that matter, supplement their Cartesian mechanical philosophy with
preformation. God preformed each living being at Creation and placed them all within the first member of each species, and the lawful motion of matter, while not adequate for forming these beings, is adequate for causing their growth.

This way of interpreting Descartes' role in the history of early modern theories of generation indicates both a positive and a negative reaction to Descartes' philosophy. The negative reaction is against his theory of generation, while the positive reaction is in support of his more foundational and far more important metaphysics and physics. Some commentators have seen generation as crucial for Descartes' overall system because the formation of a living body proves to be the toughest test case for this comprehensive system (e.g. Roger [1963] 1997, 114; Duchesneau 1975, 125). Given Descartes' own "tree of philosophy", Descartes' failed theory of generation among the branches threatens to expose the weakness at the very roots of that structure. By excising this part of the system and grafting on the theory of preformation instead, later Cartesians aim to save the more critical roots and trunk of the tree. On this view, preformation is the logical outcome of Descartes' metaphysics and physics. Preformation is the mechanical theory of generation which completes Descartes' mechanical philosophy.

There is some truth to this view of preformation as a consonant complement to Descartes' system. Preformation retains an essential aspect of Descartes' metaphysical mechanism. It refuses recourse to some sort of natural incorporeal spirit or soul as the causal agent that constructs living beings. Descartes himself, in his Generationem, notes that this would be the unwelcome option to his own theory which is based on the eternal laws of nature: "Would we have everything carried out by some spirit? But which one? Or indeed, directly by God? Why, then, are there occasional monsters? Or rather by that eminently wise nature, that draws its wisdom only from the folly of human thought?" (AT XI, 524). At the same time, preformation retains the premise, also key to Descartes, that matter itself is passive and subject only to externally-imposed motion ultimately injected into the world by God.

There is, however, another way of interpreting this story of early modern generation, and this
is Jacques Roger's interpretation. Roger sees the rejection of Cartesian embryology and its replacement by preformation in a much dimmer light, for he takes the turn to preformation to be a complete betrayal of Descartes’ own project. Preformation, according to Roger, represents a failure of Descartes’ mechanism, indeed, of the entire tree of philosophy given the metaphysical mechanism in the roots and trunk, to achieve what Descartes believes it ought to be able to achieve: “Descartes’ entire system of thought found itself called into question by the destruction of his embryology. Contemporaries thought, no doubt, that they were doing their master a favour by unburdening his system of its most vulnerable — because most theoretical -- component. But as this component was, precisely, the most perfect expression of the Cartesian ambitions, it could not be abandoned without damage to the entire body of Descartes’ thought” (Roger [1963] 1997, 356-7).

I wish to stress three points in Roger’s evaluation of Descartes’ theory of generation. The first is that Roger locates a key weakness of Descartes’ theory in the fact that it is altogether too conjectural because it is theoretical in the extreme. It is, after all, developed from a priori principles regarding the nature of matter and the laws of motion. The imagined and well-detailed formation and emergence from a plenum in motion of organ after organ, of part after part and finally of the complete living being, seems almost entirely in the realm of speculation. Roger does admit that:

[One cannot accuse him of working purely in the abstract. Still, here as elsewhere, Descartes experimented only to verify the correctness of the deductions he had made from his principles. At best, he conceded experimentation a few secondary points.... For him, true science was a matter of deductive demonstration, and experimentation had nothing to contribute to principles. It was through a purely methodological, or rather, metaphysical a priori that Descartes had chosen to find in vital phenomena only matter and motion (Roger [1963] 1997, 115-16).

In doing so, Descartes “too often... ended up describing phenomena as if he had observed them” (Roger [1963] 1997, 121), even those phenomena wholly improbable.

The second and third points relate to Roger’s evaluation of preformation as a betrayal, and not a completion, of Cartesianism. The second point concerns teleology. Roger believes that Descartes almost fully eschews the use of final causes in natural philosophy. Preformation, therefore, represents the illegitimate (to Descartes) import of teleology into the realm of natural investigations.
"[S]etting aside any final causes, he eliminated the notion of an intelligence located in particles or elsewhere, with the exception of the Supreme Intelligence that had once and for all established the laws of motion in such a way that everything happened in bodies exactly as Descartes said it did, or at least according to an analogous process" (Roger [1963] 1997, 121). According to Roger, "[g]iving up final causes", means that Descartes "no longer [considers] anything but matter in motion in this area [animal formation]" (Roger [1963] 1997, 113).

The depiction of early modern natural philosophy as a philosophy grounded in austere, teleology-free mechanical explanations is common enough (Burtt 1954, 98-9), as are recent challenges to this picture. Consider one of these challenges. According to Margaret Osler, teleology does not disappear from the scientific picture of the early modern period, but is transformed instead. For the pre-moderns, teleology in nature is an immanent final cause -- the internal (either intentional and conscious or not) ability of nature or natural beings to actualize form. For the moderns, teleology is an external final cause -- the intentional imposition of form upon nature from without (Osler 1996, 389ff). It is not the case that the pre-moderns lack the modern form of teleology, but rather they confine this externally-imposed teleology to the realm of the artisan. The realm of nature is of a wholly different kind because it is defined by the former, internal teleology. Early moderns, according to this theory of teleology-transformed, rid themselves of the pre-modern "natural", internal form of teleology and draw the line between art and nature based on the identity of the artisan. Nature is fashioned by God while art is fashioned by the human. Both are fashioned from without, by a purposeful and conscious intellect, and so differ in degree but not necessarily in kind.

Roger's comments above on Descartes and final causes provide an interesting example of the complexity in this question of teleology in the early moderns, especially as it relates to the question of generation. Certainly, Roger seems to draw an equation between final causes and active, but natural, intelligences working within the material world. But, he also recognizes another conception of teleology present even in Descartes' work, namely the active intelligence of God working on the world from without. But Roger is careful to note that this sort of teleology is limited in Descartes'
philosophy to the imposition by God of laws of motion and nothing else. For other early moderns, however, God may intervene in nature in additional ways, and it is here where preformation seems to overstep Descartes’ own limits. The preformationists, then, remain true to Descartes’ anti-teleological mechanism in so far as they bracket appeals to spirits or souls working within nature. But in supplementing this mechanical world-view with a teleology externally imposed upon nature, they go beyond the role attributed to God by Descartes (or Descartes as Roger interprets him through his theory of generation). For while Descartes believes that God imposed only the laws of motion, the preformationists believe he imposed the exact structure of every individual animal so designed as to realize specific functions. Thus, preformationists depend on intentional and conscious purpose to explain in detailed particularities that which, according to Roger, Descartes thinks ought to be explained by reference only to God-given laws of motion and a material plenum.

The third point I wish to stress in Roger’s discussion of Descartes is closely related to this second point and gets to the crux of Roger’s misgivings about the claim that preformation completes Cartesianism. Preformation proves that Descartes’ attempts to construct an explanatory edifice based solely on natural bits of matter in lawful motion is doomed, and in admitting that nature itself (its matter and laws) is incapable of explaining all the phenomena we see, the preformationists have destroyed Cartesian science; indeed, preformation is wholly unscientific (Roger [1963] 1997, 128). Bluntly, preformation is supernatural and is thus no longer properly confined to the realm of natural, physical explanations which is where Roger believes Descartes keeps his speculations regarding the formation of foetuses. Surely, Descartes’ own dismissal of the idea that God directly forms living bodies (AT XI, 524, quoted above) underscores the betrayal of Descartes’ theory which preformation represents. Thus, the fact is that preformation is not a theory which remains true to mechanism proper because, by shifting the burden entirely to God, mechanism as a natural philosophy about the workings of the physical world is undermined, in fact, destroyed, by that very attempt to save it.

This criticism turns largely on the supposition that Descartes’ mechanism is “capable of preserving but not forming beings” (Roger [1963] 1997, 174). In Georges Canguilhem’s similar
evaluation, mechanism, on Descartes’ model of it, has the power to explain the behaviour of the
constructed machines of the world, but it cannot explain the actual construction of those machines
(Canguilhem 1994, 78). This is due to the main difficulty that the preformationists find in Descartes’
theory. The laws of nature are simple and immutable and cannot account for such frequent and
regular examples of increased perfection -- animals evolving by chance from matter as simple
extension. This construction of complex and more perfect beings from simple laws and material
extension goes against Descartes’ own belief, repeated throughout Meditations 3-4, that the more
perfect the product is, the more perfect the maker of that product must be. Preformation expands the
immutability of Descartes’ natural philosophy to eliminate altogether this increased perfection. From
Creation onwards, living bodies never come into being. They never change or develop in any
meaningful way. But, “[t]his solution... [is] rigorously contrary to the scientific spirit; it [is] a solution
of despair and a true admission of impotence” (Roger [1963] 1997, 128).12 Descartes’ mechanism is
unable to explain all the phenomena of nature as it is meant to do. The necessary addition of
preformation highlights this deeply damaging fact.

The claim that preformation destroys mechanism in its attempt to save it may be partly
unfair. Certainly the mechanism which grounds preformation may not be in line with the
metaphysical mechanism of a plenum (nor even of atoms of matter) in motion, but it may represent a
refinement of the mechanical ideal precisely to perfect mechanism in the face of natural phenomena
which demand such a refinement. Moreover, not all commentators understand mechanism as
indicative of increasing naturaïsm and decreasing supernaturalism in the seventeenth century. Keith
Hutchison, for example, takes the mechanical philosophy, grounded as it is in inert nature, as a
guarantee that God will have to be persistently active in the world, or work in the world in
considerable detail (Hutchison 1983).13

More importantly, there is a confabulation in this criticism of preformation -- a confabulation
between mechanism as the understanding that all natural changes are due to matter in lawful motion
and mechanism as the understanding that the natural world and its parts are machine-like. The idea of
machines, found frequently in Descartes too, only proves the need for an artisan, i.e. God, and therefore indicates the pull toward greater supernaturalism and away from naturalism. The importance to the discussion at hand of the difference between these two concepts of mechanism will emerge in due course. Nonetheless, Roger's point that preformation removes what ought to be considered a natural phenomenon from the realm of nature and puts it securely beyond scientific study is true enough. What remains in question is whether Descartes' theory of generation is indeed as speculative and built from a priori principles, and is indeed as wholly natural and beyond appeals to God's intentions and appeals to his interventions on particular details, as is depicted in Roger's and others' evaluation of Descartes.

The sketch given above of Descartes' thoughts on generation provides considerable evidence for Roger's beliefs that Descartes' theory is wildly speculative and that experimentation wins only a few minor points against theorizing from a priori principles. While Descartes, for example, seems to adjust his theory to account for the observed fact that in the chicken, the heart forms first (AT XI, 620), this sort of appeal to experiment indeed seems minor given his apparent intransigence on the point that brittle matter and the immutable laws of motion alone are required to explain the formation of the foetus. Surely it is speculative and improbable in the extreme to suppose that the spine of every animal always forms precisely where it does because particles in their downward travels are forced aside by others moving up to the forming brain. But some curiosities in Descartes' work on generation indicate complexities in his theory, and in his method and metaphysics, which warrant further investigation. I shall note five points of importance.

First is the mere fact of experiment and observation in Descartes' work. If Descartes' theory of generation, indeed, if his theories in natural philosophy in general, are truly theories built from a priori principles in a mathematically deductive fashion as Roger believes (Roger [1963] 1997, 115), then why is Descartes motivated to experiment at all? If experiments and empirical evidence will demand only slight changes in the theory, why did Descartes perform, by his own claim, so many experiments, and why was he so reluctant to put pen to paper in order to record his theory of
generation without those many and even further experiments? Though empirical results indeed may result in changes only in small details, the mere fact of a method which includes the empirical tells us something much deeper about Descartes' system than Roger allows. We must accordingly re-read Descartes' theory of generation, and the method he exemplifies therein, taking into account the central role of experimental evidence.

The second point is found in a 1637 fragment of the Excerpta. There, Descartes suggests that the two semens themselves are composed of a variety of elemental forms differentiated by size, shape and speed of the constituent particles. This variety exists even before the semens mix and the plenum begins breaking apart due to the heat of "fermentation" and the consequent motion and collision. This is because the semen comes from the entire body (all the various parts) of the parent, and this in turn is because the semen is the final product of the nourishment which goes to the entire body of the parent (AT XI, 597-8). Note also Descartes' claim (AT XI, 252/CSM I, 321) that understanding generation (the creation of a living body) will help us understand nutrition (the maintenance of a living body), a claim which suggests some sort of continuity between these two processes. This also suggests that the seemingly uniform semen is not so. Even before it mixes with that of the other parent in the uterus, there are different constituent elements that exist within the semen. These differences, moreover, will eventually account for the 'qualitative' differences of the organs and parts of the eventual offspring, not least because they come from the 'qualitatively' different parts of the adult. Of course, for Descartes, these apparently qualitative differences are entirely subjective, existing in the senses of the perceiver and due to the differing effects upon the senses of ontological differences in quantity only. The point is that semen is not even quantitatively uniform at any point.

The third point pushes the spirit of this second point even further. This point is found in the following comment in Descartes' Description:

I leave the shape and arrangement of the particles of the seminal material quite unspecified; it is enough for me to state that the seed of plants, being hard and solid, may have its parts arranged and situated in a precise way that cannot be altered without destroying their efficacy. But it is quite different in the case of the seminal material of animals, which is very fluid.... This material is apparently just a
disorganized mixture of two fluids... (AT XI, 253/CSM I, 321-2; emphases added).

The way in which this point goes beyond the second is that Descartes seems to realize (at least in the case of plants seeds) that the initial elemental parts of that stuff which will eventually become a living being must have a fairly specific structure in order to be effective (presumably in their tasks as seeds that will eventually become plants).

In the fourth point, Descartes picks up on the idea of pre-determined structure, and extends this to the apparent “disorganized mixture of two fluids” mentioned above -- the seed or semen of animals.

If we knew well all the parts of the semen of any species of animal in particular, for example, of the human, we would be able to deduce from this alone, by reason which is wholly mathematical and certain, every figure and structure of each of its members; and also vice versa, by knowing several particularities of this [final] structure, it is possible to deduce which is this semen. But because I am only concerned here with the production of the animal in general, and thus it is necessary to make known how all the parts are formed, increased and nourished, I will continue to explain the formation only of the principal members (AT XI, 277).

We get a similar reluctance to discuss the formation of animals of a particular species in his letter to Elisabeth of 25 January 1648: “I speak about the [formation of the] animal only in general, because I do not dare to undertake this for the human in particular, failing to have enough observations for this [particular] effect” (AT V, 112).

The final point concerns Descartes’ frequent claim that there is no difference between the artificial and the natural -- that a living body such as an animal or a human (in isolation from our souls), is a machine no different from a clock. The point is that despite these claims, Descartes is not wholly insensitive to obvious differences between living and non-living machines. Indeed, Descartes does give definitions of life, and this is to be expected given that he does sub-divide the category of “self-moving machines” so as to be able to account for life, “taken as a category which includes all the forms of living things...” (letter to Regius, June 1642: AT III, 566/CSMK 214). He recognizes, for example, the facts that living machines reproduce themselves (he never attempts a treatise on clock generation), and that they are conserved as themselves through significant bodily change which is a
natural, and self-realized, behaviour of living beings: “we should bear in mind that the parts of all living bodies which require nutrition to sustain them (that is, animals and plants) are continually undergoing change” (AT XI, 247/CSM I, 319). Related to this is his contrast in the Excerpta between a mere aggregate and an individual, with the latter defined by this same criterion which characterizes the living being. The individual is distinguished by the transformation of its parts, and the material within those parts, as it grows, while the parts of the aggregate do not so change or transform when they grow (AT XI, 596).

I shall address the significance of these five, closely related points through the next two sections, and in the ensuing chapters, in which I retell the story of Descartes’ theory of generation and the birth of early modern preformation.

IV. Epistemology, method and experiment: first principles, causes and effects

Roger is not the only commentator who thinks that Descartes’ study of living beings is excessively theoretical. Thomas Hall, in his commentary accompanying Descartes’ anatomical Treatise on Man, makes the strong claim that Descartes has a total “disregard for verification” and proceeds in his study of living beings through “deductive blindness of application” of his first principles to physiology (Hall 1972, xxvii). The same criticism applies, Hall believes, to his text on generation: “About half of Descartes’ Description is an elaborate account of corpuscular movements that give rise to the parts of the body in epigenetic sequence. The whole picture is speculative and deductive and exhibits the sometimes disastrous consequences of his incautious dependence on reason divorced from adequate observation” (Hall 1972, 18-19 fn. 39).15

Descartes’ own metaphor of the tree of philosophy, and its implied method of investigation (a priori discovery of metaphysical principles first, followed by their application to physics and then to medicine), may tempt one to believe that he himself proceeds deductively from metaphysical principles at the cost of not taking full account of the experienced effects. So too may his comments to Mersenne (letter of 11 October 1638) on the method of Galileo: “[Galileo] continually digresses,
and he does not take time to explain matters fully. This, in my view, is a mistake: it shows that he has not investigated matters in an orderly way, and has merely sought explanations for some particular effects, without going into the primary causes in nature; hence his building lacks a foundation” (AT II, 380/CSMK 124). Finally, Hall also notes that the excessively speculative nature of Descartes’ natural philosophy (the dire effects of which are felt most particularly in his anatomical and physiological work) stems naturally from his belief that the visible can and must be explained by reference to the invisible and thus unobservable (Hall 1972, 5fn9). The imaginatively recreated formation of the animal cannot be anything but imagined given the fact that its starting point is the subvisible.

This depiction of Descartes’ method in natural philosophy, and its extension to generation more specifically, seems strange in light of Descartes’ repeated references to the need for experiment and observation, the first curiosity noted above. Indeed, the belief that Descartes’ approach to the study of the natural world is a purely speculative deduction from a priori first principles has been soundly debunked by recent commentators (e.g. Garber 1992). These insights have not yet been properly applied to a study of Descartes’ work in medicine, including generation. That is the goal of this section.

Hall and Roger both point to the lack of “verification” of theory in Descartes’ medical works. There is good reason for this, and this is the fact that verification of already well-developed theories is not the primary role of observation and experiment in Descartes’ method of investigation. Rather the empirical must enter at a much earlier stage of theory development.

This can be shown through a consideration of the second, third and fourth points noted at the close of the previous section. The common element in all three points is the supposition that seeds and semen are not really uniform or homogenous but that, despite appearances, there is quantitative diversity within the generative material, even before conception. Indeed, the third and fourth points both posit that there is a structure to that diversity. Descartes’ suggestion that there is a structure to the semen is coupled with the suggestion that, although we cannot know precisely what this structure
is, we must nonetheless assume some sort of structure. We must assume it because the basic empirical facts of this world force that assumption. But we cannot know it because not only is it subvisible, but it is also not in the class of things of which we can have absolutely certain knowledge. Buried in this and worth excavating are important features of Descartes' theory about the nature of our knowledge, and therefore, the nature of the method that we must use in natural investigations, and the role of the empirical therein.

Here are two comments on method, both made by Descartes in his Principles, which, at least on the face of it, seem to be in considerable tension with one another:

I consider in general all the clear and distinct notions which our understanding can contain with regard to material things. And I found no others except for the notions we have of shapes, sizes and motions, and the rules in accordance with which these three things can be modified by each other -- rules which are the principles of geometry and mechanics. And I judged as a result that all the knowledge men have of the natural world must necessarily be derived from these notions; for all the other notions we have of things that can be perceived by the senses are confused and obscure, and so cannot serve to give us knowledge of anything outside ourselves, but may even stand in the way of such knowledge (AT IXb, 321/CSM I, 288).

And:

... in order to come to know the true nature of this visible world, it is not enough to find causes which provide an explanation of what we see far off in the heavens; the selfsame causes must also allow everything which we see right here on earth to be deduced from them. There is, however, no need to consider all these terrestrial phenomena in order to determine the causes of more general things. But we shall know that we have determined such causes correctly afterwards, when we notice that they serve to explain not only the effects which we were originally looking at, but all these other phenomena, which we were not thinking of beforehand (AT VIIIa, 98-99/CSM I 255, emphasis added).

The tension, put most crudely, is between an a priori method and an a posteriori method. To clarify: this is a tension between a method which deduces effects from the starting point of intuited causes themselves arrived at with no reliance on (unreliable) sensed effects, and a method which starts from the observed effects requiring an explanation and working backwards to find the causes which will explain these effects (and more, besides).

Descartes is not unaware of the distinction and possible tension between these two approaches to natural investigations. In Rule Thirteen of his Rules for the Direction of the Mind, he
alludes to different approaches to a problem — working from effects to causes, or from causes to effects (AT X, 434/CSM I, 54). Elsewhere, he identifies the former approach as *a posteriori* and the latter as *a priori* (e.g. AT XI, 47/CSM I, 97; letter to Mersenne of 10 May 1632: AT I, 250-51/CSMK, 38; letter to Plempius of 20 December 1637: AT I, 476/CSMK, 77). The co-existence of these two approaches in Descartes’ work is certainly, at times, uneasy. Most notable are the conflicting accounts of the value placed on sensed experiences, observations or experiment. Descartes asserts more than once that the only certain way of gaining knowledge about nature is via the *a priori* method precisely because of its certain connection with initial truths intuited by the human mind. We cannot gain such certainty by our fallible senses (e.g. AT X, 364-67/CSM I, 12-13 and AT X, 526-27/CSM II, 419-20). Elsewhere, and also more than once, he notes the positive value of empirical evidence: “experience renders most... effects *quite certain*” (letter to Morin of 13 July 1639: AT II, 198/CSMK 106-7, emphasis added; see also AT X, 398/CSM I, 32 and AT VI, 76/CSM I, 150).

Nonetheless, both the *a priori* and the *a posteriori* approach blend together to find a place in Descartes’ study of nature, including his work on generation.

The method of deduction from rationally intuited causes to their effects (*a priori*) dominates Descartes’ discussion in the *Rules*. An *a priori* approach is also found in the *Meditations*, but with an important difference arising from what might be called a “metaphysical turn” in Descartes’ philosophy. In the *Meditations*, rationally intuited first principles are not only causes, but effects as well, most notably, the intuitively known effect (created by God) of one’s own self as a thinking thing. The importance of this subjective knowledge of the self will be addressed in chapter four below.

In *a priori* investigations of the natural material (as opposed to immaterial) world, Descartes numbers among the foundational first principles, the eternal truths, the essence of matter (AT VIIIa, 25/CSM I, 211) and even the laws of nature governing the motion of that matter (AT VI, 41/CSM I 131; see also AT VIIIa, 33/CSM I, 217). We also have *a priori* knowledge of the existence of God, and some of the key roles he plays in the created natural world. With these intuited first principles,
we can know every foundational cause necessary to explain change in the material world — to explain all the effects of our experience. We can do so because God implanted ideas of these first principles in our minds (AT VI, 41/CSM I, 131).18

The a posteriori method supposedly works in the reverse — from experienced effects to causes — but in fact, matters are not quite this simple. Certainly the passage from the Description quoted above suggests a perfect symmetry of method — a symmetry emphasized by François Duchesneau (Duchesneau 1975, 125-7). Recall: “If we knew well all the parts of the semen of any species of animal in particular, for example, of the human, we would be able to deduce from this alone, by reason which is wholly mathematical and certain, every figure and structure of each of its members; and also vice versa, by knowing several particularities of this [final] structure, it is possible to deduce which is this semen” (AT XI, 277). But while it is true that the starting point are the effects we experience, the process of arriving at the causes is not necessarily a process of deducing backwards to them. These causes are not, therefore, certain because arrived at via an unbroken and certain chain of deductions. Rather, in this method, it is often the case that we guess or assume the possible causes, and work forward from these suppositions to show how they may account for the effects under investigation. In such an approach, we “are satisfied if the author’s assumptions are not obviously contrary to experience and if their discussion is coherent and free from logical error, even though their assumptions may not be strictly true” (letter to Mersenne of 27 May 1638: AT II, 142/CSMK 103). Time and again, Descartes urges that we treat these suppositions or assumptions regarding causes posited to explain the effects before us simply as useful fictions which may be false and therefore are not certainly true (e.g. AT VI, 76/CSM I, 150; AT VIIIa, 85/CSM I 250).

So the a posteriori method is not simply a reverse deductive process of the a priori method. Further — and this is the reason why there is not a neat symmetry between the two — the sorts of causes posited in the a posteriori method are not the same as those intuited in the other method. Indeed, why would we need to suppose useful hypotheses if we could just discover them among our innate ideas? Rather, the hypothetical causes supposed in this second approach are causes unknown
(perhaps unknowable) either by rational intuition or by empirical discovery. These assumptions include the initial conditions (specific sizes, shapes, positions) of this world's matter and the quantity of motion and direction of that motion initially imposed by God on the various parcels of matter. These specifying causes, together with the rationally intuited essence of matter and the laws of motion (the more universal, non-specific causes) explain our experiences of this world we inhabit: "... we cannot determine by reason alone how big these pieces of matter are, or how fast they are moving, or what kinds of circles they describe. Since there are countless different configurations which God might have instituted here, experience alone must teach us which configurations he actually selected in preference to the rest. We are thus free to make any assumptions on these matters with the sole proviso that all the consequences of our assumptions must agree with our experience" (AT VIIIa, 100-01/CSM I, 256-7).

Although Descartes sometimes hints that the a priori method is, in theory, adequate for discovering truths about our natural world (letter to Vatier 22 February 1638: AT I, 563/CSMK 87; and letter to Mersenne 11 March 1640: AT III, 39/CSMK 145), more consistently he suggests that this method alone cannot, even in theory, suffice. There are at least two reasons for this. First, the rationally intuited laws of nature (and there are only three) are extremely general and thus fecund in the effects that they can bring about: "The principles which we have so far discovered [intuited essences and laws of nature] are so vast and so fertile, that their consequences are far more numerous than the entire observed contents of the visible world; indeed, they are so numerous that we could never make a complete survey of them even in our thought" (AT VIIIa, 81/CSM I, 249). Second, and conversely, one visible effect could have arisen from these general causes in a number of different ways -- by a number of different mechanisms (AT VIIIa, 289/CSM I, 289). Thus, we are forced to the method of empirical investigation and manipulation of effects (rather than rational intuition and deduction) both to determine which effects actually are true of our world, and to determine what causes might have actually brought these effects about:

... the human mind could not possibly distinguish the forms or species of bodies that
are on the earth from an infinity of others that might be there if it had been God’s will to put them there.... I admit that the power of nature is so ample and so vast, and these principles [first causes derived from certain seeds of truth which are naturally in our souls] so simple and so general, that I noticed hardly any particular effect of which I do not know at once that it can be deduced from the principles in many different ways; and my greatest difficulty is usually to discover in which of these ways it depends on them. I know no other means to discover this than by seeking further observations whose outcomes vary according to which of these ways provides the correct explanation (AT VI, 64-5/CSM I, 144).

Importantly, experience tells us exactly which effects are actually found in our world, and which are not: “natural phenomena cannot include anything which is not apprehended by the senses” (AT VIIIa, 323/CSM I, 285).

Thus, Descartes urges over and over again that in advanced studies (for example, in more detailed studies of medicine), and in studies of our actual visible world, we must resort to experiment and observation (e.g. AT VI, 63/CSM I, 143; and AT IXb, 20/CSM I, 189). One of the most telling comments on this comes in the Discourse when he decides that he must “amass a variety of experiences to serve as the subject-matter of my reasonings” (AT VI, 22/CSM I, 122), thus indicating that the method of reasoning prescribed is hardly fruitful on its own but rather requires some kind of experience to serve as the substantive content, to serve as the material of that form of reasoning.

It is possible to extract a single, blended method from these two approaches to natural investigations. Certainly, there are rationally intuited truths about the essence of matter, the laws of its motion, and some aspects of God’s role in natural phenomena, all of which must constrain any theories we posit. But we do not necessarily start from these certain truths and build to specifics through deduction. Rather, in subjects such as medicine, which “are directed only towards items that can be perceived by the senses” (AT VIIIa, 327/CSM I, 289), we start with the sensed effects and posit the sorts of initial conditions from which, together with the intuited first principles, we can deduce the effects already under investigation.19

In response to a criticism levied by Morin that Descartes will always be able to ‘prove’ the effects he sets out to prove because he has posited causes to fit those very effects, Descartes denies his method falls into the trap of being viciously circular (13 July 1638: AT II, 198/CSMK 106). One
defence is particularly interesting for present purposes, and this is as follows: “I should add that there is nothing circular by proving a cause by several effects which are independently known, and then proving certain other effects from this cause” (AT II, 198/CSMK 106). One criterion of truth he is aiming at is the coherence of this whole system by which many effects can be adequately explained by these few principles (AT VIIIa, 328/CSM I, 290).

This criterion is extraordinary in its consequences for Descartes’ philosophy as a whole, and the study of generation in particular. For it is not just the coherence of the whole system which Descartes finds convincing, but a specific relation between causes and effects. Specifically, he believes the world is ordered such that a great many well-ordered effects are achieved by very few causes. We can take a hypothetical cause as true if it is fruitful in the number and diversity of actually experienced effects derivable from it. “There are often cases in which in order to prove what is the true cause of a number of effects, it is sufficient to give a single one from which they can all clearly be deduced” (letter to Morin of 13 July 1638: AT II, 199/CSMK 107). Further, there is a natural, underlying order to the universe which makes all of nature “regular and determinate”, appearances notwithstanding. “The discovery of this order is the key and foundation of the highest and most perfect science of material things which men can ever attain. For if we possessed it, we could discover a priori all the different forms and essences of terrestrial bodies, whereas without it we have to content ourselves with guessing them a posteriori and from their effects” (letter to Mersenne of 10 May 1632: AT I, 250-1/CSMK 38).

The reason why this is extraordinary for Descartes' philosophy is the implicit appeal in natural explanation to both simplicity or elegance on the one hand, and conscious design on the other. That is, like Malebranche and Leibniz after him, Descartes wants to include in his account of the natural world a fundamental, perhaps even architectonic, criterion which is at least aesthetic if not teleological in character. The reason why it is extraordinary for Descartes' study of generation in particular is the assumption of regularity and determinacy in nature, the very qualities that critics of Descartes' theory of generation believe are missing from it. These appeals to teleology and order will
be addressed more fully in the next section and in the next chapter.

In addition to this appeal to the principles of "most from the least" and "underlying, architectonic order", there may be another reason which encourages Descartes to think we can claim truth for certain particular, assumed causes. He believes that we can manipulate certain bodies within the visible sphere to produce predictable effects, thereby lending credence to the possible truth of imagined causes which produce those effects (AT IXb, 323/CSM I, 289fn1). It is true that Descartes continues to emphasize the possible falsity of these imagined causes. The salient point is that Descartes advocates not just passive observation in his method of starting from effects. He advocates carefully directed experiment and manipulation. "For the majority of truths remaining to be discovered depend on various particular observations [expériences] which we never happen on by chance but which must be sought out with care and expense by very intelligent people" (AT IXb, 20/CSM I, 189, emphases added). Only in light of this manipulation of nature to bring about desired effects does Descartes' interest in using his medical researches to actively improve health (perhaps even to slow down the aging process [letter to Huygens of 5 October 1638: AT I, 434/CSMK 66]) make sense (AT VI, 62/CSM I, 142-3).

So, just as there are different causes being picked out by the two methods, so too are there different ideas of the empirical effects. Some effects are merely observed in our regular encounters with the world, while others are actively sought out, and perhaps even produced, by experimental manipulation. While Descartes relies on the a priori method because some sense data are quite fallible, he is forced to a method starting from the sensed effects in cases which specific causes are beyond either rational or empirical reach. But these effects may be known, even with a sort of certainty, especially if subjected to the manipulation and experiments of the "very intelligent people" who are seeking to explain them. All this casts doubt upon Barber's claim that only extension can count as ontologically real according to Descartes' epistemology. Perhaps only rationally intuited material essence (extension) is metaphysically certain, but much else in addition is morally certain, or certain enough to guide our behaviour and some research. Descartes defines moral certainty as
“certainty which is sufficient to regulate our behaviour... which we never normally doubt, though we know that it is possible, absolutely speaking, that they may be false” (AT IXb, 327/CSM I, 289fn2).

What it seems he cannot claim is *metaphysical* or absolute certainty for those suppositions. In article 206 of the fourth part of the *Principles*, however, he comes very close to this very claim of metaphysical certainty for suppositional causes. The distinction among grades of certainty in ‘knowledge’ will be important in chapter four below.

It seems that Roger and Hall have latched onto the method starting from intuited first causes and building through deduction to effects as Descartes’ primary method. Certainly they seem to have both overly neglected the critical role of experiments early in the investigative procedure which Descartes repeatedly advocates, both in his writing and in his own practical approach to the study of living beings. Nonetheless, Hall and Roger do have at least some justification for their misgivings. Indeed, Descartes himself seizes upon the very points in his work which both Hall and Roger identify as flaws: “I assign determinate shapes, sizes, and motions to the imperceptible particles of bodies just as if I had seen them, but nonetheless maintain that they cannot be perceived...” (AT VIIIa, 325-26/CSM I, 288). This observation combines one of Roger’s criticisms of Descartes’ method as applied to generation -- that he describes the formation of animals as if he had seen what he obviously could not have -- with one of Hall’s criticisms -- that he attempts to explain the visible in terms of that which is incapable of empirical verification, namely the subvisible. But Descartes goes on to defend this approach precisely by noting the second element in his theory -- the attempt to explain effects by positing causes and experimenting to amass evidence in favour of those causes as the most probable ones, “especially since it seemed impossible to think up any other explanations for them [the effects]” (AT VIIIa, 326/CSM I, 288-9).25

Does Descartes faithfully follow his own method in the study of generation? His intention is to posit causes to explain the effects. Does Descartes really account for the effects of generation through the causes which he posits? Despite his persistent caution against claiming truth for his hypothetical causes, Descartes’ intention is that we treat them as true unless one can “prove by
experience or reason that the assumptions I have made are false, [or] to show that what I have deduced from them cannot be deduced from them” (letter to Mersenne of 27 May 1638: AT II, 143/CSMK 104). Certainly, preformationists seem to think that the effects of generation -- the eventual grown and living being -- cannot be deduced from the causes that Descartes posits. Are they right?

There are four such effects which Descartes himself accepts that I wish to highlight. First, species propagate only like kinds. Second, observations of generating animals confirm the effect that bodies form part by part in a rigidly determined sequential order. Third, living bodies, as the external objects which we experience, are unified beings that work as wholes, and that exhibit (as Descartes himself notes) behaviours peculiar to them, namely the ability to reproduce themselves and the ability to sustain themselves throughout significant bodily change. Most significantly, they are to be considered individuals (as opposed to mere aggregates) in virtue of this transformation as they grow (while aggregates do not transform during growth). Fourth, the living body as the internally-experienced subject that each human is, is a unity of soul and body which exhibits all the characteristics noted above, but which also exhibits the subjectively experienced effect of (usually) being well-ordered and healthy. Can Descartes’ theory of generation account for these four experienced effects?

The causes that Descartes posits in his theory of generation can, I think, account for the first two of these effects. I take the first -- that like kinds produce only like kinds -- as encapsulating the phenomena which commentators usually identify as those which Descartes cannot account for -- the phenomena of complexity, specific structure and uniformity in the production of this complexity and structure. If I am right that Descartes’ theory of generation can properly account for this first effect, then the usual story given for the emergence of preformation is lacking, and another reason must be given. This other reason is the fact of the integrated functional unity of living beings implicit in the third and fourth effects I noted above. Descartes’ theory of generation cannot properly explain these effects. The remainder of this chapter will substantiate the claim that Descartes’ theory can account
for complexity, structure and regularity. The following two chapters will examine Descartes' failure to account for the unity of living beings and Malebranche's and Leibniz's separate answers to that failure.

V. Teleology and Descartes' "inchoate preformation"

At this juncture, let me sum the main line of argument thus far. First, considering a few highlights from Descartes' theory of generation, I noted how, indeed, it does seem to fall prey to the weaknesses that many of his contemporaries say it does. That is, it does seem wholly unlikely that a mechanical theory such as that offered by Descartes could account for the facts of the matter in generation. Preformation seems necessary in order to remove the element of chance as well as the persistent examples of increased perfection from homogenous semen to complexly-structured animals. I then noted a number of interesting points in Descartes' various writings on generation that complicate the picture of his theory, and in light of these, turned to a consideration of three of Roger's central ideas concerning Descartes' theory and the emergence of preformation as a reaction to that theory. In the previous section, I challenged the first of these points: the claim that Descartes follows an inappropriate, because overly speculative and theoretical, method. This is not the case, and in fact, experiment and observation enter Descartes' theory of generation extensively.

In this section, I shall challenge the other two points put forth by Roger. I shall argue that, first, teleology enters into Descartes' theory of generation in quite interesting ways, and second, Descartes' theory is not wholly natural -- it is not free from an appeal to God -- as Roger claims it is. At the same time I show that this is nonetheless compatible with Descartes' own disparagement of teleology and appeals to God to explain generation. The work of this section shows that Descartes can account for complex, species-differentiated structures, and that his theory allows neither chance nor persistent increased perfection in organic structures. This defence of Descartes picks up on the metaphysical counterpart to the epistemological and methodological story told above. Three of the five points of key importance noted above are relevant here. The semen is not homogeneous, even
before conception. There is a hidden structure to the semen, although this is both unknown and unknowable by us. Yet if we knew it, we could deduce, with mathematical certainty, the precise species and structure of the eventual animal. In short, there is an initial structure to the matter of the universe, which includes the matter of generation, and God established this. There is a weak form of preformation -- a sort of "inchoate preformation" -- at the core of Descartes' theory.

That is to say that this theory posits a God-instituted and God-made initial design of the matter to the world, a design such that the simple laws of motion alone will bring into existence, at the appropriate time, the complex and organized structures we experience. Among these structures are living beings, and the matter of every eventual living being is structured at the Creation simply because it is a subset of the matter of the universe as a whole. Matter is preformed to yield organisms (among other phenomena), even if it is not preformed as those very organism. The obvious major advantage of this theory is that it preserves the phenomenon of a progressively emerging organic form, while at the same time insisting that form has been fully implicit in the matter since Creation, even if not in precisely the way we experience it in the ultimate organisms. The blatant fact of species generating only like kinds, which Descartes accepts, is also accounted for on this theory because the parts and disposition of parts which determine those species are determined by the hidden (and unknown) but nonetheless existent structure of matter which has been there from Creation.  

In the more immediate, or proximate, expression of this form of preformation, there is differentiation in the elemental parts of the semen which comes from the different parts of the adult members of the species in question, and this differentiated matter must be structured so that the laws of nature alone can bring an organism into existence (it must be because we experience it). Even the initially violent, and seemingly destructive, reaction when the two semens mix could be taken into account by God in his initial structuring of the matter of the universe. Surely this is quite possible given his omnipotence and omniscience. While this may seem an unconvincing theory of generation when viewed in the microcosm -- that is, when viewed as a theory of how this organism, at this time, generates -- it is much more convincing when viewed as part of God's overall plan -- that is, when
understood as the inevitable, pre-determined outcome of God's initial, complex design of the entire universe. Descartes' attempts to explain how the foetus forms are attempts to discover particular proximate or immediate manifestations of the overall plan or design, and this is part of an attempt to understand the process of at least part of the order God imposed upon nature.

Of course, we cannot know the details of the initial grand design (it is beyond either empirical or rational discovery), nor even of the more immediate design in the animals' semen. But we can discover through experiment, with greater and greater accuracy, how this design emerges in the production of individual organisms. So while we cannot know what the exact structures of the matter of the universe and semen are, we do know that there must be such structures so as to account for the phenomena we just do experience in nature. There has to be a metaphysical fact of the matter to make the appearances possible. Thus, although Descartes urges that we will better know the nature of living beings if we can determine how they grow from seeds (or semen) -- and this is precisely the goal of his investigations into generation -- this does not necessarily detract from the belief that "they were created by God at the very beginning of the world" (AT VIIIa, 100/CSM I, 256), at least in some form.

This idea of pre-existing design and structure is implied by Descartes' frequent reference to "position" as a necessary element in mechanical explanations. Everything we experience in our actual visible world can be explained by reference to the subvisible shape, shape, position, and speed and direction of motion of the elemental matter. The relative position or arrangement of parts among themselves -- the spatial relation or structure of parts -- is one of those quantitative (because geometrical) facts of the matter required to explain the world (e.g. AT VIIIa, 314/CSM I, 279; AT XI, 26/CSM I, 89).

One may object by making reference to Descartes' claim that "matter takes on all forms". In his "On Freedom", Leibniz takes issue with Descartes on this point. Descartes "in a certain place explicitly affirms that matter successively takes on all forms of which it is capable, something hardly defensible. For it would eliminate all beauty from the universe and all choice among things..." (FC
179/AG 94-5). Descartes cannot be right, implies Leibniz, because this would result in the actual and chaotic production of all the infinite possible forms which infinitely divisible matter moving in different directions and in different speeds could take on, but this hardly reflects God's wise choice for his creation. This is surely implied by Descartes in *The World*: “Let us add that this matter may be divided into as many parts having as many shapes as we can imagine, and that each of its parts is capable of taking on as many motions as we can conceive. Let us suppose, moreover, that God really divides it into many such parts, some larger and some smaller, some of one shape and some of another” (AT XI, 34/CSM I, 91). And more forcefully, in this letter to Mersenne of January 1639: “...there is no matter in the universe which could not take on all forms one after the other...” (AT II, 485/CSMK 133). The problem with this is that it would result in all sorts of different material forms, including all sorts of organic forms, many of which we simply never experience in the world.

However, this just does not happen in our everyday experience of the world. I think, in fact, that Leibniz cannot complain that, given Descartes' theory of matter in motion, matter will take on every form that we could conceive. Here is another passage from Descartes concerning this issue, the one Leibniz himself quotes: “For by the operation of these laws matter must successively assume all the forms of which it is capable” (AT VIIIa, 103/CSM I, 258, emphasis added). Matter may not be capable of taking on all the forms we can imagine; indeed, our experiences of the world would indicate quite otherwise. Species, for example, propagate only like kinds, not some other form from among all those we can imagine. Rather, matter is capable of taking on all forms which are possible given the initial limitations of the world created by God. That is, matter can take on only the forms which the unknown (to us) natural order instituted by God at Creation will allow. We may speculate about these forms in an attempt to explain the effects, and Descartes does exactly this. In the very letter to Mersenne in which he discusses the forms which matter is capable of achieving, Descartes posits exactly three at the micro-level: spiritus, airy and earthy (AT II, 483/CSM I, 132). Clearly, matter hardly takes on all forms, but only those which are possible given the limitations of the world as God created it.
This theory that God instituted very specific initial conditions of the universe and its parts, including semen -- this theory of “inchoate preformation” undermines both of Roger’s points. Let me first note the role that teleology plays in Descartes’ theory of generation. Recall from section III, above, Osler’s depiction of the transformation of teleology in the early modern period. She argues that far from disappearing from the natural philosophy of the early moderns, teleology remains. But unlike the teleology of the ancients -- an immanent final cause, the internal (either intentional and conscious or not) ability of nature or natural beings to actualize form -- the moderns’ natural teleology is an external final cause -- the intentional imposition of form upon nature from without (Osler 1996, 389ff). The artificer is God.

This is true of Descartes’ natural philosophy as well. It is especially prevalent in his theory of the living being which is often portrayed as a machine that God has built. For example: “For they [those who know how many kinds of automatons, or moving machines, the skill of man can construct] will regard this body [human] as a machine which, having been made by the hands of God, is comparably better ordered than any machine that can be devised by man…” (AT VI, 56/CSM I, 139). As Canguilhem notes, “the theory of the animal-machine makes sense only by virtue of... [the hypothesis] that God the fabricator exists…” (Canguilhem 1994, 228). But God as fabricator is a purposeful and intentional God. He is a God directly involved in the process of building that machine -- the process, that is, of generation.

These references to God as fabricator of the living machine present quite a different picture of generation than the picture Descartes presents in his Description, for example -- the picture I have been detailing in the present chapter. I shall return to this alternative view below when discussing Roger’s second point, the point that generation is wholly non-supernatural for Descartes. Nonetheless, the story that I have been telling of Descartes’ theory does posit God as fabricator. Rather than making the fully-built machine, God makes the initial design of the world’s matter such that this design, together with the laws of nature he instituted, will eventually produce the structures of living beings. This too represents an externally-imposed, consciously-designed teleology. It is true
that Roger does admit a role for God’s intentions in Descartes’ natural philosophy. As noted above, however, he limits this to the imposition by God of the laws of nature (Roger [1963] 1997, 121), and certainly not the imposition of particular details of the living organism. I have argued that in fact those details are imposed by God at Creation, although not in the form that they will eventually take in the final product. Further, as noted above, Descartes’ own understanding of nature as one in which the largest number of effects are explained by the fewest number of principles (AT VIIIa, 328/CSM I, 290), indicates an architectonic order to nature. This criterion is at least aesthetic if not teleological in character.

What is to be made, then, of Descartes’ own claim that in natural investigations we must eschews the use of teleology? An insistence on God-given initial conditions which give rise to precisely what we experience in the world, and on a divinely-instituted natural order underlying all phenomena, seems to betray one of Descartes’ own paramount elements of acceptable method in natural philosophy. In the Principles and elsewhere, Descartes is fairly explicit on his rejection of teleology: “When dealing with natural things we will, then, never derive any explanation from the purposes which God or nature may have had in view when creating them. For we should not be so arrogant as to suppose that we can share in God’s plans” (AT VIIIa, 15/CSM I, 202; see also e.g. AT VIIIa, 80/CSM I, 248; and AT VII, 55/CSM II 38-9). In the French version of the Principles, Descartes adds, “... we shall entirely banish from our philosophy the search for final causes” (AT IXb, 37/CSM I, 202).

Is Descartes really breaking his own anti-teleology stricture in positing God as the designer and architect of the universe, including living beings, even if that design is in the form simply of matter specifically arranged? I do not think so. The reason depends on even more complexity within the notion of teleology in the early modern period than so far acknowledged, and I shall note two further complexities. First, there is a difference between the idea of the design of something, and the idea of the purpose or function for which a thing has been designed. This difference is most notable when we consider something that has been designed but where the design does not actively
accomplish any function — a tapestry, for example. Second, is the epistemological point that while we may know that God must have designed the matter of the universe, we do not thereby know what, precisely, this design is. Whatever God might have done at Creation with the initial conditions of matter, we finite creatures of “very mediocre” mental capacities do not have the cognitive ability to discern the specific metaphysical structure of the hidden world, nor to discern the purposes of it, created as it is, by the “infinite power and goodness of God” whose purposes and ends are beyond us (AT VIIIa, 80-1/CSM I, 248).

Descartes has no quarrel with asserting that God designed the matter of the universe. Indeed, it seems we must assume this so as to be able to adequately explain the effects of the natural world which he wishes to explain. This is precisely what Descartes urges the investigator to do when he urges that we make assumptions (possibly false) of subvisible nature in order to explain the effects of visible nature. Descartes’ anti-teleological stricture precludes merely the attempts to state as knowledge how precisely the world is designed, and to explain why the world and its beings are designed as they clearly are. This does not preclude the suppositions that God designed the world, and that he designed the world and its beings with purpose. It does not even preclude us from making assumptions as to how the world and its beings are designed, so long as we do not pretend that this is true knowledge. So Descartes’ point is not that there is no purpose in the world, but rather that there ought to be no appeals to this purpose in our explanations of nature. Further, we can appeal to design (without purpose) as long as we recognize that these are merely useful fictions meant to explain the phenomena. Surely, his inclusion in mechanism of the position of elemental parts in relation to one another permits or even demands reference to design, although the idea of purpose is absent from that.

Descartes’ response to Gassendi on the issue of teleology is critical for this point. Gassendi takes issue with Descartes’ exclusion of final causes from physics:

Your rejection of the employment of final causes in physics might have been correct in a different context, but since you are dealing with God, there is obviously a danger.... Leaving aside the entire world, the heavens and its other main parts, how or
where will you be able to get any better evidence for the existence of such a God but from the function of the various parts in plants, animals, man, and yourself (or your body), seeing that you bear the likeness of God?... You will say that it is the physical causes of this organization and arrangement which we should investigate, and that it is foolish to have recourse to purposes rather than to active causes or materials. But no mortal can possibly understand or explain the active principle that produces the observed form and arrangement of the valves which serve as the openings to the vessels in the chambers of the heart.... Why should the physicist not be praised if he then sees that we must necessarily acknowledge some first cause which arranged these and all other things with such supreme wisdom and in such precise conformity with his purposes? You say it is rash to investigate the purposes of God.... [this] surely does not apply to the purposes which he left on public display (Gassendi [1641] 1984: AT VII, 309-10/CSM II, 215).

Descartes' response is to note that while we must certainly acknowledge God's handiwork in such machines as those living ones Gassendi focuses on, this is an appeal to God as efficient causes, not as final cause. That is, this is an appeal to God as builder of machines (legitimate in physics), not as conceiver of their purposes (illegitimate in physics). "The function of the various parts of plants and animals etc. makes it appropriate to admire God as their efficient cause -- to recognize and glorify the craftsman through examining his works; but we cannot guess from this what purpose God had in creating any given thing.... We cannot pretend that some of God's purposes are more out in the open than others; all are equally hidden in the inscrutable abyss of his wisdom" (AT VII, 374-5/CSM II, 258). To tie this in with the account of Descartes' a posteriori approach to natural investigations, the search for the explanatory causes, even the initial conditions and underlying natural order both instituted by God, is not the same as the search for the reasons for those causes. We cannot know those reasons, and so we ought not to pretend we can by including them in explanations.

This will not be the last word on teleology in Descartes' work and in the early modern period in general. The issue is more complex than even this. We shall return to the problem of teleology in the following chapters, for the idea of function and purpose of organisms is at the heart of Malebranche's and Leibniz's theories of preformation and individual unity. Here, however, the goal is achieved. The theory of inchoate preformation which I believe is at the core of Descartes' work on generation does not appeal to God's purposes just because it does appeal to God as efficient causes of the matter which exemplifies his design, and which is supposed to eventually result in living
machines. That initial design is teleological and is required to make sense of Descartes’ theory of generation, despite Roger’s claims to the contrary.

But this, then, seems to go against Descartes’ own rhetorical question dismissing an appeal to God as creator of each animal. “Would we have everything carried out... directly by God?” (AT XI, 524). This is at the heart of the second of Roger’s concerns that I shall challenge here: preformation is wholly unscientific because supernatural; mechanism as a natural philosophy of nature is undermined by preformation; preformation is a betrayal of Descartes’ natural philosophy.

There are two ways of defending my interpretation against this charge. The first is to say that Descartes has two distinct ideas of supernaturalism -- we understand God in two different roles -- and only one is irrelevant in the study of nature. One, the rejected one, understands God in his theological role. The other, wholly acceptable, and indeed required, in natural investigations, understands God in his metaphysical role. He hints at this in letters to Mersenne (15 April 1630: AT I, 143-44/CSMK 22) and to Hogelande (August 1638: AT II, 347/CSMK 119-20), when he distinguishes what we know through revelation and what we know through natural reasoning. Natural reasoning not only depends upon God as its author, but it also leads us in our “endeavour to know him...” and without this, says Descartes, he “would not have been able to discover the foundations of physics” (letter to Mersenne, 15 April 1630: AT I, 144/CSMK 22). This is closely tied with the discussion of teleology above. God in his metaphysical role -- as efficient cause of his designs, as the being who sustains the world’s motion, as the creator of the world in all its initial detail -- is a necessary element in our natural investigations, while God in his theological role as a being with purposes and reasons for his actions belongs in a study of theology strictly defined.

But Descartes does reject the idea that generation is carried out “directly by God”, and this refers to God in his metaphysical role. This seems to preclude precisely the idea of preformation of matter which I have been pushing upon Descartes. But there is a second defence against this objection: Descartes’ inchoate preformation allows him to maintain a delicate balance between involving God intimately in the details of his creation while separating him from that creation as a
natural creation. God is the cause of everything, including the details of future organisms, but he does not carry everything out directly. Rather, the laws of motion directly realize his plans in this natural world. God is the ultimate cause of every detail, and he is even the proximate cause of the universe's sustaining motion, but the laws of motion are the proximate cause of each particular animal.

This defence is both complicated and helped by Descartes’ idea of constant creation which appears with regularity in his works. Here are just two examples. “God continues to preserve [nature] in the same way that he created it” (AT XI, 37/CSM I, 92). “...[T]he distinction between preservation and creation is only a conceptual one” (AT VII, 49/CSM II, 33). Does this not indicate that God does directly carry out everything in world? Descartes’ ideas on constant creation, preservation, and God’s concurrence in the activity of the natural world are interesting, but beyond the scope of this present discussion. I tend, however, to the interpretation that the supernaturalism implied by my interpretation of Descartes’ theory of generation is actually mitigated by his ideas on constant creation. This is because Descartes’ position on constant creation, as I read it, splits the causal action in the world between God and natural causes -- between primary and secondary cause, or ultimate (and general) and proximate (and specific) causes. “I think the only general cause of all the movements in the world is God” (letter to Newcastle of October 1645: AT IV, 328/CSMK 275, emphasis added). But “certain rules or laws of nature... are the secondary and particular causes of the various motions we see in particular bodies” (AT VIIIa, 62/CSM I, 240), including the particular causes of generated organisms. God as primary or general cause is immutable and therefore can account for the enduring existence of the world and its underlying immutable structure and order, but he cannot account for the visible changes (e.g. generation of organisms) which natural science aims to explain. Specific natural causes alone account for generation and other change. Thus, what is constant, immutable and determined in generation -- most notably the fact that the final organism is wholly implicit in the initial structure of the world’s matter and there is no increase in structural perfection but merely a change in how that perfection is visibly manifest -- depends upon God. What
is changing in generation -- namely that the initial matter does transform in its structure from a seemingly chaotic one to an ordered organism -- depends upon the laws of nature.

I believe that a theory of what I have been calling “inchoate preformation” is to be found in Descartes’ natural philosophy. There are, however, strong arguments that can be launched against this view. For example, Descartes likens the parts which make up the cosmos to the parts which make up the living being, suggesting a possible parallel between the generation of the cosmos and of the living being. The problem is Descartes’ occasional references to the “primeval chaos” of the matter of the cosmos (e.g. AT VI, 42/CSM I, 132), indicating that the matter of generation surely also must be a “primeval chaos”. If this is true, then the charge that Descartes’ theory of generation is utterly improbable is well-founded and true. The argument that the matter of the cosmos and consequently of living beings is not initially structured gains some support from the fact that Descartes’ Generationem starts with an attempt to explain spontaneous generation, as if to suggest that if Descartes could explain this chance emergence of organic form from putrefying matter, then he could explain how animals just do form from chaotic or unstructured matter without any reliance on God as an explanatory tool. The fact that Descartes even posits that mice come forth from mud (letter to Regius of December 1641: AT III, 460/CSMK 200), undermines the interpretation I have been building of strictly pre-determined generation through species lines.

VI. Concluding remarks

These challenges are not entirely damaging to the present discussion, because, although I believe that there is a theory of inchoate preformation lurking at the core of Descartes’ theory of generation, we need not push him this far to reach the conclusion I wish to reach. This conclusion is simply that an infinitely powerful and wise God could have created the world with, in Descartes’ words, “all the perfection which it now has...” (AT VIIIa, 99/CSM I, 256), but in a manifest form which it does not now have. The laws of motion, then, could have brought the eventual forms into being without God’s further attention to the details of individual organisms -- without, that is, God’s direct intervention.
This could jointly account for the empirical fact of change in our visible world and for the
theologically friendly idea of the world as, in some sense, immutable (things transform but they do
not increase in perfection) given that it is created by an immutable being. It could also account for
organic complexity and structure of given species. Better, it could even account for the empirically-
supported belief that the structural form of the final organism emerges progressively and is not fully
formed as the full-fledged theory of preformation would have it. Best of all, it could do all this
without jeopardizing Descartes’ own metaphysical mechanism of bits of matter in lawful motion.
Why did this theory not emerge, rather than preformation, as the truly mechanical completion of
Cartesianism if, as commentators tend to emphasize, preformation was proposed in order to deal with
the problem of generation in a Cartesian mechanical philosophy?

The start of an answer is in Descartes’ work itself. Recall his comment on the plant seed: “the
seed of plants, being hard and solid, may have its parts arranged and situated in a precise way that
cannot be altered without destroying their efficacy” (AT XI, 253/CSM I, 321, emphasis added). The
precise structure of the seed, Descartes suggests, may be required for it to act efficiently as a seed.
This suggests the importance of structure for a seed, or a machine, to function properly in its capacity
as a machine of a specific sort. Since living beings are machines, presumably they, too, require a
specific structure to function properly. An emerging structure of the sort indicated by the theory of
inchoate preformation may not satisfy these conditions. Similarly, another start of an answer is found
in Descartes’ distinction between an individual and an aggregate, and his equation of the former with
an organism which transforms, and gains and loses matter, at it grows (in a way an aggregate does
not).

Together, these suggestions indicate the belief that living individuals are demarcated by a
unified and integrated functioning structure. They are able to sustain themselves as the same
individuals through significant bodily change. We know this from both external and internal
observations. That is, we experience the well-integrated unity of living beings outside ourselves, and
our souls recognize the well-integrated (and healthy or sick) dispositions of our own bodies. These
are the effects, noted at the close of section IV above, that I think cannot be accounted for by a theory of inchoate preformation that I have presented here. Preformation proper was revived by Malebranche and others at least in part to account for these experienced effects.
Endnotes

1. Descartes “showed what a proper explanation must look like, and he taught how one must philosophize…” (Wolff 1764, 6; trans. Roe 1981, 106). This is because Descartes followed a method in line with that which Wolff lauds: “the only clear demonstration is to prove that if laws and principles are assumed an organic body necessarily follows, or to show the sufficient connection between principles and laws and the generated organic body” (Wolff [1759] 1896, I: 4).

2. If this organic complexity is seen as an internally-ordered complexity in which organs are instruments for the whole, then Descartes’ critics are right that his theory cannot account for this sort of complexity. But then the over-riding reason for this is that his theory cannot account for that unified, functional complexity -- and this is the problem of unity with which I am concerned. Descartes’ critics are wrong, however, when they assert that his theory of generation is unable to account for mere structural (i.e. non-functional, non-unified) complexity. See chapter one, section II for the connection between organic complexity and unity.

3. In chapters three and four I shall challenge this claim by noting that Descartes has different levels of certainty -- moral, metaphysical and psychological, which allows him to claim much more knowledge of matter than just the fact that it is extended. Also, the mathematical nature of matter, which makes it so intelligible and therefore an object of knowledge, includes not only the fact that it is extended (the most basic metaphysical fact that can be said of it) but also the fact that it is geometrical, and therefore machine-like (a derivative, scientific fact that can be said of matter).

4. This does not represent a new understanding of Descartes’ epistemology or method, since much work in this area, especially as they relate to his philosophy of science, has recently been done (e.g. Buchdahl 1969, chpt. three; Garber 1992). But these more recent interpretations of Descartes’ epistemology and method have not, to my knowledge, been applied to his theory of generation.

5. I shall return to this article of the Principles below to discuss the strong preformationist strand implicit in it.

6. The foregoing sketch is a distillation of the basic metaphysics and physics of matter as found in Principles, Part II, especially articles 4-35. This can be found throughout Descartes’ corpus, though the other sustained account is found in The World. For an examination of Descartes’ physics, including the development of his physics through his corpus, see Daniel Garber, Descartes’ Metaphysical Physics.

7. This is not true of all animals. I know of no place where Descartes acknowledges the unique problems posed on this front by hermaphrodites. But he does take the possibility of spontaneous generation seriously. That is, he thinks that some animals (mice, for example) generate from mud. This would prove the greatest difficulty to the picture of his theory of generation that I shall offer in this chapter, and I shall address this below in section V.

8. This explanation of the heart’s beat stands in contrast with William Harvey’s explanation which posits the contracting and expanding heart as the cause and the circulation of the blood as the effect. According to Descartes, the action of the heart in Harvey’s explanation relies on some sort of occult quality too closely akin to what we might expect from a Scholastic philosophy (AT XI, 241-2/CSM I, 316-7). For discussions of Descartes’ criticism of Harvey, see Grene (1993), Gorham (1994) and French (1994, chpt. 8).
9. See, for example, *Generationem*, (AT XI, 526); letter to Newcastle of 23 November 1646 (AT IV, 569-70/CSMK 302); and letter to Mersenne of 30 July 1640 (AT III, 131). See also Richard B. Carter’s explication in “Descartes’ Bio-Physics” (Carter 1985, 236) and *Descartes’ Medical Philosophy: The Organic Solution to the Mind-Body Problem* (Carter 1983, 82-3, 106ff).

10. Jacques Roger’s 1963 history of the emergence of the preformation doctrine in the seventeenth century in wake of Descartes’ failed mechanical explanation for generation, was the most scholarly, sustained and influential account of generation in the early moderns (Roger [1963] 1997). Earlier writers who had also emphasized the failed mechanical generation of Descartes as the catalyst for preformation include F.J. Cole (1930), E.S. Russell (1930) and Joseph Needham (1959). Histories written in the years since Roger’s astonishing accomplishment, and which expand on the basic thesis include those by Elizabeth Gasking (1966), Howard B. Adelmann (1966), Shirley Roe (1975, 1979 and 1981), and Clara Pinto-Correia (1997).

11. The case of Leibniz seriously complicates this picture, and in chapter four below I shall suggest that it is his appeal to an immanent force, even if not an appeal to immanent teleology in natural beings, which is responsible for his particular brand of preformation.

12. This is exactly Georges Buffon’s evaluation of the preformation doctrine two centuries earlier then Roger’s (Buffon [1749] 1780, 26-7).

13. Descartes’ own, not infrequent, reference to God as the artificer of natural machines moves toward the supernaturalism that Hutchison thinks is inescapable in seventeenth-century mechanical philosophy. Further, a number of recent studies of the relation between physics and metaphysics (including God) in Descartes’s own work also complicate the picture of Descartes’s mechanism as wholly natural (e.g. Garber 1992).

14. This materialist account of generation and nutrition as two manifestations of a single process has a long history from Hippocrates through to Descartes’ contemporary, Kenelm Digby (1644, chpt. 24).

15. Descartes has often been called a “mechanical epigenecist”. Descartes himself does not call his theory epigenesis, and the contrast between his theory and William Harvey’s, for example, complicates the picture of Descartes as an epigenecist. Harvey coined the term, and his theory posits the self-generation, parts emerging from within parts, of a living being from an initial speck in the egg or semen of the eventual animal (Harvey [1651] 1981, passim). This is significantly different from the construction of parts from whirling vortexes of matter as postulated by Descartes. The temptation to call Descartes’ theory epigenetic no doubt comes from the gradual and successively emergence of parts.

16. Cottingham *et al* note the missing text in Descartes’ *Rules for the Direction of the Mind* at this point, and suggest that Arnauld and Pierre Nicole offer a paraphrase of this missing text in their own *Logic or the Art of Thinking*. Cottingham *et al* quote from this: “In the first sort of problem causes are sought by way of effects. We know, for example, the various effects of the magnet, and we try to find the causes of these effects.... In the second sort of problem we try to discover effects by way of causes” (AT X, 471/CSMK I, 77).

17. Descartes notes other methodological approaches as well. In his reply to the Second Set of Objections, he again contrasts an *a priori* approach with an *a posteriori* approach, but seems to be using these terms very differently than when he uses them to denote, respectively, a method which proceeds from rationally intuited causes to effects, and a method which proceeds from experienced effects to causes. For an extensive discussion of Descartes’ method with regard to his science, see, for
18. Descartes' position on the creation of eternal truths may cause some confusion regarding our knowledge of them. Like his contemporary, Pierre Gassendi, Descartes believes that God created the eternal truths and could have created them entirely differently than he did. God does not simply understand truths, the essences of which are independent of God's will, and then will merely their existence. Rather, he wills all essences and existents in our world. This position has since been called "voluntarism" (as opposed to "intellectualism") because it places God's will in a position of primacy over his intellect. Gassendi's "voluntarism" urges him to deny innate ideas and rather to embrace the need for empirical investigation, first, to discover the truths of our world because they are not necessarily necessary truths, and second, to recognize their enduring truth because, dependent as they are on God's will, they could change. Their truth is contingent, and we must discover them by witnessing them in our world. Descartes' position on the eternal truths is not Gassendi's, however. Indeed, Descartes believes that God created the eternal truths (against this, however, see Discourse, AT VI, 43/CSM I, 132, where Descartes says the laws of nature would be the same in any world since they flow from God's own nature). But Descartes also believes first, that once God did so, he could not change them because of his immutability (letter to Mersenne, 15 April 1630: AT I, 145-6/CSMK 23), and second, that God implanted the idea of these truths in our minds so that we could discover them intuitively and would not have to rely on empirical evidence for them (AT I, 145/CSMK 23). For a fuller discussion of Descartes' position on God's creation of eternal truths and the impact of this on his natural philosophy, see, for example, Margaret Osler's chapter on Descartes in her book Divine Will and the Mechanical Philosophy (Osler 1994, chpt 5).

19. Much more detailed work has been done on Descartes' method in natural philosophy. For a classic study, see Buchdahl (1969). For a sustained recent work, see Garber (1992).

20. A second defence notes that what is accomplished by starting with effects and moving to causes is quite different from what is accomplished by moving in the opposite direction. Given that "experience makes most of these effects quite certain", there is no need to prove them by causes, but rather to explain them by causes (AT VI, 76/CSM I, 150). It is the causes which must be proved by the effects. Surely, this cannot be a reference to rationally intuited causes or first principles as there is no need to experientially prove those. This defence shows the difference between Descartes' approach and that of, say, Galileo. While Galileo "sets out very clearly the facts as they are, he does not explain why the facts are as they are...", quite unlike Descartes himself (letter to Mersenne of 15 November 1638: AT II, 433/CSMK 128). Galileo does not explain effects through reference to their causes. The language of "proof" in the above quote may seem odd. After all, Descartes has told us that the causes posited to explain the effects are to be treated as suppositions, quite possibly false. But Descartes does sometimes seem to want to claim proven truth for these causes, despite their initial suppositional character. The way in which he hopes to achieve this badge of truth turns in part on the defence from coherence just noted in the paper.

21. Perhaps one reason we cannot discover this order a priori is that Descartes seems, at one point at least, to equate nature with God (we cannot have full knowledge of his nature), though he quickly qualifies this: "For if nature is considered in its general aspect, then I understand by the term nothing other than God himself, or the ordered system of created things established by God" (AT VII, 80/CSM II, 56). Even on the qualified version offered by Descartes, we can see the reason for our inability to access a priori the ordered system. Created by God, and furthermore ordered, it must make reference to the intentions or purposes of God. This, as we shall see in section V below, is beyond human understanding.
22. In §22 of *The Discourse on Metaphysics*, Leibniz takes this sort of architectonic order and the simplicity of God's ways as teleological in character, and he believes this sort of appeal to teleology is essential in natural investigations.

23. Descartes' claim that one can, and that he does, establish truth for hypothetical causes is somewhat less than convincing given the nature of these causes as neither rationally intuited nor experiential. His distinction between moral and metaphysical certainty is helpful. I shall deal with this presently.

24. Another kind of effect (perhaps a variation of the experimental effect) will be dealt with more thoroughly in the next chapter on Descartes and Malebranche. This is the effect of the built machine which Descartes repeatedly tells us can help illuminate how natural mechanisms work.

25. If Descartes can be accused of anything, it is not that he fails to propose a sufficiently empirical method. Rather, he fails to implement it fully. As Osler writes, "Descartes did not always practice the methods that he preached. Most of the mechanical models he described... were highly speculative and were not grounded in the kind of experimental practice he called for in these methodological remarks" (Osler 1994, 145-6). Surely Descartes is aware of the huge gap between what he knows about the actual world (both empirical and hidden) and what remains to be known; he says so himself repeatedly and he repeatedly performs more and more experiments to try to fill the gap. In this lack, most especially regarding the question of generation, Descartes has the company of every contemporary and many more naturalists for generations to come.

26. The fact that Descartes accepts the existence of ontologically real species is implied by his discussion of different semen giving rise to different species demarcated by different bodily dispositions. It is (at least in part) such a disposition of parts that defines a human as opposed to another species of being: "the body has all the dispositions required to receive a soul, which it must have to be strictly a human body..." (letter to Regius of December 1641: AT III, 461/CSMK 200). The assumed fact of natural kinds can be found elsewhere as well. His distinction between animals in general and the particular case of the human is premised on the assumption of natural kind (letter to Debeaune of 30 April 1639: AT II, 525-6/CSMK 135). The same assumption grounds comments such as the following: "A classification is not sound unless the members of a true genus are divided into genuine species..." (letter to Regius of May 1641: AT III, 370/CSMK 181, emphasis added). It is not just the bodily structure that provides the grounds for classification of different species. This runs along generational lines as well: "...one human can produce another human being, but no human being can produce an ant..." (letter to Mesland of 2 May 1644: AT IV, 111/CSMK 231). Strikingly, these forms or species propagated through generation are exactly those that God, at the Creation, chose to put on our earth from among the infinite choices he could have made (AT VI, 64/CSMK I, 144).
Chapter Three

The machine and the living machine: Malebranche’s theory of preformation

I. Introductory comments

In the previous chapter, I argued that Descartes’ theory of generation can be read as a theory of inchoate preformation, with the matter of the eventual living being preformed as a designed structure even if not as a fully-formed organism. I also questioned why this theory, rather than preformation proper, did not emerge in the philosophies of Descartes’ successors as the proper completion to Descartes’ mechanism. In the current chapter, I will answer this question by looking at the theory of preformation as found in one of its staunchest seventeenth-century advocates -- Malebranche.

Malebranche is a particularly interesting case for this question both because of his adherence to much of Descartes’ metaphysics, and because of his theory of occasionalism, the theory which posits God as the direct and fully efficacious cause of every event in the world. If God is the sole causal agent of events in the natural world, then the building of organisms from pre-structured matter -- even if God is bound in his capacity as builder by his own laws of nature -- seems an easy extension of Descartes’ position as I read it. But Malebranche does not posit such generation. He posits, and is probably the first early modern even to revive, the theory of the completely delineated, preformed organism. Why?

As noted in the previous chapter, I believe that Descartes’ theory of inchoate preformation cannot account for the unity of the living being. This claim needs to be qualified, because if God is added as the dynamic unifier of matter, then Descartes’ theory does seem able to account for this unity. This is the work of section II.

In section III, I distinguish between two common readings of Malebranche’s occasionalism. This is important to the question at hand because the version of occasionalism that I have sketched above (the “traditional” reading) in fact does posit God as a perpetually active, dynamic force in nature, and so ought to be able to account for the unity of the organism on the theory of inchoate preformation that I suggest exists in Descartes’ work. But there is a second interpretation of
occasionalism (the “alternative” reading) which more resembles Leibniz’s pre-established harmony and which allocates a much less ubiquitous role for God in the workings of nature. Malebranche’s advocacy of the theory of preformation may then support this latter interpretation of occasionalism because Malebranche would not need to posit full-fledged preformation at all if God does act in the world in such a way that he can be the immediate builder and unifying force of organisms, as the traditional reading suggests. Preformation suggests that God builds that unity into the organism at the Creation, and this in turn suggests that God does not act as a unifier thereafter. Nonetheless, I argue the harder case by assuming as correct the version of occasionalism which posits God’s perpetual activity — the traditional reading of occasionalism. I show why, even if Malebranche accepts this version of occasionalism, he still must posit preformation because he has a more robust concept of the living machine than does Descartes. Malebranche believes that the living machine is infinitely complex, and consequently, the creation of such a machine is necessarily a miracle. With the exception of rare events, miraculous acts can happen only at the Creation, and thus preformation is the only option open to Malebranche. This is a sufficient reason for his belief in preformation.

In section IV, I bring Descartes back into the story in order to address more fully the problem of individual unity. I argue that he has two distinct theories of mechanism and two distinct theories of life at work in his philosophy of living beings. There is a deep tension between the two in each pair, grounded in the fact that the unity implied by one concept of mechanism and one theory of life is undermined by the other pair of those concepts. Malebranche is faced with the same problem of the unity of the organism and attempts to solve it with a second argument for preformation.

In section V, I examine Malebranche’s second argument in favour of preformation grounded in the recognition of the functional unity of living beings. Further, this recognition is found also in Descartes, and is the ultimate reason why his inchoate preformation cannot account for the fact of the living individual. Malebranche’s two arguments for preformation are supported by two quite different approaches that he takes to experimental data. One, commensurate with my arguments in section III, rejects the empirical because it is unreliable and forces a wholly conceptual — and non-experimental -
- approach to generation and the nature of the living being. The second approach, commensurate with my arguments in the current section, takes the empirical much more seriously and concentrates on the fact of the functional unity of the living being.

In section VI, I argue that Malebranche’s theory of preformation, and the motivations that he has for holding this theory, supports a view of nature and of God’s activity therein that favours the alternative over the traditional reading of occasionalism. Here, I aim to show how questions in the history of generation (a seemingly distant concern to those that we understand to occupy the early moderns) can shed important new light upon more traditionally central metaphysical questions in the history of philosophy.

The primary goal of this chapter, then, is to argue that preformation emerges in Malebranche in order to account for individual unity -- both unity of the organism and unity of metaphysical material substance -- in a mechanical philosophy. The secondary goal is to determine what preformation can tell us about the dispute over how to interpret occasionalism.

II. Descartes’ living machine and unity through God

As I noted in chapter one, section V, Descartes distinguishes -- sometimes explicitly, sometimes implicitly -- between different ideas of body. One example is clearly expressed in a letter to Mesland of 9 February 1645:

First of all, I consider what exactly is the body of a man, and I find that this word ‘body’ is very ambiguous. When we speak of a body in general, we mean a determinate part of matter, a part of the quantity of which the universe is composed.... But when we speak of the body of a man, we do not mean a determinate part of matter, or one that has a determinate size; we mean simply the whole of the matter which is united with the soul of that man... and we think that this body is whole and entire so long as it has in itself all the dispositions required to preserve that union (AT IV, 166/CSMK 242-43).

This suggests a difference between, on the one hand, matter generally understood as the stuff of corporeal nature, and, on the other hand, an organic body which is made up of matter but not necessarily a specific, enduring quantity of matter. Another equivocation is captured in a letter
written in March 1642: "... where you say ‘The matter of the universe exists as a machine.’ I would have preferred to write ‘The universe is composed of matter, like a machine’ or ‘All the causes of motion in material things are the same as in artificial machines’ or something similar” (AT V, 546/CSMK 213). This second comment suggests that there is a distinction to be made between body as it exists distinct from a machine -- simply extension in motion -- and body as an organized machine -- matter structured in a very specific way. Importantly, of course, the matter of the well-disposed machine is governed by the same laws as is matter understood simply as extended.

I have suggested that there are, in fact, four distinct notions of body in Descartes’ work. The second quotation above suggests a distinction between body as mere matter and body as a machine. The first quotation suggests a third idea of body, namely that of a living human. But the human can be understood in two distinct ways. First, the human can be understood only in terms of its living body; it can be understood as a living machine. As such, specific parts of matter will come and go in the human body, but the human body will nonetheless remain the same body, with a specific disposition of parts. This applies equally to an animal body which is also a living machine composed of matter that comes and goes, and which also has a very specific disposition of parts. Second, and this seems to be the suggestion of the letter to Mesland quoted above, the human can be understood as a living machine united with the human soul. In fact, the letter hints that the soul is actually that which demarcates what portion of matter counts as a particular body -- it is not the matter nor structure of matter itself, however well-disposed, which demarcates this. So, while the third idea of body is the body as a living machine, and it applies to both humans and to non-human animals, the fourth idea is the body as a hylomorphic unit of form (soul) and body (organic body) -- a kind of body that only a human can have.

In this chapter, I shall bracket the near-hylomorphic conception of the human as body unified with an “informing” soul captured in Descartes’ letter to Mesland, turning to that conception in the next chapter on Leibniz. Here, I shall concentrate primarily on the three other ideas of body, and what I believe are two theories of mechanism (and later in this chapter, two theories of life) that go with
these ideas of body. Body as extended matter obeys the laws of matter in motion, and this is one form of mechanism. Body as a machine (living or non-living), also obeys the laws of matter in motion, but in addition, it is a body organized into a whole, with the appropriate dispositions to function according to its purposes as a unified machine. As we shall see, in the case of living machines, one of these functions is the maintenance of its unity, its numerical identity through time, despite the loss and gain of matter within that body.

The distinction between the different conceptions of body and the two ideas of mechanism involved, together with this functional dimension unique to the machine, is captured by Descartes’ comment in the Sixth Meditation: “...a clock constructed with wheels and weights observes all the laws of its nature just as closely when it is badly made and tells the wrong time as when it completely fulfills the wishes of the clockmaker” (AT VII, 84/CSM II, 58). There is a correlation with the human body:

And let us recognize that the difference between the body of a living man and that of a dead man is just like the difference between, on the one hand, a watch or other automaton (that is, a self-moving machine) when it is wound up and contains in itself the corporeal principle of the movements for which it is designed, together with everything else required for its operation; and, on the other hand, the same watch or machine when it is broken and the principle of its movement ceases to be active (AT XI, 331/CSM I, 329-30).

Both clocks — the well-made and the ill-made — and both human bodies — the living and the dead — obey the laws of nature as far as they are conceived as extended matter, though there is a difference between the well-made and the ill-made grounded in how well they fulfill their functions as designed machines.

The problem with Descartes’ theory of generation by matter in motion, even if the matter is well-organized in the beginning, now starts to come clear. While the process of generation depends upon the notion of body as brittle bits of matter in motion, collision, and disintegration, the product of generation is the second notion of body as a well-functioning machine. While there exists structure in both ideas of body, only in the well-functioning machine is that structure suitably arranged to count as well-functioning, and as a unified individual in space and at least for some enduring time. The
problem can be seen as follows: if the matter which becomes the eventual body of a living being moves simply according to the laws of motion, how does it stay well-unified once it becomes organized despite the disruptive effects of those very laws of motion which brought the unity into being in the first place? What keeps that precise parcel of matter together in that precise structure while that matter is, at the same time, colliding and reacting according to laws of motion which brought it together in the first place? It is not hard to visualize the problem. Even if the matter is well-structured in the beginning, the moment a ‘whole’ structure emerges from that mass, the same laws of motion which brought it into ‘being’ will begin to dismantle that momentary ‘organization’: there is nothing to keep them unified. Descartes’ own answer that a body is one due to the common motion of a specific chunk of matter cannot explain this. To recall Grosholz’s evaluation: “unity in virtue of common motion [of a parcel of matter] does not seem strong enough to keep matter from being pulverized into the dust of subtle matter, if shattering is allowed as a possible outcome of impact” (Grosholz 1994, 51; see chapter one, section II above).

An even more damaging reason why there can be no enduring individuals given this first conception of material substance as extension is offered by Descartes himself in the Synopsis of the Meditations where he suggests that even something as apparently well-unified as a living, human body is a mere accident of material configuration: “… body, taken in the general sense, is a substance, so that it too never perishes. But the human body, in so far as it differs from other bodies, is simply made up of a certain configuration of limbs and other accidents of this sort…. [A] human body loses its identity merely as a result of a change in the shape of some of its parts” (AT VII, 14/CSM II, 10). This makes body generally conceived as all of extension a true substance, and the only true material substance. All other so-called physical individuals are really just modes of that one substance.

This problem of the unity of the material individual may not be a problem that concerns Descartes himself, though it most certainly concerns some who come after him, Leibniz most notably. Whether or not it is a concern of Descartes, he does have a solution to the problem. Indeed, it is simply an extension of his solution to the problem of the construction of those machines in the first
place. God is the fabricator, and God is the unifier. He allows as much in a letter to Gibieuf of 19 January 1642:

From the simple fact that I consider the two halves of a part of matter, however small it may be, as two complete substances... I conclude with certainty that they are really divisible. Someone may tell me that though I can conceive them apart, I have no reason to deny their inseparability because I do not know that God has not joined them together so tightly that they are entirely inseparable. I would reply that however he may have joined them, I am sure that he can also disjoin them; so that absolutely speaking I have reason to call them divisible, since he has given me the faculty of conceiving them as such (AT III, 477-78/CSMK 202-3, emphasis added).

The purpose of this passage, of course, is to establish the real distinction of parts of material objects, and consequently, the unity of parts that God has joined together is not a real unity but one externally imposed by God himself. Still, it is the best that can be accomplished on Descartes’ theory of generation, and it will suffice to hold organic bodies together when there is no other option.

This dynamic unification through God is an expected consequence of Descartes’ doctrine of constant creation according to which God’s preservation of the world is equivalent to his initial creation of it. This locates God as the ultimate source of the fact of the world’s existence, its continuing existence and some details within the world, including the detail that there are unified individuals in the world (Grosholz 1994, 51-2).

There may be room for dissent on this interpretation of Descartes.¹ This is especially true given the fact that positing God as the unifier of the living beings will result in breaching the natural laws of motion which simply should necessitate the breaking up of the matter which comprises those machines. In fact, the critical problem highlighted by the mere fact of the enduring, unified living being just is that it represents a breach of natural laws. In the end, it is this fact about the living being which proves most difficult for early modern mechanism, and this applies as equally to the full-fledged preformation theory of generation articulated by Malebranche as it does to Descartes’ theory. How does the unified organism, be it preformed by God or the result of pre-structured matter, endure as a unified, living being? This is the fourth problem of material unity noted in chapter one, section V above, the Problem of Organic Endurance. A satisfactory answer will have to wait until Leibniz’s
particular theory of preformation, although the start of an answer is offered by Malebranche’s theory as explored in section V below.

Yet this organic unity is an experienced effect (no less than the experienced effect of complex, organized specific form), and so Descartes must account for it in his theory of generation. Indeed, he himself throws down the gauntlet: “I say that there are only two ways to refute what I have written. One is to prove by experience or reason that the assumptions I have made from them [the suppositions about the hidden structure of the world] are false; the other is to show that what [the effects] I have deduced from them [the assumed causes] cannot be deduced from them” (letter to Mersenne, 27 May 1638: AT II, 143/CSMK 104). The experienced effect of an enduring and unified individual organism must be deducible from the assumed causes of generation. Mere structured matter in motion cannot explain this unity, and so another assumption must be added. This is the addition of God as dynamic unifier.

Regardless of whether or not Descartes really intends to posit God as the unifying force of the living machine, this possibility is critical for a consideration of Malebranche. Malebranche is often called a Cartesian, and although, in the end, this fails to account for his divergence from Descartes on a number of significant doctrines, it is true that there is a great deal of overlap in their metaphysical and epistemological positions. Among their more significant commonalities for our purposes is their conception of matter. Like Descartes, Malebranche believes that the structure of matter is not atomic but a divisible, extended plenum. It is internally inert and requires motion to be imposed from without. Also, there are few and simple laws of motion from which all the complexities of the created world arise. Indeed, it is a mark of God’s power, wisdom and benevolence that he is able to work in the world in this precise way -- by realizing the largest number of effects of the greatest variety by the simplest means possible. These means include the few and simple laws of nature (an example of the preceding sketch of Malebranche’s metaphysics and physics can be found in OC I, 459-67/ST 243-7). If Descartes has difficulty explaining the natural construction of complex and organized living beings which uniformly generate only like kinds, then Malebranche’s
metaphysics of matter and its lawful motion is likewise challenged. But if the option of preformed initial conditions at the Creation (even if not preformed living beings) relieves the problem for Descartes, then so too should it relieve the problem for Malebranche.

This is all the more convincing in the case of Malebranche because of his theory of occasionalism which seems to most certainly add the guarantee of God as omnipresent in the working of nature. That is, his theory of causation seems to add the guarantee of God both as immediately involved in every detail of the created world, including in each individual, and as a dynamic force in nature, adequate to ensure the unity of individual organisms. Briefly, occasionalism maintains that the causes we experience in the world — secondary causes — are not actually efficacious. Only the primary cause — God — has true efficacious power. Occasionalism is not merely an ad hoc solution to the mind-body in the face of the perceived problems with Descartes’ interaction theory, though it is a solution to this problem as well. Rather, occasionalism is a solution to the problem of causation in general. The question of bodily interaction is, in fact, as problematic for Descartes as is mind-body interaction. For one body to cause another to move and to lose motion itself upon impact with that other body, it would have to transfer motion. But motion is a mode of matter and cannot exist without matter — it cannot leave one substance and enter another since motion itself is not a self-subsisting substance. Malebranche introduces occasionalism to solve this problem by making motion entirely the result of God-as-cause acting on wholly passive matter (see Lennon 1974).²

Occasionalism, therefore, is not only the thesis that God is responsible for every natural event, including the formation of living bodies; but it might also seem to allow Malebranche to hold that God can act as the dynamic unifier of individual parcels of extended matter (such as living machines) in a manner that Descartes only hints at. Indeed, if individuals are considered individuals in so far as they are parcels of matter moving together relative to other parcels of matter, then God as the sole cause of that motion is the sole cause of individuation — the one who creates and maintains that parcel as a unified whole. Given his adherence to Descartes’ basic metaphysics of matter, together with his own theory of causation, Malebranche would seem to be in a perfect position simply

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to pick up on Descartes' own suggestion in the Description that God preforms the matter of the universe such that the laws of motion are able to bring forth living beings at appropriate times. Indeed, this is Kant’s belief: “According to occasionalism the supreme cause of the world would, in conformity with its idea and on the occasion of every copulation, directly give the mingling matter its organic structure” (Kant [1790] 1987, 422).

I may bolster this suggestion with the historical fact that the first work of Descartes that Malebranche read was the 1664 Claude Clerselier edition of the Treatise on Man and Description of the Human Body (André 1896, 11-12). That is, Malebranche’s first exposure to Descartes’ work included the very book in which is found Descartes’ theory of generation complete with the suggestion of an initial structure to the matter of the semen. Over the next ten years, Malebranche developed his own philosophy which was published in 1674 as The Search After Truth (hereafter Search). In this book, Malebranche did not take Descartes to task for his theory of generation. It is true that fourteen years later, in his Dialogues on Metaphysics and on Religion (hereafter Dialogues), Malebranche does deride the theory for being entirely improbable:

We do not understand how the union of two sexes can be the cause of fecundity, but we understand well that it is not impossible, supposing bodies to be formed already. But that this union is the cause of the organization of the parts of animals, is surely something we can never understand.... The sketch by this philosopher [Descartes] can help us understand how the laws of motion suffice to cause the parts of animals to grow little by little. But that these laws are able to form them and connect them all together, is something no one will ever prove (OC XII, 263-4/DMR XI, 204-5).

This is not, however, his first reaction to it. Indeed, in Search, Malebranche seems willing enough to allow the possible success of Descartes’ solution to the problem of generation: “... one can give some explanation of the formation of the foetus in general, as Descartes has tried successfully enough...” (OC I, 242/ST 117). Why, then, did Malebranche not adopt as his theory of generation something like Descartes’ inchoate preformation, together with Malebranche’s own most definite addition of God as the pervading unifying force, interested in all particular details of his creation (including organic individuals) as implied by his occasionalism?
III. Malebranche's occasionalism and the first argument for preformation

Two ready answers to this question present themselves. First, there is textual evidence suggesting that Malebranche just did not recognize the option of inchoate preformation in Descartes' work, even though this is stated quite clearly in Descartes' *Description of the Human Body*. To recall the critical passage which Malebranche surely must have encountered when reading that text: "If we knew well all the parts of the semen of any species of animal in particular, for example, of the human, we would be able to deduce from this alone, by reason which is wholly mathematical and certain, every figure and structure of each of its members..." (AT XI, 277). But in the *Search*, Malebranche notes that the fact of *specific* structures unique to different species cannot be accounted for by the general laws of nature and extended matter (OC II, 343/ST 465). This indicates that while Malebranche found Descartes' solution to generation *in general* quite plausible, when it comes to the actual generation *of species*, it is not plausible. And yet, Descartes' *Description* clearly states that the structure of specific semen of an animal of a specific kind will yield an eventual adult of that species and no other. And surely God's role in the creation of that initial structure makes this entirely plausible.

The second answer to the question at hand is the fact that Malebranche's theory of occasionalism is interpreted in two quite different ways. In Steven Nadler's evaluation:

In fact, at least two distinct and apparently incompatible readings of his [Malebranche's] theory [of occasionalism] emerge, and we are left to choose between two different pictures of causation and God's role therein. On one picture, God’s activity as cause is constant and ubiquitous, and is required in order to maintain a lawlike correspondence in the states of things. The other picture more closely resembles Leibniz's preestablished harmony, with God originally establishing such a correspondence once and for all by means of a few general volitions (Nadler 1993, 31).

The ready answer says that Malebranche actually means his theory of occasionalism to represent something like Leibniz's theory of the pre-established harmony. God is *not*, therefore, pervasively active in nature and does not, consequently, act as a unifying force for the material individuals of nature. Without this necessary unifying force, God must have built all living beings at the Creation as already unified precisely because the matter-in-motion option cannot account for the creation of such
unity in the first place.⁴

The following from Malebranche’s *Dialogues* seems to lend some strong evidence in favour of this interpretation of occasionalism (the one that resembles the pre-established harmony) and the connection with preformation:

At the time of creation, God constructed animals and plants for future centuries. He established the laws of motion necessary for making them grow. Now he is at rest because he does no more than follow these laws.... Everything is done in relation to the laws of motion, laws which are so simple and so natural that, although God does everything by means of them in the ordinary course of his Providence, it seems that he affects nothing, in short that he is at rest (OC XII, 253-4/DMR XI, 196).

In fact, however, the story of the relation between Malebranche’s theory of occasionalism and his theory of preformation is considerably more complicated than this. Take the quote just cited. It certainly seems that here Malebranche endorses the alternative reading of occasionalism if we concentrate on phrases such as “now he is at rest”, or “it seems that he affects nothing”. But then there are phrases as well which suggest God’s ever-present activity in the world: God “does no more than follow these laws”, or “God does everything by means of” the laws of nature (emphases added).

And yet we are faced with the fact that Malebranche endorses preformation, and we are consequently faced with the following argument that the theory of preformation provides strong proof for the alternative theory of occasionalism. If the traditional reading is correct, why does God not build each living being at the moment of its natural generation rather than all together at the outset? More specifically, together with the very idea suggested by Descartes that the matter of generation is preformed in one sense, why does not God just act upon this preformed matter in accordance with the general laws of motion to bring the living being into existence at the appropriate natural time and then unify the final organism through his perpetual dynamic activity? It is this problem of unity which is pivotal here. On either interpretation of occasionalism, the *formation* of a complex specific being from preformed matter moving according to laws of mature can happen on Malebranche’s natural philosophy no less than it can happen on Descartes’ natural philosophy (if we assume preformed initial conditions). But without God as dynamic unifier, the *enduring unity* of that complex
being cannot be accounted for, since that being will be destroyed immediately upon its formation due to the fact that its matter is in contact motion which necessitates its shattering. The fact that Malebranche posits full-fledged preformation suggests that the unity of the organism must come from something *other* than God's dynamic activity in nature -- specifically, that unity must be built into those organism by God at the Creation, the only time he acts directly and specifically upon nature. In short: preformation provides unity to the material organism; this would not be necessary if God himself provides such unity through his perpetual activity in nature, including his activity on *this* particular body; therefore God must not be perpetually and specifically active in nature with regards to specific details.

In this section, I shall show that this reasoning is incorrect by arguing that even on the traditional theory of occasionalism -- the theory that *does* posit God's perpetual and detailed activity -- preformation must be true. So whether or not God is ubiquitously active in the natural world, preformation is necessary. Preformation, therefore, does not indicate that the alternative interpretation must be true. The arguments in this section bring us to the sufficient reason for, and the first of two arguments that Malebranche provides for, his embrace of the theory of preformation. Two important themes in Malebranche set the scene for the discussion of this section: his conception of miracles and his idea of the infinite.

Leibniz derides the theory of occasionalism and distinguishes his own theory of causation, the pre-established harmony, from Malebranche's. One reason for Leibniz's derision is that he thinks occasionalism requires constant miracles -- a *deus ex machina*. He makes this clear when he explains to Damaris Masham in a letter of May 1704 why the pre-established harmony is the proper option to occasionalism: "The defenders of occasional causes hold that God continually adjusts the soul to the body, and the body to the soul. But since that would mean that God had to keep disturbing the natural laws of bodies, it could only involve miracles, and so is not very suitable for philosophy, which has to explain the ordinary course of nature" (G III, 341/NS 206). This complaint applies no less to body-body interaction: if God continually meddles in the material world, he disturbs the *natural* laws of
bodies. Thus, according to Leibniz, any direct action of God in the workings of nature is a miracle.

There are two ways of reading Leibniz's criticism of occasionalism as expressed in his letter to Masham. On one reading, what makes occasionalism miraculous is the fact that God interferes directly in nature and thereby arrests the laws of nature in some way. This cannot apply to Malebranche, even on the traditional interpretation of occasionalism that Leibniz attributes to Malebranche, because Malebranche makes clear that God almost always acts in the created world according to the laws of nature he prescribes to himself. Certainly in the ordinary course of his providence, such as the movements of bodies and mind-body interaction, God does act according to these laws. In his Elucidation to his _Treatise on Nature and Grace_, “What It Is to Act by General Wills, and by Particular Wills”, Malebranche spells this out:

> I say that God acts by general wills, when he acts in consequence of general laws which he has established. For example, I say that God acts in me by general wills when he makes me feel pain at the time I am pricked; because in consequence of the general and efficacious laws of the union of the soul and the body which he established, he makes me feel pain when my body is ill-disposed.... I say on the contrary that God acts by particular wills when the efficacy of his will is not determined at all by some general law to produce some effect. Thus, supposing that God makes me feel the pain of pinching without there happening in my body, or in any creature whatsoever, any changes which determine him to act in me according to general laws -- I say then that God acts by particular wills (OC V, 147-8/TNG Elucidation I-II, 195).

God acts by particular wills only in very unusual -- indeed, miraculous -- circumstances (OC V, 149ff/TNG Elucidation IVff, 197ff). According to Malebranche, then, even if God acts directly in the world, he almost always acts strictly according to the laws of nature.⁵

On the other reading, what Leibniz understands as miraculous is not that the lawful behaviour of bodies and of minds is constantly being compromised but rather, that this behaviour is not _natural_. That is, what makes the activity miraculous is the fact that, as lawful as the activity is, the actual cause of that activity is supernatural and not natural. It is not that God disrupts the _lawfulness_ of the created world, but rather that God disrupts the _naturalness_ of that world.⁶ This certainly applies to Malebranche if we accept the traditional interpretation of his theory of causation as I have done for the sake of the current discussion.
Malebranche, however, does not see his theory as one which relies on constant miraculous activity, and his reason turns on a different definition of “miracle” from that which Leibniz holds. Malebranche does not agree with Leibniz that a direct action of God in nature -- an action in the created world that goes beyond the power of some created substance -- is a miracle. In fact, Malebranche has at least two definitions of “miracle”, but either of these two definitions stands in contrast with Leibniz’s understanding of a miracle, and either can be used as a defence against the accusation that occasionalism, traditionally defined, posits miraculous activity.

Here is a passage from the Dialogues which defines what a miracle is according to Malebranche, and which also captures the equivocation in his definition:

... when I say that God always follows the general laws he has prescribed for himself, I am talking only of his general and ordinary providence. I do not exclude miracles or effects which do not follow from his general laws. But further... when God performs a miracle and does not act as a consequence of the general laws which are known to us, I maintain either that God acts as a consequence of other laws unknown to us, or that what he does then is determined by certain circumstances he had in view from all eternity in undertaking that simple, eternal, and invariable act which contains both the general laws of his ordinary providence and also the exceptions to these very laws (OC XII, 177-8/DMR VIII, 130-1).

A miracle, according to Malebranche is a direct volitional action of God in the created world which is either in accordance with a law unknown to us or in exception to all laws since there are only the very few general laws that do govern nature and that are known to us (see OC III, 223-4/EST §15, 667-8 for an example of support for the latter definition). Either definition allows room for God’s direct but non-miraculous activity in the natural world -- activity which therefore disrupts its naturalness but not its lawfulness. Either definition, that is, is incompatible with Leibniz’s understanding of a miracle that maintains that any direct action of God -- any action beyond the power of created substances themselves -- is miraculous.

This divergence from Leibniz permits Malebranche to endorse the theory of occasionalism as traditionally understood without, according to his own definitions, asserting that God resorts to constant miraculous activity. But how does this help with the problem of preformation? If we recall Descartes’ theory of generation as I interpret it, God preformed the structure of matter at the Creation.
such that the regular laws of motion would bring forth a well-organized and integrated living being at the appropriate time. The main difficulty with this theory is not that is cannot explain the organization of living organisms and the regular respect for species, but rather that it cannot explain the enduring unity of this specific organization. The addition of God as dynamic unifier may be able to explain this unity. I suggested that Malebranche would seem to be in an ideal position to accept this option given his occasionalism, traditionally understood. Now with Malebranche's own definition of miracles in hand, it is possible to complete this picture. God creates the world with matter suitably structured so that the lawful motion of that matter results in organized living beings, and as long as God acts by those laws, even if he acts directly and pervasively on matter, he is not acting in a miraculous fashion. God's efficacious will can be the unifying, but not miraculous, factor in organic beings missing on the picture of matter in motion.

Malebranche does not choose this option, however, because generation is, for him, a miracle, and for two reasons. One reason, but one that I do not think Malebranche fully faces, is implicit in the discussion thus far. No matter whether the laws of motion are themselves efficacious or whether God is the lawfully efficacious agent in the world, the laws of motion would seem to demand the continuous collision and breaking apart of matter. That is, God could surely hold the bits of matter together in an organism as soon as it is formed -- God can do anything. But he can only do this by suspending the very laws of motion which permit the bringing together of bits of matter in the first place. He can only do this by breaking his own laws of nature and thus acting miraculously. Critically, however, this suspension of laws must occur even on the theory of preformation because unity of the organism confounds the disintegration of its own structure made up, as it is, by matter in motion. Once again, this is the Problem of Organic Endurance noted in the introduction to this work. Here, Malebranche's acceptance of the fact that God always acts according to natural laws is crucial. I shall return to this problem in later sections of this chapter, and in the next chapter because only in Leibniz do we find a full resolution to this problem.

The second reason why generation is a miracle depends on Malebranche's conception of the
organism, which is importantly different from Descartes’ and which turns on his acceptance of infinity in the natural world. Descartes is cautious of applying the concept of the infinite to the natural world, at least in part because of his desire to reserve this concept for God alone, and not for the creation (AT VIIIa, 15/CSM I, 202). Malebranche is not cautious of doing this, and there are pivotal ramifications of this for his theory of generation. Indeed, the idea of infinity in the natural world first arises in the Search in the precise chapter which contains his first discussion of preformation, the chapter in which he also approaches the question of the limits of the senses. There, he states it plainly. Extension is infinite, but more critical for our purposes:

We have clear mathematical demonstrations of the infinite divisibility of matter, and although our imagination is shocked at the thought, this leads us to believe that there might be smaller and smaller animals to infinity. God made matter only to fashion his wonderful creation from it, and since we are certain that there is nothing whose smallness could limit his power of forming these tiny animals, why limit it and diminish without reason the idea we have of an infinite craftsman by measuring his power and skill with our finite imagination (OC I, 81/ST 26)?

One main criticism launched against preformation by its detractors is the impossibility that all future organisms could be enclosed within the single original -- living beings within living being -- starting from the Creation and extending into the indefinite future. The mathematical possibility of infinite smallness, together with God’s unlimited power to create the infinitely small, erases this problem. Theodore (Malebranche’s spokesman in the Dialogues) poses exactly this worry of the possibility of preformation to his pupil Aristes who earns Theodore’s praise for his answer:

... I know that matter is infinitely divisible, and that the small is such only in relation to the larger. Although my imagination resists it, I easily conceive that since what we call an atom can be continually divided, every part of extension is in one sense infinitely large, and that from it God can make in miniature everything we see on a large scale in the world at which we wonder. Yes, the smallness of bodies can never impede the power of God, this I conceive clearly. For geometry demonstrates that there is no atom in extension, and that matter can be eternally divided (OC XII, 231/DMR X, 177).

Consequently, “if the world endured several thousand centuries, within a single bee God could form all the bees to come from it...” (OC XII, 232/DMR X, 178; see also OC I, 81/ST 26, OC III, 347-8/EST “On Optics”, 747). Malebranche’s embrace of infinity makes preformation possible.
Further, the concept of the infinite makes preformation not only possible but also necessary in the following way. The infinite divisibility of matter and the infinite smallness of the resultant parts allows infinite complexity in the parts of organisms. “Reason teaches us that the smallest of all objects would not be small by itself, since it is composed of an infinite number of parts from each one of which God could fashion an earth that would be but a point in comparison to the other taken together” (OC I, 86/ST 28-9). It is the infinite complexity of the organisms which necessitates preformation because no general law of motion could ever bring an infinitely complex being into existence. This would be, by definition of the infinite, an endless task, and yet organic beings do regularly appear throughout time, complete and finished. To form such a being without appeal to an infinite length of time necessary for the formation, God necessarily acts beyond the general laws of nature he establishes for himself. Generation of animals, therefore, requires an extraordinary action on God’s behalf and thus represents a miracle. Miracles happen rarely, generation is an extremely common occurrence. To avoid positing a near infinite number of miraculous acts on God’s behalf, we must equate generation with creation -- itself miraculous -- and posit preformation. Malebranche makes explicit the connection between the infinite complexity of organisms, the necessity that their formation is a miracle and the consequent necessity of preformation to explain generation:

But since the laws of motion cannot construct bodies composed of an infinity of organs, it is a necessity, therefore, that flies be contained in the larvae from which they hatch.... I simply claim that all the organic parts of bees are formed in their larvae, and are so well proportioned to the laws of motion that they can grow through their own construction and through the efficacy of these laws, and can assume the shape suitable to their condition, without God intervening anew through extraordinary providence (OC XII, 253/DMR XI, 195-6, emphases added).

Generation, then, is a miraculous event beyond the power of nature itself, and beyond the power of God acting in accordance with his general laws. It cannot be otherwise given the nature of the organism as infinitely complex, and so all cases of this event must happen at the Creation. For this reason, it is reasonable to explain the formation of the universe (which is not infinitely complex) but not the formation of animals (which are infinitely complex) by appeal to God’s ordinary providence (OC II, 343-4/ST 465). The fact of the infinite complexity of the organism, together with the
conception of miracles as God’s activity which goes beyond the general laws, is the necessary and sufficient reason why Malebranche supports preformation. And preformation is not decisive, at least at this juncture, in deciding which of the two interpretations of the theory of causation is correct, because it is the only acceptable theory of generation even on the interpretation of occasionalism which posits the direct and particular action of God in each and every natural event in the world.

It may seem that the discussion thus far does not make any serious impact on the problem of the unity of the individual organism. This problem is, after all, the one which I believe ultimately motivated the emergence of the theory of preformation. In fact, the discussion so far more or less supports the received understanding of preformation (rather than mine) as an attempt to explain generation on a mechanical philosophy of nature: because the simple laws of nature governing matter in motion and in collision are incapable of creating an organized living being (in Malebranche’s case, because it is infinite), God must do this directly and miraculously at the Creation.

But in fact the discussion so far does make some impact on that problem of unity. An infinitely complex living being can never be anything but infinitely complex, no matter how much of its complexity it loses. It will always somehow be ordered internally no matter how much it is corrupted by colliding motion, and therefore, if defined by its infinite complexity, it will always be a unity even if the ordered structure changes. It is, however, probably not Malebranche’s intention to solve the problem of the unity of living beings in this way, though I will argue in the next chapter that Leibniz does draw on this fact to help him solve the problem of material unity. Indeed, Malebranche’s comments on the death of the creature due to the corruption of its proper structure suggests that it is not the infinite complexity of the living being which makes it a unified whole, but rather a very specific structure which happens to be infinitely complex: “All those who have some knowledge of anatomy, and who have noted the prodigious number of an animal’s parts, the connection between these parts and the various uses to which they are destined, will undoubtedly judge that the collision of bodies might well destroy living beings, but that it is not suited for constructing their various organs” (OC III, 339ffEST “On Optics”, 741, emphasis added). Note that
the living being is destroyed if its essential structure changes even though, given the concept of infinity, it still must be infinitely complex. I shall return to this point presently.

In this section, I have argued that preformation is necessary for Malebranche regardless of whether or not God is the sole and ubiquitous source of motion and activity in the world. That is, even assuming that the traditional interpretation of occasionalism is correct -- the interpretation that would be most friendly to Descartes’ inchoate preformation -- preformation is the only acceptable explanation for generation given the inherently miraculous nature of that feat. In the end, I argue that, despite this conclusion, preformation does urge us to accept the alternative interpretation of occasionalism, and unsurprisingly, given my central thesis, it is the problem of material and organic unity which encourages this conclusion. To set the scene for this work, let me look more closely at the problem of unity in Descartes’ theory of the organism, and how this problem urges a second argument for preformation found in Malebranche’s philosophy.

IV. Descartes: two theories of life, two concepts of mechanism and two problems of unity

There are four threads which I shall now pick up and address. First, there are really two distinct theories of individual unity which have not yet been fully distinguished, though hints of these two theories have crept up from time to time. These are the theories of individuation at the level of the organic individual, and individuation at the more foundational metaphysical level of material substance. The clash of these two theories is the problem that I have termed the Problem of Reconciliation. Second, related to this is the suggestion that living beings seem to represent a breach in natural laws. That is, the sustained unity of organic beings can only seem to occur if metaphysical substance as extension does not behave as it is supposed to since this would necessitate the shattering of anything composed of such substance, including those organic unities. So a second problem of unity, a problem I have called the Problem of Organic Endurance, arises from the first problem. Third, not only the generation, but also the maintenance, of living beings (even pre-formed organisms) would therefore seem to represent a miracle on Malebranche’s definition of miracle given
that living beings represent an interruption or breach of natural laws. This is true whether or not we believe that those laws are themselves efficacious, or they are merely ideas constraining God's will, the only really efficacious force in nature. Fourth, Descartes has, as I argued at the start of this chapter, four conceptions of body, three of which are important in this chapter: body as extended matter, body as non-living machine and body as living machine. Related to this are his two concepts of mechanism — matter-in-motion, and machine-like — and two concepts of life. And these distinctions, in turn, relate to the fact that the problem of unity includes unity at the level of the organism and the level of material substance. I shall address these four threads and their connections by starting with an examination of Descartes’ two conceptions of mechanism and two conceptions of life.

The first concept of mechanism is that which grounds Descartes’ theory of generation: all phenomena are explained by matter as extension, moving according to a few inviolable laws of nature, colliding and breaking apart upon collision. This concept represents the metaphorical roots and trunk of Descartes’s tree of philosophy (AT IXb, 14/CSM I, 186). The second concept of mechanism is that which grounds Descartes’ theory of the fully-formed organism: mechanism as machine-like. This concept is at the core of two of the three specific sciences in the branches of the tree of philosophy — mechanics and medicine. Descartes wants us to believe that all natural beings, including living animals and the human body, are machines conceived in perfect equivalence with what we call artificial machines — clocks and the like.

A human or animal body and a clock both are well-structured machines that are self-moving. They are both automata.

Given this, it may seen strange that Descartes bothers with a definition of “life” at all. If there is a seamless equivalence in kind, even if not in degree, between a “living” and a “non-living” machine, then why bother with such qualifiers? In fact, despite his constant attempts to draw a strong equivalence between the two classes of machines, Descartes also wants to sub-divide the category of “self-moving machines” so as to be able to account for life, “taken as a category which includes all the forms of living things...” (letter to Regius, June 1642: AT III, 566/CSMK 214).
So how does Descartes demarcate the category of “all living things”? He has at least two theories of life. The first involves heat and motion. Life is the self-motion of an automaton derived from a corporeal principle unique to living machines: an extreme and enduring heat. In his theory of generation, this heat appears immediately upon the mixing of the two semens, and it is responsible for the apparently living movement of particles as they begin to travel in vortices and to form an organism. The rapid motion of particles, started by a kind of fermentation, signals “that perpetual struggle in which animal life consists” (AT XI, 509; see also AT XI, 124; AT I, 529). Elsewhere, Descartes locates this living heat in the animal’s heart, but the absence of a heart in the early stages of generation indicates that the heat does not require the heart though it does resides there in the finished organism. This heat acts as the corporeal principle that is responsible for all behaviours and phenomena we associate with living beings. There is no need for an incorporeal principle (a soul) to bring about these behaviours (e.g. AT VI, 52-55/CSM I, 137-9; AT XI, 329ff/CSM I, 329ff; AT V, 267ff/CSMK 361ff; AT III, 122).

Descartes’s second theory is that life is a specific disposition or configuration of organs such that the whole is able to function properly on its own, and to maintain itself. As Gary Hatfield writes, “[i]n his physiological writing and thinking [Descartes] clearly acknowledged the organism to be an integrated whole, in which the parts and their relations show a certain integrity, are suited to certain ‘uses’ or ‘functions’” (Hatfield 1992, 361). A clear expression of this in Descartes is found in his Passions of the Soul: “For the body is a unity which is in a sense indivisible because of the arrangement of its organs, these being so related to one another that the removal of any one of them renders the whole body defective” (AT XI, 351/CSM I, 339). Once this removal of an essential organ happens, death occurs (AT XI, 330/CSM I, 329-30; and AT VI, 153/CSM II, 109). On this second definition, life is the integrated and internally-referred wholeness of essential organs and parts. Life depends on the unity of the organism. On the face of it, this does not seem to allow for any distinction at all to be made between the living machine and the non-living machine. A clock is also a well-disposed whole requiring a well-integrated structure of essential parts. We shall see shortly, however,
that there is more to this theory of life than the integration of structure; there are life-specific functions or behaviours that the specific structures of living beings make possible.

The two concepts of mechanism map onto two ways of knowing which recalls Barber's claim that only what can be clearly and distinctly known for Descartes can be ontologically real. Barber focuses on knowing something through pure conceptualization. Thus material substance is extension, and in the physical realm, only this is real for Descartes. This aligns with the first concept of mechanism just noted. But in an important article of the *Principles* (Part IV, art. 203), Descartes acknowledges a second way of knowing the ontological constitution of the world: we know what can be the case from doing or from making things ourselves. This aligns with the second concept of mechanism just noted.

... I was greatly helped by artefacts. For I do not recognize any difference between artefacts and natural bodies except that the operations of artefacts are for the most part performed by mechanisms which are large enough to be easily perceived by the senses — as indeed must be the case if they are to be capable of being manufactured by human beings. The effects produced in nature, by contrast, almost always depend on structures which are so minute that they completely elude our senses.... Men who are experienced in dealing with machinery can take a particular machine whose function they know and, by looking at some of its parts, easily form a conjecture about the design of other parts, which they cannot see. In the same way I have attempted to consider the observable effects and parts of natural bodies and track down the imperceptible causes and particles which produce them (AT VIIIa, 326/CSM I, 288-9).

We can gain theoretical knowledge of the construction of the natural world and natural beings therein by extrapolating from our own practical knowledge or "know-how". But without that practical know-how, we would not arrive at the idea that the world is machine-like. We would be left only with the pure conceptualization of material substance as extension that Barber notes Descartes can claim.

Note that the first way of knowing, the way that Barber concentrates on, gives what Descartes calls metaphysical certainty (AT VIIIa, 327/CSM I, 289), but this certainty (material substance is only extension) can tell us very little about the particular effects in the visible world. The second way of knowing, knowing from doing, provides merely what Descartes calls moral certainty. That is, we can be fairly certain that the mechanisms that we posit are the true causes of the effects in the visible
world if they explain many effects, if there is coherence in our speculations and so on. This sort of ‘certainty’ is less certain than metaphysical certainty, but is needed to explain the many particular effects in the world.

For the most part, the two theories of life sketched above are wholly compatible. The well-disposed machine that is the living body is driven and moved to realize its “living” behaviours by the heat that happens to be located in the heart. Indeed, one may believe that the first theory -- the theory of motion-causing heat -- is more critical in achieving a definition of life. After all, as noted above, the theory of life as a well-disposed machine cannot seem to distinguish a living body from a clock -- this theory of ‘life’ cannot seem to distinguish the living from the non-living. By picking out a corporeal principle of movement unique to living beings, Descartes seems able to maintain the equivalence between living and non-living as self-moving machines (both are well-disposed, well-integrated wholes), while distinguishing between them on the basis of the specific corporeal principle that makes each of them move. But even this theory of life-as-heat fails to make the necessary distinction. For that special kind of heat is present in the sperm even before the foetus -- the living machine -- begins to form. And Descartes is happy to analogize the heat that seems to define life to the non-life involving heat of fermentation found in wet hay or wine.

But Descartes himself wants to divide the category of self-moving machines into “all living things”, and then all the rest. The intuition that there is a difference between living and non-living machines is captured by Bernard de Fontenelle, himself a preformationist:

You say that animals are machines like watches? Then place a dog machine and a bitch machine next to each other, and you will see that a third little machine may be the result; whereas two watches can spend their entire lives next to each other without their ever making a third little watch. And so we have discovered... that all things being two and having the power to make themselves three, are of a nobility far above that of a machine (Fontenelle 1742, 1: 323).

Certainly, Descartes never attempts a treatise on clock generation, nor does he attempt to show how a clock nourishes, regulates and repairs itself through its lifetime, though he does attempt this with living machines.
Consider, also, the following from Descartes's letter to Denis Mesland of 9 February 1645, a passage noted at the outset of this chapter to show the different conceptions of "body" found in Descartes' work:

First of all, I consider what exactly is the body of a man, and I find that this word 'body' is very ambiguous. When we speak of the body of a man, we do not mean a determinate part of matter, or one that has a determinate size; we mean simply the whole of the matter which is united with the soul of that man. And so, even though that matter changes, and its quantity increases or decreases, we still believe that it is the same body, numerically the same body, so long as it remains joined and substantially united with the same soul; and we think that this body is whole and entire so long as it has in itself all the dispositions required to preserve that union. Nobody denies that we have the same bodies as we had in our infancy, although their quantity has much increased and, according to the common opinion of doctors, which is doubtless true, there is no longer in them any part of matter which then belonged to them, and even though they no longer have the same shape; so that they are numerically the same only because they are informed by the same soul (AT IV, 166-67/CSMK 242-43).

Many commentators have noted the apparent hylomorphism expressed in this letter, and have concentrated scholarly efforts on that. This is extremely interesting, and it will be more fully addressed in the next chapter. Here, let me focus on something else. The matter in the living human body, unlike the matter in a non-living machine, is in a constant state of flux. The living human gains and loses matter all the time, and this is quite normal behaviour. But even though there are significant changes in the actual matter that constitutes the human body, and in the actual size and even proportion and shape of the parts, something besides the soul does remain constant through all this change: that body continues to have "in itself all the dispositions required" to preserve its unity with the soul. Elsewhere, Descartes refers to the soul's recognition of the body's proper and healthy configuration of parts (e.g. letter to Chanut, 1 February 1647: AT IV, 604-5/CSMK 307), a disposition required for the proper (healthy) functioning of the whole. This functioning includes (the doctors tell us) the constant gain and loss of matter.

Much of this is no less true, however, of a non-human, and soulless, animal body than it is of a human body. Remove all references in this passage to the informing soul, and many of the same observational claims can be made of any living body. In fact, Descartes does expand this concept of a
unity, despite constant material flux, to include animals (thereby removing any need to refer to the soul at all): “we should bear in mind that the parts of all living bodies which require nutrition to sustain them (that is, animals and plants) are continually undergoing change” (AT XI, 247/CSM I, 319).13

Here, then, would seem to be a way of splitting the class of well-disposed, internally integrated, unified machines into the living and the non-living. Life can simply refer to behaviours which include the internally-regulated transformation of the body and its continued identity as a well-disposed, whole organic form despite the constant loss and gain of bits of matter. This might just be another way of defining nutrition and growth. We can add generation to the behaviours which demarcate the class of living machines. In short, Descartes seems to take as a starting point the brute fact of life as we experience it in the behaviours of what we call living beings. Strikingly, Descartes seems to focus on the very behaviours of life, including the fact that living beings have an internal and not an external source of material unity, that Aristotle also focuses on when he demarcates the natural living being from the artificial being. Taking this brute fact of life as primary need not, of course, undermine the fact that these behaviours can be described and explained in mechanical terms (matter in lawful contact motion), as Descartes attempts.

That this just is how Descartes draws the distinction garners further support in a fragment from the Excerpta, where he makes an extremely strong distinction in kind between machines that exhibit behaviours we associate with life, and machines that do not exhibit these behaviours. There he notes that there is an essential difference between an individual and an aggregate: the individual is designated by precisely those behaviours associated with living bodies — it is designated by the fact that its parts transform while it grows. The aggregate, on the other hand, is designated by the fact that its parts remain unchanged through any growth it undergoes (AT XI, 596). Living machines (both those with and without soul) by virtue of their behaviour are individuals while non-living machines are seemingly mere aggregates. One could expand on Descartes’ basic point and indicate another, and closely related, essential difference. Whatever changes in matter that a clock may undergo throughout
its “life” time due to repairs, must be achieved by an external source of motion and change. In contrast, the living body, the individual, by virtue of its particular bodily dispositions, achieves its transformations by itself.

Can the structured, extremely agitated and therefore hot, semen of the not-yet-integrated foetus count as such a living individual for Descartes? On the one hand it seems that it must, but on the other hand, it cannot. It seems it must because Descartes defines this mass as “alive” (“that perpetual struggle in which animal life consists”), and therefore in that class of things which are behaving in the way that individuals behave. Further, it must be an individual because Descartes sees the formation (generation), growth, nutrition and reproduction of living beings as all stages of the same cycle of a single, individual life (Carter 1985, 243-45). Semen is the excess product of the activity of nutrition (AT XI, 597-8). The quantitative differences within the semen are due to the quantitative differences of the various body parts from which that excess product derives, and it explains the quantitative differences in what will be the eventual foetus. Most critically, Descartes tells us that understanding the process of generation will shed light upon the process of nutrition given that foetal formation is an earlier stage of the same process of which nutrition is a later stage (AT XI, 252). Nutrition, in turn, is that which helps the foetus grow; it is also that which makes possible the eventual reproductive capacities of the foetus. That initial mixture is simply the early stage of the animal’s life. It is forming into a new living being; it is transforming as it grows — precisely the definition of an individual.

But at the same time, it cannot be an organic individual because it does not have the properly-disposed organic structure needed to be able to realize on its own these transformations or the functions of life. William Harvey expresses this paradox quite clearly: “...the body is nourished and increased before the organs dedicated to concoction, namely, the stomach and the viscera, are formed” (Harvey [1651] 1981, 295). Again: “...it seems a paradox to say that the blood is created and made to move... before any organs for making it or giving it movement exist” (Harvey [1651] 1981, 294). Harvey eventually ‘solves’ the difficulty by appealing to God and to divine spirits working in
the world as the efficient cause of generation.

Descartes cannot resort to such mysterious, unknowable agents. As Barber notes, Descartes’ criterion of certainty, and the limits this places on ontological claims, makes this impossible. And yet the mass of semen in itself does not have the integrated structure required to function in its generative, transformative role. And so the laws of nature are the efficient cause of formation. But the laws of nature are an external cause, not the internal cause of change one would expect (even an internal cause that obeys the laws of nature) if this mass is truly an individual transforming as it grows. It does not, in fact, transform itself but is transformed by something extrinsic. It does not, therefore, seem to be an individual at all. While generation (formation) is meant to be part of a seamless process of life together with growth, nutrition, repair and reproduction, generation depends on a definition of life and a concept of mechanism both of which are too limited to accomplish the behaviours of living beings.

The idea of an integrated, functioning machine which grounds growth, nutrition, repair and reproduction is also required for the individual to be able to form itself. If an animal is a self-regulating machine, then this machine must enter the process of that animal’s life at its earliest stage -- the stage of foetal formation. Paradoxically, once this living machine is introduced, it is no longer needed for that very feat of generation since that feat is thereby already accomplished. The concept of mechanism that Descartes is working with in his theory of generation -- the concept of brittle matter in contact motion -- may be able to account for eventual complexity in structure, but it cannot account for the eventual functioning unity of the structure. Ironically, this is a unity needed for the process of generation itself.

This is precisely the move that Malebranche makes in positing preformation, and he does so with explicit reference to the experienced fact of the functional, organic unity in living beings. I shall return to this, Malebranche’s second argument for preformation, in the next section. I shall conclude the present section by connecting these points to the issues of unity and miracles.

Recall the first reason -- mentioned briefly above -- why generation on the model of
Descartes' inchoate preformation would represent a miracle for Malebranche. This reason applies not to the formation of the infinitely complex, organized being, but rather it applies to the maintenance of that being once it is formed. That is, the mere fact of enduring unity is a miracle on the model of inchoate preformation because it requires the suspension of the very laws of motion which permit the bringing together of bits of matter in the first place. Any organic structure that arises as a result of well-designed bits of matter related only externally to each other and not internally as parts of a whole, will be a momentary structure with no true unity and will begin to disassemble as soon as it forms, precisely because of the motion and collision which brought it into being in the first place.

But is this not also true of the fully-formed organism? Given the story just told of Descartes' theory of life based on the disposition of organs and parts, and given his different conceptions of body and of mechanism, it is possible to argue that this is not true of the fully-formed organism for Descartes. Living machines function as wholes, and are further defined by functioning in order to maintain organic unity in the face of the disassembling mechanism of matter in motion. The mechanism of living machines overrides, or at least can accommodate, the mechanism of extended matter in motion. Indeed, the continuous shedding and re-collecting of matter is a normal part of the functioning of living machines, even though this would destroy the functional unity of non-living machines.

Two points need to be drawn out of this. The first point is that the structural form, and not the compositional matter, is what defines a living machine as an organic individual. This form is itself material, but it is also a unity, and importantly, a unity not of any specific parcel of material substance but rather of a specific organic structure. One of the functions of this structure is precisely to "process" the compositional matter -- to make it come and go -- such that there is unity at the organic level but not at the level of the metaphysics of material substance.

The second, related, point is that there seems to be a recognition that living machines are somehow different from non-living machines, even if Descartes does not go so far as to posit a distinct set of laws for living beings. Indeed, despite Descartes' recognition that living machines do
seem to represent a breach in the laws of nature because of their ability to endure as unities while the laws of nature nonetheless continuously destroy the unity of it compositional material substance, he still attempts to explain their unified functions entirely within the purview of the general laws of nature. Still this fact remains: the organic body is a unity even while its compositional matter is not; there is unity at the organic level but not at the more foundational level of the metaphysics of matter.

Regardless of Descartes’ attempts to explain the functional unity of a material form according to the laws of nature, Hatfield and Geneviève Rodis-Lewis both believe that there is a deep tension in Descartes between his two theories of mechanism (Hatfield 1992, 362; Rodis-Lewis 1978, 164). This is highlighted by Malebranche when he writes that “the collision of bodies might well destroy living beings”. And, in fact, in the end, it does destroy living beings for both Malebranche and Descartes, neither of whom deny the death of the organism (defined as the disassembling of a specific structure). If this is so, why does the collision of matter within the organism not destroy that organism by destroying its unity directly after its creation by God? Why does the collision of matter in motion not destroy living beings for all the centuries that they lie in waiting (on a preformationist model of generation), and for all the years those beings exist on earth? But this motion clearly does not immediately destroy the organism, and so the laws of motion must be suspended and thus broken as least for as long as the organism persists as one. The unity of the preformed organism, no less than the unity of the organism formed from pre-structured matter, is a miracle. This is the Problem of Organic Endurance, a direct outcome of the Problem of Reconciliation (between body as extended matter and body as living machines).

This underscores an important point regarding preformation. As noted in chapter one, the problem of the unity of individuals is closely related to, indeed, is the flip side of the coin to, the problem of generation on the mechanical philosophy which Descartes proposes and Malebranche accepts. Because, at the most basic ontological level, the material universe is nothing other than infinitely divisible, brittle matter in contact motion, it is difficult to account for any organic unity at all as long as this depends on a specific disposition of parts. Malebranche does have a solution to one
problem of unity. The infinitely complex material being must always be a unity because it cannot ever fully lose internally-related complexity, regardless of how much structure it does lose due to matter in motion. But this eternally enduring unity is of metaphysical material substance, not of a living individual of a given species as Malebranche defines such an individual. The living individual will not maintain its unity eternally because it requires quite a specific material form to be considered a unified living being. That it does maintain its unity for any length of time at all is difficult to account for given the mechanism at work in each of its parts. What endures despite material corruption is infinite complexity of matter, not a living being. If that living being, that living machine, is made up of nothing other than well-disposed extended matter which is itself bound by laws of motion and collision, then even on preformation, enduring organic unity will be hard to explain in the final analysis. This is, ultimately, the reason why Malebranche’s full-fledged preformation will flounder on the same sticking points as does Descartes’ inchoate preformation — the sticking points of the various problems of material unity in a mechanical philosophy as both thinkers define it.

V. Teleology and Malebranche’s second argument for preformation

Despite this, Malebranche no less than Descartes, is aware of the functional unity of organic individuals. Descartes’ second definition of life -- life as the functional disposition and arrangement of organs -- is also essential to Malebranche’s definition of life: “life begins when spirits cause the organs to work, which cannot occur unless they are actually formed and connected” (OC II, 344/ST 465, emphasis added; see also OC II, 395-6/ST 495). Malebranche goes further with this definition than Descartes does. He is aware that a theory of generation such as Descartes’ cannot properly account for this ultimate unity for precisely the reasons noted in the previous section. A fully-formed organism is needed for a living individual to perform life functions, including its own formation, if this is considered the first stage in the single life cycle. Paradoxically, by positing the pre-existence of that fully-formed organism, which is precisely what preformation does, it is no longer needed for that feat of generation.
That Malebranche does argue for preformation based on the functional unity of the organism and the inability of a non-unified, non-whole organism to be considered a living being, is clear from the following passage:

... there is a great difference between the formation of living and organized bodies, and that of vortexes of which the universe is composed. An organized body contains an infinity of parts that mutually depend upon one another in relation to particular ends, all of which must be actually formed in order to work as a whole. For it need not be imagined with Aristotle that the heart is the first part to live and the last to die. The heart cannot beat without the influence of the animal spirits, nor can these be spread throughout the heart without the nerves, and the nerves originate in the brain, from which they receive the spirits. Moreover, the heart cannot beat and pump the blood through the arteries unless they, as well as the veins that return the blood to it, are already complete. In short, it is clear that a machine can only work when it is finished, and that hence the heart cannot live alone.... It would be wrong then to pretend to explain the formation of animals and plants and their parts, one after the other, on the basis of the simple and general laws governing the communication of motion; for they are differently connected to one another by virtue of different ends and different uses in the different species (OC II, 343-4/ST 465).

The argument is clear enough, but profound in its implications. Living beings come as wholes; living machines cannot work and realize their purposes unless they are complete with all their essential parts intact and properly disposed to one another in such a way as to be able to function towards their ends.

This correlates with Malebranche’s discussion of death noted above. Once the structure of a living being begins to be corrupted, the organism can no longer function towards its ends and is considered dead. But this equally applies to the organism before ‘birth’. Without the fully coordinated structure, a machine cannot function according to its purposes; a living machine cannot function at all according to the purposes of life without the structure necessary to accomplish these purposes.14 Consequently, the whole is prior to its parts: a functioning whole cannot build itself up out of parts because it requires all those parts to pre-exist in a specifically disposed and unified fashion to be able to function at all. And it is this unified, functioning whole which constitutes an organic individual.

This recalls a point raised in the section on Aristotle in chapter one. Aristotle dismisses Hippocrates’ wholly materialist theory of generation because it posits the passing on of organic parts from both parents in the parental semen. But “if the parts of the body are scattered about within the semen, how do they live? If on the other hand, they are connected with each other, then surely they
would be a tiny animal” (GA 722a35ff). Since empirical evidence does not support the latter possibility, Aristotle dismisses this theory. But his point is important: in a living being, the whole must come before the parts or the parts as belonging to that whole lose their essential character. For Aristotle, the whole is an incorporeal formal whole passed on by the male parent. By dismissing the incorporeal form of Aristotle, materialists and dualists who reject the role of soul in the process of generation must find another whole. Malebranche takes the “tiny animal” to be that whole -- a whole that is a material whole.

Malebranche finds support for both arguments for preformation in the discoveries made with the aid of the microscope by some of the naturalists of his day. He has, in fact, two distinct reactions to these discoveries which align with his two arguments for preformation.

The microscopic discoveries made during Malebranche’s time were often used by advocates of preformation in support of this theory. The three whose discoveries are most critical to this end are Marcello Malpighi, Jan Swammerdam and Antoni van Leeuwenhoek. Malpighi’s contributions to this story centre around his dissection of chicken’s eggs and his conclusion that “the first filaments of the chick pre-exist in the egg and have a deeper origin, exactly as [the embryo] in the eggs of a plant” (Malpighi [1672] 1966, 945). Swammerdam’s observations are varied: he demonstrated that the complete butterfly is encased in the chrysalis, thus suggesting that the complete animal is already formed, although hidden, and not a new formation (Swammerdam [1737] 1970, 137); he also claimed that the black spot found in frogs’ eggs may be considered the frog already formed. And finally, Leeuwenhoek discovered the spermatozoa, though he, and virtually everyone else who knew of this discovery, took these to be already fully-formed animals.15 Malebranche indicates his familiarity with these discoveries in the Search (OC III, 347-8/EST “On Optics”, 747), but more prevalently in the Dialogues (OC XII, 226-30/DMR X, 174-76).

One of Malebranche’s reactions to these discoveries is found in the same chapter of the Search where he first discusses the concept of infinity, and where he first posits preformation as a solution to the problem of generation. Exceedingly telling is the fact that this reaction comes in a
chapter on the limitations, and consequent unworthiness, of the senses. These discoveries of the
naturalists serve to prove the unreliability of sensations and our need to rely instead on what is
conceivable by the understanding alone. “Our vision is very limited; but it must not limit its object.
The idea it gives us of extension has very narrow limits; but it does not follow from this that
extension is so limited” (OC I, 80/ST 26; see also OC XII, 226-8/DMR X, 174-5). Similarly, what we
are able to see through microscopes goes only to prove that we have been deceived by our limited
vision in the past and may certainly still be so deceived: “… in the final analysis, there are always tiny
animals to be found with microscopes, but not always microscopes to find them” (OC I, 81/ST 26).

The conclusion is extreme: because sensation, and even our imagination, cannot go beyond a
certain limit, even with the help of a microscope, we must rely on what our reason tells us can be the
case. Reason, as geometry helps us understand, tells us that matter is infinitely divisible into infinitely
small pieces and our reason tells us, therefore, that animals can be an infinite complex of infinitely
small parts. “As far as vision is concerned, a mite is only a mathematical point. It cannot be divided
without being annihilated…. [But] reason teaches us that the smallest of all objects would not be small
by itself, since it is composed of an infinite number of parts from each one of which God could
fashion an earth that would be but a point in comparison to the other taken together” (OC I, 83-4/ST
27-9). On this reaction to the discoveries of the microscopists, there is no positive knowledge to be
gained from those discoveries, but only the negative conclusion that senses are not to be trusted,
reason must lead us if we wish to reach trustworthy conclusions, and in the case of generation, the
conclusion is preformation. “So according to this view, which will appear strange and incongruous
only to those who measure the marvels of God’s infinite power by the ideas of sense and imagination,
it might be said: (1) that in a single apple seed there are apple trees, apples, and apple seeds, standing
in proportion of a fully grown tree to the tree in its seed, for an infinite, or nearly infinite number of
centuries; (2) that nature’s role is only to unfold these tiny trees by providing perceptible growth for
that outside its seed” (OC I, 82/ST 27).

But Malebranche uses the experiments of the naturalists in a distinctly different way as well
to give us an account of the natural world based on a positive evaluation of the observed data gleaned from those experiments. Referring to Leeuwenhoek’s discovery of the spermatozoa, mistaken for tiny animals, Malebranche takes this as positive proof that there are live animals beyond those that we can see with the naked eye, and in order to be alive, they must have specific structures:

> With magnifying glasses, we can easily see animals much smaller than an almost invisible grain of sand; we have seen some even a thousand times smaller. These atoms walk as well as other animals. Thus, they have legs and feet, and bones in their legs to support them.... They have muscles to move them, as well as tendons and an infinity of fibres in each muscle; finally they have blood or very subtle and delicate animal spirits to fill or moves these muscles in succession. Without this, it is impossible to conceive how they should live, nourish themselves, and move their tiny bodies from place to place according to the various impressions of objects... (OC I, 80/ST 25).

Perhaps these two approaches to the observational data can be understood as compatible in the following way. We can trust our senses well enough to know that there truly are live animals where we see movement with a microscope while at the same time believing that our senses cannot be trusted to tell us the whole truth, namely that there are animals smaller than those we can see, even when our sight is aided.

In the final analysis, however, I believe the two approaches to the microscopic discoveries are incompatible as are the two arguments for preformation with which they are aligned. The first approach to the experiments lends no credence to the testimony of the senses, and leads us to the conclusion — conceivable only by reason — that the living organism is defined by infinite complexity. The second approach does lend some credence to the testimony of the senses, and leads us to the conclusion — confirmable only by sensory awareness — that the living organism is defined by a specific structure. But as the problem of unity shows, infinite complexity is useful for maintaining unity of material substance because it is never lost, and a material being thus defined will never cease to be. This cannot be said of living beings, which are unities only at the organic level and only for as long as their specific structure remains uncorrupted.

Malebranche’s second argument for preformation is interesting for two final reasons that I shall explore in this chapter. First, it alerts us to yet further complexity in the issue of teleology than
that approached in the previous chapter. Second, it lends support to the alternative theory of preformation. I shall deal with the issue of teleology in the remainder of this section and turn to the issue of occasionalism in the next section.

In the previous chapter, I argued that teleology enters Descartes’ natural philosophy in a way that does not jeopardize his own strictures against appeals to teleology in our natural explanations. In his theory of generation, Descartes does appeal to the fact that the initial matter (of generation and of the universe generally conceived) must be designed by God to explain the phenomena we experience. God creates not just being, but order (Sloan 1985, 125-6). This appeal to the fact of design, however, amounts neither to a claim that we can know what that design is precisely, nor to a claim about the purposes God might have had for designing matter as he did. But there is yet more complexity in the concept of teleology.

The teleology found in Descartes’ inchoate preformation is quite distinct from that found in Malebranche’s full-fledged preformation (or, for that matter, in Descartes’ own theory of the fully-formed living individual). While Descartes may posit an intentional design (even if merely hypothetical) to the initial material conditions -- and he must posit this to explain the facts -- it is design merely. Malebranche posits intentional design that is also functional. This could be defined as a difference between design and organization, with “organization” best understood as including the word “organ” or instrument. The preformed organism is instrumental -- it is useful -- in a way the preformed or prestructured matter of Descartes’ theory is not useful or instrumental. This functional teleology is what Stephen Asma has called a “neglected teleology”: a post-ancient form of teleology that does not make appeal to mind or soul (neither God’s nor a soul internal to nature itself); it is an “ontological holism” or “organic teleology” (Asma 1996, 138).

The preformed matter, conversely, may be designed, complex and regular, but it is not functional. It represents quite a different teleology, and one incapable of transforming into the useful teleology found in the fully-formed organism that Descartes himself recognizes. When he writes to Mersenne that he believes he could explain the formation of the body of an animal no less than he is
able to explain “the origin of a grain of salt or a crystal of snow” (letter to Mersenne, 20 February 1639: AT II, 525/CSMK 134-5), he exposes the weakness of the theory of generation that he does, eventually, give. His theory of generation can explain organic design only (a crystal is merely design), but it cannot explain organic functions. Nor can it explain that upon which these functions depend: organic unity — a unity, in Kant’s evaluation, that does something and is therefore useful (Kant [1790] 1987, 252).

Two final points regarding this functional teleology need to be made. The first draws upon distinction Ernst Mayr makes between function as a physiological process and function as a feature of a life cycle (Mayr 1992, 124). His example to elucidate this distinction is the following. An appeal to physiological teleology would state that a rabbit has legs for the purpose of running. This is illegitimate in Mayr’s view, as it is in Descartes’. Descartes’ criticism of Gassendi’s discussion of teleology shows this: everything that Gassendi says about physiological functions, Descartes claims, has nothing to do with God in a teleological role, but rather has only to do with God in his role as efficient cause. However, an appeal to life-cycle teleology would state that a rabbit has legs for the purpose of long-term survival. This, says Mayr, is both legitimate and a true example of teleology. This idea is in Descartes as well. Stated in even more broad terms, the living body is structured as it is in order to be able to nourish itself, make itself grow, reproduce and so on — in order to be able to fulfill its long-term life functions. Malebranche simply expands this to include the function of generation which is, as argued, thereby eliminated.

Second, Asma claims that the functionalist or organicist teleology, which I claim motivates Malebranche’s second argument for preformation, demarcates the animate from the inanimate (Asma 1996, 68); it demarcates the organism (nature as its own end) from the machine (nature as machine) (Asma 1996, 54). This distinction is found in both Descartes and Malebranche as well, though they would not articulate it as Asma has done. If the living body is an artefact made by God, then the organism is a machine according to these two, but it no less internally embodies its own ends as expressed as its life cycle. Malebranche’s argument for preformation from the functional holism of
the organism shows this most clearly. This point is especially instructive for my final concern in this chapter: what preformation can tell us about occasionalism.

VI. Preformation and occasionalism

So, the final point is the as-yet unresolved problem of how to interpret occasionalism. Although I think there is a deep equivocation in Malebranche on this point, I also think that preformation does tell us something positive and important about this debate. Recall that the debate centres around whether Malebranche's occasionalism more closely resembles Leibniz's pre-established harmony (the alternative interpretation) or whether it posits a more thorough-going and direct involvement of God in every detail of every change or event in the natural world (the traditional interpretation). Does God efficaciously and ubiquitously act upon nature other than at the Creation or not? Is there a pervasive, one-to-one correspondence between each natural event in the world and a necessarily efficacious act of will on God's part, or is each natural event the result of the single act of God's general will at the Creation? In this section, I shall outline the two interpretations of Malebranche's occasionalism as understood against a background of the problems of theodicy and concepts of nature which might motivate either interpretation, and conclude that while preformation sheds no light on this debate when framed primarily in theological terms, Malebranche's second argument for preformation does provide support for the alternative (pre-established harmony) interpretation because of the concept of nature that this argument implies.

The competing interpretations of occasionalism have a long history, dating at least to Leibniz's correspondence with Arnauld in the late 1680s. In a letter of 4 March 1687, Arnauld challenges Leibniz to distinguish between the pre-established harmony and the position of the occasionalists. In Arnauld's estimation, the pre-established harmony says

the same thing in other terms that those say who maintain that my will is the occasional cause for the movement of my arm and that God is its real cause; for they do not claim that God does this at the moment by a new act of will each time that I wish to raise my arm, but by a single act of the eternal will by which he has chosen to do everything which he has foreseen that it will be necessary to do, in order that the
universe might be such as he has decided it ought to be (letter of 4 March 1687: G II, 84/CA 173).

Earlier in their correspondence (14 July 1686), Leibniz insists upon a distinction. The system of occasional causes in fact does affirm that for every natural event God exercises a discrete act of will, and it is precisely for this reason that occasionalism, but not the pre-established harmony, signifies a reliance on "continuous miracles" (G II, 57/CA 134). And in direct answer to Arnauld's challenge, he writes in a letter of 9 October 1687, that the occasionalists understand the problem of mind-body interaction (a subspecies of the problem of general causation that occasionalism and the pre-established harmony are meant to solve) as a problem that requires the solution of a *deus ex machina* (G II, 113/CA 214).

How is it that two of the seventeenth century's most astute minds seize upon such different interpretations of Malebranche's occasionalism? Malebranche's own discussions of the doctrine in his various writings do much to create the confusion in the first place. Here are some examples from his *Search* and *Discourse* where his own view of the theory seems to be in line with Leibniz's traditional interpretation according to which God is constantly active in an inherently passive nature.

Thus, the motive force of a body is but the efficacy of the will of God, who conserves it successively in different places.... bodies cannot move each other, and their encounter or impact is only an occasional cause of the distribution of their motion. For as they are impenetrable, it is a kind of necessity that God, whom I suppose to act always with the same efficacy or quantity of motive force, as it were, imparts to the body so struck the motive force of the body which strikes it... (OC XII, 161-2/DMR VII, 117, emphasis added).

But what is a moving body? It is a body transported by a divine action. The action which transports it can also transport that body which it meets, if it is extended to it. Who doubts this? However, this action -- this motive force -- does not in any way belong to body. It is the efficacy of the will of him who creates them or who conserves them successively in different places. Matter is essentially mobile. By nature it has a passive capacity for motion. But it does not have an active capacity, it is actually moved only by the continuous action of the creator (OC XII, 164/DMR VII, 119).

... there is only one true cause because there is only one true God;... the nature or power of each thing is nothing but the will of God;... all natural causes are not true causes but only occasional causes.... only [God's] will can move bodies if we wish to state things as we conceive them and not as we sense them.... A natural cause is therefore not a real and true but only an occasional cause, which determines the
author of nature to act in such and such a manner in such and such a situation (OC II 313/ST 448).

... there has to be in God a positive will to put a ball in motion... and it is sufficient for it to be at rest that he stops willing it to be moved... (OC II, 431/ST 516-17).

But contrast these with the following passages from the Treatise on Nature and Grace which more readily support Arnauld’s alternative reading:

... it is true that the general cause ought not to produce his work by particular wills, and that God had to have established certain laws of the communication of motion which are constant and invariable.... it would have been unworthy of his wisdom to multiply his wills in order to stop certain particular disorders... (OC V, 34/TNG I, XXII, 119-20).

For in order that the general cause act by general laws or wills, and that his action be lawful, constant and uniform, it is absolutely necessary that there be some occasional cause which determines the efficacy of these laws, and which serves to establish them. If the collision of bodies, or something similar, did not determine the efficacy of general laws of the communication of motion, it would be necessary that God move bodies by particular wills (OC V, 67/TNG II, III, 139).

The reason why it is inappropriate to expect that God acts by “particular” volitions is because this is to expect that he works by miracles (OC V, 34/TNG I, XXI, 119). It is no wonder, then, that commentators from Leibniz and Arnauld through to the present day have come to no clear agreement on what Malebranche intends by his doctrine of occasionalism. Malebranche, himself, seems to have no settled view.16

A main problem that occupies Arnauld in how to interpret occasionalism is a theodicean problem. As noted, Arnauld understands occasionalism on the alternative interpretation -- God does not act upon nature with a one-to-one correspondence between his will and a natural event. But this is precisely the worry:

He [Malebranche] takes for the same thing to act by general volitions and to act according to general laws. However, this is just what must not be confounded, the latter being very different from the former, to speak exactly, as he professes to do. [Rather] the laws are the order according to which things are done, and the volitions are (above all in God) that by which things are done.... [As a general cause, God is like a king] who governs his kingdom by general orders, but who cannot himself ordinarily see to it that they are well executed; like a bishop who has a general care for his diocese, but who cannot, by himself, attend to each soul in particular (Arnauld 1775, 175-78).
This conception of God as a general cause — as acting by general volitions with non-specific content — denigrates God's nature because it fails to recognize the providential care he has for each of his creatures. Malebranche is wrong, according to Arnauld, because what God really does is to work by particular volitions — by acts of will with specific content, choosing "every effect in particular, positively and directly, although in conformity with a general law" (Arnauld 1775, 174-75).

Two modern students of Malebranche also focus on this problem of theodicy and solve it in two different ways given the interpretation of occasionalism each supports: Nadler endorses the traditional interpretation according to which God is the ubiquitous cause of everything in the natural world (Nadler 1993); Andrew Black endorses the alternative interpretation (Black 1997).

Nadler defends Malebranche against Arnauld's attack by claiming that Arnauld misunderstands Malebranche on what is meant by general and particular volitions, and that Malebranche, in fact, intends precisely what Arnauld demands. According to Nadler, Malebranche does posit God as direct efficacious cause of every natural event — God acts on every occasion according to the laws of nature which he prescribed to himself (with the possible exception of miracles). Essentially, "Malebranche's God acts by means of what Arnauld understood as 'particular volitions' and what Malebranche understood as 'general volitions' — that is, by means of individual volitions in accordance with general laws" (Nadler 1993, 43). Nadler garners support for his interpretation by turning to what Malebranche says about general and particular volitions in the very book where much of the support for Arnauld's reading of occasionalism seems to be found; Nadler cites Malebranche's First Elucidation of the Treatise on Nature and Grace, "What It Is to Act by General Wills, and by Particular Wills". The passage is the one that I quoted in section III above to show that God can act directly in every event of the natural world, but that he still must act in accordance with the general laws he instituted at the Creation: "I say that God acts by general wills, when he acts in consequence of general laws which he has established. For example, I say that God acts in me by general wills when he makes me feel pain at the time that I am pricked..." (OC V, 147/TNG Elucidation I, 195). This passage is important for my purposes because it helps establish
that neither the infinite complexity of organisms, nor their organic unity, can be brought about by God even if he works in a one-to-one correspondence with events in nature because he does so strictly in accordance with a few general natural laws. Generation, therefore, is a miracle. The passage is important for Nadler’s purposes because it establishes that Malebranche does conceive of God as providentially interested and involved in all the activities of each of his creatures because he is directly responsible for each one of them, even if in a law-like manner.

Black finds Nadler’s reading lacking on two fronts (Black 1997, 40). First, and most important to Black, is the problem of the simplicity with which God works in the world. This is peripheral to my concerns and so will not be the focus here. Second, and most important for my purposes, is the fact that Malebranche sometimes claims that the laws of nature are efficacious, and so to claim that God is fully efficacious is redundant. Black points to the very passage from Treatise to which Nadler appeals in order to support his interpretation of occasionalism: “... in consequence of the general and efficacious laws... which he has established, he [God] makes me feel pain when my body is ill-disposed” (OC V, 147/TNG Elucidation I, 195). On Black’s picture of God, nature and causation in nature, God acts efficaciously with respect to particular events at the Creation, but the laws he establishes act efficaciously thereafter to bring about the abundance of particular natural events we witness.

There is, predictably, also evidence against the idea that the laws of nature are, by themselves, efficacious. This is predictable given that the efficacy of nature is the other side of the coin to the efficacy of God in the natural world. Just as there is substantial evidence for both views of the degree of God’s activity in the world, so too is there evidence for both views of the inherent activity or not of the natural world. Black, himself, is not explicit on the possible combinations of God’s and nature’s power, but Robert Sleigh lays this out for us. “With respect to causality there are just three alternatives: either creatures go it alone or God sometimes concurs with creatures or God goes it alone. Leibniz and Malebranche agreed that the first alternative is theologically unacceptable” (Sleigh 1990, 183). If Sleigh is right that Malebranche does not believe in the fully independent
efficacy of creatures, and I think that he is right, then an interpretation of Black’s position which
would fit this picture is as follows. The fact that Black takes seriously the efficacy of natural laws
means that the second option put forth by Sleigh obtains -- creatures and God are together responsible
for events in the world, and this coincides with the alternative interpretation which likens
occasionalism to the pre-established harmony.18 The efficacy of nature’s laws precludes the third
option Sleigh suggests which captures the traditional interpretation of occasionalism.

All this notwithstanding, it is not simply the case that the degree of activity in the world
depends in reverse proportion upon the degree of divine activity. Rather, it is also the case that, for
Malebranche, it does not make sense to attribute certain kinds of activity to the natural world, and so
these kinds of activity must be attributed to God. This turns on Malebranche’s rejection of what he
takes to be pre-modern explanations for natural events.

We therefore admit something divine in all bodies around us when we posit forms,
faculties, qualities, virtues, or real beings capable of producing certain effects
through the force of their nature.... Perhaps it will be said that substantial forms,
those plastic forms, for example, that produce animals and plants, do not know what
they are doing and that, thus lacking intelligence, they have no relation to the
divinities of the pagans. But who will be able to believe that what produces works
that manifest a wisdom that surpasses all philosophers produces them without
intelligence (OC II, 309-10/ST 446)?

It may seem that this motivation tilts the scales in favour of the traditional, Leibniz-Nadler,
interpretation of occasionalism. Positing activity in nature means positing a form of ‘explanation’ that
many early moderns, Malebranche included, find non-explanatory. It can be argued, however, that
this does not necessarily detract from Black’s interpretation that the laws of motion themselves are
efficacious. That is, here Malebranche is suggesting simply that motion in nature which exhibits
intelligence is divine, not that any motion whatsoever carries the mark of divinity. The laws of
motion in mechanical explanations are not motivated and guided by their own intelligence in the way
that Malebranche clearly believes is the case with the “forms, faculties, qualities, virtues” of the
ancient style of natural explanations.19

Nonetheless, in Charles McCracken’s evaluation, this is decisive in proving the traditional
interpretation the correct one. The natural “powers and forces and causes” which Malebranche rejects includes not just the forms and so on of the ancients, but the moderns’ laws of motion: “instead of supposing that God’s will is the cause of nature’s laws, suppose that those laws are identical with God’s ‘wills’. On this view, particular events will still be explained by general laws, but those laws will not be supposed the mysterious effects of the divine will; rather they will be taken to be God’s most general volitions” (McCracken 1983, 91). But why would McCracken take the non-intelligent laws of nature (few in number, indiscriminate in operation and measurable in effect) to be mysterious as are the forms and faculties of the ancients? McCracken takes issue with the idea that laws are the sorts of things which can be causally efficacious in the material world. What might a law be, distinct from any natural substance, in order to have power in the material world (McCracken 1983, 90)?

This skepticism surrounding the belief that independent laws themselves are efficacious gains support from Malebranche’s own contention that “our idea of cause or power to act... represents something divine” (OC II, 309/ST 446; see also OC II, 316-7/ST 450-1; OC III, 204-5/EST §15, 658; OC XII, 165-6/DMR VII, 119), and divinity would not seem to apply to the laws of nature, or, for that matter, to anything natural if the distinction between God and his creation is to be maintained. That is, it is not only certain kinds of power (namely, intelligent) which are attributable to God alone, but also any degree of power (of any kind) at all. At most, perhaps, divinity would apply to the immaterial human soul, but certainly not to material nature.

Here is some textual evidence from the Dialogues against the idea of efficacious laws of nature existing apart from God himself, and acting independently from God:

In a word, he [God] has these reasons [to depart from the simplicity of his ways] when he acts as much or more according to his nature by departing from the general laws he has prescribed for himself than by following them. For God always acts according to what he is. He inviolably follows the immutable order of his own perfections, because it is in his own substance that he finds his law...” (OC XII, 293-4/DMR XII, 231, emphases added).

Sense can be made of Malebranche’s claim to the efficacy of laws of nature if we understand these laws not to be distinct from God but to be part of the substance of God himself. Specifically, the laws
are the fruit of, if not identical with, his intellect. Each time a lawful event in the world happens, this is a direct act of God’s will which is constrained by his understanding (expressed as the laws of nature). On this reading, the laws would be efficacious because the substance which is God himself is necessarily efficacious if he chooses to act. This, of course, would favour the traditional, Leibniz-Nadler interpretation of occasionalism, according to which God alone is efficacious in the world. Yet this is ironic indeed given that nothing could be further from a natural explanation than this. It is as supernatural as one can get. The appeal to what constitutes a proper natural explanations does not, arguably, bring us any closer to an answer about how best to interpret Malebranche’s occasionalism.

Even turning to the close connection between the two concepts of nature (active or passive) and problems of theodicy, we cannot adjudicate this controversy. There are two problems in theodicy relevant here. The first relates to the demand that motion be understood only as something divine. Positing the inertness of the natural world avoids the conclusion that nature is a rival to the divinity’s unique power. It also ensures the conclusion that God has a positive role to play in nature beyond his initial creative act and is not made redundant beyond that point by his own creation. But as many theists (Leibniz included) have also maintained, positing the inertness of the natural world denigrates God because it implies he has made a terribly faulty product — one so deficient that it requires God’s constant fiddling to keep it going.

The second theological concern recalls Arnauld’s worry that occasionalism, as he interprets it, seems to make God an absent landlord, one who does not care for each and every one of his creatures. The advantage of the Leibniz-Nadler interpretation is that, given the perpetual activity in the world ascribed to God, he does show an intimate, indeed, a thorough-going, care for every aspect and every creature in his creation. There is a down side to this. God is directly responsible for every evil in the physical world. The advantage of the Arnauld-Black interpretation is that these evils would come about as the direct result of nature’s own activity, even if God foresaw these evils and created the world such that they would happen.
Let me now see in what way preformation can shed some light upon this controversy. Note that in the case of generation as understood by a preformationist, this last theological advantage (that God is not directly responsible for every evil in the world) is not available to those who favour the alternative reading of occasionalism. No less than on the traditional view of that doctrine, God is directly responsible for every organic evil — for every monster or mal-formed foetus. If God creates every living body directly at the Creation, if every generation is actually a supernatural creation, then every monstrous living being has been directly and willfully formed by God. The theological advantage of the alternative theory of causation is lost in the case of generation. So there is no way of adjudicating the debate over the correct interpretation of occasionalism from any theological advantages of preformation.

But if we frame the question with an emphasis on how nature is conceived, preformation is helpful in adjudicating this debate. Preformation has been called a paradigm example of a supernatural ‘natural’ philosophy. Generation is explained through appeal to God’s direct involvement in nature, not through the actions of nature itself. This will be soundly challenged in the next chapter with an examination of Leibniz’s own brand of preformation. But even in Malebranche, there are hints of a challenge to this interpretation. Certainly it is true that as a theory of generation, preformation is supernatural. But preformation is introduced, as Malebranche’s second argument demonstrates, to account for the very natural fact of the organic teleology or holism of living beings. Consider, one final time, Descartes’ theory of inchoate preformation. Let us bracket for now the problem of the miraculous cessation of the laws of matter in motion which would be necessary to account for the unity and thus functioning of an organism on a model of inchoate preformation. We can bracket this since, as I have argued, the miraculousness of this applies equally to preformation proper if we take the organic being to be essentially just extended matter. On the theory of inchoate preformation, God structures matter so that the designed organism emerges from it, and then God ensures that it stays unified, and that it begins to function properly and that it continues to do so. On this picture, the unity and ends or purposes are not internal to the organism but are imposed from
without by a mindful being. On the theory of preformation, conversely, the unity and function belong to the ends-oriented organism itself and are internal to it: the ends exist in nature itself — in the fully-formed organism.

This supports the alternative theory of occasionalism in the following way. The second argument in favour of preformation indicates a belief that some natural substances, namely organic individuals, are independently active and capable of independent functioning. That is, such substances are internally ordered in such a way as to be naturally efficacious and to be capable of realizing organic goals themselves. This takes seriously the idea of secondary causes, or natural causes, as being internally and truly efficacious in and of themselves and not having to rely on God as the external source for their efficacy. Indeed, if the traditional interpretation of occasionalism is correct (and if we bracket for the moment the issue of infinite complexity which makes inchoate preformation impossible), then inchoate preformation, together with God directly building the machine and directly causing the heart to beat, the blood to circulate, and so on, *even before the whole organism appears*, would be entirely adequate to explain the phenomena. That is, Aristotle’s worry with Hippocrates’ theory that unconnected parts could not live loses force in a peculiar way. According to this picture I am sketching, it hardly matters that the parts are not alive because neither is the finished whole alive in any robust sense; every last one of its actions is actually God’s direct volition, and the organic holism we think ascribes to living wholes is illusory. Malebranche’s second argument for preformation turns on claims such as this: “The heart cannot beat without the influence of the animal spirits...” (OC II, 344/ST 465). But if the traditional interpretation of occasionalism is correct, then the heart *can* beat without the influence of animal spirits or any other body part; it can beat because God makes it beat.

This is implicit in the argument for occasionalism (traditionally understood) that Nadler puts forth as the argument from necessary connection (see footnote 21). The causal chain of events in the world have to be necessarily connected, but Nadler argues that only God can provide this connection. Yet if this were so, there would be no need for preformation to account for the functional holism of
the organism, as urged by Malebranche's second argument. The following, from Search, provides more evidence for the active independence of organisms in nature: "Let us glorify God and let us recognize that in his limitless wisdom he placed in the animals every principle of action necessary for the preservation of their life..." (OC II, 152/ST 353, emphasis added). The unity and consequent functional independence of the individual organism, which serves as one of Malebranche's arguments for preformation, serves as an argument for the alternative interpretation of occasionalism too.27

VII. Concluding remarks

In this chapter, I have argued that Malebranche could not have accepted Descartes’ theory of inchoate preformation, even if he recognized this in Descartes' work. One reason is logical and mathematical, turning on the nature of the living organism as an infinitely complex being. Another reason is natural and organic, turning on the nature of the living organism as an internally-referred, organic whole comprised of essential parts and organs. The first reason is also an argument for unity at the level of the metaphysics of material substance. The second reason is also an argument for unity at the level of the organic body. Further, Malebranche’s second reason lends support to the alternative theory of occasionalism, because it urges the reader to view the organism as functionally independent, something that would not be required if the traditional interpretation of occasionalism is true because then God could be directly responsible for every organic function. I do not take this as conclusive evidence in favour of the alternative interpretation; indeed, I believe that there is a very deeply-rooted equivocation in Malebranche’s work on this point. But preformation is yet one more piece of evidence useful in adjudicating the debate about what Malebranche means by his theory of occasionalism.

There are difficulties left, however, and these are the four problems of unity noted in the introduction to this work. First and second are the Problem of Reconciliation and the Problem of Organic Endurance: these represent the ultimate tension between unity at the organic level (body as living machine) and unity at the metaphysical level (body as extended matter). The organic individual
may be considered a unity, but that unity is forever in a fragile and precarious state because of the destabilising effects of its constitutive matter, moving, colliding and breaking apart (the Problem of Organic Endurance). Further, this relates to the fact that the organism conceived of as a living machine is individuated by material form but not by constitutive matter, while (in considerable tension) the organism conceived of as extended matter is individuated by common parts are rest relative to each other (the Problem of Reconciliation). Leibniz will solve these problems by collapsing Malebranche’s two arguments for preformation into one, and redefining life, death and the laws of nature. Third, as yet unaddressed, there is the question whether, on a Cartesian metaphysics of material substance, there can be any material individual at all, defined as the ultimate ontological unit of reality (the Problem of Material Existence). Leibniz does not think so, and so he redefines material substance as essentially organic (at least for as long as he has a metaphysics of material substance), and this redefinition plays a critical role in his theory of generation by preformation. Fourth, there is the problem, spurred by Malebranche’s occasionalism as Leibniz interprets it (God is the sole and ubiquitous cause in nature), as to whether or not there can be individual unities distinct from God (the Problem of Material Independence). Preformation enters into the solution to this problem too.
Endnotes

1. For example, God’s continuous role in sustaining the universe may simply be his role in sustaining its existence by imparting a whole quantity of motion without further specifying that motion in order to unify individuals. See Principles II, 36-42 (AT VIIIa, 61-66/CSM I, 240-43).

2. Steven Nadler goes further, arguing that occasionalism is only secondarily, if at all, about mind-body interaction and is primarily about bodily interaction. This belief may seem to be undermined by the following passage: “Since the idea we have of all bodies makes us aware that they cannot move themselves, it must be concluded that it is minds which move them. But when we examine our idea of all finite minds, we do not see any necessary connection between their will and the motion of any body whatsoever” (OC II, 313/ST 448). Nadler argues that the lack of necessary connection between mind and body is not due to the mind’s incorporeal nature but to the fact that it is finite. As Nadler points out, occasionalism is premised on the idea of mind (God’s) acting upon body, and the necessary connection here derives from the necessary efficacy of an infinite mind (Nadler 1997, 86).

3. Later in the Search, Malebranche comes to Descartes’ defence against charges that his physics denigrates God because it supposes the natural world is capable of achieving all its perfection without a role for God. This is, roughly, the “received” view of Descartes’ physics as applied to generation, detailed above in chapter two, section III. Malebranche cites Descartes’ Principles, part III, article 45, where Descartes writes: “For if we consider the infinite power of God, we cannot think that he ever created anything that was not wholly perfect of its kind. Nevertheless, if we want to understand the nature of plants or of men, it is much better to consider how they gradually grow from seeds than to consider how they were created by God at the very beginning of the world” (AT VIIa, 100/CSM I, 256). Here is Malebranche’s reaction: “Then why accuse Descartes of being contrary to scripture because, wanting to examine the nature of visible things, he studies their formation according to the laws of motion, which are inviolably observed in all cases?” (OC II, 342/ST 464).

4. There are two obvious problems with this suggestion. The first is that Leibniz’s theory of pre-established harmony may not necessarily preclude the idea that God acts on his creation from each moment to each moment. He frequently writes of divine concurrence in natural events, thus suggesting that his pre-established harmony is actually closer to the traditional interpretation of occasionalism. Second, and more importantly, while it may be easier to imagine that matter in motion cannot convincingly become a unified system -- mechanical or organic -- on its own, it is also not difficult to conceive that an organized and unified material system is nonetheless subject to the same corrupting influences of matter in motion. Preformation, therefore, may explain the unity of organisms to start with, but it cannot readily explain how they maintain that unity in the face of motion and impact. In fact, this was a common argument against preformation -- how is structural and functional integrity of the living being maintained for thousands upon thousands of years from Creation until growth of the organism? Both problems will be addressed in the next chapter on Leibniz’s theory of preformation, and the second problem will be partly addressed by Malebranche.

5. Leibniz would not agree with the suggestion in this passage that there are “laws of the union of the soul and the body”. Rutherford suggests that Leibniz does not find mind-body interaction to be natural at all because of the application of his principle of sufficient reason within the order of nature. Nature’s intelligibility requires that the sufficient reason for any effect be found in a cause that is bound by the same sorts of laws. That is, “Leibniz draws on the principle of intelligibility... to insist that from any given being there follow just those effects proper to the type of being it is...” (Rutherford 1993, 149). Rutherford identifies two types: minds and bodies (Rutherford 1993, 145fn18). According to this picture, what Leibniz finds miraculous is the fact that God must alter mental and physical laws because of the need to account for mind-body interaction. God does not,
however, have to alter physical laws (he merely needs to follow them) on Malebranche’s occasionalism traditionally understood, and so the “intelligibility” of physical nature is not jeopardized. Of course, there is only one sufficient reason — God himself — and so if nature’s intelligibility demands a natural sufficient cause for each event (as Rutherford also suggests: Rutherford 1993, 149), then for this reason, nature becomes unintelligible for Leibniz on Malebranche’s theory of causation, traditionally understood.

6. The exchange between Leibniz and Pierre Bayle in wake of the Leibniz’s New System captures this definition of miracle and dissent from it along Malebranchian lines. In “Remark H” of his essay “Rorarius”, Bayle claims that occasionalism does not require that God act miraculously because he acts according to general laws (Bayle [1696] 1997, 74). Leibniz agrees with the claim that God acts according to general laws, but “in my opinion this does not suffice to remove the miracles, taking this word, not in the popular sense of a rare and marvellous thing, but in the philosophical sense of what exceeds the powers of created things” (G IV, 520/L 494).

7. Criticizing Descartes’ theory of generation, Malebranche writes: “Finally, an infinity of general laws — which would hardly make them general — would be required to be able to form the organic bodies of plants and animals by following these laws exactly” (OC XII, 246/DMR X, 190*). This can be read in one of two ways. It is likely that Malebranche intended this to indicate that Descartes’ theory of generation is inadequate because a few general laws of motion cannot form something of such complexity as living beings. This only underscores the point made at the start this section — Malebranche does not recognize the option of inchoate preformation which posits complexity in the structure of matter which, together with few and simple laws, can bring complex organic forms into being. The second reading focuses on the fact of infinity which precludes inchoate preformation as well as the received reading of Descartes’ theory of generation, which I believe is a misreading.

8. This is, at least, Malebranche’s own evaluation of the impact of the infinite upon generation. Malebranche, however, gets it wrong. Suppose the first step of a process takes $\frac{1}{2}$ of a second to complete, then the next step takes $\frac{1}{4}$ of a second to complete, and the $n^{th}$ step takes $\frac{1}{2^n}$ seconds to complete. Then the whole process takes one second, even if there are an infinite number of steps because this is a series that converges. Leibniz, of course, would understand this, and he has no problems accepting both the infinite complexity of organisms, and the ability of nature to bring into being in a finite period of time a fully-finished organic structures such as we experience them in the natural world. For more on this, see the next chapter. I thank Donald Ainslie for bringing this mathematical point to my attention.

9. This passage can be read in at least two ways, one in line with the alternative interpretation of occasionalism, and one in line with the traditional interpretation of that doctrine. The reading in line with the alternative interpretation takes Leibniz’s view of miracles as correct. The laws themselves are efficacious and bring about the growth but not the construction of organisms which happens at the Creation. God does not interfere at all because this would be miraculous activity on his behalf. The reading in line with the traditional interpretation maintains that God does interfere but always by his ordinary providence — by acting in accordance with the laws he has set for himself — and not by extraordinary providence, or by miracles — by acting beyond the laws he has set for himself or by laws so rare that we do not recognize them as laws.

10. A living body such as an animal or a human (in isolation from our souls), is a machine: no different from a clock except for the smallness and invisibility of its mechanisms given that it is a machine made by God (AT VIIIa, 326/CSM I, 288). Note the conflict between this explanation for the origin of forms and the account in Descartes’s anatomical texts. The fact that the naturalist account cannot do the job in the end does force an explicit recourse to God.

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11. There is an obvious distinction here between animals and plants. Although I am restricting the focus in this work to animals, as I noted in chapter one, section VI, there is an extremely interesting point that arises because of differences between the two kingdoms. Plants, unlike animals, do not partake in life in quite the same way as do animals if we accept this first definition of life offered by Descartes. That is, there is no extreme heat produced by the mixing of semen at the early stage of generation because plants come from hard seeds, not liquid semen. The point raised in chapter two, section III above regarding plant seeds is instructive here. Descartes writes “that the seed of plants, being hard and solid, may have its parts arranged and situated in a precise way that cannot be altered without destroying their efficacy. But it is quite different in the case of the seminal material of animals, which is very fluid.... This material is apparently just a disorganized mixture of two fluids...” (AT XI, 253/CSM I, 321-2; emphases added). The efficient cause of generation of animals is the rapid movement caused by heat, while the efficient cause of the generation of plants somehow derives from the precise structure of its seed. This latter source of the efficient cause is more in line with Descartes’ second definition of life, to be dealt with presently. It also grounds Malebranche’s second argument for preformation. It is possible, however, that Descartes may suppose that even plants have the life-heat (though not as intensely in generation as is the case with animals), since he believes that cold-blooded animals have this heat: “So far as the question of heat is concerned, even if we do not feel much heat in fishes, their hearts do feel hotter than any other organs in their body” (letter to Plempius of 15 February 1638: AT I, 529/CSMK 83).

12. Again, I am bracketing that this is a geometrical and not a substantial theory, at least as Descartes presents it.

13. Descartes’s letter to Mesland is an attempt to deal with the problem of transubstantiation, and this might explain his reference to the soul given that only by reference to Christ’s soul can the bread be deemed his body.

14. W. Coleman, in writing on George Cuvier’s embrace of preformation, states this idea nicely. For Cuvier, “successive development of the various parts would produce only physiological chaos and the death of the individual” (Coleman 1964, 128).

15. For Leeuwenhoek’s discussion of his discovery see, especially, his letter to Grew of 18 March 1678 (Leeuwenhoek [1678-80] 1941, II, 327), and his letter to Hooke of 5 April 1680 (Leeuwenhoek [1678-80] 1941, III, 203).

16. As a number of commentators have noted, the issue of temporality and God’s atemporality, impacts this question. Nadler points out that the traditional interpretation of occasionalism would seem to be in jeopardy given God’s atemporality -- it makes no sense to speak of a one-to-one correspondence between acts of God’s will and temporalized events in the created world since this makes God subject to time. Consequently, God’s atemporality would seem to urge the alternative interpretation of that doctrine. But Nadler also notes that the problem exists for the alternative interpretation as well: “In fact, the issue would be a problem for either reading of Malebranche’s occasionalism, since even on Arnauld’s ‘Leibnizian’ interpretation God must act ‘in time’ to create the world with all its implicit future states” (Nadler 1993, 44). Black thinks there is no problem regarding time and God for either interpretation. “There are particular volitions, with particular times associated with them. God wills, for example, that at the first instant of creation Adam should be a full-grown man, or that at time t the water is turned into wine. Note that this is different from saying ‘God wills at t that the water be turned into wine.’... The effects of the particular volitions will occur at the relevant times, but that is not to say that is when the volitions occur” (Black 1997, 39-40). Here is Malebranche in his Dialogues on time and God: “From all eternity God willed, he will continue to will eternally; or to put it more precisely, God wills continuously -- but without variation,
without succession, without necessity — everything he will do in the course of time” (OC XII, 159, DMR VII, 115). Rutherford takes this as evidence for the second of the following two possibilities: “... God acts either by a continuous series of particular acts of will, intervening at each moment to secure particular effects, or by an eternal or timeless will, which is sufficient to account for the effects of all things at all times, without the action of secondary causes” (Rutherford 1993, 141). Although the issue of time and God in the question of occasionalism is extremely interesting, I shall bracket it, citing Nadler’s point that God’s atemporality does not weigh the balance toward the alternative interpretation because the fact of the creation of a temporal world is troublesome for this interpretation too. The possibility that God’s atemporality erases the difference between the two interpretations fails to account for the fact that on the traditional interpretation, secondary causes have no efficacy whatsoever, while on the alternative interpretation, secondary causes do have efficacy.

17. Briefly, Black shows that the perfection of God’s creation is measured not only by the details of that creation, for if this was the case, God’s creation, replete with defects, would be far indeed from perfect. Rather, the perfection of God’s creation is measured by the balance of the details (effects) and the means by which God brings about these details. Specifically, our world is so perfect because God has chosen the optimum balance between simplicity in the means of creation and complexity in the effects. Defects could have been avoided but only if God had greatly complicated the way in which the effects of the world are brought about. That is, defects could have been avoided only by increasing the complexity of means and thereby upsetting the actual — and best — balance of means and ends.

Nadler, too, notes the importance to Malebranche’s theodicy of the simplicity of God’s ways, and also remarks that this seems in serious tension with his theory of causation as traditionally understood. As Nadler puts it, “[t]he tension, briefly stated, appears when this emphasis on the generality, simplicity, and uniformity of God’s ways in considered in conjunction with what appears to be a demand within the occasionalist theory of causation for an infinite number of particular volitions on God’s part” (Nadler 1993, 37). Nadler seems to believe that the problem of simplicity is alleviated by the proper understanding of general and particular volitions. God may act by an infinite number of volitions, but they are simple in content: they are all (with the possible exception of miracles) in accordance with a few simple and general laws of motion. They are simple because they are almost never unlawful.

Black thinks that this alone is not what Malebranche means by simplicity of ways. Rather, he means both this and the fact that God works by a very few actual number of volitions. Malebranche says as much: “Now these two laws are so simple, so natural, and (at the same time) so fruitful, than even if one were to have no other reason for judging that it is they which are observed in nature, one would still have every reason to believe that they are established by him who always acts in the simplest ways — in whose action there is nothing that is not law-governed, and who proportions it so wisely to his work that he brings about an infinity of marvels through a very small number of wills” (OC V, 31/TNG I, XVII, 117-8, emphasis added). Black, therefore, thinks that Arnauld has correctly interpreted Malebranche by interpreting his theory of causation in the alternative way.

Nonetheless, Black says that Malebranche does not have the theodicean problem of God’s lack of care for his creatures that Arnauld thinks he does, despite the fact that Arnauld is right in his interpretation of occasionalism. Black’s defence of Malebranche rests on his belief that Malebranche distinguishes between God’s choice of worlds on the one hand and his will to create on the other. In his choice, God considers each creatures and each state of affairs that he wishes to create, and the content of this is the fully specified design of the world along with the means of its production and conservation. At this stage, God thereby shows the providential concern for every creature which Arnauld thinks is missing from his theodicy. In his act of will at creation, God wills the initial state of that creation and all its laws. This is a simple act of will with very few volitions. There is no need to repeat endless particular volitions thereafter just to show providential care for every creature since God showed this in his initial consideration and careful weighing of all aspects of the world he chose

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to create (Black 1997, 40ff).

18. Alfred Freddoso explains what this picture of concurrence might look like. God acts as the most general cause in the world, and secondary causes (laws of nature on Black's view) act as the causes that further "specify" or "channel" the general cause to give rise to the very specific and various effects we experience (Freddoso 1988, 80n8). Patrick Riley believes that Malebranche may have had a theory somewhat like this (Riley 1991, 65ff). The advantage with the concurrence model is the simplicity in God's ways that it allows. God can act as a general, non-specific (simple) but utterly necessary cause, while natural causes can act in large numbers (complexly) to bring about the infinity of diverse effects we experience. See Black on simplicity in footnote 17 above. Against concurrence as an interpretation of Malebranche's occasionalism, Sleigh suggests that Malebranche's desire for "ontological economy" may urge him to posit just one cause, namely God (Sleigh 1990, 181; see also Rutherford 1993, 147). In Malebranche's words, "... it is useless to multiply beings without necessity" (OC III, 241/EST §15, 679). This, according to Nadler, is one of Malebranche's main arguments in favour of occasionalism as traditionally understood: "... it is an 'absolute contradiction'... that anything besides God alone should move a body" because God's sustaining activity in the universe is identical to his creation of it, and creatures dependence upon God is complete in both cases (Nadler 1997, 84ff).

19. This lack of intelligence in the laws of nature is precisely part of the reason why Malebranche believes that matter moving according to these laws is not considered adequate to build living beings which are clearly intelligently designed. But this does not apply to the case of inchoate preformation which can explain the formation of intelligently designed organisms by the unintelligent laws of nature because the initial matter of generation is itself intelligently designed by God. After all, Malebranche does consider it possible to account for the fully-grown organism by appeal to intelligently built tiny organisms (full-fledged preformation) together with those laws of nature. So why not appeal to intelligently structured matter together with the laws of nature? This is yet more evidence in favour of the suggestion made earlier that Malebranche just did not recognize the possibility of inchoate preformation in Descartes' Description, among the first of Descartes' books that Malebranche read.

20. Leibniz picks up on this worry in his On Nature Itself when he denies that a "divine law that... bestowed a mere extrinsic denomination... on things" can continue to be efficacious. For a natural law to have any power at all, it must be "an inherent law" belonging to the substance of things themselves (G IV, 506-7/AG 158). This will be key in the following chapter.

21. Sleigh cites this argument in Malebranche (Sleigh 1990, 170), and notes Leibniz's response: "In order for creature to be weak and dependent, must it be without any power? And in order for the Creator to be supremely powerful, must he alone be powerful and active?... I agree that God acts on creatures at every moment by conserving them, but if he alone acts, what perfection has he given them?" (G IV, 586-87/NS 161). This difference between Malebranche and Leibniz, a difference that at least Leibniz believes exists, supports the traditional interpretation which distinguishes occasionalism from the pre-established harmony in a way that the alternative interpretation does not. Further support for the traditional interpretation comes from another argument that Malebranche gives for occasionalism in the same vein as the one that conceives of any power at all as being necessarily divine. This is the argument from necessary connection, and both Sleigh (1990) and Nadler (1997), among others, deal with it. According to Malebranche, the idea of causation is premised on the idea of necessary connection (OC II, 316/ST 450), but nothing finite can provide that necessary connection. Therefore necessary connection, and consequently, causation (be it among finite bodies or between finite bodies and finite minds) depends upon God's necessarily efficacious, because infinite, will (OC II, 128-9/ST 338-9; OC II, 316/ST 450; OC XII, 162-3/DMR VII, 117).

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22. Malebranche's theory of ideas, the "vision in God", might even strip human souls of all activity. Roughly, Malebranche believes that ideas are not actually present in the human soul but rather, humans think only because we participating, in a small way, in God's store of ideas.

23. In some ways, this is Charles McCracken's interpretation of Malebranche's approach to nature. McCracken sketches two concepts of nature, and he notes the concept which he believes Malebranche favours. "Two concepts of nature compete with each other, in Malebranche's view. According to one, nature is a dynamic storehouse of powers and forces and causes, which produce all the events our eyes behold (or at least those that do not depend on the human will). According to the other, natural events, though occurring in a perfectly uniform and invariable way, are connected only by the temporal relations of before and after. On the latter view, the cause of these events is not some other, earlier event; the cause is solely the will of God. The former concept of nature, though false [in Malebranche's evaluation], is -- because bound up with our fallen nature -- almost universally accepted, even by Christians; the latter concept, though true, is almost wholly unknown or ignored" (McCracken 1983, 97). Later, however, McCracken seems to suggest as correct the alternative reading of Malebranche's theory of causation and God's role therein: "Having formed these general volitions, God need not perform some particular act each time an event in the body occasions an event in my mind, or vice versa" (McCracken 1983, 101). McCracken's view, as I read it, maintains that God's initial and general volitions (in Arnauld's understanding of that term) just are the general laws of motion, and they are adequate to realize all specific events in the world. Freddoso dissents from this view. General causes have to be further "channelled" or "specified" in order to give rise to specific events (Freddoso 1988, 80n8). See footnote 18 above.

24. For the same reason, preformation is not natural philosophy as Buffon would point out a century later. This is a paradigm supernatural theory; it is not a natural theory. The need to distinguish the natural from the supernatural is the point on which Leibniz sees a distinction between his theory of causation and Malebranche's. Leibniz's principle of sufficient reason, according to Rutherford, demands that within the order of nature, the reason for natural events should also be a natural event. Leibniz, thus, dismisses supernatural causes along with occult natural causes in his theory of causation (Rutherford 1993, 142).

25. And on many views, not only is this explanation supernatural, but nothing could be a more mysterious and "occult" cause than God himself. As Richard Watson puts it, "occasionalism is not philosophy" because "when we talk of God we do not know what we are talking about" (Watson 1993, 81). Of course, what is considered unknown to the twentieth-century mind may be well known to the seventeenth-century mind -- and God may be among the most well-known beings of all.

26. Malebranche has an enduring interest with monsters or malformed foetuses, and he offers two distinct explanations for the fact of monsters, each commensurate with one of the two interpretations of occasionalism. The divergent explanations for monsters, therefore, brings into sharp relief the tension at the root of Malebranche's metaphysics that we see in his equivocal theory of causation. The explanation more in line with the tradition, Leibniz-Nadler, interpretation of occasionalism, relies on the belief that God creates and maintains the world such that there is the unique, best balance between God's means and his ends. This unique balance maximizes the variety of effects in nature while minimizing the laws of motion by which these effects are realized. God could have gotten rid of monsters, but this would have required a multiplication of laws beyond the divine simplicity of laws which characterizes our created universe. Such a multiplication would upset the perfect balance which God, with his understanding and benevolence, has created (OC XII, 225-6/DMR X, 172-3). God does directly form monsters, but his will is forced to do this by his more important intellect which sees the overall perfection of the maximum variety from minimum means. The second explanation for monsters, which is more in line with the alternative, Arnauld-Black, interpretation,
relies on a belief that maternal imagination manipulates the malleable foetus so that a germ which would have otherwise developed into a perfect living creature rather develops into a malformed being (OC I, 235-44/ST 113-117). This, of course, places a great deal of power in nature itself. It may even jeopardize the ontological split between mind and body that Malebranche respects much more rigorously than does Descartes (see the next chapter for a discussion of Descartes’ mind-body union through ‘hylomorphism’). But against the theory of maternal imagination, see Malebranche’s *Elucidations* (OC III, 340-1/EST “On Optics” 743). For thorough treatments of monsters or malformed foetuses in the early modern period, see Park and Daston (1981 and 1998) and Purcell (1997).

27. Sleigh argues that Leibniz takes necessary connection as being merely natural or physical, and that Malebranche takes it as being more strictly metaphysical and therefore requiring God (Sleigh 1990, 171). The case of generation seems to be one example of Malebranche relaxing these standards to those that Leibniz accepts.
Chapter Four
The hylomorphic organism: Leibniz’s theory of preformation

I. Introductory comments

If I am right that preformation is primarily a theory that attempts to solve the problem of the individual unity of (at least) organisms and (perhaps also) material substance most fundamentally, then Leibniz gives us the most perfect rendition of that theory. Even if I am wrong, Leibniz proves to be the figure whose theory of preformation is most clearly motivated by the concern for individual unity; indeed, it could be argued that much of his philosophy is motivated by a concern for individuation, and generation is not an exception to this. Leibniz therefore provides both the strongest support for my thesis and the strongest counter-example to the claim that preformation is a theory meant only to solve the problem of the regular generation of complex forms in a mechanical philosophy.

As noted at the close of the previous chapter, there are four problems surrounding unity that have not been fully dealt with by either Descartes or Malebranche. Leibniz does solve these, and his answers to them give rise to a version of the theory of preformation quite distinct from that of Malebranche’s version. To recapitulate, these four problems are as follows. First, there is the Problem of Material Existence: the problem of deriving any distinct and singular material individuals at all — individuals as the fundamental order of being — in a Cartesian metaphysics of material substance as infinitely divisible extension. Second, there is the Problem of Material Independence: the problem of deriving existence for individuals, separate from God, on the interpretation of Malebranche’s occasionalism that Leibniz favours. Third, there is the Problem of Reconciliation: the problem that arises from the tension between the individuation and unity of extended matter and the individuation and unity of material organisms. The problem is the fact that the individuation of extended matter turns on the common motion of a particular portion of matter; when one part of this matter is lost, the individual is lost. Conversely, the individuation of material organisms turns on a material structure
which gains and loses matter all the time. Thus, a material organism endures as an individual (organically defined) even while it does not exist as an individual (metaphysically defined) for long.

Fourth, there is the Problem of Organic Endurance: the problem of how organic structures endure given that these structures are made up of extended matter in motion and collision which ought to disassemble the structure of the organism. Yet it does not; the organism endures for a notable length of time, thus seemingly suspending the laws of motion in the living being for as long as that living being is alive. Leibniz’s solutions to these problems are closely bound up with his solution to the problem of generation.

In section II, I shall explore Descartes’ fourth notion of body — the human as a hylomorphic union of body and soul. I give reasons why Descartes cannot be seen as offering a hylomorphic theory of the human being, concentrating on the overlap between humans and other living machines, the process of generation, and relation between epistemology and ontology in Descartes’ theory of the human being. Even if Descartes does hold a theory of hylomorphism, however, the way in which we know this and what our knowledge can tell us about the nature of ourselves as hylomorphic unities are distinctly different from how and what we can know about hylomorphic substance according to Leibniz.

In section III, I begin an investigation of Leibniz’s hylomorphic theory of substance, noting the difference between Descartes and Leibniz on the relation between epistemology and ontology on this issue, and noting some of the specific ontological problems that Leibniz must solve by appealing to a hylomorphic ontology. The key problem here is one of the four residual problems of material unity left over from our discussion thus far of Descartes and Malebranche — the Problem of Material Existence: how can any material unities exist at all if matter as extension is infinitely divisible into infinitely small pieces?

In sections IV and V, I present two main solutions that Leibniz has to this problem. In section IV, I note his monadic metaphysics — the metaphysics that denies the reality of corporeal substance altogether and ascribes reality only to unextended substantial forms. These are the individual
substances of the natural world, and I note the essential defining features of them. In section V, I discuss Leibniz's organic metaphysics — the metaphysics that ascribes reality to hylomorphic individuals of substantial forms coupled with organic bodies. In this section, I answer the question of why Leibniz chooses the organism as the paradigm of material individuals.

In section VI, I argue that Leibniz's need to account for material individual unity through his organic metaphysics leads directly to his theory of preformation. He is not led to this theory because of the need to explain generation on a mechanical philosophy. But Leibniz's unique concerns with material individuation and his solution through hylomorphism and preformation leads to a unique rendition of the preformation doctrine, as well as to distinct theories of the nature of the organism and of life. I examine these issues in section VII.

In section VIII, I look at some aspects of Leibniz's theory of natural laws to argue that his concern with unity leads to a new conception of mechanism which dovetails neatly with his theory of preformation. To underscore the importance of this: it is the concern with material unity that prompts Leibniz's theory of preformation, not the limits of the mechanical philosophy which, in fact, Leibniz adjusts in such a way that this new mechanism leads to both preformation and a way of accounting for truly unified material individuals.

II. Descartes' 'hylomorphism'

It is famously known that in the height of the apparently anti-Scholastic seventeenth century, Leibniz broke ranks with those, like Malebranche, who had dismissed "forms, faculties, qualities, virtues, or real beings" (OC II, 309/ST 446). Leibniz re-admitted substantial forms into his ontology of substance. He does so explicitly in order to rescue individual unities as the fundamental order of being. We shall return to this in the next section. But was he the first prominent early modern philosopher to do so?

In recent years, many commentators have claimed that in fact Descartes himself does not shy away from an Aristotelian metaphysics of substance at least in so far as the human being is
concerned. One of the most explicit statements of this hylomorphism is found in Paul Hoffman’s “The Unity of Descartes’ Man”: “...Descartes believes mind inheres in body as form inheres in matter, and... this hylomorphic conception of the union of mind and body does real philosophical work for him.... Descartes’s account of the per se unity of his man compares favorably with medieval accounts of per se unity, and, indeed, is remarkably close to the views of Scotus and Ockham” (Hoffman 1986, 342). Other suggestions of this hylomorphism are found in other authors as well. John Cottingham argues that Descartes actually embraces a triallistic theory of substance rather than a dualistic theory, and Cottingham identifies the “man qua embodied being” as the third substance (Cottingham 1992, 219) — a substance which combines matter and soul into a unity. Roger Ariew also hints at a hylomorphism in Descartes’ theory of the human when he notes Descartes’ reaction against “the attempt of materialists to reduce the human body to the body of an animal, even though the human body, according to Descartes, unlike the body of an animal, has a real functional indivisibility and internal finality derived from its union with a soul...” (Ariew 1983, 34). Martial Gueroult argues something similar to Ariew’s claim when he claims that “the indivisibility of the human body is in no way characterized by a reciprocal relation among the different parts which constitute the whole organic mechanism as such, but solely by the fact that this machine belongs to the soul with which it is associated.... This conception of the indivisibility of the organism, which is uniquely ascribed to an actually animated organism, conceals a psycho-physical finality and is hence ascribed to man alone...” (Gueroult 1953, 180ff). And this hylomorphism is also suggested by C.A.J. Coady in his “Descartes’ Other Myth” (Coady 1983).

Descartes certainly invites this reading of his theory of the human. The letter to Mesland of 9 February 1645, quoted in chapter three above, is one of the texts in Descartes most frequently cited in support of his hylomorphism. To recall:

First of all, I consider what exactly is the body of a man, and I find that this word ‘body’ is very ambiguous. When we speak of the body of a man, we do not mean a determinate part of matter, or one that has a determinate size; we mean simply the whole of the matter which is united with the soul of that man. And so, even though that matter changes, and its quantity increases or decreases, we still believe that it is
the same body, numerically the same body, so long as it remains joined and substantially united with the same soul... Nobody denies that we have the same bodies as we had in our infancy, although their quantity has much increased and, according to the common opinion of doctors, which is doubtless true, there is no longer in them any part of matter which then belonged to them, and even though they no longer have the same shape; so that they are numerically the same only because they are informed by the same soul (AT IV, 166-67/CSMK 242-43).

The same idea is found in a slightly later letter (also to Mesland) of 1645 or 1646: “the numerical identity of the body of a man does not depend on its matter, but on its form, which is the soul” (AT IV, 346/CSMK, 279).

There are other relevant texts as well. In the sixth Meditation, he writes that

[n]ature also teaches me, by these sensations of pain, hunger, thirst and so on, that I am not merely present in my body as a sailor is present in a ship, but that I am closely conjoined and, as it were, intermingled with it, so that I and the body form a unit... For these sensations of hunger, thirst, pain and so on are nothing but confused modes of thinking which arise from the union and, as it were, intermingling of the mind with the body (AT VII, 81/CSM II, 56; see also the Discourse, AT VI, 59/CSM I, 141).

In his letter to Princess Elisabeth of 21 May 1643, he notes “two facts about the human soul on which depend all the knowledge we can have of its nature. The first is that it thinks, the second is that, being united to the body, it can act and be acted upon along with it” (AT III, 664/CSMK 217-8). This union of the soul with the human body is one of three substantial “primitive notions which are as it were the patterns on the basis of which we form all our other conceptions” (AT III, 665/CSMK 218). The two other substantial primitive notions are the body in particular, and the soul on its own.

And in his letter to Regius of January 1642, Descartes suggests

that a human being is a true ens per se, and not an ens per accidens, and that the mind is united in a real and substantial manner to the body. You must say that they are united not by position or disposition, as you assert in your paper -- for this is open to objection and, in my opinion, quite untrue -- but by a true mode of union, as everyone agrees... (AT III, 493/CSMK 206).

Later in the same letter, Descartes advises Regius on how to defend himself against the attacks of Voetius, supporter of Scholastic philosophy who finds Regius’ own philosophy a threat to the reigning Scholastic tradition. Descartes’ suggestion is as follows: “[w]e affirm that human beings are made up of body and soul, not by the mere presence or proximity of one to the other, but by a true
substantial union.... [I]f a human being is considered in himself as a whole, we say of course that he is a single *ens per se*, and not *per accidens*; because the union which joins a human body and soul to each other is not accidental to a human being, but essential, since a human being without it [the union] is not a human being” (AT III, 508/CSMK 209).

There are a number of problems and questions raised by Descartes’ supposed hylomorphism that various commentators have addressed. There are three, quite specific issues, that I want to concentrate on here as particularly relevant for my purposes. The first issue regards the product of generation -- the finished living being, both human and non-human -- and the suggestion that only humans are true individuals (*ens per se*) because only humans are hylomorphic substances. The second issue regards the process of generation -- how living beings, human or non-human, come into being -- and the fact that hylomorphism does not at all impact this process as Descartes sees it, quite in contrast with many earlier writers in the hylomorphic tradition, including Aristotle himself. The third issue regards the distinction between the knowledge the human has of her union with a body and the ontology of that union. This third issue also regards the distinction between the way we know of our nature as unified with a body and the way we know of our nature as a mind distinct from the body.

At root, I think that these issues all point to an important distinction that needs to be made between two problems of unity. First, there is the problem of mind-body unity. This tends to be of uppermost concern for most commentators, and I believe that this alone is the problem that motivates Descartes’ hylomorphic-sounding pronouncements. Second, there is the problem of bodily unity -- the wholeness or oneness of a particular part of matter. This is, ultimately, my concern, but it is also implicitly dealt with by many commentators who are primarily focused on mind-body unity. Hoffman, for example, says that the soul *actualizes* the body which, he implies, exists as one due to the soul. I believe this suggestion on material unity in Descartes is wrong. Each of the three issues to which I now turn will establish that material unity in Descartes can be understood independently of his supposed hylomorphism, that the unity of living bodies precedes temporally and ontologically the
unity of some of those bodies with souls, and that consequently, hylomorphism is not used to establish the unity of material individuals in Descartes’ ontology.\(^2\)

\textit{A. Hylomorphism and the product of generation}

First, let me address the impact of non-human living beings on Descartes’ supposed theory of hylomorphism. Recall in chapter three that I indicated four different conceptions of the body found in Descartes’ work. The first concept is body as extended matter. The second concept is body as a non-living machine. The third concept is body as a living machine, and this includes plant, animal and human bodies. And the fourth concept is body as a hylomorphic union of the human organic body and the soul.

Along with each concept of body are different theories of the individuation of material substance into unified beings. At one extreme, in the \textit{Synopsis to the Meditations}, Descartes starts with the first concept of body and draws the conclusion that all supposedly particular bodies are mere accidental arrangements of extension and are not true individuals at all (AT VII, 13-14/CSM II, 10). Elsewhere, however, he does indicate that bodies comprised of parts of extension that are at rest relative to each other can be considered individual substances (AT VIIIa, 71/CSM I, 246). This is especially true if we recognize that Descartes allows that God may choose to act in order to keep these parts of extension at rest relative to one another (AT III, 477-8/CSMK 202-3).

Both the second and third concepts of body can allow for individual unity of physical bodies by appealing to the internal wholeness of parts referred to each other and disposed to function as a unified machine. The third concept of body -- the living machine -- is even more capable of accounting for individual unity. Part of its functioning ability is to maintain by itself the structure or disposition of parts that permits it to function in the first place. Thus, the distinction between a non-living and a living machine, I argued above, amounts to the fact that living machines exhibit behaviours unique to them -- behaviours of life taken as facts constitutive of life in our physical world, behaviours such as nutrition, growth, the ability to reproduce, and the ability to sustain its
organic structure and to repair that structure by itself.

This criterion of life sets living machines off from individual substances of mere extended matter as well, and also shows the point of tension between these two concepts of body on the issue of unity. Individuals of extended matter -- individuals picked out by the fact that parts of matter remain at rest relative to each other -- are destroyed when any part of matter is lost, while living machines do not so change but remain the same individual when they loose matter so long as the functioning structure endures. But the laws of motion which destroy the unity of parts of matter at rest relative to one another should also destroy the structure of the living machine. That the living machine works against this tendency can represent a breach of those very laws. At the least, however, there is a tension to be noted between the tendency to disintegrate at the micro-level of body-as-extension, and the ability to endure in the face of this disintegration at the meso-level of organic bodies.³ There is also a contradiction between the two definitions of material unity when applied to living beings. According to the definition that takes the material individual to be the same so long as the same parts of matter remains at rest relative to themselves, the living being is never the same individual for long. But according to the definition that takes the material individual to be the same individual so long as the same structure remains even while that structure loses and gains constitutive matter, then the living being does endure as the same individual, at least for an extended period of time.

The fourth concept of body, the hylomorphic conception, goes farthest in establishing individual unity precisely because it embraces the ontology of substantial forms which serves to establish this unity for those in the Aristotelian tradition. As Barber notes, form “accounts for... identity through time... [which in turn] requires that the individual in question at each moment of its existence be distinct from all other individuals” (Barber 1994, 6). Form establishes the ontological unit of being, and so Descartes’ apparent fourth notion of the informed body would seem to do so too.

But if Descartes really believes that matter informed by soul constitutes a human being, and
that it is the soul alone that ensures the numerical unity of the human body despite change in that body's constitutive material substance, then the only true individual unities in material nature are those with soul — ensouled human bodies (or embodied human souls). On the hylomorphic picture, other living beings that do not have soul are not true material unities but are, perhaps, merely unities per accidens. And of course, parts of extension at rest relative to one another are also, then, not true unities but merely accidental unities as Descartes suggests in The Synopsis is true of all so-called 'individuals'. This picture of the human as the only true individual certainly seems to be the gist of the letters to Mesland that I quoted above (AT IV, 166/CSMK 243; and AT IV, 346/CSMK 278-9), and that Hoffman cites in support of his claim that "[t]here is... a suitably powerful sense in which the mind actualizes the human body — a human body exists only so long as it is united to the mind" (Hoffman 1986, 359). It is also the gist of the letter to Regius in which Descartes denies that the human is a true individual as a result of "mere position and shape and the other purely corporeal modes", and affirms, rather, that the human is an ens per se because she is unified with her soul (AT III, 508/CSMK 209).

But while it is true that only a human body is appropriate to receive a human soul, I argued above in chapter three, sections IV that there is a great deal of overlap between human bodies and other (non-human) living machines. The points of overlap show where the material unity of all living beings is explained by Descartes without appeal to hylomorphism (which is, as I claimed above, required only to explain mind-body unity). These points of overlap include the fact that Descartes sometimes thinks that a non-human living machine is also numerically one despite the gain and loss of matter so long as its bodily disposition or structure remains such that it can maintain its own functioning structure through this change (AT XI, 247/CSM 1, 319). This parallel between human and non-human is in accord with Descartes' comments on the human body in the Passions in which he indicates that such a body is "a unity which is in a sense indivisible because of the arrangement of its organs..." (AT XI, 351/CSM 1, 339), and not because of its unity with a soul. This latter, wholly material, criterion of individual unity also accords more closely with the division between the
individual and the aggregate that Descartes' makes in the Excerpta: the individual is one that transforms as it grows while the aggregate does not transform as it grows (AT XI, 596). The individual, that is, is demarcated by precisely those behaviours unique to living machines understood only as material machines, either human or non-human. Much earlier, Descartes also makes explicit the connection between life and the material individual in a letter written in the summer of 1631 to Villebressieu in which he approves of the latter's acknowledgment of “a productive seed or a material life which takes specific form in all the noble particular individuals which cannot fail to be an object of our wonder” (AT I, 217/CSMK 33, emphases added).

Indeed, although Descartes makes a clear appeal to Scholastic terminology when writing of the soul as the form of the human body, he also uses this same terminology when writing of other wholly material things in the following letter to Regius of December 1641. “A simple alteration is a process which does not change the form [formam] of a subject, such as the heating of wood; whereas generation is a process which changes the form, such as setting fire to wood. Although both kinds of process come about in the same way, there is a great difference in the way of conceiving them and also in reality. For forms, at least the more perfect ones, are collections of a number of qualities with a power of mutual preservation” (AT III, 461/CSMK 200-1, emphasis added). The fact that all living bodies, human and others, have a collection of material parts with the power of mutual preservation surely counts them all among those more “perfect” forms.  

So it seems that, in so far as living things are concerned, it is possible to attribute to Descartes two different definitions of what constitutes an individual. One is the individual as a hylomorphic union of mind and body, and this limits the class of such beings to humans only. The other is the individual as an organically structured being which can function independently so long as its essential structure (though not its constitutive matter) remains intact. According to this definition, the individual is wholly material, and this definition expands the class of individuals to include all living beings. I shall argue presently that it makes more sense to take the individual latterly defined as ontologically and temporally prior to the hylomorphic individual.
If we do take the latter definition as the definition of the individual that Descartes takes seriously, then Ariew's and Gueroult's remarks regarding the human body as the only example among living beings of "a real functional indivisibility" or a body with true "internal finality" are cast in doubt. The soul does not create this finality or internally-referenced functionality. This finality and functionality are due entirely to the disposition of parts, and are equally relevant to the animal body. Indeed, this was the point argued above in chapter three, section V when I suggested that teleology enters Descartes' system in all living beings in so far as they exhibit "organic teleology" or "ontological holism" aimed toward fulfilling the various ends of their life cycles. Animal bodies, no less than human bodies, exhibit functional indivisibility or internal finality.

To drive this point home, let me quote Descartes in his replies to the fourth set of objections: "Now a very large number of the motions occurring inside us do not depend in any way on the mind. These include heartbeat, digestion, nutrition, respiration when we are asleep..." (AT VII, 229/CSM II, 161). And similarly from the Discourse: "And when I looked to see what functions would occur in such a body [human] I found precisely those which may occur in us without our thinking of them.... These functions are just the ones in which animals without reason may be said to resemble us" (AT VI, 46/CSM I, 134). But these functions are exactly those which maintain the structure of a living body even as its constitutive matter does not remain the same. These are the functions that belong to every animal's life cycle. Thus, the facts relevant to living beings (Descartes' third concept of body) challenge the implication of his supposed fourth, hylomorphic, concept of body -- the implication that only human are true individuals, and they are so because they are united to and actualized by its form, the soul.

B. Hylomorphism and the process of generation

The second important issue that impacts the claim to Descartes' hylomorphic theory is the problem of organic generation itself -- the process by which all living beings come into being. Here it is helpful to examine Hoffman's claim that "there is... a suitably powerful sense in which the mind actualizes
the body -- a [living] human body exists only so long as it is united to the mind" (Hoffman 1986, 359). The second claim -- that a living human body exists so long as it is united to the mind -- is a weaker claim than the first -- that the mind actualizes the body. This first, stronger, claim seems to give the soul an active role; the soul gives actuality to a body. The second, weaker, claim may simply imply that the presence of a mind indicates that the living human body is appropriate to be united with that mind without also indicating that the mind itself is actively responsible for the existence of that specific body.

What would the stronger hylomorphic claim -- the claim that the soul actualizes the body -- amount to in the case of organic generation? More specifically, what would it amount to on Aristotle's own hylomorphic ontology? For Aristotle, it means that the fully actualized form, passed on by the adult male, actualizes the merely potential matter (menstrual fluid) of generation provided by the female. But as I made clear by the depiction of his theory of generation provided in chapter two, Descartes cannot mean that the soul actualizes the body in this sense. That is, hylomorphism on an Aristotelian model does not enter Descartes' theory of generation at all, and Descartes' theory of generation sets clear limits to what his own brand of hylomorphism could accomplish if he indeed endorses such an ontology. On this point, he is strictly in line with the stance that Malebranche would also take against forms, faculties and real qualities charged with the construction of nature's machines.5

Even if it likely that the early moderns misinterpreted the precise function of the form in Aristotle's theory of generation (that is, by claiming that Aristotle ascribes to form intelligent and determining rather than merely active and pre-determined powers),6 Descartes is unequivocal that there is no role whatsoever for the soul (or form of the human) in generation of the human body. This applies equally whether the role of form is conceived of as intelligent and purposeful, or is conceived of as merely active while simply carrying out (without intention or purpose) an end fully actualized and pre-determined in the form itself. This is surely to be expected given that the soul in Descartes' ontology is a far more narrowly defined form than is the soul in Aristotle's ontology. Descartes does
not take the soul to encompass any of the biological functions that Aristotle ascribes to the nutritive, generative, sensitive or motive aspects of the soul. If Descartes holds a hylomorphic theory of the human, it represents a union between the body and the soul simply in the realm of activities confined to those a thinking thing can accomplish -- willing certain voluntary movements, for example -- but not those activities that the body accomplishes without our thought. Using the same terminology Hoffman uses, Descartes makes this clear in his replies to the fifth set of objections: “I..., realizing that the principle by which we are nourished is wholly different -- different in kind -- from that in virtue of which we think, have said that the term ‘soul’, when it is used to refer to both these principles, is ambiguous. If we are to take ‘soul’ in its special sense, as meaning the ‘first actuality’ or 'principle form of man’, then the term must be used to apply only to the principle in virtue of which we think...” (AT VII, 356/CSM II, 246).

That Descartes does not allow for the soul to actualize an organic body from extended matter in generation is also made clear when he lays out “the purpose or use of substantial forms” (or, more accurately, mis-use) in the very letter to Regius in which is found some of his most hylomorphic-sounding pronouncements:

They were introduced by philosophers solely to account for the proper actions of natural things, of which they were supposed to be the principles and bases.... But no natural action at all can be explained by these substantial forms, since their defenders admit that they are occult and that they do not understand them themselves. If they say that some action proceeds from a substantial form, it is as if they said that it proceeds from something they do not understand; which explains nothing. So these forms are not to be introduced to explain causes of natural things (AT III, 506/CSMK 208-9).

It is a mainstay of Descartes’ theory of living things that the creation and maintenance of the biologically functioning body is not to be ascribed to a soul acting upon matter. Soul does not actualize the body in this way.

Rather, as made explicit in my exposition in chapter two of Descartes’ theory of generation, the body is generated as the result of externally imposed motion moving bits of matter around according to a few laws of nature. Once the matter has been arranged into a human body that can
sustain itself (although I have given reasons why this cannot be the outcome of his theory), then it is joined by a soul, one which God specifically creates at that moment in order to unite it with the body. Even then, however, the soul is irrelevant to many of the functions of the self-sustaining human body:

These functions [those that occur without our thinking of them] are just the ones in which animals without reason may be said to resemble us. But [when I went on to consider animals, and in particular men] I could find none of the functions which, depending on thought, are the only ones that belong to us as men; though I found these later on, once I had supposed that God created a rational soul and joined it to this body in a particular way which I described (AT VI, 46/CSM I, 134; see also AT VIIIa, 29/CSM I, 213).

Descartes does go so far as to say that the body, upon its generation from matter in motion, must be united with a soul, since it would be miraculous for it to not be so joined (AT III, 461/CSMK 200). But this does not necessarily mean that the soul is required to actualize a body which would not be actual without a soul. Rather it could simply mean that a body with all the physiological marks of being a human body must have the defining feature of humanity, namely a soul. Specifically, given that the human body is capable of achieving certain acts which humans alone can achieve -- the ability to use language, most notably (AT VI, 56/CSM I, 139-40; and letter to Pollot of April/May 1638: AT II, 40/CSMK 99) -- that body must have a soul so as to be able to actually realize those capacities.

The passivity of the soul in its union with the body in so far as the biology of the body is concerned, as opposed to its activity (a mark of hylomorphism, and something clearly implied by Hoffman's reference to the actualizing power of the soul), is underscored in Descartes' claim to Chanut that, on being joined by God to the body, the soul would feel the passion of joy caused by the body's own good condition, marked in part by its own, independent, ability to function well as a living being (AT IV, 604-5/CSMK 307-8; repeated in the Passions, AT XI, 399 and 407/CSM I, 362 and 365). The soul recognizes the proper disposition of parts and their functional indivisibility, but (pace Ariew and Gueroult) it does not create nor maintain nor explain that indivisibility. The soul recognizes, but does not cause material unity.\(^7\) This functional indivisibility or internal finality belongs to animal bodies too, even if they do not have souls to sense and recognize these features of

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the body.

This suggests a solution to the tension between the two models of individual unity of the organism noted above. Recall that one model is the hylomorphic model while the other model depends only upon a disposition of parts that allows self-maintenance of a functioning structure. Hoffman’s solution is to state that there is no tension. “I am not so sure that there is a conflict. There would be a conflict if Descartes asserted that the identity of the human body derives solely from its union with the soul. But in the letter to Mesland he seems to think that the identity of the human depends on both its union with the soul and the disposition of its organs” (Hoffman 1986, 359fn42).

Rodis-Lewis also comes to the conclusion that “the two views are complementary” (Rodis-Lewis 1978, 169fn37), but she goes into much greater depth to show how the apparent tension can be relieved. This depends on the purely material notion of properly disposed essential parts serving as the more fundamental conception which makes hylomorphism (or the union of mind and body) possible. The reverse cannot be the case: the union of mind and matter does not precede and make possible (nor actual) the well-disposed body as is found, for example, in Aristotle’s theory of generation. As Rodis-Lewis writes:

... animal behavior manifests such a capacity of adaptation that one cannot deny them either a first degree of ‘feeling’ [AT VII, 436/CSM II, 294] or a set of reactions externally similar to those of our own ‘passions’. This relative continuity between man and animal acutely raises the problem of a certain internal finality as the condition of the functioning of every machine. Commentators of Descartes generally grant that an internal finality appears in man, and in man alone, because the union of mind and body constitutes ‘as it were, a single whole’ (Meditation VI: AT VII, 81). As a result the absence of man entails the disappearance of indivisibility. Commentators of Descartes in particular grant the animal, as well, that ‘interdependence of Parts’ which conditions the mind-body union. It would seem that this [interdependence] is a necessary, but not sufficient, condition in itself. Each machine has its own particular dispositions and, in order to give itself over to a body, the soul perhaps requires that it have a higher degree of organization than that of unthinking animals (Rodis-Lewis 1978, 162-3).

Quite in contrast with Ariew’s claim that “the human body... has a real functional indivisibility and internal finality derived with its union with a soul” (Ariew 1983, 34), it is rather the case that the union with a soul is derived from the necessary prior fact of the human body’s having this functional
indivisibility and finality independently of the soul. Yet again, on the issue of the generation of living beings, we see that material unity must be taken as a concern distinct from the issue of mind-body unity, and material unity is both temporally and ontological prior to the unity of a human body with a soul.

And so, while the human body may have a higher degree of organization, or may have a specific organization useful for human behaviours such as speech, animal bodies are also organized, and the ontological holism, organic teleology, internal finality or functional indivisibility of the human body applies to them too. This unified holism does not depend upon hylomorphism, if hylomorphism is defined simply as the union of mind and body. Or if such holism is the mark of hylomorphism, then the fact that animals exhibit this too indicates that hylomorphism does not depend upon the immaterial soul, but rather, on a wholly material form that combines function and structure.

C. The epistemology and ontology of the union and distinction of mind and body

The final point of interest for a consideration of Descartes’ supposed hylomorphism is also, in my view, the most critical, and it shows where Descartes and Leibniz diverge most notably from one another on the issue of hylomorphism. This concerns the relation between ontology and epistemology, and there are two important distinctions to be made here. First, we must distinguish between the knowledge of our soul’s union with an organized body and the ontology of that union. Second, we must distinguish between the kind of knowledge that we can have of the union between mind and body, and the kind of knowledge we can have of the mind and body existing distinct from one another.

Recall Barber’s claim that in the seventeenth century, but most notably in Descartes, there was a shift from the primacy of ontology to the primacy of epistemology -- only that which could be clearly and distinctly known through exercise of reason alone could be considered real. I have thus far challenged Barber’s claim on two fronts, both of which take issue with Barber’s narrow
conception of what counts as 'knowledge' and as 'certainty' for Descartes. First, in chapter two, section IV, I noted that Descartes may take extension as the only aspect of material substance about which we can have *metaphysical* certainty, but we can have *moral* certainty about the fact that there has to have been an initial structure to that extension (and we may even be able to have moral certainty about what that structure was) because in no other way could we explain the precise effects that we experience in our visible world. Second, in chapter three, section IV, I noted that Descartes himself claims knowledge not just through pure conceptualization of essences (as Barber would seem to have it) but also through what we learn by doing or making things: we can make educated conjectures — and even, perhaps, be morally certain of these conjectures — about hidden mechanisms in God-made natural machines if we have significant experience ourselves in making machines (AT VIIIa, 326/CSC I, 288-9).

Both these challenges to Barber presuppose some sort of experience with the world — experience of effects or experience through our actions. Here is a third challenge, also dependent on our experience and not on our unaided reason alone: we can know that we are united to a body simply by sensing it, and we sense that this body is whole and one. But this sensing is not the more advanced experience of manipulating effects, building machines or experimenting with material objects; this sensing is the first, brute experience that we have of our own selves. This is the sense experience that, as Cottingham notes (Cottingham 1992, 219ff), Descartes includes in his list of varieties of thinking: “But what then am I? A thing that thinks. What is that? A thing that doubts, understands, affirms, denies, is willing, is unwilling, and also which imagines and has sensory perceptions” (AT VII, 28/CSC II, 19), and which elsewhere (especially in his letters to Elisabeth) is sense experience of our union with a body. It is this knowledge through immediately given, undeniable sense that leads Cottingham to posit the “third substance” — the union of body and mind — because only if we are united with a body can we sense at all, and sense the presence of that body.

Barber notes the impact on the problem of individuation and identity of his belief in the primacy of epistemology (narrowly conceived) in Descartes. He notes that for Descartes, substance
was reduced to essence alone, and in the case of material substance, this essence was extension and nothing else. Likewise, the substantial forms of the Scholastics were lost. Consequently, and for two reasons, there was no longer an ontological principle of individuation. First, matter as essentially extension is infinitely divisible and actually does so divide upon contact and collision of its parts. Individual parcels of matter should therefore always be shattered on contact with other parcels, and could never remain as individuals for long. Second, without form acting as the principle of identity through time of material substance, then there simply can be no identity through time of any physical individual.

Two of the challenges that I mount against Barber’s conception of knowledge and certainty in Descartes’ work both serve to show ways in which enduring individual unity might be rescued. First, the challenge that by making machines we can better know the machines that God has made, shows how the physical substance of the world may be structured into machines, and may endures as machine-like individuals defined in part by their capacities to fulfill certain functions. Second, the challenge that by immediate phenomenology we can know our union with our bodies, shows that some substance of the world may be structured into mind-body unions, and may endure as hylomorphic individuals defined in part by their immediate recognition of themselves as individuals. But even if we do not take the sensed experience to this hylomorphic conclusion, that experience nevertheless informs us of the existence of unified bodies, the fact of which undermines Barber’s conclusion regarding the individuation of material substance in Descartes’ ontology.

Still, Barber’s point is not without force as will come into sharp focus in my consideration of Leibniz in the next section. The problem of individual unity still looms given another (metaphysically certain) fact about material substance: it is essentially defined by extension that is indefinitely divisible. Even machines and living human bodies are comprised of this kind of substance, and their unity -- indeed, their very being -- is in constant threat because of this. This is true of the human body no less than the machine given the limited role of soul-as-form on Descartes’ ontology of the soul.

So this brings me to the critical question and the first of the two distinctions noted at the
outset of this sub-section: can the immediately-given *phenomenological* sense that we have of our union with a body (that we sense is a whole) lead to a truly hylomorphic *ontology*, as so many commentators implicitly or explicitly claim? To address this question, let me start with the second distinction: that between our knowledge of our union with a body, and our knowledge of the soul and the body considered as distinct substances. In his letter to Elisabeth of 28 June 1643, Descartes notes that with regards to substance,

I distinguish three kinds of primitive ideas or notions, each of which is known in its own proper manner and not by comparison with any of the others: the notion we have of the soul, of body and of the union between the soul and the body.... The soul is conceived only by the pure intellect.... [W]hat belongs to the union of the soul and the body is known only obscurely by the intellect alone or even by the intellect aided by the imagination, but it is known very clearly by the senses.... [And] to conceive the union between two things is to conceive them as one single thing (AT III, 691-2/CSMK 226-7).

Importantly, by Descartes’ own definition of “metaphysical certainty”, both the soul as distinct from the body and the soul as unified with the body into one entity, are metaphysically certain truths.

Absolute certainly arises when we believe that it is wholly impossible that something should be otherwise than we judge it to be. This certainty is based on a metaphysical foundation, namely that God is supremely good and in no way a deceiver, and hence that the faculty which he gave us for distinguishing truth from falsehood cannot lead us into error, so long as we are using it properly and are thereby perceiving something distinctly (AT IXb, 324; AT VIIIa, 328/CSM I, 290).

We can be absolutely certain that the soul can be distinct from the body because we can clearly and distinctly conceive this: “I have a clear and distinct idea of myself, in so far as I am simply a thinking, non-extended thing; and on the other hand I have a distinct idea of body, in so far as this is simply an extended, non-thinking thing. And accordingly, it is certain that I [as a thinking thing] am really distinct from my body and can exist without it” (AT VII, 78/CSM II, 54). But also among these metaphysical certainties — and Descartes himself includes this in his discussion of what is metaphysically certain — is the truth that material things, including our material bodies closely united to our souls, exist because “we can have no sensory awareness of external objects unless these objects produce some local motion in our nerves”, and God would not deceive us about this (AT VIIIa, 329/CSM I, 290-1).
There are, I think, three different arguments found in Descartes that lead us to the conclusion that we are most certainly unified as minds and bodies. All three arguments are implied in the discussion so far, all three start from the phenomenological fact of our experience of our bodies, and none of these three can tell us anything positive or substantive about the ontology of that union. One argument is transcendental in character – there must be a material world that affects us, and we must have an organic body united with our souls that is so affected by the external world, in order to make that experience possible (e.g. AT VIIIa, 41/CSM I, 224). This leads to the ontological claim that we are a unity of soul and body, but it does not lead to any robust ontology of what that union amounts to. Certainly, it cannot be, as Cottingham points out, “an automaton hooked up to a pure intellect... a robot hooked up to a sophisticated language-using computer which had no sensation, but was able to form intentions and make the judgement that it needed to top up its nutritional levels or energy reserves” (Cottingham 1992, 227). This kind of ‘union’ could not make possible the precise phenomenological facts in need of explanation. But this negative conclusion of what this union cannot be does not give us a strong positive conclusion of what that union really is. Is it, for example, a case of mind and body being co-extensive (AT VII, 442/CSM II, 298; and AT III, 434/CSMK 147)? Or is it a case of interaction between an extended body and an unextended soul somewhere deep within the brain in the pineal gland (e.g., AT XI, 35ff/CSM I, 340ff)? Descartes offers both solutions, although they depend on radically different metaphysical conceptions of the nature of the mind.

The second argument moves from the phenomenological facts through metaphysical certainty of God’s nature as a non-deceiver to the consequent veracity of the “teachings of nature” which include the ontological conclusion that as living humans, we are unified with our bodies. This union is such that I can, most of the time, trust what my “nature” (my true nature, not “nature” as simply a label which depends on my thought”) as a combination of mind and body teaches me: “to avoid what induces a feeling of pain and to seek out what induces feelings of pleasure, and so on.... For the proper purpose of the sensory perceptions given me by nature is simply to inform the mind of what is
beneficial or harmful for the composite of which the mind is a part; and to this extent, they are clear and distinct" (AT VII, 82-3/CSM II, 57). But once again, the ontological conclusion is limited. I know that it is my true nature as a living human to be a union of mind and body, but I do not know what the nature of that union itself is.

This is also the problem of the third argument which also starts from the phenomenological facts, and then makes use of Descartes' "primitive notions" concept to arrive at the conclusion that we know that we are a union because of our immediate sensory awareness of it, and because of our certainty that we are aware of it. But this third argument is especially important because it reminds us that there are other primitive notions and forms of knowledge that may tell us more about the ontology of the union of mind and body, and also about the ontology of material unity. That is, our purely intellectual knowledge of the primitive notion of the soul considered in itself tells us about the nature of the soul, and this includes the fact, outlined above, that the soul has no part in the actions of the body that are wholly divorced from thought -- biological actions such as actualizing the organic body through generation or preserving the body through the activities of nutrition, repair and growth, for example. This, in turn, tells us more about the nature of the primitive notion of the union than either of the other two arguments can tell us. It tells us that the union is limited in what it is able to accomplish, most especially in how the mind can (or cannot) act as a form for the body.

Once again, we are faced with the critical need to keep the two questions of unity clearly distinct from other another. The knowledge that we gain through immediately-given sense is knowledge of mind-body unity. But the knowledge that we gain through reason (perhaps aided by imagination) of the nature of the soul and body considered as distinct tells us that material unity is not dependent on the soul, and that it precedes both temporally and ontologically the unity of soul and body.

So here is a second, broad criticism against Barber's claim that epistemology limits ontology for Descartes. The first broad criticism was that Barber has too limited a conception of what counts as knowledge and certainty for Descartes. Sensory awareness and experience enter into his theory of
knowledge far more pervasively than Barber allows, and this sort of knowledge makes a significant impact upon the related problems of generation and individual unity. The second broad criticism is that in the case of the human being, and her subjective knowledge of herself, Barber is wrong about the primacy of epistemology and the limits it places on ontology. The nature of the union itself is not clearly known, and yet the fact of that union is not denied by Descartes. He advises Regius to embrace the truth (as even Descartes sees it) of that union without trying to explain “what this amounts to”, since this is something nobody tries (AT III, 493/CSMK 206). Or perhaps, more charitably to Barber, this is not a case of ontology (the fact of mind-body union) triumphing despite the inability of humans to know clearly that ontology. Perhaps, rather, this is a case of one form of knowledge usually less valued by Descartes -- our clearly-known and immediately-given sense of ourselves as a union -- taking precedence over another form of knowledge, usually favoured by Descartes -- our intellectual ability to clearly understand what that union is and is not.

III. Epistemology and ontology in Leibniz’s hylomorphism

In her letter of 1 July 1643, Elisabeth expresses dissatisfaction with Descartes’ answer to her queries on the nature of mind-body interaction. Elisabeth has been asking Descartes how two very different kinds of substances -- unextended, incorporeal souls and extended, corporeal bodies -- can affect each other; or, more precisely, Elisabeth has been asking how a substance like the soul could make contact with and then move a substance like the body (6/16 May 1643: AT III, 661; Blom 106). In answer, Descartes has appealed to the idea of different “primitive notions”, and the correct way of knowing different primitive notions. Descartes has told Elisabeth that interaction can be explained by mind-body union, and this union, as a primitive notion, must be known differently from how we would know the soul, for example. The union is known clearly through the senses and only obscurely through the understanding. The nature of the soul in itself, as another primitive notion, is known clearly through the understanding while the senses can clearly tell us nothing about it (AT III, 691-2/CSMK 227).
Then Elisabeth expresses her dissatisfaction with this: “I too find that the senses show me that the soul moves the body; but they fail to teach me (any more than the understanding and the imagination) the manner in which she does it” (letter of 1 July 1643: AT IV, 2; Blom 117). This captures my misgivings surrounding Descartes’ supposed hylomorphism that I expressed in the previous section; we can know that the body and mind are united, but because we know this through sense and not understanding, we know very little about how they are united or what this union amounts to. Elisabeth’s further comments are also instructive: “I think that there are unknown properties in the soul that might suffice to reverse what your metaphysical meditations, with such good reason, persuaded me concerning her inextension” (AT IV, 2; Blom 117). Elisabeth has already spelled out what this reversal would amount to: “I admit it would be easier for me to concede matter and extension to the soul, than the capacity of moving a body and being moved, to an immaterial being” (10/20 June 1643: AT III, 685; Blom 112). If we try to understand the nature of the union, as opposed to merely sensing the fact of it, we are led away from Descartes’ ontology of the soul. Or conversely, as I noted in the previous section, if we retain Descartes’ ontology of the soul and what we know of it by way of our understanding, we know that it does not interact with the body in many of the organic ways in which his hylomorphic predecessors believe that the form interacts with matter (or in any way, if Elisabeth’s arguments are convincing as they certainly seem to be).

Perhaps it could be argued that Elisabeth is being a better “rationalist” (if any meaningful sense can be made of that term) than is Descartes. At the very least, Elisabeth proves a better example of Barber’s claim that many seventeenth-century figures put epistemology before ontology. Indeed, Elisabeth suggests that we re-conceive the soul’s nature — that we think of it as extended — in order to better satisfy what she can clearly understand of its interaction with the body, an interaction undeniably given to the senses. Further, she, much more so than Descartes, seems to be more strictly respecting the demands of reason alone rather than allowing what the senses tell us to count as ‘knowledge’.

Leibniz occupies an interesting position in the relation between epistemology and ontology
especially as this impacts the issue of hylomorphism. Robert Merrihew Adams believes that “[i]t was characteristic of much early modern philosophy, and especially the critical philosophy of Kant, to assign a dominant role to epistemology. Of the great early modern philosophers, however, Leibniz was probably the least preoccupied with epistemology. He was typically willing to begin an argument with whatever seemed true to him and might seem true to his audience, without worrying too much about whether epistemology would present it as something we can really know” (Adams 1994, 3). If we interpret Descartes as making ontological claims about the human being (the fact of his union with a body) despite our epistemological inability to know what that ontology amounts to -- that is, if we interpret Descartes on this score as not limiting ontology by epistemology -- then perhaps there are affinities between him and Leibniz. But there are important divergences to be noted which will emerge throughout the discussion of this section, and here is one. While Descartes reaches the ontological conclusion of the union of mind and body by concentrating on our internally-referred, sensed knowledge of the self as such a union (a ‘knowledge’ that refuses to bend to the understanding which cannot clearly grasp the nature of that union), Leibniz reaches the ontological conclusion of the unity of substantial forms and bodies by concentrating on externally-referred problems in the metaphysics and physics of the material world. These are problems that present themselves not uniquely to ourselves as sensing beings; these are problems that reason has a large role in identifying and solving.

Here, then, is where a key difference between Descartes and Leibniz lies, a difference that importantly impacts the issue of hylomorphism. Descartes starts with the immediate, internal sense that we have of our union with a body -- a body that we sense is one and whole. But we cannot get beyond this knowledge to give an ontological account of the union of mind and body that will satisfy reason. Quite the opposite obtains, in fact: reason leads us away from endorsing such an ontology. Another way of putting this is to say that one aspect of our knowledge of ourselves as human suggests that we are hylomorphic beings, but the method which Descartes believes is an acceptable one by which to investigate the natural world cannot make use of this particular form of knowledge and
cannot, in the end, accommodate hylomorphism as a part of natural explanations.

Leibniz, in contrast, starts with the knowledge that we have of problems in the natural world external to us, and the form of knowledge that we have of these things is not confined to immediately-given sense data but also relies on what reason tells us. When Leibniz turns to hylomorphism to solve these problems, he therefore has to make some kind of claims about what that ontology amounts to, and how it solves, to the satisfaction of reason, the problems that spur his investigations in the first place. Another way of putting this is to say that our knowledge of hylomorphism in the world is a form of knowledge appropriate to the method by which we ought to investigate nature, and in the end, Leibniz can (and must) accommodate hylomorphism in natural explanations, even if in a very specific and limited way.

Yet another way to draw the distinction between the two thinkers is to specify the sorts of effects that each identifies as leading to the conclusion of hylomorphism (to whatever degree each maintains this conclusion), and to determine how these effects impact method. Recall that in chapter two, I argued for the importance in Descartes’ methodology of working from effects to causes, and noted that the finished product of a complex living being of a given species (the effect) was not inconsequential in his theory of generation. Indeed, the fact of this effect leads to the belief that one part of the cause (the initial conditions of the universe generally, and the seminal fluid specifically, as designed by God) must be something very specific to make this experienced effect possible. The present discussion indicates another effect -- the internally-experienced subject as a unity of a soul and of a body. Most critical for my purposes is the fact that this body is experienced as one whole that is more or less healthy, that functions more or less properly. Indeed, this is the fourth effect of living bodies that I identified at the close of section IV in chapter two above as one effect that Descartes must be able to account for by his theory of generation. It is, I argued, an effect that he cannot properly explain by that theory. Further, this effect is of limited use in the method appropriate for natural investigations, again because of how we know it. The effects in the natural world that Leibniz identifies as requiring explanation are quite different, and known quite differently. These
effects and our knowledge of them are useful in his method of investigating the natural world.

What are these problems in the metaphysics and physics of the material world that compel Leibniz to embrace a hylomorphic ontology? What are the experienced effects of the natural world that cannot be adequately explained without appeal to hylomorphism as part of the cause? There are several, closely related, and here are a few. First, Leibniz sees no way of explaining the brute phenomenon of motion in the material world without positing a source for that motion. Motion clearly does occur -- we witness this effect in nature all the time. But since matter, as defined by both Descartes and Malebranche, is extension and extension alone externally moved, matter itself cannot be the source of motion. Leibniz writes, in “On Nature Itself”, that “we must admit that extension, or that which is geometrical in bodies, if taken by itself, has nothing itself from which action and motion can arise.... [Ma]ter cannot initiate motion through itself...” (G IV, 510-1/AG 161-2). And again: “But in the concept of motion there are included not only body and change but a reason and a determinant of change as well, which cannot be found in a body if its nature is considered to be purely passive, that is, to consist in extension alone or even in extension and impenetrability” (letter to de Volder 6 July 1701: G II 228/L 525; and throughout their correspondence, e.g., 23 June 1699: G II 324/L 519; and 30 June 1704: G II 271/L 538). A derivative problem is how to explain the phenomena of change and diversity -- how can anything change or be unique and distinguishable from other things in the material world if all there is in the material world is extension, one part indistinguishable from any other? Matter as extension cannot, alone, give distinct and diverse characteristics to bodies (e.g. “On Nature Itself”: G IV, 512-4/AG 163-5).

As an early solution to both the problem of the source of motion and the cause of diversity, Leibniz (like Malebranche) seems to make recourse to God as the source of all activity in the otherwise passive material world (e.g. letter to Thomasius, 20/30 April 1669: G I, 22-3/L 99). But this leads to a second problem. If God is responsible for all activity in the world, then how are we to draw a clear distinction between God and that otherwise impotent world? This, of course, is the problem of Spinozism that Leibniz believes occasionalism falls prey to, and that urges Leibniz
himself to shy away from this early solution. In a letter to de Volder of 10 November 1703, Leibniz identifies both the problem of accounting for diversity among material bodies if matter is defined as extension alone, and the inadequacy of the occasionalist appeal to God as the source of motion and of diversity: "I had added a demonstration taken from phenomena — to the effect that if this difference [the intrinsic difference between bodies] did not exist, one state of matter in a plenum could not be distinguished from another, for equivalents could always be substituted for each other.... [This] applies especially to Malebranche, Sturm, and other occasionalists, who ascribe all force or active power to God alone, so that there is no principle of distinction in corporeal things themselves" (G II, 257/L 532). Without a principle of distinction (nor of motion) in corporeal things themselves, Leibniz states elsewhere ("On Nature Itself"), "it would follow that no created substance... nothing would be conserved by God, and consequently everything would be certain vanishing or unstable modifications and phantasms, so to speak, of one permanent divine substance. Or, what comes to the same thing, God would be the very nature or substance of all things, the sort of doctrine of ill repute which a recent writer [Spinoza], subtle indeed, though profane, either introduced to the world or revived" (G IV, 508-9/AG 160; see also later in the same work G IV, 515/AG 165-6).

A third problem motivating Leibniz is the need to explain the behaviour of bodies in collision. Descartes’ own theory of material substance cannot adequately explain the brute phenomena on this front, even though Descartes thinks he can explain it. This complaint is found in various forms throughout Leibniz’s corpus, such as in the Discourse on Metaphysics, §21:

For if there were nothing in bodies but extended mass and nothing in motion but change of place and if everything should and could be deduced solely from these definitions by geometrical necessity, it would follow, as I have shown elsewhere, that, upon contact, the smallest body would impart its own speed to the largest body without losing any of its speed; and we would have to accept a number of such rules which are completely contrary to a formation of a system (G IV 446/DM §21; see also, for example, “On the Nature of Body and the Laws of Motion”: G VII 280-3/AG 245-50).

A fourth problem is one first fully addressed in “A Brief Demonstration of a Notable Error of Descartes” (1686: GM VI, 117-9), and broached in various texts thereafter. This is the problem of the
proper relation between force and motion, and indeed of the proper definition of force. Descartes takes force to be derivative of motion and defines it as mass times speed, or $mv$. This motive ‘force’ or quantity of motion is, according to Descartes, conserved. Leibniz, however, discovers situations in which the quantity of motion is actually not conserved. Given that quantity of motion is not conserved, and that it is the same thing as motive force according to Descartes, then motive force is also not conserved. Consequently, if force is to be conserved, force must be defined differently, and Leibniz does so, claiming that what is conserved is mass times speed squared -- $mv^2$ -- or force properly conceived (see, for example, “Dynamics: On Power and the Laws of Corporeal Nature” GM VI 287-92/AG 105-11; also NS 33). Indeed, Leibniz redefines the relation between motion and force altogether, conceiving of force as more fundamental (and metaphysical), while motion is derivative of force (and is, furthermore, merely phenomenal). This gives Leibniz’s physics a natural grounding in metaphysics which Leibniz believes is lacking in Descartes’ physics. (For detailed discussions of the import of Leibniz’s discovery, see, for example, Gale 1988 and McGuire 1976.)

In some way or another, a more fundamental and more deeply metaphysical problem enters into all these other concerns. This is the problem of Descartes’ definition of the essence of material substance as extension. I want to focus my discussion of Leibniz’s hylomorphism on a fifth problem that arises directly from this definition. This is one of the four residual problems of material unity left over from the discussion of Descartes and Malebranche, a problem left to Leibniz to solve. This is the Problem of Material Existence: how is it possible to derive any distinct and singular material individuals at all -- individuals as the fundamental order of being -- on a Cartesian metaphysics of material substance.

Recall Descartes’ three primitive notions. The primitive notion of the union of mind and body suggests hylomorphism because the sense give us an immediately recognition of the unity of body and soul (as form). The primitive notion of the soul considered in itself precludes hylomorphism because reason tells us what the soul does not do in its union with the body. The primitive notion of body considered in itself also precludes hylomorphism because reason (aided by
the imagination) recognizes the essence of material substance as extension and nothing else (AT III, 691-2/CSMK 226-7) — certainly not soul or form. But for Leibniz, the primitive notion of body considered in itself demands hylomorphism because reason recognizes that if material substance is defined as essentially extension and nothing else, then numerous problems ensue including the problem of how any material substance can exist at all.

The argument is roughly as follows. Matter as extension is infinitely divisible, and if we can conceive of matter as infinitely divisible, then God can certainly actually so divide it. But this means that matter can be divided without end, and there will never be any ultimate units from which the material world can be constructed. There can never be, that is, a material world at all unless there is some way of securing the existence of ultimate material units as the singular simple building blocks of that world. This is a problem Leibniz identifies very early, but perhaps the most succinct expression of it comes in a letter to Arnauld, where Leibniz plays on a difference of emphasis: “... there is no plurality without true unities.... what is not truly one being is not truly one being” (G II, 97/CA 191). Matter can have no ontological reality unless it can have unity. There must be indivisible material units in order to explain the reality of the material compounds which we experience, but matter defined as infinitely divisible extension cannot yield such unities. This problem opens Leibniz’s *Monadology*, but here he takes immaterial monads at the only real existents, because only these can be truly simple in the strictest sense.

1. The Monad, of which we will speak here, is nothing else than a simple substance, which goes to make up composites; by simple, we mean without parts. 2. There must be simple substances because there are composites; for a composite is nothing else then a collection or *aggregatum* of simple substances. 3. Now, where there are no constituent parts there is possible neither extension, nor form, nor divisibility. These Monads are the true atoms of nature, and, in fact, the elements of things (G VI, 607/M §1-3).

But the monadology is not Leibniz’s only answer to this problem. He also turns to hylomorphism.

This alerts us to yet another divergence between Descartes and Leibniz on the relation between epistemology and ontology, and how this relation impacts hylomorphism. Above, I noted that Descartes reaches whatever form of hylomorphism that he does reach due to the immediately
given sense each of us has of him- or herself as a mind unified with a body while Leibniz is motivated to embrace hylomorphism due to problems that he comes across in his attempts to explain the nature of the material world in general. Here it is relevant to note Leibniz’s dissent from Descartes’ claims about how we know the nature or essence of material substance. Descartes believes that reason primarily (though perhaps aided by the imagination) leads us to the conclusion that material substance is simply extension. Leibniz claims, however, that reason does not lead us to the conclusion that Descartes reaches. “Those good Cartesians, whatever they may boast about their clear and distinct perceptions, don’t seem to me to perceive extension in this way” (letter to Johann Bernoulli of 18 November 1698: GM III 541/AG 169). Further, “the conception of extension is much less clear and distinct [than is the conception of substantial form]; witness the remarkable difficulties found in the composition of the continuum” (letter to Arnauld 8 December 1686: G II, 77/CA 163) that arise from the definition of material substance as mere extension. In fact, Leibniz believes that extension is not at all known by reason but rather by the imagination, and that reason demands something more. What reason gives is a proper metaphysical foundation that Leibniz believes is missing from Descartes’ physics:

... a conception of forms is necessary for philosophizing properly, and no one can think that he sufficiently understands the nature of body unless he has turned his mind toward such things and understood that the crude notion of corporeal substance, which depends on the imagination alone and was carelessly introduced some years ago through an abuse of the corpuscular philosophy..., is imperfect, not to say false.... We must admit something metaphysical, something perceptible by the mind alone over and above what is purely mathematical and subject to the imagination.... Whether we call this principle form or entelechy or force does not matter, as long as we remember that it can only be explained through the notion of forces ("A Specimen of Dynamics": GM VI, 235, 241/AG 119, 125, emphases added).

IV. Substantial forms as the true unities of the natural world

There are two ways of interpreting Leibniz’s inclusion of substantial forms as the metaphysical basis of physics. Both readings have substantial textual support. Indeed, Garber notes that

[The careful reader can find at least two different strains in Leibniz’s writings.... In general, [one view] seems to be that genuine substances are to be understood as
living creatures of a sort, on analogy with the human being, unities of soul and body, and that the world is filled with an infinity of such genuine substances, nested in one another to infinity. Better known is the metaphysics of the Monadology, where Leibniz’s individual substances, what he comes to call monads, are conceived not on the model of animals but on the model of Cartesian souls (Garber 1995, 293-6). In fact, the careful reader need only look at Leibniz’s correspondence with Bartholomew Des Bosses to witness the (uneasy) blending of these two views. There Leibniz states: “Every substance is alive. Substances are either simple or composite. Simple substances [are] monads.... Composite substances are those which constitute a per se unity, composed of a soul and an organic body, which is a machine of nature resulting from monads” (notes for letter of 5 February 1712: G II, 439/AG 200).

Although I am most interested in the first view that Garber notes — the view that genuine individual substances are hylomorphic organisms — I shall devote this section to some brief comments on the second view that Garber notes — the view that genuine individual substances are soul-like monads. This is because the substantial form (or monad, force, entelechy or soul) is essential to both views, and some general remarks about the metaphysics of individuals conceived of as monads will be helpful in a proper treatment of the metaphysics of individuals conceived of as hylomorphic organisms. This work will be expository and schematic merely and will not attempt to explain in detail why Leibniz makes many of the claims that he makes, as this work is well beyond the scope of the current discussion.

According to the monadic interpretation offered, for example, in the early sections of the Monadology, the true and only realities of the world are immaterial substances — monads that cannot be divided because they are not extended. The matter we experience in the world is a mere phenomenon, somehow founded upon these soul-like substances. That is, precisely because there can be no ultimate material units (because matter can always be divided), there can be no ontologically real matter. When pushed by de Volder to explain the nature of body and the relation between body and substantial form, Leibniz edges closer and closer to this view and away from embracing the ontological reality of corporeal substance, finally admitting “I don’t really eliminate body, but reduce it to what it is. For I show that corporeal mass, which is thought to have something over and above
simple substances, is not a substance but a phenomenon resulting from simple substances, which alone have unity and absolute reality” (letter of 1704 or 1705: G II, 275/AG 181). The thought is echoed in a slightly earlier letter to Sophie Charlotte (1702): “it would not be impossible, speaking with metaphysical rigor, that, at bottom, there should only be these intelligible substances [mind or soul], and that sensible things should only be appearances” (G VI, 503/AG 189), though he turns back to embracing ontologically real matter a few paragraphs later on in the same letter (G VI, 506/AG 191).

There is one immediately clear metaphysical advantage of endorsing the monadic view of individual substances. The substantial form can count as a true unity in the strictest sense because it alone in nature meets the strictest test for unity — it is indivisible because unextended because incorporeal: “in order to get... real unities, I had to have recourse to a formal atom, since a material thing cannot simultaneously be material and perfectly indivisible, or possessed of genuine unity” (G IV, 478/NS 11-12). But substantial forms have other notable features besides their strict indivisibility. Forms are also real in a way that mathematical points, for example, are not real; mathematical points are merely ideal because essentially geometrical and in no way substantial.14 “Mathematical points are really indivisible, but they are only modalities. It is only metaphysical or substantial points (constituted by forms or souls) which are both indivisible and real...” (G IV, 483/NS 16; see also Leibniz’s Remark B on Foucher’s objections to the “New System”, G IV, 491/NS 45-6).

To a large degree, what makes substantial forms real unities as opposed to merely ideal unities is their inherent activity. Leibniz notes over and over again that the defining feature of individual substances is the ability to act (though he also notes other essential and even defining features of substance), and one example is found in this passage from “On Transubstantiation”: “Substance is a being which subsists in itself. Being which subsists in itself is that which has a principle of action within itself” (A VI, i, 508/L 115). He repeats the idea clearly in the draft to his “New System” — “it is necessary that what constitutes corporeal substance is something... which is indivisible and yet active” (G IV, 473/NS 23), and in many other texts as well, including his
“Specimen of Dynamics” (GM VI, 234/AG 118), and the correspondence with Arnauld (G II, 99/CA 194).

For my purposes, there are two especially noteworthy consequences of this inherent activity as the definitive characteristic of substantial forms as genuine individuals. The first is that it allows natural individuals some independence from God. “[T]o act is the mark of substance”, because otherwise, ‘substance’ must be utterly dependent upon God (GM VI, 234/AG 118) who then becomes the one true substance. Allowing creatures their own inherent activity permits their independence from God necessary to avoid Spinozism and to retain a metaphysics of substantial individuals at all.

This does not mean that substantial forms, or natural beings in general, have no further use of God beyond the initial Creation. Recall Sleigh’s three options as noted above in chapter three, section VI: “With respect to causality there are just three alternatives: either creatures go it alone or God sometimes concurs with creatures or God goes it alone. Leibniz and Malebranche agreed that the first alternative is theologically unacceptable” (Sleigh 1990, 183). Given his insistence that natural substances have their own intrinsic source of activity, Leibniz clearly believes that the third option is incorrect as well, and this leaves the second option. In fact, the textual evidence is much in favour of this second option. Leibniz notes frequently that we should recognize God as the general cause, or the continual creator, but not as the immediate cause of an individual’s actions. The individual itself, as the secondary cause, must be understood to give rise immediately to its own effects (e.g. GM VI, 241/AG 125; G IV, 484/NS 17-8; GM II, 294/NS 56-7; G IV, 573/NS 139). As Leibniz writes in his remarks to François Lamy’s criticisms of “The New System”, “[d]o created things, because they are weak and dependent, have to be completely without power? And must the Creator, because he is the sovereign power, be the only powerful and active being? Can there be no perfections in creatures just because God in infinitely perfect?” (G IV, 586/NS 161).

In one way, Leibniz’s understanding of God as cause in the world is similar to Descartes’. Recall that in chapter two, section V, I suggested that God, for Descartes, constantly sustains the world while the specific laws of nature bring about the specific effects of this general cause.
Similarly, Leibniz seems to allow individuals the ability to specify effects, even while depending upon God at every moment for their enduring existence. The critical difference between Descartes and Leibniz is that for Descartes, the specifying, immediate cause is a law of nature external to substance while for Leibniz, the individual substance itself is the specifying, immediate cause of the specific, natural events.\textsuperscript{15}

The second noteworthy consequence of the inherent activity of substantial forms is that it ensures their independence from all other created substantial forms as well. Substantial forms do not need other such forms to explain their activity and change; they are their own source of this activity and change. Leibniz is clear that "there are no purely extrinsic denominations, denominations which have absolutely no foundation in the very thing denominated" (C 520/AG 32). There are a number of metaphysical advantages to this doctrine. For one, it denies that substances are at all defined by their relations with other substances (except for the concurrence of God), and this most assuredly secures their position as true individual substances rather than, for example, modes dependent in some way upon other beings.\textsuperscript{16}

But whatever the advantages of the claim that substantial forms have only intrinsic denominations, there are clear challenges that arise from this. One of these is the fact that there can be no metaphysical interaction among these substances (G VI, 607-8/M §7), and yet individual substances seem to interact within each other all the time. The fact that substantial forms are completely isolated from each other, and yet behave as if they are not (a mind, for example, processes and reacts to the information another mind seems to give it when two humans are in conversation), leads Leibniz to the doctrine that every created substantial form contains, or expresses, or mirrors the entire universe. Only this can explain how each substance appears to take into account the actions of other substances even though this cannot, metaphysically, be the case. "Now, this interconnection, relationship, or this adaptation of all things to each particular one, and of each one to all the rest, [even though Monads have no windows through which anything may come in or go out], brings it about that every simple substance has relations which express all the others and that it is consequently
a perpetual living mirror of the universe” (G VI, 616, 607-8/M §56, §7; see also G IV, 433-4/DM §9; C 521/AG 32-3; and FC 319/AG 103). The fact that a given substance expresses or reflects the whole universe, and consequently contains in some way within itself the facts about all other individuals in the universe, explains both the apparent interaction among individuals (G VI, 607/M §3) and the harmony of the whole of created nature (G VI, 608/M §12). In order to contain the entire universe, substantial forms have to be infinitely complex, even while they are simple in the sense that they have no corporeal parts.

Yet this doctrine, too, carries challenges that need to be overcome. Is not an infinite, incorporeal being that contains the entire universe something fairly close to God himself? In order to overcome this worry, Leibniz notes clear limitations to individual substantial forms. While he repeatedly notes that the essence of individual substances is to act, he also notes in places “that the very substance of things consists in a force for acting and being acted upon” (“On Nature Itself”, G IV, 508/AG 159; see also G VI, 615/M §49; letter to Bernoulli 18 November 1698: GM III, 551/AG 168). Of course, the “being acted upon” will not be a case of true interaction among substances, but will rather be a case of the “limitations” of substantial individuals -- a “confused” rather than a “clear” perception of the entire universe, for example, or a passive force complementing its active force (e.g., G VI, 610-1/M §18-24).

One way in which Leibniz notes the specific limitation -- the very limitation that identifies one individual as exactly that individual and not others (and not God) -- as well as the completeness and independence of individual substances, is to claim that each substantial form contains all the events that will ever happen to it (e.g. G IV 436-9/DM §13). This unique set of predicates, belonging to the substance as subject, identifies and distinguishes from all others the individual and its unique point of view upon the universe (e.g. G IV, 432-3/DM §8; G II, 41-2/CA 110). Indeed, a substance requires this sort of complexity for any change to occur at all (G VI, 608/M §11-13) -- to give content to the substance as an active being, to give the source of activity some substance through which this activity is manifest. And it is necessary that this complex of predicates always belongs to the
individual substance so as to explain the harmonious appearance of interaction with other substances; each substance then is constituted by God at the Creation to unfold in such as way that each of its states corresponds harmoniously with each state of every other individual also fully constituted by God at the Creation (e.g. G IV, 433-4, 439-40/DM §9, §14). God does not meddle with his creation part way through to ensure the appearance of interaction (e.g. G IV, 484/NS 17). All these ideas come together in the following passage from “A Specimen of Discoveries about Marvelous Secrets of Nature in General” (around 1686):

For it is the nature of an individual substance to have a complete notion, in which all the predicates of the same subject are involved.... But since all things have a connection with others, either mediatelly or immediately, the consequence is that it is the nature of every substance to express the whole universe by its power of acting and being acted on, that is, by the series of its own immanent operations. It is also truly one being, otherwise it would not be a substance, but several substances. This principle of action, or primitive active force, from which a series of various states follows, is the form of the substance (G VII, 316-7/MP 84-5).

Leibniz has an empirical argument for the necessary existence of the substantial form, as well as a rational argument based on the need for true unities. In his letters to Masham, for example, he notes that our experience of our own soul alerts us to something active in the world -- something which naturally strives forward through a series of perceptions -- and the principle of harmony and orderliness demands that there be beings like this everywhere (e.g. G III, 339/NS 204; see also NE 235; G II, 348/L 528; G IV, 510/AG 161). Masham’s reply is interesting since we see yet another way in which Leibniz diverges from Descartes on the relation between epistemology and ontology. Masham notes that while we experience thought, which may be active and perceptive, we do not experience an immaterial soul or rational substantial form. Though we experience active thought, this is all we experience. We do not experience an immaterial substance, and so thought could just as well be an attribute matter as it could be an attribute of soul since God is as capable of giving thought to matter as he is capable of giving thought to soul (G III, 360/NS 217). This has some echoes with Elisabeth’s reaction to Descartes’ ‘knowledge’ of the mind-body union: she, too, recognizes through experience the union of mind and body, but experience does not tell her what it is. In fact, it is easier
for her to attribute extension to the soul than it is for her to understand through reason how something like a soul can act upon body.

But Leibniz does not proceed in the same way Descartes does. Descartes starts with this empirical knowledge -- he starts with the phenomenology. Leibniz starts with problems concerning the nature of matter and the metaphysics and physics of the natural world and is led, by reason, to the need for substantial forms. His internal experience of activity and perception suggests that he has found within himself an example of the very substance (an active being with a unique point of view) which he has already determined must exist in the created world if that world is to have any reality at all. He is not working from our experience of thought backwards to the cause as an immaterial soul. Rather he has prior need for something immaterial, unextended and active, and he simply latches upon himself (as mind) as an example of this kind of active being. And "souls serve to give us a certain knowledge of others at least by analogy" (G II, 77/CA 162).

One final, and crucial, fact about the substantial form must be noted before turning to the second, organic, strand of the metaphysics of individual substances. This final fact has been touched upon already, but let me make it explicit. All substantial forms were created, fully formed with everything that would ever happen to them, by God at the Creation. One reason for this is grounded in the nature of the substantial form as unextended. Such a being cannot come into existence naturally but rather only supernaturally as an act of creation by God. This follows from the fact that to come into existence naturally, the substantial form would either have to be compounded out of existing beings or it would have to be the result of the dissolution of existing beings into parts. If the former, then the 'substantial form' as the ultimate individual unity would not be such a unity because it would be a compound and not a simple substance. If the latter, then it may be a whole, complete and self-subsisting substance, but then it has always existed as such and did not come into being upon breaking apart from an existing being; indeed, that breaking apart is the dissolution not of a single substance itself but of a compound. Substantial forms come into being only by creation ex nihilo, and they cease to exist only by annihilation (e.g., see G VI, 607/M §4-6; G IV, 479/NS 12). Since both
these events are miraculous and since miracles are rare events, God brings all substantial forms into existence only at the Creation, and he will eliminate them only at the end of the universe (G IV, 479/NS 12).¹⁹

The need to avoid numerous miracles explains not only why all monads are created at the Creation but also why they are created fully formed complete with all their states. Changes in the nature of a substantial form cannot occur naturally — they cannot gain or lose predicates or states due to interaction with other substantial forms, for example. Such changes can only occur supernaturally by an act of God. Since it is miraculous to so change substantial forms, God ensures that all changes throughout the duration of the created universe can be natural changes — changes arising from the nature of the individual itself and not from God.

The monadic metaphysics solves all four problems of material unity by simply side-stepping the issue altogether; if there is no ontologically real matter, then there are no more metaphysical problems of material unity. If matter is a phenomenon, then unity of matter is phenomenal too, perhaps believed to exist in nature by the perceiving soul. But the problems of material unity are not entirely moot for Leibniz because he often suggests that substantial forms cannot come without material substance attached to the form. That is, Leibniz sometimes claims that soul-like substantial forms on their own are incomplete and must come attached to some sort of material body in order to be considered a complete substance. He writes to Masham of 30 June 1704: “As for complete substances which have no extension, I believe with you, madam, that there are none among created things, for souls or forms without a body would be something incomplete... the soul is never without an animal...” (G III, 357/NS 215; see also letter to Bernoulli, 20/30 September 1698: GM III, 542/AG 168; letter to de Volder of 20 June 1703: G II, 250-1/AG 175-6). Even when he does not go so far as to say that monads or souls are incomplete on their own, he frequently claims that they nonetheless are always attached to bodies. “Substantial principles do not fly about outside substances. The soul is never naturally without a body” (G IV, 474/NS 24). This is, of course, his hylomorphic metaphysics.²⁰
V. Hylomorphic organisms as the true unities of the natural world

The organic, hylomorphic metaphysics begins with many of the problems in the physics of matter that I noted in the previous section -- the problem of how to account for bodies in collision and the conservation of force, for example. Many, if not most, of these problems, present themselves to Leibniz in some form or another very early. An early and enduring solution is to declare that extension on its own cannot be the nature of material substance, but this solution does not proceed to the denial of material substance altogether. Rather, this solution posits that something mind-like, together with extension, constitutes the essence of material substance. Leibniz identifies the necessary element of mind in a letter to his teacher, Thomasius, written in April 1669: “the first principle of motion is the primary form, which is really abstracted from matter, namely mind, which is at the same time the efficient cause” (G I, 22/L 99). Around the same time (perhaps slightly earlier), in his “On Transubstantiation” he links mind with matter and makes explicit the connection between this link and true substantial unity or oneness or being. Here are the critical points in the argument: “Being which subsists in itself is that which has a principle of action within itself.... If that which has a principle of action within itself is a body, it has a principle of motion within itself.... No body has a principle of motion within itself apart from a concurrent mind.... Therefore no body is to be taken as substance, apart from a concurrent mind.... Thus the substance of body is union with a sustaining mind” (A VI, i, 508-9/L 115-6).

Christia Mercer argues that through Leibniz’s early and middle years what changes in his theory of material substance is not this basic hylomorphism of passive body together with something active like a mind as the model for individual material unity. Rather what changes in this general hylomorphic framework is the nature of the mind or activating principle. As Mercer charts Leibniz’s development, the activating principle is first God, then thought, and then conatus or force (Mercer 1989, 135ff). We get a statement of this general hylomorphic framework in a letter to Arnauld of 14 July 1686, where Leibniz specifies it as the correct alternative to Descartes’ theory of material substance. “If the body is a substance and not a mere phenomenon, like a rainbow, nor a being,
brought together by accident or accumulation, like a pile of stones, its essence cannot consist in extension and we must necessarily conceive of something which is called substantial form and which corresponds in some sort to the soul” (G II, 58/CA 135). Importantly, in this correspondence, Leibniz develops his ideas regarding the nature of the material principle in the hylomorphic union -- and his final answer (one that endures for the rest of his life) is that substantial forms are unified with organic bodies.

Early in the correspondence, Leibniz starts with the suggestion that we can be certain that humans (or at least one -- oneself) qualify as substantial beings, but he eventually widens the class, concluding that substantial material unities, or true beings, are animated and living bodies, or organisms. Here are some key texts in this progression: “Substantial unity calls for a thoroughly indivisible being, naturally indestructible.... It can be found... in a soul or a substantial form, such as the one called the me” (letter of 28 November/8 December 1686: G II, 76/CA 161). This could be read not as an example of Leibniz’s hylomorphic metaphysics, but rather an example of his monadic metaphysics — what is real because indivisible is the human soul. But in the Discourse, Leibniz has already written of the composite human being (body and soul) as a true individual substance: “... the bodies which constitute a unum per se, as human bodies, are substances, and have substantial forms” (G IV, 458/DM §34).

In the correspondence, Leibniz is reluctant to limit the class of hylomorphic individuals to humans only. “I think... that to attempt to limit true unity to man alone is... shortsighted in metaphysics...” (letter of 30 April 1687: G II, 98/CA 192-3). “It seems to me that, however, certain, that if there are corporeal substances, man is not the only one, and it appears probable that beasts have souls although they lack consciousness” (draft letter of 28 November 1686: CA 156). And eventually he concludes that

... I am far from saying that animated bodies constitute only a small proportion of the bodies of the world; for, I think rather that everything is full of animated bodies.... and that matter being divisible without end, no portion can be obtained so small that there is not in it animated bodies, or at least such as are endowed with a primitive entelechy, and (if you will permit me to use the word life so generally), with the vital
principle, that is to say, with corporeal substances, of all of which it may be said in general that they are alive (letter of 6 October 1687: G II, 118/CA 221, second emphasis added).

Although he is slow to admit all organisms into this framework (especially plants), Leibniz does do this eventually, and the conclusion is that corporeal substances just are animated bodies or organisms such as humans, animals and plants (G II, 126/CA 233). This ontology persists well beyond the correspondence. Here is what he writes in the *Monadology*: there are no “souls wholly separate from bodies, nor bodiless spirits” (G VI, 619/M §72), and “[i]t is evident, then, that every living body has a dominating entelechy, which in animals is the soul” (G VI, 619/M §70; see also “New System”: G IV, 480-1/NS 14; notes for a letter to Des Bosses, 5 February 1712: G II, 438ff/AG 199ff).\(^\text{21}\)

Why does Leibniz claim that substantial forms always come unified with organisms as opposed to any other kind of matter?\(^\text{22}\) I think that there are many reasons for this, but I shall look at only those most pertinent to the issue of preformation. There are three points in particular that I wish to look at, and all three have been broached in the discussion of Leibniz’s monadic metaphysics. These are the ideas that the individual is something unified because indivisible, something complex and something active.

Leibniz makes the connection between unity and indivisibility quite clear. The reason why extended matter cannot constitute a unity is because it is divisible without end. The substantial form is a unity because it is not divisible because it does not have corporeal parts. But the same cannot clearly be said of the organism which does have corporeal parts. Although it may not be defined only nor even essentially by its extension, an organism nonetheless seems to include extension whatever else may be said of it. Since a “body is not a substance but an aggregate of substances, since it is always further divisible, and any given part always has another part, to infinity” (FC 319/AG 103), and since an organism is at least a body, it would seem to follow that an organism falls prey to the same argument against its individual substantiality. After all, a living being can be split in half (and so on) in a way the substantial form cannot be.

On this point, an organism is no more strictly indivisible than is a material atom which
Leibniz denies is indivisible precisely because it has parts — it has a right hand side and left hand side, for example, regardless of how small and dense it is imagined to be. If it is conceptually divisible, God can divide it. Atoms are excluded from the class of true unities precisely because they are extended (“Primary Truths”: C 522/AG 34), and so organisms would seem to be excluded for the same reason. But although the organism and the material atom share the characteristic of being, strictly speaking, divisible, Leibniz rejects the material atom as a unit in material nature for a further reason which is instructive for the present discussion. Atoms cannot be true unities or real beings because the “atom, which consists of only an imagined mass with an infinite duration... cannot contain in itself all its past and future states...” (letter to Arnauld of 28 November 1686: G II, 78/CA 164). This is because the atom, “although it has parts, has a uniform interior” (comments on Bayle: G IV, 544/NS 101). Since it does not contain a variety of states, it never changes. Since it is only material, it is passive and unable to move itself or be active. It does not have the essential marks of an individual substance in the way a substantial form does; it is not active and does not carry itself through its successive and various states because it is not a complex being with a variety of internal states.

The same cannot be said of organisms. Organisms, unlike atoms, do not have a “uniform interior”, and in fact are complex in a way that atoms are not. Given this, perhaps it could be argued that an organism is the paradigm of a true material unity because, although it is not indivisible in quite the same way that a substantial form is indivisible, it is nonetheless indivisible in a way that atoms are not. An organism cannot be split in two without ceasing to exist as a living being (see, e.g., Mercer 1989, 163). This, of course, must be qualified. A living being cannot loose certain essential parts (a heart, for example) without ceasing to exist as a living being, but it can continue to exist as itself (as a living being) if the division separates off a non-essential part, such as a hand. Still, if we take the division as one that separates from each other certain essential parts so that there remains no intact structure capable of functioning as a living whole, then living beings as living beings are whole and indivisible because they cannot be divided in this way.
Arnauld recognizes that some material things are indivisible in the sense that organisms are indivisible, while others are unlike organisms in that they can be divided without changing their essential nature. “[E]very body which can be divided so that each part will remain of the same nature as the whole, such as metals, stones, wood, air, water and other fluid bodies, have no substantial form.... [O]nly animals have substantial forms, and... therefore in your opinion only animals are true substances” (Arnauld [1686-90] 1995, 174). Atoms can be added to the list of those bodies which can be divided so that “each part will remain of the same nature”.

But I do not think that this captures why Leibniz focuses on the organism as the prime example of a material unity. A critical reason, to be taken up in section VII below, is that Leibniz believes the life continues whatever divisions befall the organic body. Let me deal with another reason here. This reason turns on the way in which living and non-living machines are distinguished (or not). Even if it is true that an organism cannot be split in parts (at least in certain ways) while still maintaining its defining feature of life (if we think of life as the ability to function in certain ways), neither can a non-living machine be divided in certain ways while still maintaining its defining feature of functioning according to its specific purpose. The tip of the hand of a clock can be broken off from the rest of the clock, just as a living human’s hand can be severed, and the clock will still function more or less according to its purpose. But certain springs or weights in the clock are essential to its ability to continue functioning as a clock no less than certain parts of living bodies are essential to their ability to function as a living being. A clock cannot be split in half with each part remaining of the same nature as the whole any more than can a living body be split in half. As far as structural indivisibility goes, the living and non-living machine seem to have a great deal in common. Indeed, Leibniz is explicit that structural organization, even internally-referred organization that consequently belongs to a single whole machine, does not constitute true substantial unity. “The regular or irregular arrangement [of machines, or of my body by itself] does not constitute substantial unity” (G II, 75/CA 159). Rather, unity through function is only a higher degree of accidental unity than, say, the ‘unity’ of a pile of stones (G II, 100/CA 196). On this point, Leibniz clearly diverges
from Descartes who, I have argued, takes the regular structural arrangements of the wholly material parts of living machines to be adequate in explaining the functional integrity that in turn explains the enduring identity of an individual unity.

Yet Leibniz does believe that organisms are true unities in a way that well-functioning artificial machines are not: “In my view the unity of a clock... is completely different from that of an animal; for an animal may be a substance with a genuine unity... while a clock is nothing but an aggregate” (“First Explanation of the New System”: NS 48). Animals are not mere machines (G IV, 478/NS 11). Let me turn to the distinction between the natural and the artificial to tease out two primary reasons why I believe he makes this distinction. The first reason follows from a typically early modern way of distinguishing between the artificial and the natural, while the second reason follows from a very Aristotelian way of making this distinction.

Given the prevalent early modern belief that natural beings, such as organisms, are machines on par with clocks and the like, it is necessary to find some way of accounting for the intuition that there is a distinction to be made between natural machines and artificial machines. That at least some early moderns hold this intuition seems clear -- my discussion of Descartes and Malebranche on the difference between living and non-living machines underscores this. A standard way of making the distinction between the artificial and the natural is to note the identity of the artificer in each case. Artificial machines are made by humans while natural machines are made by God. Thus, while there is no difference in kind, there is a difference in degree. Both Descartes and Malebranche note that natural beings are machines, though their parts are smaller and more complex (for Malebranche, infinitely so) than are the parts of artificial machines. Leibniz also makes the distinction between natural and artificial machines at least partly in this way, a distinction that Leibniz believes has not been fully appreciated (e.g. G III, 356/NS 214). Like Malebranche, Leibniz believes that natural beings, such as organisms, are infinitely complex. Further, this complexity takes on a very specific form. “It needs to be recognized, then, that nature’s machines have a truly infinite number of organic parts.... A natural machine is still a machine even in its smallest parts...” (G IV, 482/NS 16). Natural
machines are machines within machines to infinity, while artificial machines are finite in their complexity and do not include machines to infinity in each of their parts.

Sometimes Leibniz indicates that we can take nature's machines to be infinitely complex because this shows the workmanship of God with his infinite mind who would not create something limited if he could create something more glorious and infinitely orderly (e.g. G IV, 482/NS 15-6; G III, 340/NS 205; G II, 126/CA 233; G VI 617-8/M §63). But a reason that connects more directly with natural philosophy takes heed of the fact that organisms are united with substantial forms and have to be the sort of beings that are appropriate to be united with these forms. "[I]t seems hardly reasonable that souls should remain, useless, in a chaos of confused matter" (G IV, 480/NS 14), and it is natural to assume that souls are always found in bodies that are organized (G II, 124/CA 230). This is where organisms, as natural and infinitely complex machines constructed by God, satisfy minimal conditions that neither a material atom nor an artificial machine can satisfy. Given that substantial forms are infinitely complex in the sense that they have an infinite number of predicate or states within themselves, only a material being that is also infinite can be an appropriate counterpart to that formal principle. Organisms, or natural machines made by God, are able to express their past and future states as do substantial forms because they are complex (as atoms are not), and they are able to do so without limit (as artificial machines are not able to do).

The importance of this final point ought to be drawn out more explicitly. Just as substantial forms must be able to mirror the entire universe -- just as such forms must be able to contain the entire universe, expressed from its own point of view -- so too must the material portion of individual substances contain a certain expression of the entire universe. "In my judgment an organic machine... always contains an infinity of organs so it can express, in its own way, the whole universe; indeed, it always contains all past and present times, something in the very nature of all substances" (letter to de Volder, 20 June 1703: G II, 251/AG 176). As substantial forms progress from state to state, and given the need for such an infinite variety in these states at least in part to account for the apparent interaction with other substantial forms, organisms must be able to progress through an infinite
number of states given that they are the material half of the complete substance. Only something made by God could satisfy these conditions, and so natural, but not artificial, complex machines must be the material counterpart for substantial forms.

On this point, Leibniz is clear that, while matter may be extended, extension is not what defines its essence. Rather, "organism, that is to say, order and ingenuity, is something essential to matter produced and arranged by a sovereign wisdom..." (letter to Masham, May 1704: G III, 340/NS 205; see also G II, 98/CA 193). Leibniz, thus, defines the essence of material substance by its organization and not its extension, but makes use of extension and its infinite divisibility to achieve the definition of natural, organic machines in the first place. Because matter (as extension) is infinitely divisible, God is able to make material substances (as organisms) infinitely complex in order to mirror the universe as is in the nature of individual substances (G VI, 618/M §65).

But Leibniz also latches upon the organism as the paradigm example of a material unity on his hylomorphic metaphysics because it satisfies another criterion that artificial machines cannot satisfy. This makes use of an Aristotelian way of distinguishing the natural and the artificial, although I have argued in chapters two and three above that both Descartes and Malebranche also rely heavily on the intuition at the core of this Aristotelian distinction. This is the idea that natural beings carry their own source of motion and change within them while artificial beings are moved or changed from without (Physics 192b9ff). One of Malebranche's two main arguments for preformation relies on this intuition, because this argument turns on the belief that the organism must come with all essential organs and parts attached and functioning — every essential parts implies every other. This argument makes use of the idea that the organism is internally capable of maintaining itself and functioning (moving and changing) due to its own structure which permits that functioning.

Similarly, Descartes takes the living machine to be different in kind (they are individuals) from non-living machines (they are mere aggregates), because the living machine transforms as it grows and it grows due to its own source of action which, like Malebranche, depends essentially on a specific functioning structure.
Leibniz shares this intuition that natural machines are self-moving and self-transforming in a way that artificial machines are not. But he dissents from the belief that a wholly material form is adequate for the functional integrity that serves to maintain the material unity of the natural machine. Something else must account for the structural integrity, or the ability of such machines, of organisms, to maintain themselves even as they transform in certain ways. This ultimately depends upon Leibniz’s rejection of Descartes’ conception of material substance. Specifically, Leibniz’s dissent from Descartes depends upon one problem of this definition; it depends on the fact that something merely extended — bulk or mass -- even if somehow structured into a material form, cannot be the source of the motion or activity necessary to account for the self-maintenance and transformation we witness in living machines. To reiterate, while Descartes seems to believe that material structure permits the specific functions needed to maintain material unity in the form of organic structure, Leibniz does not believe that such a structure will suffice, because without a source of activity, the material structure will not function at all.

At this juncture, it might be useful to look at Descartes’ two conceptions of life as presented above in chapter three, section IV. One conception is the theory that states that life is a specific disposition or configuration of organs such that the whole is able to function on its own. The second conception is the theory that states that life is heat, specifically the heat of rapidly moving particles in the heart. While I argued above that the first conception must be the one he endorses in order to explain the behaviours of living beings, I suggest here that the second conception is critical as the source of the living body’s active behaviours. The heat of the heart is what forces particles of matter to move throughout the body in its various living functions. But Leibniz’s concern regarding the essence of material substance as Descartes defines it is relevant here. How can essentially passive matter be a source of activity? The heat is caused by rapid motion, and rapid motion causes heat, but what starts the cycle (something akin to fermentation, Descartes tells us, but what are the mechanics and the metaphysics of that?) and what keeps the cycle going? As long as organic structures are made of nothing other than material extension, no matter how well-structured that extension is, this
question remains.

So in order to explain active living behaviours, there must be a source of those behaviours -- a source of activity -- in organisms. Organisms cannot be only material substance. They cannot even be only structured material substances -- or material forms -- since these, too, require a source of their living actions not found in mere matter, regardless of its organization. Indeed, the living structure itself, as complex, diverse and distinct, also requires a source of its complexity, diversity and distinctness not found in passive extension. Organisms, as machines no less than human-made machines, require something with an essentially active nature in order to function. According to Leibniz, this thing is the substantial form. "I can conceive of properties in the substance which cannot be explained by extension, by form and by motion... unless we have recourse to the force that is the cause of the motion and that adheres in the corporeal substance.... The wholly bare supposition of extension... mass, by itself... is as much inferior to a substance... as a dead body is below an animal or as a machine is inferior to a man" (G II, 98/CA 193, emphasis added).

This brings us to the central reason why, in my estimation, Leibniz chooses the organism as the paradigm of material unity, or the paradigm of the individual material substance. The reason is not that an organism cannot survive as itself (as a living being) if divided, for this can be said of any functioning machine, living or not, and so there is no reason to choose an organism rather than any other machine. (Again, as noted above, I shall qualify this later as Leibniz actually believes that the life continues despite the destruction of the organic body.) The reason is not that an organism is strictly indivisible, because it clearly is divisible in a way that unextended substances are not. The reason is not even the fact alone that the organism is infinitely complex, because this alone cannot account for internal, self-motivated change. Rather, like Descartes, Leibniz latches upon certain behaviours of living beings as the mark of the individual. But unlike Descartes, the behaviours in question are much more broadly defined. It is not nutrition and generation and reproduction and the maintenance of a very specific structure that Leibniz latches upon as the living behaviours that make organisms especially worthy of the title of the material individual. I suggest that it is the general
behaviour of self-activity; it is the phenomena of motion and change in general, and specifically the self-motivated and self-maintained motion or change that, in the visible world, seems to belong most clearly to living beings. Certainly nutrition and so on are among those processes broadly conceived of in which the subject in question is active. However, Leibniz is not concerned only with the specific behaviours that Descartes chooses as indicative of living beings; rather what is key is any active behaviour or change in general originating from within the living being itself. To reiterate what I noted in the discussion above of the substantial form, Leibniz frequently writes that whatever has a principle of action within itself is a substance — “the state of the body at moment B follows the state of the body at moment A... according to the concept of substance in general” (G II, 114/CA 215, emphasis added) — and the self-transformative capacities of organisms reveal their substantial reality because they expose the presence of a principle of action within.

There is evidence in a number of places that Leibniz has something like this in mind. In some of his letters to de Volder (especially 10 November 1703: G II, 257-9; and 21 January 1704: G II, 262-5), he notes that we can discern the presence of a substantial form by observing the phenomena — if we experience change or motion, we will understand that there must be a source for that change or motion. Thus, rocks and other inorganic bodies are not to be taken as substances unified with a substantial form, although animals and other animated beings, “perhaps also other kinds which are entirely unknown to us”, are to be taken as such substances (“Considerations on Vital Principles”: G VI, 539/L 586). In answer to Arnauld’s queries as to whether the sun, moon and earth have substantial forms and are therefore true substances, Leibniz answers that he could only be sure if he knew definitely whether or not they are animated (G II, 77/CA 162).24

This mix of modern and Aristotelian ways of distinguishing the natural from the artificial leads to an interesting blend of commonality with and divergence from Descartes’ theory of the living machine, and his theory of hylomorphism. In common, both thinkers hold that natural machines, or at least living machines, transform and change in certain ways and yet remain the same individual. Both attribute the ability to transform, at least in part, to the complexity of the material machine. For
Descartes, a very specific complex structure is required for that transformative behaviour to occur. For Leibniz, complexity is needed for there to be the variety of states required for the organism to move successively through those states.

But the differences between the two thinkers are significant. For Descartes, living functions are the *cause* of the unity of the material individual. For Leibniz, living functions are the visible *effect* which reveals the presence of a source of activity, which is the source of substantial unity itself. This source is the substantial form. Another way to phrase this crucial parting of ways is as follows. For Descartes, the transformation of matter into a material organic form (specifically the human) prepares that form for the reception of a soul. For Leibniz, the transformation of an organism through the various stages of its history reveals the presence of a soul, or something soul-like. For Descartes, if it is a living (human) organism, it therefore can have a soul, while for Leibniz, if it has a soul (or a substantial form), it therefore can be counted as a living organism. Descartes explains life in wholly material terms, while Leibniz attributes life to the (plainly self-acting) organism in virtue of its union with a substantial form. For Descartes, life is very narrowly defined by a small number of behaviours requiring specific structures, and living beings are a small subset of the reality of the material world. For Leibniz, life is defined by the union of a substantial form and a body essentially organized, but not limited to a single structure, and living beings are the only realities of the material world, and they have to be everywhere for the natural world to have reality at all (G II, 118/CA 221; I shall return to the claim of the thorough-going prevalence of organisms in nature in section VII below). And indeed, Leibniz frequently makes this connection between life and an active substantial form (rather than between life and a specific shape or material form). “[A]nimated machines [are those] whose soul or substantial form constituted the substantial unity independently of the external union of contact” (G II, 77/CA 162; see also G II, 100/CA 194; NS 239; GM III, 552/AG 169).

The concerns Leibniz has about the physics and metaphysics of the material world are all alleviated by this organic metaphysics. The phenomena of motion and change are accounted for because there is a source of, a cause of, these phenomena. The living being, as an organism united
with a substantial form, is the source of motion. Similarly, the diversity of the material world is accounted for, because diverse and varied organization simply is essential to material substances understood as organisms (letter to de Volder, 20 June 1703: G II, 249/AG 175). And both the problem of the behaviour of bodies in collision and the problem of the conservation of force are solved once Leibniz posits force as substantial form as primary, with motion as derivative. There are two other problems I mentioned above: the problem of how to distinguish God from creation if God is the sole cause of activity in creation, and the problem of how to derive any material-unities at all on a metaphysics of material substance as extension. Both of these problems are also solved by the hylomorphic organic metaphysics, but since these are problems also of material unity and individual identity, I shall address these as part of the general problem of individual unity which I maintain preformation is meant to solve. So let us now turn to preformation in Leibniz, and its connection with the unity of the individual.

VI. Preformation: miracles and unity

The correspondence of 1686-88 is key in the development of Leibniz’s theory of the organism as the paradigm material unity. To my knowledge, it is also the beginning of his theory of preformation. Indeed, in his Discourse on Metaphysics, written just prior to his correspondence and which initiated the letters of the years I am interested in, he puts forward a theory of generation remarkably like the “inchoate preformation” that I have argued is at the core of Descartes’ theory of generation. “God is also a workman able enough to produce a machine still a thousand times more ingenious than is our body, by employing only certain quite simple liquids purposely composed in such a way that ordinary laws of nature alone are required to develop them so as to produce such a marvelous effect. But it is also true that this development would not take place if God were not the author of nature” (G IV, 447/DM §22). Once the groundwork of the correspondence is set, however, Leibniz is one step away from endorsing the preformation doctrine, or at least his own unique version of it. And we are a small step away from reaching this conclusion and establishing the connection between that doctrine
and Leibniz’s theory of material individuation and identity.

To explicate Leibniz’s theory of preformation, let me start with the problem of miracles. I shall show that, like Malebranche, Leibniz posits preformation in order to avoid a huge number of miracles (one for every generated life), but the fact that Leibniz has a different definition of miracles means that he posits preformation for markedly different reasons than does Malebranche.

Malebranche, I argued in chapter three, embraces preformation in part to avoid an appeal to miracles. The arguments runs roughly as follows. A miracle, according to Malebranche, is an event in the world which either is unlawful or accords with a law beyond human understanding. Consequently, while occasionalism may imply that God works ubiquitously in the world as the immediate and exclusive efficacious cause of everything that happens, this is not a miracle according to Malebranche as long as this action is lawful and at least potentially knowable. Generation of organic unities through a Cartesian model of the lawful motion of bits of divisible matter rather than through preformation is nevertheless a miracle on Malebranche’s system. There are two reasons. One reason, and this is a reason that I do not think Malebranche fully recognizes, is that the maintenance of organic unity once it is achieved required a suspension of the very laws of motion that brought that unity into being in the first place. The laws of motion that govern matter understood metaphysically as extension threaten at every moment to destroy the organic structure of the living being (this is the Problem of Organic Endurance).

Things are even worse. Even on the theory of preformation this threat is ever-present. That is, Malebranche admits that the laws of motion are fully capable of destroying a living organism (though they cannot create one), and so the question remains why these laws, and the motion and collision of matter do not so destroy organisms for all the years since the Creation that they lie in waiting in the ovaries of their mothers, and for all the years that they are alive as we experience them. The second reason why generation on Descartes’ model of “inchoate preformation” represents a miracle depends on Malebranche’s supposition that natural laws cannot, in a finite period of time, bring an infinitely complex organism into existence. This requires a special creative act of God, or a miracle, and must
happen at the Creation to avoid positing a huge number of miracles throughout the duration of the universe.

I think that Leibniz has adequate answers to both of these worries. I shall deal with his answer to the first problem in subsequent sections of this chapter. Leibniz could answer the second worry as follows. It is in fact possible that infinite complexity can come into being in a finite amount of time as long as the initial conditions of matter are such that the general laws of motion could achieve this (as suggested in DM §22). This turns on Leibniz’s own infinitesimal calculus. The first step in an infinite series of steps (that will, without fail, end in a complete organism of a given species as long as the initial matter is so structured) might take $\frac{1}{2}$ second, the second step might take $\frac{1}{4}$ second, the third step might take $\frac{1}{8}$ second, the $n$th step might take $\frac{1}{2^n}$ second, so that the whole series — a series that converges — could be completed in a single second.

But Leibniz does not, in the end, accept the Cartesian “inchoate preformation” as the solution to the problem of generation even though it appears to be his approach in the Discourse §22.27 Interestingly, I believe that his reason, like Malebranche’s, can be understood as a rejection of miracles in the everyday event of generation. But because Leibniz defines miracles quite differently, the issue of miracles figures quite differently in his theory of preformation. Miracles are, according to Leibniz, actions or events in the world that go beyond the powers of creatures themselves and depend, rather, upon God. As Leibniz claims in the Discourse: “... that which goes beyond the natures of all created substances is supernatural” (G IV, 442/DM §16; also NS 82).

As I showed above in a discussion of Leibniz’s monadic metaphysics (section IV), this way of conceiving miracles impacts his metaphysics of the substantial form in at least two ways. First, regarding their generation, substantial forms can only be brought into being by an act of God. They cannot, because of their nature as unextended, be brought into being naturally either by composition of other natural substances nor by dissolution of such substances. But the bringing into being ex nihilo of a substantial form is necessarily a miracle because this is an act beyond the nature of the substantial form itself. Thus, all substantial forms were created by God at the Creation. Second,
regarding their alteration, substantial forms can only change by having states or predicates added or subtracted by God (there can be no influx of predicates from substance to substance). A second option is that substantial forms have all their states within themselves at the Creation, put there by God so that they would unfold throughout the history of the universe. Given his desire to avoid miracles, Leibniz opts for the second route, and posits not only that God created all substantial forms all at once at the Creation, but also that he did so with all the predicates that would ever apply to them as intrinsic to their nature.

Thus, the need to avoid innumerable miracles (which would make them meaningless as miracles) leads Leibniz to a theory of substantial forms which makes them entirely independent from other substantial forms, largely independent from God and with their own enduring identity. That is, the need to avoid miracles leads Leibniz to firmly establish the independent and complete individuality of the substantial forms. Once we couple this with his hylomorphic, organic metaphysics, preformation follows. Substantial forms are created with all their future states at the Creation; substantial forms are never found apart from organic bodies that are infinitely complex partly so that they can transform through various states as do their associated substantial forms; further, substantial forms cannot transmigrate from organism to organism (e.g. G IV, 474/NS 24); and consequently, all organic bodies are also created with all their future states at the Creation to coincide with the substantial forms with which they are joined into per se unities. This is preformation, and the doctrine arises in Leibniz precisely because he needs to maintain the independent individuality of the formal principle of the organism on pain of postulating perpetual miracles.

Leibniz makes clear the progression from problems of individual unity to his theory of organic preformation in his “New System”. Here, he denies that a substantial form can ever leave its pre-assigned (at the Creation) organic body and transmigrate to another. That is, the single whole corporeal substance can never cease to exist as a hylomorphic organism, as a unity per se. Once this is established, he concludes that the “duration which must now be attributed to [ordinary forms or brute souls]... might give rise to the idea that they pass from body to body.... There is no such
passing... [N]o animals or other organized substance begins when we think it does, and... its apparent
generation is only a development, or a kind of augmentation” (G IV, 480/NS 13). In a letter to
Foucher regarding the doctrines of the “New System”, Leibniz indicates that preformation follows
from the incorruptibility, and thus unity, of the soul (G I, 391/NS 54-5). Similarly, in the
“Considerations on Vital Principles”, after having explained that substances are autonomous from
each other and from God, and are imperishable because of the need to keep them autonomous (G VI,
540ff/L 587-8), Leibniz notes that this issue of individual independence and unity distinct from others
and from God has led him to his theory of generation by preformation. “I have come, imperceptibly,
to an explanation of my opinion of the formation of plants and animals, since it appears from what I
have said that they are never formed entirely anew” (G VI, 543-4/L 589).

So we can now see how Leibniz’s solutions to the first two problems of material unity first
noted in chapter one, section V lead directly to preformation. The first problem is the Problem of
Material Existence, and Leibniz solves this by noting that matter gains reality only through its
hylomorphic union with something that is indivisible and therefore capable of real being, namely the
substantial form.29 The second problem is the Problem of Material Independence. This follows from
the difficulties of how to account for natural, material activity given Descartes’ definition of matter
which includes the fact that it is passive. Leibniz solves this by the same hylomorphism: matter can
be independent from God’s ubiquitous role as efficient cause (as Malebranche’s occasionalism
demands, in Leibniz’s view) because matter has its own internal source of activity, derived from its
union with a substantial form. But the Problem of Material Independence is part of a broader problem
of independence from both God and other substances that applies to immaterial substances too. Thus,
the substantial form, to be a real substance, needs independence from God and other substantial forms
or else Spinozism (with its erasure of individual substances altogether) looms. Consequently, as
argued above, the substantial form must be complete with its infinite states and created thus at
Creation. So, too, must the associated matter be so created, and this matter must be an organism to be
the sort of thing that can be properly associated with a substantial form. Leibniz’s theory of
preformation is primarily a theory meant to solve difficulties in the early modern period with individual unity and identity (both material and immaterial), and it only incidentally solves the difficulty of how to account for the regular generation of complex, organic forms on a mechanical philosophy.

In chapter one of this work, I noted that my interest is primarily with the generation of material bodies considered in isolation from the soul wherever possible, and that consequently, my primarily interest is with the individuation of material unities. I also noted, however, that it would not be entirely possible to fully isolate material individuals from immaterial, formal principles. Leibniz proves this point most clearly. This is established by the above exposition of how Leibniz’s solutions to the first two problems of material unity lead to preformation -- the solutions to these problems rely on an active and immaterial soul-like individual.

Leibniz’s theory of preformation also solves the other two problems of material unity. Recall that these are the Problem of Reconciliation and the Problem of Organic Endurance. I shall deal with Leibniz’s solutions to these two problems more thoroughly in subsequent sections. Here, let me say just a few words about them. The third problem of material unity that Leibniz is able to solve is the tension between extended matter and material organisms and the way in which material individuals are individuated into unities that maintain their identity on these two models of body. On the model of extended matter, according to Descartes, an individual is any portion of matter at rest relative to itself. The consequence of this definition is that the material individual ceases to exist once any part of that matter is lost or once a new part is gained. Conversely, on the model of material organism, an individual is the persisting organism which is gaining and losing matter all the time as part of its normal functioning. The consequence is that the individual endures as long as the organic structure endures even if parts of matter are lost or gained. These two conceptions of material individuation stand in conflict with each other, and Leibniz solves this by denying the reality of matter as extension and consequently refusing the idea that a material unity can be individuated by parts of matter at rest relative to each other (e.g. “A Specimen of Dynamics”: GM VI, 253/AG 136). Corporeal substances
(those that have ontological reality) are only material organisms unified with a substantial form which are gaining and losing constitutive matter all the time while still remaining material unities.

The fourth problem (of Organic Endurance) also arises because of a tension between the two conceptions of body. This is the fact that extended matter, moving and colliding according to laws of nature, should destroy the structural unity of material organism. This is one reason why generation is a miracle for Malebranche: the maintenance of organic unity requires a suspension of the laws of motion working upon the matter that makes up all the parts of the organism. Leibniz has an answer to this too, but a proper treatment will have to wait until we have investigated the nature of the organism and of life, as well as the nature of mechanism, as these are pivotal to a proper solution to this difficulty.

Let me close this section with a comparison between Leibniz and Aristotle, and between Leibniz and some of his contemporaries on the relations among generation, miracles and hylomorphism. Leibniz certainly revives an Aristotelian ontology of substance in order to account for material unity (as Aristotle himself uses this ontology) but there are more differences between the two than there are similarities. As noted in the introduction, Aristotle uses the substantial form in order to explain not only the unity and identity of individuals but also to explain the generation as opposed to mere alternation of such individuals. Leibniz uses the substantial form only for the first task, and even then, his approach is notably different.

Here is one main similarity besides the basic form-matter ontology. Both Aristotle and Leibniz believe that form and matter must always comes together (this, of course, does not apply to Leibniz's monadic metaphysics) with the one exception of God who is pure form. There is no such thing in nature as prime, uninformed, matter, and there are no substantial forms without some sort of matter attached.

But Leibniz takes this requirement in a much stricter sense than does Aristotle. Leibniz believes that the same substantial form must be attached to the same organic body throughout the creation, even if this body transforms dramatically. Here, Harvey’s criticism of Aristotle’s theory of
generation is instructive. Harvey takes this to be a theory of metempsychosis which incoherently demands that a second, unembodied, soul be passed from male to female, and that this soul is present in the female before it (somehow) informs the egg (Harvey [1651] 1981, 217-18). Leibniz’s own law of continuity demands that the form does not migrate from matter to matter since this would mean that it would have to make a leap from one sort of matter to matter quite different, and this would require that the form itself undergo a leap in states as well (G VI, 529/NS 75; see also G II, 99-100/CA 195; G VI, 601-2/AG 209). But this is precisely what seems to happen on Aristotle’s theory of generation where the male passes the form over to the female matter. Indeed, it is precisely this bringing together of a form and some matter previously not joined that permits organic generation (the change in a being’s form) at all for Aristotle. By denying this migration of form to new matter, Leibniz gives up the Aristotelian solution to organic generation and indeed, he has only a theory of alteration or transformation.

But Harvey’s misgivings alert us to another worry. The form that migrates from the male to the female’s matter itself has to have come from somewhere. The adult male has always had (and still has) his own form, and so obviously has not passed his own form over to the female. But where, then, does the new form come from? Leibniz’s concerns with indivisibility strictly defined leaves him with this problem clearly framed. How does the form itself (and not just the organism) generate? It must come into existence ex nihilo even if the organism does not. Leibniz notes the inadequacy, in his view, of Aristotle’s position on the generation of form itself. “Aristotle also understood the necessity of attributing something other than extension to bodies. But he did not understand the mystery of the duration of substances, and he believed in real generation and corruption, which for him turned these ideas upside down” (letter to Foucher, 1687/8: NS 55). All the difficulties “surrounding the origin of forms... cease on my [Leibniz’s] way of explaining things” quite unlike on the view of the Peripatetics like Aristotle (letter to Des Bosses, 29 May 1716: G II, 518/AG 204). This point, like the previous, leaves Leibniz with a theory of alteration but not of generation.30

Even if Leibniz could agree with Aristotle on these two points, and even if he could accept
the basic model of the male passing on the form to the female's matter, Leibniz could not countenance the way in which Aristotle believes the machines of nature are built. That is, Leibniz would not accept the idea of the *pneuma* as a particularly special material principle that follows the instructions encoded in the form (which it also carries) in order to make the new living being. This is unintelligible and violates the laws of nature. This follows from a very restricted role that Leibniz envisions for the substantial form in the details of the physical world. It also hooks up with his rejection of similar principles in some of his contemporaries.

So while the substantial form is therefore essential to an organized body (e.g. AG 103-4), its role in nature is limited to this foundational metaphysical role. It consequently makes only very general differences in the phenomena. So, for example, the substantial form is responsible for the very fact of material reality by giving matter unity and therefore being (G II, 58/CA 135; G II, 446/L 603); it is responsible for the facts of motion and change, each of which requires the form as a source of activity (G III, 355-6/NS 214); and it is even responsible for the general laws of motion and collision, lending a metaphysical basis (force) to the physical phenomena (G IV, 444, 446/DM §18, §21).

But beyond this general impact upon the phenomena, substantial forms make no difference to the particular phenomena.

[I]t is useless to make mention of the unity... or the substantial form of bodies when it is a question of explaining the particular phenomena of nature, just as it is useless for Geometers to examine the difficulties of the continuum when they are at work in solving problems. These things are nevertheless important and worthy of consideration in their places; all the phenomena of the body can be explained mechanically or by the corpuscular philosophy in accordance with certain assumed mechanical principles without troubling oneself as to whether there are souls or not (G II, 77-8/CA 163; see also G IV, 434-5/DM §10).

Among the particular phenomena that Leibniz explicitly states are not affected by substantial forms are the facts about the course of motion -- the substantial form does not direct motion (G III, 356/NS 214; G VI, 540/L 587), and the details of particular bodies. Most explicitly, Leibniz insists that the substantial form does not act as an intelligent, nor even pre-determined, builder of nature’s machines.
On this point, Leibniz clearly distances himself from Henry More, Ralph Cudworth and other “vitalists” who also posit active forces in nature but who do so in order to account for the details of the created world by positing something like a *pneuma*:

However, even though I admit an active and, so to speak, vital principle superior to material notions everywhere in bodies, I do not agree with Henry More and other gentlemen distinguished in piety and ability, who use an Archaeus (unintelligible to me) or hylarchic principle even for dealing with the phenomena, as if not everything in nature can be explained mechanically, and as if those who try to explain everything mechanically are thought to eliminate incorporeal beings... (“A Specimen of Dynamics”: GM VI, 242/AG 125-6).

Leibniz seems particularly keen on distancing himself from the idea that there are intelligent incorporeal natures at work on the matter of the world (e.g. G IV, 504/AG 156; G IV, 512/AG 163). And he is also clear that whatever the substantial form may be, it is not the builder of organisms: “It is, unfortunately, our destiny that... [w]e must return to chimeras, to Archae, to certain plastic *intelligences* that attend to the formation of the fetus, and afterwards, to the care of the animal...” (“Against the Barbaric Physics”: AG 312). Thus, although Leibniz’s theory of preformation derives directly from his need to establish true individual unities in the world, it also consequently helps to account for the generation of animals bodies on a mechanical philosophy which cannot account for the organization of matter (the received view of preformation): “I am thus of the opinion of Mr. Cudworth, whose excellent work for the most part well supports me, that the laws of mechanism by themselves could not form an animal where there is nothing already organized.... [But] I have no need to resort, as does Cudworth, to certain immaterial *plastic natures*... because this preformation and this infinitely complex organism provide me with material plastic natures that meet the need” (“Considerations on Vital Principles”: G VI, 544/L 589).

Yet another point on which Leibniz and Aristotle diverge follows from Leibniz’s strict criterion of unity. Because a real being must have an indivisible substantial form, the only real beings in the created world, according to Leibniz, are living beings. There is no such thing as a real statue, understood in the Aristotelian sense of matter structured into a certain shape (form). The only kind of form for Leibniz is a soul-like and active substantial form. Consequently, the form-matter ontology

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permits only natural, living beings into the category of true substances. That is, the kinds of beings that Aristotle takes to be the truest examples of individuals (living beings, beings by nature) are the kinds of beings that Leibniz takes to be the only examples of individuals in the created world.

Aristotle's statue, for example, falls prey to the argument from infinite indivisibility which strips it of any reality at all.

Even within the class of living beings, there are interesting points of overlap and divergence besides that noted earlier. Here, it would be helpful to include Descartes and Malebranche in this discussion. For Aristotle, the living being is a combination of soul and organic body, both of which are required for the other. So a soul needs an organic body of specific material and structured in a specific way for the soul to be able to accomplish its tasks, and an organic body without a soul is not really an organic (living) body at all. Here is a point of overlap with both Descartes and Malebranche: the living being must be an organism of a specific disposition or else it could not be alive, and it cannot count as an individual example of a specific type. Once that disposition is lost, the life is lost. But Descartes and Malebranche attribute the life to the structure itself, and not to an informing soul. Here is a point of overlap with Leibniz: Aristotle attributes active life functions to the soul; the structure alone is useless as a functioning being without the soul. But Leibniz believes that the life of the substantial form can continue without a specifically disposed body; in fact, the organism with which the substantial form is associated transforms radically all the time. For both Aristotle and Leibniz, the form and organic body come together and each requires the other, but because Leibniz is primarily concerned with the generation of the form itself, the nature of both form and organism alter quite notably from the nature of these according to Aristotle.

Let me make just two points of contrast between Leibniz and his contemporaries. First, while Leibniz and Malebranche both posit generation to avoid miracles, the relation between miracles and generation is quite distinct for these two. For Malebranche, because organisms are infinitely complex, their formation must be a miracle (according to Malebranche's definition of a miracle). For Leibniz, because the creation of an organism, complete with its necessary substantial form, is a miracle, and
because its existence as a unified individual depends on it being wholly natural with no immediate
dependence upon other organisms or upon God (otherwise, a miracle would ensue), then the
organism must be infinitely complex. It must be so because it is created at the Creation, can be
annihilated only at the end of the universe, and to endure as a substantial being united with an
infinitely complex substantial form, it too must have infinite complexity.

Second, there is a divergence between Leibniz and Descartes on their forms of
hylomorphism, and God's role in these. Descartes takes the organized body to be both temporally and
ontologically prior to the union of that body with a soul. Only once the human body is generated and
ready to receive such a soul will God create that soul and unite it with the body. Further, it would be a
miracle for that body to remain without a soul, but it is not a miracle for other, wholly material,
organic unities (non-human living bodies) to endure and function without souls. Leibniz, on the other
hand, believes that all organic bodies have always been united with a soul-like substantial form. Since
it is essential to living organic bodies to be united with such forms or else they would not be genuine
beings, and since forms cannot be found separately from organic bodies, presumably it is a miracle
for any organic bodies to be without substantial forms. And it is a miracle to bring such forms into
existence throughout the duration of the universe since this is obviously an action in the created
world beyond the natural power of creatures (Leibniz's definition of a miracle). Descartes seems to
have no qualms about suggesting that God creates ex nihilo a new soul whenever a new human body
is generated. In fact, it would be a miracle for God to not do so.

Leibniz is not entirely free from the problem of miracles in the generation of human beings,
however. He does deny the creation ex nihilo of a new soul on the generation of such a being, but the
problem remains given the change of the pre-existing soul into a rational being. This follows from the
fact that human souls are in a class quite distinct from all other substantial forms: they belong to the
kingdom of grace and must follow the moral laws of that kingdom. This makes them far more perfect
-- in a different class, in fact -- than ordinary substantial forms. So on the birth of a human, a
substantial form would either have to elevate itself to stature of rational soul due to its own internal
nature, or God would have to interfere directly to elevate the soul to status of rational being or to create a new soul (e.g. G IV, 479/NS 12; G VI 531/L 556). The former option would be a case of something clearly inferior (a merely active monad) producing something far more perfect (an active monad that also follows the laws of morality, and that consequently belongs in God’s kingdom of grace) — it would be a case of the effect being beyond the nature of the cause, a principle Leibniz rejects (e.g. “Preface to the Dynamics”: GM VI, 287/AG 106). But the latter option would be a miracle. Leibniz is never able to fully solve this dilemma (see Fouke 1991).

Further, I have argued that Descartes appeals to hylomorphism (to whatever degree he does) to account for mind-body unity, and not at all to account for bodily unity. In fact, the bodily unity of non-human living beings requires no soul at all, and unity of human bodies must be clearly established before a human soul will occupy that body. Then, and only then, will God endow such a body with a soul, and the soul might even feel “joy” at the pleasure of a union with such a well-constructed, properly-functioning machine. Quite in contrast, Leibniz appeals to hylomorphism to account for bodily or material unity. This comes into play at the most fundamental level. Leibniz requires hylomorphism to establish any individual material units at all, because the definition of material substance offered by his most prominent modern contemporaries cannot do the job. A well-ordered machine — even the machine that is a human body — does not constitute a genuine unity in itself for Leibniz. Only if it is united with a substantial form (which it must be in order to be a living human) does it become more than accidently unified (G II, 75/CA 159). This only serves to underscore the divergence between Leibniz and Aristotle in artificial beings; there cannot be any such beings (they are only aggregates of other beings) for Leibniz.

One final point needs to be broached, and this is that there is a serious tension in Leibniz’s work. I must mention this, not in order to provide a solution, but in order to show that Leibniz’s theory of preformation remains intact despite the tension. This is the tension between his hylomorphic organic metaphysics on the one hand and his theory of the pre-established harmony on the other hand. Both these elements in Leibniz’s thought arise from the problem of individual unity.
and Leibniz's solution to the problem. In order to establish true individuals in the natural world, Leibniz posits that they are created at the Creation with all their states built into their very natures. This establishes relative independence from God and full independence from each other; it also establishes the fact that each individual substance gives rise to its next state from within its own nature and not from interference or influx of any kind, either by God or by any other natural individual. This, I have argued, gives rise to Leibniz's theory of organic preformation on his organic metaphysics which couples matter with a substantial form. But this also gives rise to his theory of the pre-established harmony which ensures the appearance of orderly and harmonious interaction among all the metaphysically isolated individuals of the created world.

The problem is that Leibniz also uses the pre-established harmony (perhaps secondarily to monadic 'interaction', but he uses it nonetheless) to explain the appearance of orderly and harmonious interaction between body and soul which are actually metaphysically distinct. What happens in the body follows from its nature while what happens in the soul follows from its nature, and God coordinates their natures at the Creation so that the two unfold harmoniously and seemingly in interaction with each other. The pre-established harmony is meant to solve the problem of mind-body interaction without defaulting to direct interference by God, that is, without defaulting to occasionalism. So preformation based on the hylomorphic, organic metaphysics implies the real union between body and soul, or matter and form, while the pre-established harmony drives an ontological wedge between body and soul. Indeed, the pre-established harmony pulls apart the two principles that, in his organic metaphysics, Leibniz claims cannot be found apart since each one without the other is incomplete. Further, the pre-established harmony seems to deprive matter of the principle which gives it existence and which is required to explain the motion and change of that matter. To state it bluntly, while Descartes appeals to hylomorphism (to whatever degree he actually does) to account for mind-body unity but not at all to account for bodily unity, Leibniz appeals to hylomorphism to account for bodily unity but not, paradoxically, to account for mind-body unity.

Even while he is developing his theory of the organism as a hylomorphic unity of a soul-like
substantial form together with an infinitely complex and organized body, Leibniz is also expounding his theory of the pre-established harmony despite the deep tension that this produces. This is the case in the correspondence with Arnauld, for example.

God created souls from the very start in such a manner that for the ordinary events it has no need of these interventions [of God himself], and whatever happens to the soul comes from its own being, without any necessity, on its part, of accommodation in the sequence of events to the body, any more than there is of the body’s accommodating itself to the soul. Each one follows its laws, the one acts freely, the other without choice, and they accord with one another in the same phenomena. The soul is nevertheless the form of its body, because it expresses the phenomena of all other bodies according to their relation to its own (letter of 14 July 1686, G II, 58/CA 135; see also FC 321/AG 104; NS 168).

The tension did not escape some of Leibniz’s contemporaries. Perhaps the clearest expression of the problem is given by René Joseph de Tournemine: “For after all, correspondence, or harmony, does not make a union, or essential connection.... [W]e need a principle which shows that there is between a certain body and a certain soul a connection so natural, so essential and so necessary, that no soul other than mine could animate my body, and no body except mine could be animated by my soul” (Tournemine [1703] 1997, 249). Leibniz does not disagree (not surprisingly given his organic hylomorphism) but his answer is not particularly helpful:

My aim [with the pre-established harmony] was to explain naturally what they [the occasionalist Cartesians] explain by perpetual miracles, and in doing so I attempted only to give an explanation of the phenomena, that is to say, of the relation we perceive between the soul and the body. But since this metaphysical union, which is added on to that, is not a phenomenon, and as we have not even been given any intelligible notion of it, I have not taken it upon myself to look for an explanation of it. However, I do not deny that there may be something of this kind; it would be something like presence.... (NS 250).

Whatever Leibniz’s solution to the tension may be, or even whether there is a solution, this does not, I believe, impact the issue of preformation. If we go the route of the hylomorphic metaphysics, preformation follows as I have argued in this section. It follows because the organism has to be the sort of thing capable of being united with an infinitely complex soul which nevertheless does not act intelligently upon the matter of the world to build machines from it.

If we go the route of the pre-established harmony and assume an unbridgeable ontological
distinction between body and soul, Leibniz still maintains some special relation between a given organic body and a given soul, and since the soul is eternal (or at least as durable as the universe itself), so too must the organic body be eternal to maintain that special relation with that one soul. And indeed, this just is what the pre-established harmony is. It is the establishment at the Creation by God of all individual substances such that their unfolding accords harmoniously with the unfolding of all other individuals, and this includes the establishment of all the states in each organic body. Indeed, in his "Reflections on the Doctrine of a Universal Spirit", Leibniz says exactly this. Although the soul and body may be separate in some way, they are connected in a way that demands preformation (G VI, 533/L 556-7; see also G IV, 476/NS 26). More striking is Leibniz's comment in the Theodicy that preformation is the pre-established harmony as applied to time, while mind-body 'interaction' is the pre-established harmony as applied to space (Th 68).

Indeed, because both the pre-established harmony and preformation on a hylomorphic metaphysics derive from individual unity and Leibniz's strict idea of that unity -- an individual's independence from God, from others and its dependence only upon its own nature -- organic preformation will follow whether the organism is distinct from or metaphysically united with a substantial form. Preformation is merely the organic expression of Leibniz's general theory of individual unity and identity.

VII. Preformation: the nature of the organism and the nature of life

Because Leibniz ultimately derives his theory of preformation from the strictest criterion of unity -- the indivisibility of the substantial form -- rather than the functional unity of the material form as is the case with Malebranche, Leibniz has a very peculiar theory of preformation, much changed from the theory that Malebranche endorses. There are two points that have come up in the discussion thus far that need further elaboration. First, because life attaches to the substantial form and not the material form (NS 239), and because the substantial form by its very nature must be created only at the Creation and must be annihilated only at the end of the universe, each life endures for the length
of the universe itself, even if that single life goes through transformations in its “degree of life”,
different “degrees” seemingly appropriate for different sorts of organic bodies ("Principles of Nature
and Grace": G VI, 599/AG 208). Second, there are living beings everywhere; they are not just
confined to the visible plants and animals that we see around us: “all of nature is full of life” (G VI,
598/AG 207). “So in a fish pond there are many fishes and the liquid in each fish is, in turn, a certain
kind of fish pond which contains, as it were, other fishes or animals of their own kind; as so on to
infinity” (comments on Fardella: FC 322/AG 105). I shall deal with each point in turn.

The nature of the substantial form is to be created at the Creation with all its future states, as
an expression of the universe from a specific point of view, and as an active being capable of
transforming itself as its nature unfolds through all its states. Similarly, the nature of its associated
body is to transform through various states. On first glance, it may seem that Leibniz’s idea of the
organism transforming while nonetheless remaining the same living individual is in accordance with
Descartes’ ideas on the living machine. In his Excerpta, I have shown, Descartes makes the
distinction between an aggregate and an individual by claiming that the latter, but not former,
transforms as it grows (AT XI, 596). In his Description, he notes that the living being just does gain
and lose matter while its bodily disposition or structure nonetheless remains relatively intact and able
to continue functioning as a being that gains and loses matter (AT XI, 247/CSM I, 319). And in his
letter to Mesland of 9 February 1645, he writes that

[w]hen we speak of the body of a man, we do not mean a determinate part of matter,
or one that has a determinate size.... And so, even though that matter changes, and its
quantity increases or decreases, we still believe that it is the same body, numerically
the same body...Nobody denies that we have the same bodies as we had in our
infancy, although their quantity has much increased and, according to the common
opinion of doctors, which is doubtless true, there is no longer in them any part of
matter which then belonged to them... (AT IV, 166-7/CSMK 242-3).

In a similar vein, Leibniz writes that each “mechanism [which comes under the name of organic
body]... even though it preserves its form in general, remains in flux, and is, like the ship of Theseus,
perpetually repaired” (letter to Wagner 1710: W 505). The body is the same body in the way that a
river is the same: not because of its constituent matter (letter to Des Bosses, 30 April 1709: G II,
But because Descartes associates life with a material form while Leibniz associates life with a substantial form, in fact the same life goes through far more significant transformations according to Leibniz than Descartes would ever allow. Indeed, the references to the ship of Theseus or to a river do not capture the extremity of Leibniz’s position, for in these cases, at least the basic structural form remains the same. One significant divergence between Leibniz and Descartes which underscores the extreme nature of Leibniz’s position is what each says about death. While death, for Descartes, occurs when the basic disposition of essential organs and parts is destroyed (AT XI, 330/CSM I, 329-30; and AT VI, 153/CSM II, 109), death, for Leibniz, never occurs; or rather it never occurs while the universe endures. This follows from the fact that, while the substantial form can only be brought into existence due to a special (miraculous) act by God, so too it can only go out of existence by such an act, and so it will only be annihilated at the end of the universe with the destruction of the substantial form, not throughout the duration of the created world with the destruction of the organic form to which it is essentially united. “Corporeal substance can neither arise nor perish except through creation or annihilation. For when corporeal substance once endures, it will always endure, since there is no reason for any difference, and the dissolution of parts of a body has nothing in common with its destruction. Therefore, animate things neither arise nor perish, but are only transformed” (“Primary Truths”: C 523/AG 34; see also G VI, 620/M §76). Preformation is as much a theory about death as it is a theory about generation, and it must be so given that it is primarily a theory about individual unity and identity of that unity through time. Both ‘generation’ and ‘death’ are merely certain stages in the constant transformation of the single organic individual. For most preformationists, this is a theory about the generation from others (its parents, but most especially either its mother in the case of ovism or its father in the case of spermism), while for Leibniz, this is a theory about a creature arising out of its precursor being.

So while Descartes permits transformation within the organism, especially of constitutive matter, the degree of transformation is strictly limited. In contrast, Leibniz admits that there will be a
wide variety of transformations, some minor and slow (like the change in bodily constitutive matter during growth, nutrition and repair), and some more significant and sudden (like ‘generation’ and ‘death’). An organism can lose its “grosser parts” (G IV, 573/NS 139); it can lose many of its organs (“Reflections on the Doctrine of a Single Universal Spirit: G VI, 534-4/L 557-8; letter to Bernoulli, 23 January 1699: GM III, 565/AG 171), even those that Descartes would consider essential to it; it can even transform through what we would call different species: “it has been decided that, by means of conception the animal is disposed to great transformations, so as to become an animal of another species. We can see cases somewhat similar outside of generation when grubs become flies and caterpillars become butterflies” (G VI, 619-20/M §74); it can even transform into a human (NS 239). Just as the substantial form transforms through various “degrees of life” (G VI, 599/AG 208), so too will its associated body transform through various organic bodies.

There are small animals in the seeds of large ones, which, through conception, assume new vestments that they appropriate for themselves, which give them the means to nourish themselves and grow in order to pass to a larger stage and to bring about the propagation of the large animal. It is true that the souls of the human spermatic animals are not rational and do not become rational until conception settles that these animals will have a human nature. And since animals generally are not fully born in conception or generation, they do not fully perish in what we call death, for it is reasonable that what does not begin naturally does not end in the order of nature. Thus abandoning their mask or their tattered dress, they merely return to a smaller stage, where they can, nevertheless, be just as sensitive and well-ordered as in the larger.... Thus, not only souls, but also animals cannot be generated and cannot perish. They are only unfolded, enfolded, reclothed, unclothed, and transformed.... Animals change, but they acquire and leave behind only parts. In nutrition this happens a little at a time and by small insensible particles, though continually, but it happens suddenly, visibly, but rarely, in conception or in death, which causes animals to acquire or lose a great deal all at once (“Principles of Nature and Grace”: G VI, 601-2/AG 209).

Critically, while there may be significant transformations, and while these transformations may even happen quickly, they always follow the law of continuity progressing, perhaps quickly, from state to state always through intermediate states. There are no “leaps” in nature such as the sudden change in the nature of a soul’s associated body, a leap which is required under the theory of the transmigration of souls from body to body, or the theory of metempsychosis, “according to which the soul passes all at once into another body, quite differently organized” (G IV, 529/NS 75; see also G II, 99-100/CA
Further, because there really is no death in nature, what we think of as the dead body actually houses life, though not in the form which we previously experienced it. Not even fire can fully destroy life, for the substantial form will still retain an organized body; the experiments of the microscopists prove that life is found everywhere (G III, 340/NS 205), even in ash or powdered chalk and other similar substances (G IV, 480/NS 14). So, perhaps because the same life endures and transforms so notably throughout the duration of the universe, Leibniz has difficulty settling on which theory of preformation to endorse (letter to Bourguet, 1714: G III, 569/W 199): ovism (seeds are in the ovaries of the mother), animalculism (seeds are housed by the father), or panspermism (seeds are scattered everywhere — indeed, even in ash). Leibniz tends toward animalculism, a theory bolstered by Leeuwenhoek’s observations of the moving spermatozoa, and this theory seems a natural choice given Leibniz’s concentration on the activity of organisms as the mark which alerts us to their life and consequently their union with a substantial form and thus their genuine substantial unity. Still, there is no significant metaphysical reason why this should be his theory of choice. In fact, his appeal to the sub-visible existence of living beings throughout the whole of the apparently chaotic nature (W 200) even in ash or in chalk, makes panspermism seem as likely a choice as any.

I argued above in section V that organisms have to be infinitely complex for Leibniz because of their essential union with an infinitely complex substantial form. Here we can now see the advantage, and not just the requirement, of that infinite complexity. The advantage is that it provides the first step in the solution to one of the remaining problems of material unity. This is the Problem of Organic Endurance. At the outset of section VI above, I noted that this is a worry for Malebranche for the following reason. The organic body must retain a specific structure to be able to continue functioning as a single whole, and yet its constitutive matter, extended matter, is moving and colliding according to the laws of motion, and this disruptive activity should act to disassemble the whole organism. In fact, this just is what brings on death, for Malebranche (OC III, 338/EST “On Optics” §38, 741), and yet then the question arises why this lawful activity does not bring on the...
destruction of structure and therefore death earlier than it does. It seems that the laws of motion must be suspended for the continuance of life to be explained.

This worry loses some of its force with Leibniz because Leibniz does not take organic unity to depend upon a specific organic structure. The laws of motion could pulverize an organism into infinitely small pieces and the substance that defined that original living being as alive -- the indivisible substantial form -- remains in some sort of organized body, and it carries on the original life and maintains the material unity of some organic body because of its enduring union with it. So when Arnauld suggests, for example, that plants cannot be unities with substantial forms because slips can be taken from them and either become a new and separate plant on its own or be grafted onto another plant like itself (Arnauld [1686-90] 1995, 174), Leibniz counters with the claim that “although one part of a tree planted or grafted can produce a tree of the same kind, it is possible that there is in it a seminal part which already contains a new plant” (G II, 92/CA 183). This is made possible by the fact of its infinite complexity -- by the fact that within every part of every organism there are other organisms and so on to infinity. Similarly, when Arnauld asks “[w]hat would be said of a worm, of which, when cut in two, both parts move off as before” (Arnauld [1686-90] 1995, 177), Leibniz answers, substituting an insect for a worm, that “the soul of the whole insect will remain only on one side and as in the formation and in the growth of the insect the soul has already been in a certain part alive from the very start, it will remain also after the destruction of the insect, still alive in a certain part, which will always be as small as is necessary to serve as an asylum from the action of him who is tearing or destroying the body of this insect” (G II, 100/CA 196). Thus, “since the mechanisms of nature are mechanisms down to their smallest parts, they are indestructible, since smaller machines are enfolded in greater machines into infinity” (“Consideration on Vital Principles”: G VI, 543/L 589)

Leibniz therefore relies upon the infinite complexity of an organic being to explain its enduring unity in a way that Malebranche does not, and Leibniz is able to do so while Malebranche is not because Leibniz’s organism is defined essential by its unity with a substantial form. Still, it
should be noted that the original worry is not totally alleviated. Why do living beings endure as very specifically structured organic unities for the large number of years that many do while the mechanism of material extension is disruptively working away in every part of them? Why do gradual changes in the material unity (changes due to growth, nutrition and repair, for example) suddenly give way to rapid changes (‘death’, for example); why at this time and not earlier? I shall return to this issue and Leibniz’s role in solving this problem in the next section on laws, mechanism and teleology.

This discussion brings us to the second issue needing attention in this section. This is Leibniz’s claim that there are living beings everywhere, and that all of matter is full of life (e.g. G II, 122/CA 227; G II, 124/CA 230; PNG: G VI, 598/AG 207). This would not seem to be the case given that our experience with the world is quite different. Certainly there are humans, animals and plants around us all the time, but there are also desks, watches and piles of stones, none of which are living beings. Similarly, Arnauld’s query about the worm cut in two and Leibniz’s response would seem to alert us to this difficulty in another way. While the substantial form remains in one half of the divided living being, and that half (or something in it) is consequently still alive, the other half is surely dead because no longer united with a substantial form. A related, but much more foundational problem is the problem of unity strictly defined. The cases we have been considering underscore this crucial fact: bodies, even living bodies, are divisible in a way that the substantial form is not, and while the living substantial form endures all forms of destruction in the natural world, this living body, this living human, just does not endure all forms of destruction. What is to be made of the desk, the watch and the pile of stones; what is to be made of the half of the worm without the substantial form which unified the whole; what is to be made of the human corpse? These are not, prima facie, cases of matter “full of life”. Further, does the fact that they are not living organisms themselves mean that they are not ontologically real -- that they are mere phenomena -- because they do not have the unifying substantial form that alone could give them being and existence?

This is where we have to understand Leibniz’s organic metaphysics, and the ontology of the
living being, on two distinct levels. The living human is at one and the same time a human being -- a whole, living being in itself, defined essentially by the substantial form -- and a human body -- a composite of an infinity of distinct, whole living beings. "Man is a substance; his body or matter is a collection of substances. I would say the same thing about the living things which lie in flint" (letter to Bernoulli, 17 December 1698: GM III, 560/AG 170). To de Volder, on 20 June 1703, he writes that "[a]lthough I say that a substance, even though corporeal, contains an infinity of machines, at the same time, I think we must add that a substance constitutes one machine composed of them, and furthermore, that it is activated by one entelechy, without which there would be no principle of true unity within it" (G II, 250/AG 175; see also G VI, 619/M §70).

In contrast, the dead human is not a human being, but it is still (for a while at least) a human-shaped body, composed of an infinity of living beings. These living beings give the dead body reality, not as a unity itself but as an aggregate of unities. The same can be said for the desk, the watch, the pile of stones and the 'dead' half of the severed worm. These are all bodies that are real and not phenomena. They are real because they are aggregates of real unities, of living beings, even if they are not such unities themselves (G IV, 473-4/NS 23-4). There is life absolutely everywhere. There is nowhere that is barren (G VI, 618-9/M §69). "And although the ground and the air which lies between the plants of the garden, and the water which is between the fish in the pond, are not themselves plant or fish, yet they nevertheless contain these, usually so small, however, as to be imperceptible to us" (G VI, 618/M §68). Only some of these omnipresent lives are visible, and most are sub-visible (though we can see some with a microscope). But even that which is visible and not itself alive is nonetheless composed ultimately and only of living beings.

So we can see the human is two distinct ways -- as a being and as a body. The human being is the human understood strictly metaphysically; the human body is the human understood physically or naturally. Just as the human can be understood metaphysically as well as physically or naturally, so to can both life and death be understood in two ways each. Strictly and metaphysically speaking, there is no death, and life endures forever. This is because life (metaphysically speaking) attaches to the

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substantial form which only transforms but never ends because it endures essentially united with some sort of (often sub-visible) organic body. Consequently, death is simply a more dramatic example of sleep (letter to Wagner, 1710: W 508); it is merely a change in the "perception" or "degree of life" of the enduring substantial form (and of its associated body). But physically or naturally, a particular life does end because the organic structure suitable for the specific life stage of the substantial form is lost. Thus, death (physically speaking) is the cessation of the functions associated with a particular organic structure (G VI, 534/L 557) and thus it is the cessation of that specific stage, that specific "degree of life", of the substantial form. To Bernoulli, he writes that "[w]hen I say that the moment of death cannot be defined, I at once signify that in a *metaphysical* sense there is no such moment; nor do I see that it destroys the laws of continuity to say that somehow a great change takes place in this very short time. It is quite consistent for such a thing to happen in *nature, especially in death*" (21 February 1699: GM III, 575/L 514; emphases added).

Importantly, we need to recognize that the same two ways of understanding the created world apply also to generation. This is to be expected given that death and generation are really equivalent from the point of view of being two stages of the single metaphysical life. There may be no metaphysical generation according to Leibniz’s theory of preformation, but there could be physical or natural generation. Thus, the expression of the "inchoate preformation" found in the *Discourse §22* may be seen as an expression of physical generation, the true physical emergence part after part of a living being. At the same time, however, Leibniz’s metaphysical views demand that that seminal matter is composed of already fully-formed organisms, one of which will simply grow to transform into its next stage in its long-enduring metaphysical life.

**VIII. Preformation: laws, mechanism and teleology**

I shall now return to the final problem of material unity, the Problem of Organic Endurance. This was posed in the previous section when I dealt with the conflict between the endurance of the organism on the one hand, and the mechanical motion and collision of parts of material substance which should
undermine this endurance on the other hand. Despite the fact that Leibniz is able to nonetheless ensure the endurance of the same life because this requires only the endurance of the substantial form and some sort of organic body, a question remains. Why do the living structures we experience endure as organic unities for the large number of years that many do while the disruption of material mechanism is working away in every part of them? The problem for Leibniz is not the enduring metaphysical life, but rather the problem is the enduring natural or physical life. But the problem is quite stark. In this case, the enduring physical life is also the enduring metaphysical life as long as we think of the living being in terms of its hylomorphic union with a dominant entelechy, rather than in terms of body.

Leibniz does, after all, believe that bodies in the material world abide by the laws of mechanism and that his appeal to substantial forms is not to be drawn upon to explain particular phenomena of nature. This is the lesson of his insistence on distancing himself from Cudworth, More and others. The substantial form is essential for providing a metaphysical basis for the reality of the natural world, but it does not impact the physics of the world by, for example, building and maintaining animal bodies and then ceasing some sort of maintaining action thereby permitting natural death to befall those bodies ("Against Barbaric Physics": G VII, 337ff/AG 312ff; G II 58/CA 135-6). Once the body has been built by God, all natural events that happen to it proceed according to the laws of its own material nature. That is, while it is true that mechanical motion of matter cannot end a life, metaphysically speaking, in Leibniz’s system, it nonetheless can end a life stage associated with a particular organic structure -- it can end a life, physically speaking. Indeed, given the laws of mechanism, it seems that there should never be a stage that lasts very long at all, and yet the endurance of the structure clearly frustrates this outcome of mechanical motion and collision of parts. This is a seemingly very serious problem for Leibniz given his two ways of understanding the living being. On the one hand, a living being is a metaphysical, hylomorphic being which is a forever-enduring life. On the other hand, a living being is a mere material body which is a thing that should and eventually does disintegrate due to the mechanism of matter in motion.
Descartes and Malebranche have, I contend, no satisfactory answer to this problem. Leibniz does, and this depends upon a reconception of laws and consequently of mechanism. Both Descartes and Malebranche posit a few number of laws of nature, working externally on extended matter. These are general laws of motion and collision; they are applicable to all of nature equally, and there are no special laws for life. The extended matter that is moved about by these laws of nature is itself inherently passive.

But then this seems to require that the laws be real in some sense --- almost substantial in themselves. Recall, in chapter three, my discussion of the role of laws in Malebranche's occasionalism. Charles McCracken suggests that one interpretation, Arnauld's interpretation that likens occasionalism to the pre-established harmony, posits that it is not God who is immediately efficacious in the material world, but that God creates laws that are causally efficacious. McCracken takes issue with the idea that laws are the sorts of things which can be causally efficacious in the material world. What might a law be, distinct from any kind of substance, in order to have power in the created world (McCracken 1983, 90)? The traditional interpretation of occasionalism solves this because it makes God the immediate cause of every event, and so the laws are part of the substance of God. But this, of course, then leads directly to Leibniz's worry that 'individual substances' in nature are really just modes of the one true substance, God ("On Nature Itself": G IV 508-9/AG 160).

Further, this does not solve the problem of organic endurance because God works in nature strictly according to laws which demand the breaking up of the organic structure under the disassembling influence of matter in motion and collision externally imposed.

This worry is alleviated in Leibniz's philosophy because he has a different conception of laws. First, he contends that God creates laws that have some ontological reality in the natural world distinct from God; they are themselves substantial and consequently can be efficacious. Criticizing an occasionalist contemporary (John Christopher Sturm) in On Nature Itself, Leibniz writes:

He grants... that the motions now existing happen by virtue of the eternal laws God once set up, a law he then calls a volition and command. He also grants that there is no need for a new divine command, a new volition, not to speak of a new effort, or
for any other labors.... But, yet, it certainly seems to me that this explanation is insufficient. For, I ask, has that volition or command, or, if you prefer, divine law that was once laid down, bestowed a mere extrinsic denomination, as it were, upon things? Or, on the other hand, has it conferred some kind of enduring impression produced in the thing itself... an inherent law (even if it is not known to the creatures in which it exists), from which both action and passions follow (G IV, 506-7/AG 158, last emphasis added)?

Leibniz opts for the latter choice; creatures have their own enduring inherent law.

A key reason why Leibniz rejects the former option, and consequently why Leibniz rejects the Cartesian approach, is that motion cannot be something inflicted upon matter because motion is not itself real or substantial; it is the phenomenon that arises from real material substances changing their spatial relations due to the activity that arises from their inherent force. Descartes erred when he “set up the laws of motion as if motion were something real and absolute” (“A Specimen of Dynamics”: GM VI, 248/AG 131). Because motion is not real and absolute, motion cannot work upon matter. The relation is the reverse: the inherent activity of material substance is fundamental and motion is derivative (see “A Specimen of Dynamics”: GM VI, 234-54/AG 118-38; and “On Nature Itself”: G IV, 504-16/AG 155-67).

But neither is it the case that matter as extension is the sort of thing that can hold laws and consequently have inherent activity from which motion derives (e.g. GM VI, 240/AG 124; GM VI, 253/AG 136; G IV, 478/NS 11). Rather, according to Leibniz, the law is coded into something that can both hold and make use of it. Laws are coded into the substantial form of individual substances. In fact, Leibniz often indicates that the law itself is what constitutes the individual: “Now, according to me it is the nature of a created substance to change continually in accordance with a certain order.... And this law of order... constitutes the individuality of each particular substance” (NS 80; see also Th §291; G IV, 512/AG 162-3). Leibniz also makes this equation between law and form (and sometimes force) in some of his letters to de Volder. After explaining the need for something other than extension to establish the reality of body, and noting that this other thing is an active force, Leibniz writes, “I recognize, in the active force which exerts itself in various ways through motion, the primitive entelechy or in a word, something analogous to the soul, whose nature consists in a
certain perpetual law of the same series of changes through which it runs unhindered” (letter of 3 April 1699: G II, 171/L 517, emphasis added). And again: “For me nothing is permanent in things except the law itself which involves a continuous succession and which corresponds, in individual things, to that law which determines the whole world” (letter of 21 January 1704: G II, 263/L 534). The law is real and efficacious because it is individual substance -- the force or form -- itself. The law-as-form explains why the individual’s states unfold in the order that they do (G IV, 476/NS 26). This persisting law also explains why the individual maintains its identity and persists as the same individual throughout all its changes: “The fact that a certain law persists which involves all of the future states of that which we conceive to be the same -- this is the very fact, I say, which constitutes the enduring substance” (letter to de Volder of 21 January 1704: G II, 264/L 535).

There is a clear link, then, between the laws of nature and preformation, and the link is established through individual unity and identity. The individual is constituted by the substantial form which is also the law which unites and unfolds all of the individual’s states. The fact that this law was coded, so to speak, into the substantial form at the Creation, results in the fact that the substance is pre-formed at the Creation, and so too is its associated organic body. This is related, as well, to the requirement that individual substances do not truly interact with each other because this would make some of their predicates relational, which in turn would make substances dependent upon others and not, therefore, truly independent as substances, robustly defined, ought to be. The continual transformation of organic bodies, pre-formed at the Creation, is due to their individual laws unfolding all those states. Leibniz is explicit in his belief that these organic transformations are not just lawful but are mechanically lawful:

Don’t we know that men are ingenious enough to make automata capable of turning at just the right moment at certain street corners, and of thus adjusting to a certain number of accidents? And a proportionally greater mind could provide for a greater number.... There is nothing strange in that, once we consider that a craftsman as great as God can make an automaton which resembles a servant and which is capable of acting as one, and of carrying out at the right time the orders it has been given, over a long period of time.... The automaton which acted as a servant would need only a structure which made it perform its functions in accordance with mechanical rules (G IV, 536-7/NS 97-8).
Leibniz’s system of laws makes his mechanism extremely expansive and flexible in what it is able to explain.

But there are clear worries with this theory. One is that which I mentioned, but then bracketed, at the close of section VI above. The “servant” that God can make which progresses mechanically through all its states and transformations cannot be merely material. It surely cannot “need only a structure which made it perform its functions in accordance with mechanical rules”, as Leibniz claims. It cannot be so for at least two clear reasons. First, only a substantial form can contain the law that dictates the progression of states, and second, only a substantial form can activate the automaton to actually change or move from state to state. Yet Leibniz introduces the idea of the automaton to provide evidence for the pre-established harmony which puts an ontological wedge between the body and the mind -- the servant is only material. The system of laws that Leibniz proposes makes explicitly clear that this tension between the pre-established harmony on the one hand, and his hylomorphic metaphysics on the other, requires a solution. Perhaps that solution lies (as suggested in footnote 31) in understanding the ontological wedge as one placed between rational mind and body, with body including force. This places the wedge between laws of grace (which govern the rational mind) and laws of nature (which govern the material world). But the laws of nature are still laws -- that is, they still belong to something capable of housing laws, namely a non-rational substantial forms. There is a fair degree of evidence in Leibniz that this is his intent (e.g. G IV, 480/NS 13; G IV, 475/NS 25; NS 52; GM II, 297/NS 58; letter to Bernoulli of 13/23 January 1699: GM III, 565/AG 171).

A second problem is Leibniz’s insistence that the substantial form does not affect the particular phenomena of nature which are to be explained by the laws of mechanism alone. And yet, if laws just are the substantial form, then it is hard to know how Leibniz can maintain this claim about the limited role of substantial forms. That is, he sometimes seems to suggest that the substantial form serves as the metaphysical grounding for the laws of nature, but that the laws of nature alone directly account for phenomena of nature (e.g. G II, 58/CA 135-6; G II, 77-8/CA 163). But by
equating laws with forms, the substantial form itself seems to become responsible for every particular phenomenon.

A third problem arises from the fact that Leibniz, no less than Malebranche, believes that part of God's way of working in the world includes a balance of simplicity of means with an abundance and variety of ends. His heading to the fifth section of the *Discourse* reads as follows: "In what the principles of the divine perfection consist, and that the simplicity of the means counter-balances the richness of the effects" (G II, 12/DM §5). Part of this simplicity requires that the world is governed by a very few general laws and yet allows a wide variety of effects nonetheless. An infinite number of individual laws does not seem to achieve this purpose; quite the opposite obtains. Besides, this system seems to undermine the whole purpose of laws. As Kathleen Okruhlik puts it: "A law is not a law unless its abstracts to some degree from concrete individuals.... The *raison d'être* of laws is precisely that they allow us to *escape* the infinite complexity of individual substances..." (Okruhlik 1985, 197). Besides, although these individual laws may have been pre-established within each substance at the Creation to ensure the appearance of interaction where there really is no interaction among substances, "this interaction may be chaotic"; the world comprised of such substances "is not necessarily a *law-governed* world in any usual (non-trivial) sense of that word" (Okruhlik 1985, 189).

These last two problems might be alleviated by two distinctions Leibniz makes in his system of laws. The first distinction is that been the subordinate laws and the general law of order. The second distinction is one made within the realm of subordinate laws, and this is a distinction between laws of individual substances on the one hand and laws of mass which are abstractions from the individual laws on the other hand. Let me look first at the distinction between the general law of order and subordinate laws. In his unpublished comments on Bayle's Note L of his *Dictionary* article "Rorarius", Leibniz writes that "when we say that each monad, soul, or mind has received a specific law, we must add that this is only a variation of the general law which orders the universe.... The marvel is that the sovereign wisdom has found in representing substances a way to vary the same world at the same time to an infinite degree..." (G IV, 553-4/NS 106-7). The law that governs each
individual is a subordinate law which nonetheless expresses, from a particular point of view, the
general architectonic law of the whole universe (see also G IV, 441-2/DM §16; letter to de Volder of
21 January 1704: G II, 264-5/L 534-5). Thus, each individual history of each substance conforms
with an over-arching order.

The second distinction is one made within the subordinate realm of laws. This is the
distinction between subordinate laws of the substance of individuals, and subordinate laws of the
phenomena of natural world, laws that can be abstracted from all individuals and which apply to them
all. Each individual is a unique law unto itself, and the activities of an individual are therefore lawful
activities, even if we cannot discern the law governing it. Something may appear to be “helter
skelter”, but there will always be a law to define it and give it regularity (G IV, 431/DM §6). This, of
course, does not help us in physics or natural philosophy precisely because it applies to one
individual only; at least part of physics is to explain regularities that we simply do experience in the
world. This is where abstractions from all individual laws enter the picture, and these abstractions
apply to the phenomena of mass, or aggregates as opposed to substantial individuals:

[I]n phenomena or aggregates, all new change derives from the collision of bodies in
accordance with laws prescribed, in part, by metaphysics and, in part by geometry,
for abstractions are needed to explain things scientifically. Hence, in mass, we regard
the individual parts as incomplete things, each contributing its own certain
something, while we regard the whole mass as made up of the coming together of
them all. And therefore, any body whatsoever is understood, in and of itself, to tend
in a straight, tangent line even if curvilinear motion results through the continual
impressions of other things. But the substance, which is complete in itself and
envelops everything, contains and expresses the way that curved line is brought
about, since everything that will happen is also predetermined in the present state of
a substance (letter to de Volder, 20 June 1703: G II, 252/AG 177-8).

Other subordinate laws of this nature include the preservation of force (G IV, 442/DM §17), for
example. Thus, among the subordinate laws of the universe there are two quite distinct varieties – the
individual laws of the individual substances, and abstractions which are universal laws of mass.

This helps Leibniz with both the difficulties noted above. The phenomena of the corporeal
world are governed by a very few number of general laws, but these are the laws of mass, the laws of
abstraction. And although it is true that the substantial form is the law itself, it does not impact the
Particular phenomena because the phenomena are governed by the abstract laws, the laws of mass. Furthermore, and this is where Leibniz diverges most notably from Descartes and Malebranche, although the laws of mass are few and general, they are not the only laws at work in the created world. Laws of the individual are also at work in the created world, and the general and abstract laws of motion are accounted for in each individual’s law.

Consequently, the preservation or endurance of the individual as a hylomorphic union of substantial form and specific organic body can be explained because the consequences of the abstract laws have already been accommodated by the individual law which includes the organic endurance at least for a certain period of time. “And these crashing bodies which destroy themselves in collisions, are they not consequences of the natural laws that God has put into bodies, whether one accepts my system or some other?... But it is again necessary to distinguish between a substance and an assemblage of substances which make up a mass. Each substance conserves itself; but masses in virtue of the laws of their own nature tend to destroy themselves, for they break themselves up by their internal movement...” (remarks on François Lamy, November 1702: G IV, 585/NS 159-60). The living being is, at one and the same time, both a substance (understood metaphysically) and a mass (understood physically). As a substance, it tends to preserve itself, even though its mass tends toward destruction. But its mass is still made up of other substances which express the same universe as the organic individual, and they must reflect the universe in which the organism endures for a specific length of time as a natural life.

This may seem to be a case of appealing to individual laws to ‘explain’ the phenomena after it has been experienced — a case of saying, for example, that such-and-such a living being existed for a certain number of years because it was so encoded in the individual laws of that being as well as in the individual laws of the other beings that compose its body. This after-the-fact explanation hardly has the kind of explanatory power, which one expects from the laws of nature. But abstract laws of nature are useful as laws because they explain generalizations and regularities, and lives that endure for approximate periods of times and manifest specific life cycles are among these regularities too.
even if they are not as strictly measurable and deterministic as are some other regularities of the physical world. Leibniz’s system of laws can accommodate the phenomena of living bodies in a way that Descartes’ and Malebranche’s systems of laws cannot. For Leibniz, each individual living being follows its own individual law which dictates that it will endure as a specific organic form for a specific period of time, and this will, for the most part, conform to abstract regularities in nature which, I contend, includes the life cycles of living beings.

Leibniz’s understanding of mechanism, then, is significantly different from that of either Descartes or Malebranche, and the difference arises at least in part because of the need to solve the problem of material unity that the earlier form of mechanism creates. This dovetails with Leibniz’s theory of organic generation. Without centers of unextended activity — without forces — united with extension, matter can have no existence because there can be no unities out of which material reality is constituted. These forces ensure the unity of material individuals, just as they ensure the distinction of those individuals from each other and from God. Further, these forces include the laws of each individual which determine the states and succession of state of that individual’s complete history. These laws, as intrinsic to force itself, are created at the Creation. Together with their requisite organic body, they unfold and transform in a way that accords with the general lawful harmony of the universe as well as abstract regularities of natural phenomena. The laws necessitate organic preformation, just as they solve the problems of material unity that Leibniz inherits from his predecessors, including the concern of how organic structures endure for a lifetime while the lawful mechanism of matter in motion ought to be destroying them. They are not so destroyed because their individual laws demand their endurance, and the general, abstract regularities of life cycles are encoded into all of these individual substances no less than are other abstract laws of nature.

All this indicates an extremely pervasive role for teleology in Leibniz’s theory of generation by preformation. Like Malebranche, the preformed organism exhibits teleology of the sort Osler claims was typical of the early modern period. For the moderns, teleology is an external final cause — the intentional imposition of form upon nature from without (Osler 1996, 389ff), and this is certainly
found in both thinkers’ doctrines of preformation in which God imposed the form or organic structures upon matter. But Malebranche, I argued in chapter three, section V, includes a sort of holistic, organic teleology, and indeed, this form of teleology is found in Descartes’ theory of the final product of generation, the living being. This kind of teleology acknowledges that there needs to be a specific organic structure that can function. This is the functional teleology that Stephan Asma calls an “ontological holism” (Asma 1996, 138). There is even a further form of teleology found in both Descartes and Malebranche (chapter three, section V). This form of teleology recognizes the regularity of life cycles, and notes that certain living behaviours serve long-term ends that repeat through generations. The living body is structured as it is in order to be able to nourish itself, make itself grow, reproduce and so on – in order to be able to fulfill its long-term life functions which are one cycle in a repetition of the same cycle.

At the natural or physical level, all these forms of teleology enter Leibniz’s theory too. Organisms have to have specific structural dispositions to count as the sorts of bodies that are appropriate for their specific substantial forms each one of which has its specific “degree of life” associated with a physical species. It requires this structure to be able to carry out the active functions of the substantial form in its particular stage of its history. This just happens to be a particular life-cycle of a given organic species.

At the metaphysical level, however, things are quite different for Leibniz. While there has to be an organic body of some sort for the enduring substantial form to be associated with, it need not be of a specific disposition or structure for its entire life (metaphysically speaking, for as long as the universe itself). Indeed, the structure of the metaphysical life undergoes radical transformations that would result in the death of the organism according to both Descartes and Malebranche. Indeed, the need for a whole organism of a rigidly-defined specific structure grounds one of Malebranche’s arguments for preformation. A body cannot live without any number of essential parts, and a theory that posits the sequential formation of such parts (epigenesis) makes the untenable suggestion that a being missing critical instruments is nonetheless operating to achieve one of life’s functions, namely
generation. This is an argument with no force for Leibniz given his very different definition of life. The massive transformations that each organism undergoes -- even to the point of losing organs, the very instruments that carry out functions -- only serves to underscore this fact. Leibniz does not posit preformation in order to ensure the existence of a specific functioning structure. He posits preformation in order to ensure the existence of any structure that can be unified with a substantial form.

Thus, at the metaphysical level, Leibniz also has (more clearly than either Descartes or Malebranche) the ancient form of teleology that Osler says was largely lost in the early modern period. This form of teleology is an immanent final cause -- the internal ability of nature or natural beings to actualize form (Osler 1996, 398ff). While this is partly implied by the "organic holism" noted above, this teleology derives from different natural sources for our thinkers. Both Descartes' and Malebranche's organic holism pertains to the organic whole itself; it belongs to a wholly material system. Leibniz's organic holism ascribes to the substantial form far more in keeping with Aristotelianism. But Leibniz carries this much further than does even Aristotle. The material organism unfolds according to the unique individual law embodied in the substantial form, not a general realization of a species form. This individual law is further teleological in the sense that it is an individual expression of the architectonic, universal law of order and harmony of the whole universe.

IX. Concluding remarks

We have now reached the end of the consideration of the problem of material unity and its ultimate solution in the doctrine of preformation. Leibniz is responding to four problems of material unity created by the early modern conception of the nature of the material world, and his theory of preformation solves all four. These are the Problems of Material Existence, of Material Independence (from God and other individuals), of Reconciliation (of extended matter with organic bodies), and of Organic Endurance. In order to solve these four problems, Leibniz reverts to Aristotle's solution to
the problem of material individuation by bringing back a full-fledged hylomorphicism of active forms united with passive matter. Aristotle takes living beings to be the prime example of individual substances in the natural world. So, too, does Leibniz and for roughly the same reason; such beings have their source of activity and change — their substantial form — within their very being. There are hints of this “biological” intuition in both Descartes’ and Malebranche’s theories of the living machine, and in Malebranche’s use of this theory in his doctrine of preformation. But neither thinker went beyond material forms to reintroduce the necessary substantial form.

But Leibniz’s hylomorphicism is markedly different from Aristotle’s because Leibniz is constrained by concerns that do not impact Aristotle, to the same degree as they impact Leibniz. Consequently, Leibniz too must embrace preformation. The most notable of these constraints is the strictness of Leibniz’s idea of indivisibility. Aristotle, Descartes and Malebranche all endorse an indivisibility of structure: living beings cannot be divided without destroying the functioning structure that defines them as living beings, and so they have a structural-functional unity. Leibniz’s criterion of indivisibility is the far stricter criterion of being unextended. It is only because matter is unified by an unextended substantial form that it gains unity (by indivisibility) and therefore, being. The substantial form is essential to Aristotle’s system of living beings as well. But also essential is the idea of organic holism (a unity due to a specific structure) picked up by Descartes and Malebranche. Thus Descartes and Malebranche on the one hand, and Leibniz on the other, embrace different aspects of Aristotelianism.

Leibniz’s criterion of indivisibility shows a further point of divergence from Aristotle. Because of his clearness on the idea of substantial form as indivisible, Leibniz recognizes the need to explain the generation and destruction of the substantial form itself. Aristotle uses the substantial form to explain the generation and destruction of composite individual substances (a substance generates when it changes its form and is destroyed when it loses its form). Leibniz is compelled to explain where the form itself comes from and goes to before and after those events. He finds that they have always and will always exist, and so he denies the generation or annihilation of substantial
forms.

But this, coupled with his embrace of early modern mechanism and what he takes to be intelligible explanations, forces him to deny the generation and annihilation of organic form too. Indeed, it forces him to deny generation and destruction of individuals altogether. Aristotle’s appeal to the pneuma, the semi-divine corporeal principle which builds all of nature’s machines, is strictly precluded from Leibniz’s vision of an adequately intelligible natural explanation. This is no better than Cudworth’s plastic nature or More’s spirit of nature. Similarly, the substantial form does not build nature’s machines, and so God must do so at the Creation. Material organic form, no less than substantial form, is created and annihilated only by God.

Further, Leibniz is extremely strict about Aristotle’s own ideas regarding the whole individual substance. For Aristotle, no form ever comes without matter (except God) and no matter ever comes without form; the whole being is a composite of both. Leibniz agrees. But since, for Leibniz, forms cannot transmigrate from body to body (this would entail a break in the law of continuity because it would require that the form suddenly “leap” to a wholly different organic structure), forms are always attached to the same organic whole, even if that whole is infinitely complex with organisms within organisms to infinity. It is certainly not the case, as Aristotle contends, that the form of an eventual individual is housed separately (in the male) from the matter of that individual (in the female) before its generation. This strict union, for Leibniz, of individual form and specific matter reinforces the need for organic preformation since that organism has to have come into existence with the form -- at the Creation.

But most of all, what leads Leibniz to his theory of preformation is his very modern problem of material unity, bequeathed to him by Descartes and his followers given the Cartesian definition of material substance. While the doctrine of preformation may explain the ‘generation’ of organisms on a mechanical philosophy, it is first and foremost a theory meant to account for material individuals and their identity through time. In no early modern thinker is this made so thoroughly clear as it is in Leibniz.
Endnotes

1. Perhaps most notable among these issues is the tension between the two facts about the human soul that Descartes brings to Elisabeth’s attention. If the soul and body can be and sometime really are distinct, then their union cannot result in a single substance but is rather the joining of two substances; but how can this be an ens per se in itself (Richardson 1982, 27-8)? Descartes himself seems to acknowledge at least the difficulty of understanding this in a slightly later letter to Elisabeth (28 June 1643): “It does not seem to me that the human mind is capable of forming a very distinct conception of both the distinction between the soul and the body and their union; for to do this, it is necessary to conceive them as a single thing and at the same time to conceive them as two things; and this is absurd” (AT III 693/CSMK 227). Commentators have also struggled with trying to understand the relation between soul-body interaction and soul-body union; is one more fundamental than another? are they two different ways of understanding the same thing? Another difficulty surrounds the problem, first noted by Gassendi and picked up by Elisabeth, of how two substances as heterogeneous as the soul and the body can either interact or be unified with each other. Further, are they unified in the way that Descartes suggests in his replies to the sixth set of objections: “This is exactly the way in which I now understand the mind to be co-extensive with the body – the whole of the mind in the whole body and the whole mind in any one of its parts” (AT VII, 442/CSM II, 298, emphasis added; see also letter to Hyperaspistes August 1641: AT III, 434/CSMK 197); or are they unified by the unextended mind somehow interacting with the extended body in the pineal gland (AT XI, 351ff/CSM I, 340ff)?

2. Against the view that Descartes appeals to hylomorphism to establish any unity whatsoever, including mind-body unity, see Rozemond (1998).

3. T.S. Hall notes three levels of mechanism in Descartes -- what Hall calls micro-mechanics, meso-mechanics and macro-mechanics. With regards to living beings, only the first two levels apply: micro-mechanics applies to the movement of micro particles within the body, while meso-mechanics applies to the living machine as a whole. Hall believes that with regards to studies of the living body, Descartes is a micro-mechanist first and foremost. That is, what matters in his explanations is what happens in the subvisible parts of the body (Hall 1970, 250-66).

4. Interestingly, it is possible to read Aristotle’s hylomorphism regarding living beings in a similar way. Jennifer Whiting, for example, suggests that “one way to understand the intrinsic unity of [the organic body and its soul] is to argue that each of its ‘components’ is the same thing considered or described in a certain way. On this account the form... is really an embodied soul, the matter... an ensouled body” (Whiting 1990, 62). Joan Kung has a similar reading: form is simply “a complex, highly organized set of abilities to carry on the life activities, most fully developed in the adult male” (Kung 1980, 71).

5. Many early moderns simply misinterpreted Aristotle on this point. The form passed on by the male is not intelligent or purposeful, but rather includes everything necessary to create a new body from the menstrual fluid through a series of pre-determined, and not at all purposeful or intelligent, realizations (Bates 1998). While this may be anachronistic, many commentators have pointed out that Aristotle’s theory of generation makes use of the same sorts of intuitions that ground current theories of reproduction. All the information needed to construct a living being pre-exists and does not demonstrate intentional purpose as it forms the body. It may also be true, however, that many early moderns may not have misinterpreted later theorists who also adopt a hylomorphic ontology, and who do rely on intentional souls or forms in nature to accomplish natural feats such as generation.
6. Leibniz is one who believes that Aristotle has not been properly interpreted by the early moderns, but part of this misinterpretation is due to the perversion of Aristotle’s principles by lesser Scholastic Aristotelians who came after Aristotle. See, for example, his letters to Thomasius of the late 1660’s. For a detailed account of how Leibniz interprets and changes Aristotle and other Scholastics on this point, see Christia Mercer (Mercer 1989, chapter two). It is not, however, just Aristotle whose work has been corrupted by followers. As Leibniz writes in “Reflections on the Advancement of True Metaphysics”, “The later Platonists spoke in a mysterious way, which they carried to absurdity; and the scholastic Aristotelians were more interested in raising questions than in answering them” (NS 31).

7. One problem with this interpretation is that sometimes Descartes says that the soul is active with respect to the body not only, seemingly, when it consciously wills something, but also with respect to the health of the body. Yet the body’s good or ill health would seem to rely only on that body’s independent functions of which the mind is not aware — even if it is aware of the result of that functioning by recognizing the symptoms of good or bad functioning. The on-set of death, for example, is not brought about by the soul and neither does it corrupt the soul, though the soul may be temporarily confused due to its union with a deteriorating body (AT VII, 353-4/CSM II, 245). That is, the body’s good or ill health would not seem to be effected by the thoughts of the soul. But this is quite in contrast with what Descartes writes to Elisabeth: “[t]he remedies which Your Highness has chosen [for illness], diet and exercise, are in my opinion the best of all — leaving aside those pertaining to the soul, for there is no doubt that the soul has great power over the body, as shown by the great bodily changes produced by anger, fear and the other passions.... I know no more thought proper for preserving health than a strong conviction and firm belief that the architecture of our bodies is so thoroughly sound that when we are well we cannot easily fall ill..., while when we are ill we can easily recover by the unaided force of nature...” (AT V, 65/CSMK 237).

Still, I think that this letter does not overly support a hylomorphic theory on the model of the soul actualizing the body. First, the soul has no active role in the generation of the body even if it is able to help preserve its good health. So it does not serve to actualize the body in the case of generation. Second, the soul does not intentionally preserve the health of the body, but does so only indirectly: “The soul guides the spirits into the places where they can be useful or harmful; however it does not do this directly through its volition, but only be willing or thinking about something else” (letter to Elisabeth of 8 July 1644: AT V, 65/CSMK 237). Third, the soul makes use of the body as an instrument — “the mind, so long as it is joined to the body, uses it like an instrument to perform the operations which take up most of its time” (AT VII, 354/CSM II, 245) — but the body as a useful instrument must first exist for this to be possible. As an instrument, that completed structure, it must already be fully actualized and ready for use. Finally, whatever good effect the active soul can have upon the health of the body, it is confined to the volitional aspect of the soul, and not some other aspect. The fact still remains that Descartes does not envision a direct biological role for the soul as a generative, nutritive, or sensitive faculty.

8. As Udo Thiel notes, there is a difference between claiming certainty through self-awareness of ourselves as individuals, and knowing the ontological nature of that individuality (Thiel 1998, 223). Thiel is writing about self-as-soul, but this applies equally to self-as-union.

9. It is true that there are political considerations motivating this letter. Descartes is giving Regius advice on how to deal with a clash with the traditionalists (especially Voetius) in the University of Utrecht. Voetius and his colleagues are trying to remove Regius from his university chair because of his claims that the human is an ens per accidens and that there are no substantial forms. Descartes could be coaching Regius on how to handle these charges in order to keep his chair, not in order to provide a philosophical position that Descartes himself believes is true. However, there is enough evidence elsewhere, as I have argued in this section, to suggest that Descartes does believe that the

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10. The monadic strain of metaphysics certainly starts off the *Monadology*, but starting in §61, there are clear hints of the organic metaphysics in many of the sections.

11. This passage indicates what might be considered a contradictory role for monads. As Hidé Ishiguro phrases it, “can monads well-found phenomena in which monads already play a role essentially related to the phenomenal” (Ishiguro 1998, 537)? See this article for Ishiguro’s understanding of how the two metaphysics and other related points of tension in Leibniz might be reconciled.

12. Leibniz often uses these various terms interchangeably, though it is not altogether clear that he does so consistently, or that there ought not to be distinctions made among them. Lady Masham worries over this point. “Perhaps my not being accustomed to such abstract speculations made me not well comprehend what you said there of ‘formes’, upon which I think you build your hypothesis: for (it seems to me) you sometimes call them ‘forces primitive’, sometimes ‘des âmes’, sometimes ‘formes constitutives des substances’, and sometimes substances themselves...” (29 March 1704: G III, 337/NS 203-4). Leibniz’s answer is as follows: “[w]hether these principles of action and of perception are then to be called *forms, entelechies, souls, or minds*, and whether these terms be distinguished according to whatever notions one may choose to assign them, things will not be changed in any way” (May 1704: G III, 339/NS 205). This is similar to his earlier claims (“A Specimen of Dynamics”, 1695): “Whether we call this principle [the metaphysical principle necessarily added to physics] form or entelechy or force doesn’t matter, as long as we remember that it can only be explained through the notion of forces” (GM VI, 241/AG 125). Leibniz does, however, recognize some differences. While animals and humans both have souls, for example, the human soul is unique because rational (e.g. G IV, 459-61/DM §34 and §35), and it ought not to be confused with “forms which are sunk in matter” (G IV, 479/NS 13). Also, Leibniz sometimes claims that only humans and animals have forms; all other individual substances have forms. For the purposes of my discussion, I shall not distinguish among the various terms used, supposing that they share an essential nature which (I shall note presently) consists in activity, complexity and unity. I shall, however, note the difference between rational and non-rational forms as this is critical at various junctures.


14. This is one of Leibniz’s main worries with Descartes’ definition of material substance as extension. This, too, is wholly geometrical and not substantial, and consequently allows no substantial reality at all to material ‘substance’. Again, I have simply bracketed this more fundamental problem, assuming that there is a substantial counterpart to the geometrical definition Descartes gives us. That is, I am assuming that Descartes also believes that there is extended *matter* -- something that is extended.

15. Obviously, much more can be said of the meaning of God’s concurrence as far as both Descartes and Leibniz understand it, but this is not critical to the current work.

16. Leibniz is no doubt aware of the argument that Spinoza makes for one single substance, “God or Nature”, based on the belief in relations among ‘individual’ substances. Spinoza starts with a very strict definition of substance: “that which exists in itself and is conceived through itself” (Spinoza...
[1677] 1949, I, def. 3), and from there develops an argument that any two things that are related to each other are actually just two different modes of a single substance. Since all so-called individuals are actually related to others, there are no individuals besides the one -- God or Nature. The only way out of this conclusion is to deny that what appears to be relations actually are relations among individual substances. This is, of course, Leibniz’s route.

17. I am running together here two threads that are distinct, however closely related they may be. These are first, the logical idea of what Leibniz calls a complete individual “concept” or a complete “notion” of an individual (e.g. G IV, 437/DM §13) -- the idea of a predicate within a subject, and second, the metaphysical idea of a substantial form. While I recognize that these are distinct threads, I bracket an investigation of the nature of their relation and just posit that the metaphysical substantial form is also the logical subject that somehow includes an exhaustively defining collection of predicates.

18. Masham is making reference here to Locke’s contention in An Essay Concerning Human Understanding that while “[w]e have the Ideas of Matter and Thinking, [we] possibly shall never be able to know, whether any mere material Being thinks, or no...” (Locke [1695] 1975, 540). This gave rise to the “thinking matter” controversy in which Leibniz and many others, including Masham, Mary Astell (1705, 245ff), and Catharine Cockburn (1702, 26ff) participated. For an extended discussion of this controversy see Yolton (1983).

19. There may be an exception made here for rational forms. I shall deal with this briefly below.

20. Glenn A. Hartz argues that Leibniz maintains a metaphysics of corporeal substance through to his mature metaphysics and never abandons this even though it leads to enormous difficulties for him (Hartz 1998).

21. The reason why Leibniz is so reluctant to expand the class of hylomorphic individuals beyond humans seems to be a result of how such substances are known. As I noted above, Leibniz suggests that the human soul is a paradigm of the substantial form because we have immediate awareness of ourselves as active thought. He therefore ascribes to the rest of nature active things like our souls. Similarly, the human being as a hylomorphic unity of soul and body is a paradigm of the substantial individual on his organic metaphysics because we have immediate awareness of ourselves as such beings. But, as Leibniz notes, it is difficult to be absolutely sure that other animals are like humans. “I judge that it is probable that plants and animals are animate, though I cannot say anything with confidence about any body in particular except the human body with which I am intimately acquainted” (marginal comments to his notes on Michel Angelo Fardella’s objections to Leibniz’s philosophy: AG 104fn148). Still, “even if we do not want to say anything definite about animals, plants, or any other species in particular, we must still recognize in general that everything has to be full of such species, which contain in themselves a principle of true unity which is analogous to the soul, and which is joined to some kind of organized body” (G IV, 473/NS 23).

22. A more fundamental questions which I shall bypass and simply assume to be answered is the following: why does Leibniz insists upon any material substance at all rather than just opt for the monadic metaphysics and a Berkeleyan-like idealism? Here are a few suggestions found in Leibniz’s corpus; I shall mention them only and not elaborate on them, nor assess their viability. First, material substance is required as the limiting factor of substantial forms. Matter is the limiting factor of substantial forms which are, after all, “limited” active beings and not the pure activity that God, for example, is (“Reflections on the Doctrine of a Single Universal Spirit”: G VI, 537/L 559). There are a variety of ways of understanding this relationship between active form and passive matter. Obviously, my current concern is the relationship between substantial form and organic body, but
Leibniz also speaks of this relationship as one between active force and passive force, or living and dead forces. This latter approach helps start to make sense of the ontology of hylomorphism -- how it is that a formal and material principle can be unified into a unity per se despite their very different natures. For discussions of the ontology of hylomorphism, see especially Garber (1982). Second, the soul cannot come without a body because the soul needs something material to represent the world to it (e.g. G IV, 530/NS 76), or the soul needs the body in order to function and think. This is implied in Leibniz’s rejection of those who believe “that the soul subsists without any body yet does not cease having its thoughts and functions” (G VI, 532/L 556). The most appropriate body for such purposes in an organic body that has the organs necessary for the soul to have perception. For a discussion of the necessary relation between the soul and the organism due to the perceptive capacity of the soul, see Ishiguro (1998). Third, and closely related, monads need bodies as the instrument through which is it able to express the universe (letter to de Volder, 20 June 1703: G II, 253/AG 178). The last two suggestions find a serious challenge in Leibniz’s admission that “[i]t is true that if God were to decide to destroy everything external to the soul, but to keep the soul in isolation, with its affections and modifications, they would bring it, through its own dispositions, to have the same sensations as before, just as if the body were still there, although this would then be nothing but a kind of dream” (G IV, 530/NS 76). For a discussion of why Leibniz cannot do without material substance, plus the difficulties that this poses for Leibniz, see Hartz (1998).

23. Leibniz’s rejection of the material atom as a unity in nature, and his consequent rejection of the material atom as capable of existence at all, is a complex doctrine which draws on many points of metaphysical import in Leibniz’s philosophy. For a thorough treatment of this, see Wilson (1982).

24. For this same reason, there are a number of phenomena in the world that may or may not be individual substances, and the limits of our knowledge may mean that we are not yet able to determine their ontological status. A wave in the ocean or a cloud are examples; both seem animate, but the limits of our knowledge means, perhaps, that we cannot be sure about things such as these two.

25. Canguilhem notes the difference between the two as follows. Both conceive of life as organization, but “[f]or Descartes, the organic ‘organ’ was an instrument that needed no organist, but Leibniz believe that without an organist there could be no structural or functional unity of the ‘organ’ instrument. Without an organizer, that is, without a soul, nothing is organized or organic...” (Canguilhem 1994, 81).

26. Leibniz writes this passage in the context of showing how efficient and final causes can work well together in natural explanations, and in the context of showing how final causes are useful in natural philosophy. This only serves to underscore my belief that teleology does enter into Descartes’ system given that I believes he, too, maintains something like what Leibniz puts forward here.

27. I shall qualify this claim below because the theory sketched in Discourse §22 (the “inchoate preformation”) may refer to the process of generation at the physical or natural level while Leibniz might still envision preformation proper at the metaphysical level.

28. The one possible exception to this is the change of a substantial form into a rational soul. Leibniz notes several times that such transformations depend upon a special act of God raising a non-rational monad to a state of rationality because it is not in the nature of something bound entirely by natural laws to be able to raise itself into a being bound by the moral laws of grace (e.g. G IV, 479/NS 12; G VI, 532/L 556). Of course, this means that Leibniz must either resort to a miracle (a special act of God to do something beyond the powers of natural beings), or postulate that non-rational souls can transform into things so clearly more perfect from within their own natures (which may also
constitute a miracle for Leibniz since this represents an act beyond the power of natural beings in themselves). Neither option is attractive. For the difficulty Leibniz has in the generation of rational beings (human beings), see Fouke (1991).

29. Leibniz then simply denies that the nature of material substance is extension, and rather suggests that hylomorphic organisms — organized bodies given true unity by their union with a substantial form (G IV, 482/NS 16; GM VI, 234-6/AG 118-120; G II, 251/AG 176) — are the essence of matter. Whatever is material in the world is either one of these things or is compounded out of a multitude of these things. Further, given that every organized body is always united with a unifying substantial form, these bodies are always real beings because they are always true unities, made so by the substantial form. As noted above, section III, Leibniz is more beholden to give an ontology of hylomorphism than is Descartes because of the way each claims to know that there are hylomorphic substances. Because Leibniz knows this primarily through reason, he is supposedly in a better position to explain the nature of the union between form and body than is Descartes who simply knows through phenomenal self-awareness that the union exists. But Leibniz's ontology of hylomorphism is not all that clear. Sometimes he seems to give no proper account of this at all, simply claiming that because there must be hylomorphic substances (because without them there would be no real bodies), then there are hylomorphic substances (G II, 77-8/CA 162-3). And he is sometimes forced to admit that although there must be a union between form and body, this union is "I know not what" (letter to de Volder, 19 January 1706: G II, 281/AG 184). Still he does believe that indivisible substance does not enter into "the composition of the body as a part, but rather as an essential, internal requisite" (comments on Fardella: C 320/AG 103, emphasis added). Elsewhere he notes that the pre-established harmony notwithstanding, "I do not deny some real metaphysical union between the soul and the organic body, according to which it can be said that the soul is truly in the body" (letter to Des Bosses of 30 April 1709, G II, 371/L 598). Leibniz’s clearest attempt to explain the nature of the hylomorphic union is framed in terms of force with the substantial form likened to the primitive active force and matter likened to the primitive passive force (see especially "A Specimen of Dynamics"). For developments of this latter attempt see Gale (1970) and Garber (1985).

30. Another interesting divergence between Leibniz and Aristotle emerges as a result of this point. Leibniz's own way of explaining things, of course, includes the fact that all substantial forms are created by God at the beginning of the natural world because their coming-into-being is necessarily creation ex nihilo and therefore a miracle; there is no temporal generation. His own way of explaining things also includes the fact that all substantial forms are created complete with all their states, and so the diversity and change among natural individuals is not due entirely to the matter in the composite as it is for many in the Aristotelian tradition. George Gale believes that Leibniz's Aristotelianism endures into his later years. Gale also believes that Leibniz's substantial form, unlike Aristotle's, is the principle not only of unifying individuation (picking out and unifying one bundle of matter apart from all others), but also of diversity. Aristotle, Gale claims, takes the substantial form as a species form only, a form that individuates matter, while it is the matter that establishes diversity (Gale 1989, 99). This may not be wholly accurate on Aristotle as the form may not be a species form at all but rather an individual form (Balme 1987). I think that this is largely accurate on Leibniz, but with a qualification. The soul alone is not the principle of diversity, for Leibniz. Rather, if we take seriously his Aristotelianism which includes hylomorphic individual substances, then it is the soul together with the unique organic body (a body that also expresses the universe in its own unique way) that is the principle of individual diversity.

31. One possible solution, grounded in the acceptance of hylomorphism, takes seriously the idea that substantial forms or souls, while all divisible and active, nonetheless vary significantly among themselves in other ways. It is true that substantial forms or monads in general are soul-like, but not
all are rational souls in the way that all souls in Descartes’ ontology, for example, are rational. Leibniz writes that “I do not remember having said that there are no substantial forms excepting souls...” (G II, 118/CA 221), and later embellishes on this: “To hold that every substance which is not divisible... is a mind and must think, appears to me incomparably more rash and more destitute of basis than the conservation of forms.... It seems more evident that nature, which loves variety, has produced other forms than those which think” (G II, 121/CA 225).

This possibility continues by suggesting that the pre-established harmony is not invoked only to explain how indivisible and unextended immaterial substances can interact or be unified with divisible and extended material substance. Rather, the pre-established harmony is invoked perhaps primarily to separate laws that rational souls follow (laws of spontaneity, laws of justice and of morality and of grace) from the laws that corporeal substances follow (laws of necessity, laws of nature). Yet these corporeal substances must be, by definition of substance, organisms unified with substantial forms which may well be non-rational. Thus, while the pre-established harmony forces an ontological wedge between rational souls and organic bodies, it need not drive such a wedge between non-rational souls or substantial forms and organic bodies. Rutherford, for example, thinks that Leibniz finds mind-body interaction impossible because “Leibniz draws on the principle of intelligibility... to insist that from any given being there follow just those effects proper to the type of being it is...” (Rutherford 1993, 149). Rutherford identifies two types of beings: minds and bodies (Rutherford 1993, 145 fn 18). Of course, this could refer to the ontological type of being, but Rutherford does note that it is the kind of laws that make minds different from bodies.

There are strong suggestions of this in the letters to Arnauld. In the following passage, for example, Leibniz notes the distinction between laws that govern rational souls and those that govern animals — beings which are nonetheless still animated substances because still joined with some sort of substantial form.

With regard to spirits, that is to say, substances which think and which are able to recognize God and to discover eternal truths, I hold that God governs them according to laws different from those with which he governs the rest of substances; for, while all the forms of substances express the whole universe, it can be said that animal substances express the world rather than God, while spirits express God rather than the world. God governs animal substances according to the material laws of force and of the transfer of motion, but spirits, according to spiritual laws of justice, or which the others are incapable (G II, 124/CA 230, emphases added).

If this suggestion is right, then hylomorphism, and consequently material unity, is not necessarily threatened by the pre-established harmony because the unifying substantial form is not governed by laws of justice and need not be strictly separated from mere matter which is governed solely by laws of nature. Rather, material unities as material organisms intrinsically unified with a substantial form may obey material laws alone and not the laws of grace or morality. This is implicit in Leibniz’s discussion above of the “material laws of force” which couple the concept of matter together with the concept of the substantial form because matter as extension alone cannot be a force. In fact, Leibniz often just does call substantial form the “force” of the body. The “material laws of force”, therefore, encompass both matter and form, and they preserve hylomorphism. Later in the correspondence, Leibniz also suggests this route when he distinguishes between moral and physical laws (G II, 136/CA 245). Perhaps the strongest evidence in favour of this approach is his 13/23 letter to Bernoulli when he notes that entelechies are never found apart from matter and that they are governed by natural laws, as are matter, unlike other kinds of forms, namely rational souls, that are governed by different kinds of laws altogether (GM III, 565/AG 171). Similarly, in the Theodicy, he writes that:

we also mean something when we speak of the union of the soul with the body to make thereof one single person. For albeit I do not hold that the soul changes the laws of the body, or that the body changes the laws of the soul, and I have introduced the Pre-established Harmony to avoid this derangement, I nevertheless admit a true
union between the soul and the body, which makes thereof a suppositum. This union belongs to the metaphysical, whereas a union of influence would belong to the physical (Th pd §55).

For other evidence in favour of this interpretation, see (G IV, 479-80/NS 13; NS 49; NS 51-2; GM II, 297/NS 58). Note that this interpretation also splits force from teleology in the sense that teleology refers to intentionality. The force of hylomorphic organisms is not intentional.

Predictably there is evidence against this attempt to save both the pre-established harmony and preformation. Leibniz does sometimes note that the idea of “influx” between two substances is unintelligible (“A Specimen of Dynamics”: GM VI, 250/AG 133; “Against Barbaric Physics”: G VII, 344/AG 319), especially if the two substances are heterogenous (G III, 353-4/NS 212), as are forms and matter, presumably. He also talks of the pre-established harmony when writing of a dog’s soul and body, even though the dog’s soul does not follow the laws of grace (G IV, 531-2/NS 77). And he also contrasts the laws of body with the laws of desire, the latter applying to all sorts of substantial forms, not just rational souls (G IV, 544-5/NS 102).
Chapter Five

Conclusion: future research and rethinking the history of generation

I. Introductory comments

In this concluding chapter, I shall sketch areas of future research suggested by this new reading of the preformation doctrine. One general area of research is to look at what generation as a concern seemingly distant to central metaphysical questions, can tell us about those metaphysical questions. Another general area of research is to look at the impact of seventeenth-century metaphysics on the continuing debate surrounding generation in the eighteenth century. In this chapter, I shall note only briefly some of the various areas of future research in these two general areas just mentioned (section II). I shall spend slightly more time (sections III through V) on a third general area of research. This area centres on the need to rethink some of the conclusions often drawn by commentators regarding the early modern generation debate -- the conclusion that preformation is naturally paired with mechanism while epigenesis is naturally paired with vitalism, for example, and the conclusion that the two theories are distinct and necessarily at odds with one another.

II. Areas for future research

The vast majority of historical studies of generation examine metaphysical commitments to explain why thinkers hold the theories of generation that they do. These approaches tend to emphasize one direction of influence only (if at all): the influence of metaphysics on natural philosophy. For example, in approaching the question of generation in Malebranche, Roger writes that "[i]t is not the aim here to analyse the role of the [preformation] theory in Malebranche's philosophy" (Roger [1963] 1997, 269). Shirley Roe's approach to the Haller-Wolff debate of the eighteenth century is similar. In her book, she turns to the philosophical commitments these two men have in order to explain why each maintains the theory of generation that he does despite shared experimental data. This approach is similar to Roger's as they both explain generation in terms of underlying philosophy and
metaphysics.¹

I think the converse relation is equally interesting. This means looking at what the thinker’s
time of generation can tell us about his or her deeper metaphysical theories. More than one
commentator has noted the value of the study of generation for understanding key and interesting
questions regarding nature, matter, God, creation and other metaphysical issues in the early moderns
(e.g. Pyle 1987, 227; Wilson 1989, 175). This approach is valuable because it allows a more critical
examination of the metaphysical foundations of the natural philosophy. Roe, for example, is trying to
explain why Haller and Wolff — two practising naturalists who both did extensive experimental work
on plants, animals and chickens’ eggs — chose different and supposedly opposed theories of
generation given that they had access to the same set of experimental and observational data. She
turns to their philosophical predilections to explain this divergence, claiming, for example, that Haller
is a mechanist while Wolff is closer to vitalism, and this helps account for the difference. But as the
case of our three figures shows, these underlying metaphysical ideas are themselves open to
evaluation and different interpretations. This was seen in the evolution of the idea of mechanism from
Descartes through Leibniz, and the fact that this evolution was necessary to account for issues in
material unity, in general and in the organism.

This dissertation has tackled one major way of looking at deeper metaphysical issues through
the prism of preformation by having as its central aim the goal of establishing the tight connection
between this seemingly peripheral concern in the history of natural philosophy — generation by
preformation — and a concern at the core of metaphysics — the individuation of material substance.
This work has shown the use of studying generation for the light it sheds on deeper metaphysics on
another point as well; Malebranche’s theory of preformation provides insight into the problem of
causation in Malebranche, for his embrace of the preformation doctrine lends support to the more
naturalist interpretation that Arnauld favours, the interpretation that likens occasionalism to the pre-
established harmony.²

There are other possibilities too. There are extensive connections between Leibniz’s embrace
of the preformation doctrine and his metaphysical theories, and many of these connections have been broached in this work. One interesting point for future investigations would be to look at the oft-made assertion of Leibniz’s ‘vitalism’ (e.g. Merchant 1980, chpt. 12) in light of his approach to generation. Particularly interesting would be to examine the apparent link between Leibniz and Anne Conway on this point. A number of commentators have claimed that Conway’s metaphysics positively influenced Leibniz’s mature metaphysics (e.g. Merchant 1979, Frankel 1991). They point to shared doctrines, many of them central to the issue of preformation in Leibniz, as evidence for the influence. These doctrines include the ideas that nothing in the universe is dead, that each portion of matter contains an infinity of creatures, and that the monad is the ultimate unit of reality in the created world.

But Conway, unlike Leibniz, believes that organisms are not generated by preformation, but rather through a process with more notable Aristotelian elements:

Now, let us consider briefly how creatures are composed.... In every visible creature there is body and spirit, or a more active and a more passive principle, which are appropriately called male and female because they are analogous to husband and wife. For just as the normal generation of human beings commonly requires the conjunction and cooperation of male and female, so too does every generation and production, whatever it may be, require the union and simultaneous operation of those two principles, namely spirit and body... (Conway [1690] 1996, VI §11).

This opens the possibility that the doctrines that these two thinkers both embrace may not stem from the same motivations at all, but may rather indicate a coincidental overlap on ideas without a deeply shared metaphysics to ground these ideas. In fact, I think this is the case, and the issue of generation illuminates this fact. Conway’s theory of generation, in which the spirit fashions the matter in its own likeness (the spirit of a horse will fashion a horse, and so on) discloses the fact that she has a completely different idea of natural activity than does Leibniz, but it also discloses the fact that she has no satisfactory idea of material individuation. The reason a spirit can act upon a body is that they are one and the same substance of different densities. They are both extended, but nonetheless indivisible in the following sense: “if a body is understood as one single individual, then it is indivisible. What we commonly mean by the divisibility of bodies is that we can divide one body from another by placing a third between them” (Conway [1690] 1966, VII §4). This is a theory of
indivisibility that Leibniz would find indefensible. From this divergence on the issue of substantial unity, a huge gulf between the two opens.\textsuperscript{3}

Another area of research would be to investigate the sorts of claims made by four recent Leibniz scholars who have all noted some aspect or another of the “biological” or organic nature of his philosophy. Daniel Garber, in his influential paper on the Aristotelianism of Leibniz’s middle period, argues that in the mid-1680s the foundation to Leibniz’s natural philosophy is biology (Garber 1985, 88). Robert Merrihew Adams and Donald Rutherford both attempt to solve some of the trickiest questions in Leibniz scholarship: those surrounding the problem of the relation between the material world and the world of incorporeal monads. They both conclude that Leibniz uses the model of an organism to mediate the two realms (Adams 1994, 289; Rutherford 1995, 230-32). Catherine Wilson finds a shift in Leibniz’s thought between the years surrounding his Discourse on Metaphysics and those surrounding the Monadology, and she characterizes the shift as from a concentration on logic and analysis to a concentration on biology and dynamics (Wilson 1989, 160). Wilson also finds a biological outlook at the centre of Leibniz’s idea of the internal development of a substance (Wilson 1989, 175).

These suggestions are all interesting and do capture something important in Leibniz’s thought, but they must all first grapple with the concepts of the biological and of the organism. If Leibniz’s natural philosophy, and even his metaphysics, is modelled on the concept of the organism, then what precisely is the content of this concept for Leibniz (as opposed to for a twentieth century mind)? When we compare his concept of the organism with, for example, Descartes’ and Malebranche’s, it is the latter two who have a more truly “biological” conception -- death just does ensue when the organism loses an essential structure and so on -- even if this does not ground a metaphysics of matter in the same way that it does for Leibniz.

Another area for future investigation is to note the impact of seventeenth-century metaphysical ideas on the continuation of the debate over generation in the eighteenth century. Most especially interesting here is the debate, already mentioned, between the preformationist Haller and
the epigenecist Wolff. This is particularly interesting because both are positively influenced by Leibnizian metaphysics. Haller notes with approval Leibniz’s theory of preformation as found in the *Theodicy*. And Wolff is indirectly influenced by Leibniz’s metaphysics through the biological adaptation of that metaphysics by the elder Wolff, Christian Wolff. Indeed, here I think an argument can be made that Haller and Wolff each draw on different aspects of Leibniz’s metaphysical thought — Haller upon the idea of unity and Wolff upon the idea of internal development and activity — aspects that Leibniz thinks must be necessarily joined to account for material unity at all. This combination of the two principles which separately lead Haller and Wolff to embrace quite distinct ideas of generation, may explain why Leibniz’s theory of generation bears marks not only of preformation but also of epigenesis (Tymieniecka 1965, 142-151; see below section IV for an elaboration of this claim).

With these possibilities simply noted, let me move on to another area of future research, one I shall expand upon in slightly more detail here. This is an investigation of the claims that preformation and epigenesis are to be understood as clearly distinct theories in the early modern period, and that preformation aligns with mechanism while epigenesis aligns with vitalism. I think these claims need to be rethought, and the work accomplished thus far which shows the connection between generation and unity help us to understand why.

III. The preformation-epigenesis dichotomy

This reconsideration of the preformation-epigenesis dichotomy, and supposed connection with mechanism and vitalism, is perhaps best introduced by way of a few ideas from the work of those who have examined generation or its history. Trained as a developmental biologist, Clara Pinto-Correia claims in *The Ovary of Eve* that the preformation-epigenesis controversy endures in current biological debates: “As with any other fundamental debate, the basic concepts involved never die. They just acquire modern incarnations and find their way back to the core of the crucial philosophical perplexities they represent” (Pinto-Correia 1997, 302). Similarly, in the late nineteenth century, the
German biologist Oscar Hertwig compared his theory of embryological development with that of August Weissmann and determined that the debate between them was essentially the old epigenesis-preformation debate with scant difference between the earlier and later versions of this controversy (Hertwig [1894] 1977, 1-10). Weissmann himself had already noted that his theory of the germplasm was essentially preformation: “I believe that I have established that ontogeny can be explained only by evolution [preformation] and not by epigenesiis” (Weissmann 1893, 14). And Hertwig believed he was contributing the epigenetic position.

Recall in chapter one, section I the four early twentieth-century historians of biology -- Russell, Meyer, Needham and Cole -- who maintain quite the opposite from Pinto-Correia, Hertwig and Weissmann. Pinto-Correia’s ideas about the endurance of the debate challenge the belief held by these four that epigenesis finally triumphed over the old preformation prejudice thus freeing embryology forever from the albatross which was preformation. Nonetheless, many of these same critics of preformation conclude that the two approaches to embryology mirror two great and dichotomous philosophical traditions which would, seemingly, suggest the sort of endurance Hertwig and Pinto-Correia identify (unless, of course, the critics of preformation believe either that one tradition no longer endures in science or that scientists no longer work with deep philosophical presuppositions informing their work, consciously or otherwise). M.W. Wheeler captures this philosophical dichotomy, noting that a direct line can be drawn from Parmenides through Plato to the doctrine of preformation, “the very negation of all development, since the theory held that all the individuals of a species had been created simultaneously for all time” (Wheeler 1899, 268). Similarly, epigenesis is born from the lineage of Heraclitus and Aristotle: “The physiologist, who deals with process, who is ever mindful of the Heraclitean flux, inclines naturally to this view [epigenesis]” (Wheeler 1899, 282). Russell picks up this dichotomy and concludes:

Epigenesis and preformation represent two different attitudes to the problem of development, arise from two fundamentally different philosophies. The epigenetic view is dynamic, vitalistic, physiological: the preformationist is static, deterministic, and morphological. The one stresses time or process, the other space and momentary state — the one emphasizes function, the other concentrates on form (Russell 1930,
Later, he draws the distinction in a similar way, though this time emphasizing one particular way of distinguishing the theories: preformation is almost always materialistic and mechanical while epigenesis is almost always vitalistic (Russell 1930, 132-34).

So some commentators believe that preformation and epigenesis, however they may change and develop as biological theories, rest upon metaphysical foundations which are dichotomous and have endured from the earliest of philosophical history through to the late twentieth century. Further, not only do some commentators believe that the underlying metaphysical debate which started in antiquity continues today, but many have found the two sides of the biological debate expressed as early as Aristotle (e.g. Preus 1970, 5ff; Peck 1963), and some have found traces of the preformation doctrine in Plato’s Timaeus (e.g. Cole 1930, 37). This is one broad approach: to maintain the continuance of the dichotomy, at least in so far as they represent metaphysical predilections, but perhaps also as biological theories. And there are two specific claims in this approach that I shall highlight. First, preformation and epigenesis are strictly distinct. Second, they align respectively with mechanism and vitalism.

There is a supposed historical trend that goes along with this idea of a persisting dichotomy. This is suggested by Thomas Thomson in his 1812 History of the Royal Society where he writes of the then-recent trends in the study of the living being.

When Newton and his contemporaries laid the foundations of mechanics, upon the rigid principles of mathematical demonstration, physiologists embraced with eagerness the fashionable doctrines; the human heart was converted into a hydraulic machine; the force of the heart and the velocity of the blood were rigidly ascertained; and everything was accounted for by the size, shape, and motion, of the different particles of matter of which the body was composed. When mechanical philosophy began to lose its novelty, it was in some measure supplanted as a fashionable study by a peculiar species of metaphysics, which was prosecuted with much ardour for a time, till it at length terminated in universal skepticism. During the progress of this enticing science, physiologists laid hold of its notions and doctrines, and two opposite systems were produced, the more ancient explaining everything by the action of a living principle, and the more modern by a principle somewhat indefinite, to which they gave the name of irritability (Thomson 1812, 120).

Thomson was surely among the first to allege a mid-eighteenth century transition from a prevalence
of mechanical explanations of the phenomena of life to a prevalence of a new sort of explanation which would be finally named “vitalism” ten years later. But this trend was a reversal of the one from earlier forms of vitalism to mechanism in the sixteenth to seventeenth centuries. That is, Thomson seems to sketch a broad strokes historical trend in the study of nature in general, and consequently in the particular study of life phenomena as part of nature, which proceeds from an early vitalism (Aristotle and his Medieval followers, for example) to a period of austere mechanism in the seventeenth and early eighteenth centuries (Descartes, Malebranche, Newton) and back to a period of vitalism starting in the later eighteenth century (Stahl, Wolff, Haller, Blumenbach). Others have noted this trend (or at least one of the two transitions). Theodore M. Brown and Robert Schofield, for example, have analysed the mid-eighteenth century transition from mechanism to vitalism (T. Brown 1974, Schofield 1970, 191ff). And the earlier transition to mechanism — the “mechanization of the world view” — has had a long hold on the historical imagination, though both Roger and Phillip R. Sloan, among others, have paid particular attention to the study of life in this transition (Roger [1963] 1997; Sloan 1977).

Running parallel with this supposed trend is a second supposed trend: from an early acceptance of epigenesis to the pre-eminence of preformation in the interim mechanical period to a resurgence of support for epigenesis in the mid-eighteenth century. The temptation is to drawn a connection between the two trends which is deeper than a mere correlation. Several authors do make this connection: preformation and epigenesis are split along lines of mechanism and vitalism respectively (e.g. Driesch 1914, 12; Gould 1997, xiv-xv; Russell 1930, 132-4), and rise and fall with the fate of these outlooks. The triumph of preformation in this era represents the triumph of mechanism. This is, of course, the “received” view of the emergence of preformation which maintains that preformation arose because this seemed the only way of explaining generation on a mechanical philosophy.

Let me sketch why some commentators tend to make the other pairing between epigenesis and vitalism. To do so, I shall follow the model offered by A.J. Pyle in his examination of early
modern generation. He suggests that the variety of theories of generation postulated during the Scientific Revolution can be categorized depending on their answer to two questions: what is the agent of generation? and what is the schedule, or time factor, of generation? (Pyle 1987, 228-29). From the answers to these he develops a taxonomy of several different theories each of which finds some advocates in the early modern period. His analysis is somewhat more detailed than that required for the purposes at hand, but his approach is useful, and so I shall deal with the issue of epigenesis from a similar direction. I shall pose a slightly different pair of questions, however. First, as with Pyle, what is the agent -- the proximate efficient and/or ultimate planning cause -- of generation? There are three broad ways of answering this. Either God is the direct and only agent, or something natural is the direct and only agent, or there is a sharing of the work between God and a natural agent. Second, by what means does the agent perform its work? In the case of God, the means is most likely his intellect at the planning stage and his will as efficient, executing cause. In the case of a natural agent, the means by which it effects its work will depend on its nature.

There are two aspects of the definition of epigenesis offered above in chapter one, section VI that I will reiterate here as hallmarks of that theory. These are the fact that generation proceeds through successive steps with organs forming one after another in a rigid sequence, and the fact that these formations are truly a new formation or coming-into-being of form.

So let us start with the first point. Epigenesis maintains that form emerges through successive steps beginning after coitus. This claim is based on observation. Both Harvey and Wolff, two of the strongest advocates of epigenesis in the period under consideration, maintain this belief because of extensive dissections and observations on chicken eggs, and in the case of Harvey, on the foetuses of deer. But advocates of preformation do not necessarily dispute the observations. Rather, the preformationist may dispute the limits of the observer, or may have different ideas from the epigenecist of what "form" or "coming-to-be" might mean. For example, Haller, himself an experimentalist, has no quarrel with Wolff on the observational facts but rather on how they are to be interpreted. And in fact, the experimental data cannot settle the debate in principle because the
preformationist's claim is unverifiable. It is metaphysical in the extreme — God created all germs at Creation, and this can never be observationally verified. This is not to suggest that the preformationists do not use the observations offered, for example, by new microscopic discoveries; they do as we saw in the case of both Malebranche and Leibniz. But they appeal to observational data in ways quite different from the epigenecists.

This divergence with regards to observation is captured by J.S. Wilkie's claim that epigenesis is a description of embryonic formation and growth while preformation is an explanation of that phenomenon (Wilkie 1967, 142). This suggests that there is no real metaphysical difference between the two theories but rather a difference in emphasis — while the epigenecist is not interested in providing an ultimate explanation for the observations, the preformationist is, and if the epigenecist should shift emphasis to explanation, he too would arrive at something like the preformationist's position. That is, should the epigenecist ask how the adequately described transformation of matter into a living being occurs, she may be forced to deny that the initial matter is homogenous, undifferentiated, unorganized and non-complex. In this way, preformation and epigenesis need not be seen as distinct metaphysical positions but as the answers to different questions, or a difference in epistemology. The epigenecist may ask how (descriptively) form emerges during embryonic growth, and the preformationist may ask how (explanatorily) form comes into being. The preformationist may agree wholly with the epigenecist on the answer to the first question, and should the epigenecist ask the preformationist's question, he may be forced to a similar answer. This suggests a dichotomy between the two positions grounded in methodology, but it is not a dichotomy of ontology.

The second claim above is the belief that the observed progressive emergence of form is truly a new formation — a coming-into-being of form. That is, the material out of which organisms form really is initially homogenous, undifferentiated, unorganized and non-complex. Somehow during the process of development this material is transformed into a heterogenous, differentiated, organized, complex and unified entity. This claim goes beyond the merely descriptive. It is a metaphysical claim about the initial constitution of the material which will eventually become an entity we call a living
being. If there is a true locus of difference between preformation and epigenesis, it lies here.

Assuming that the epigeneticist really does believe that the apparently new formation is really a new formation, then let us turn to the two questions posed above. First, what is the agent of generation? God can be the full and sole agent on an epigenetic account of generation no less than on a preformationist account of generation. This is, after all, what Kant suggests the occasionalist should posit rather than positing the creation of all future lives at the Creation: “According to occasionalism the supreme cause of the world would, in conformity with its idea and on the occasion of every copulation, directly give the mingling matter its organic structure” (Kant [1790] 1987, 422). While this would be a sufficient and final ‘explanation’ of generation, it would be no more a natural explanation of the coming into being of form than would preformation be such an explanation. In an important way, this ‘explains’ nothing.

If, however, epigenesis posits something natural as the agent of generation, this agent may be more or less responsible for the formation of the foetus. The prevalent understanding of the universe during the period under consideration is premised on a Christian God. Questions of the physical world cannot be separated from questions of metaphysics which in turn are woven through with questions of theology. These disciplines come as a piece together as “natural philosophy”. The natural world is a created world, and while there are a number of potential theories of creation, the belief that God brought the world in its entirety into being is not, for the most part, in dispute. This understanding is rarely bracketed from an investigation of the working of nature. Given this, then, God is ultimately responsible for the fact of the existence of all material and spiritual being. No matter or souls truly come into existence except by a divine act. But the details of the created world, for example, its organization and arrangement, the form-as-material-structure or organism, may be more or less dependent on God’s will and even wisdom.

For example, and this seems to be required by the epigeneticist if generation is really a new formation, God may have created wholly undifferentiated and unorganized matter, entirely unformed, but then he would have had to create and add to this world of unorganized matter some kind of
principle which would be capable of making organic beings out of such matter. When the epigenecist posits a natural agent as the cause of organization and asks as well for a full explanation of generation, he is then required to provide some sort of explanation for the transformation of the material; he is required to explain the means by which that agent works. This is where the mechanism-vitalism split is usually ushered into the debate. Mechanism as the idea of matter in contact motion behaving according to a few simple rules, is not adequate to explain the regular and frequent development of complex organisms which resemble their parents. Further, laws would not seem to be the sorts of things that can be responsible for motion unless they have some substantial reality. Preformation, the argument goes, is the only plausible explanation for the origin of form given the explanatory limits of the mechanical philosophy. In denying preformation as an explanation for origin of organic form, the epigenecist must necessarily turn to explanations other than mechanical ones. She must resort to vitalism.

In what way is vitalism a solution to this problem? In the broadest sense, as it is understood in the nineteenth century when the term was coined to capture theories about the nature of living beings such as Wolf's (Bates 1998), vitalism posits that the origins and phenomena of life are the result of a vital principle which cannot be reduced to or understood in terms of physical or chemical forces. While this principle may not be fully comprehended nor explicable in itself, it is needed as the 'explanatory' principle behind the undeniable phenomena of life, itself inexplicable through mechanism. The vitalist, then, maintains an unbridgeable ontological gap, a radical dualism, between life and non-life while the mechanist rejects this dualism and rather maintains a continuity among all things in nature. But the vitalists usually do not explain to the satisfaction of mechanists, for example, exactly how the vital principle does its work; such a principle is simply required because without it, life could not be explained at all.

Hilde Hein understands the distinction between vitalists and mechanists as starting from a distinction in the nature of matter (Hein 1972, 163ff). Vitalists take matter in the Aristotelian sense; matter is defined by its passivity. Vitalists, therefore, posit an external but natural source of activity
which is responsible for phenomena of life which passive matter cannot explain — the maintenance of living bodies, the replication of those beings and so forth. She admits that this external source can fit any number of ontological descriptions, and this gives rise to a “multitude of vitalistic theories” (Hein 1972, 164). G.E. Stahl’s biomedical soul, Wolff’s vis essentialis, Hans Driesch’s entelechy (not to be confused with Aristotle’s, Hein warns) all qualify as that source of activity distinct from and superior to matter which is needed as the efficient cause given matter’s utter inability to move itself.

Mechanists, Hein claims, usually take matter to be active. This, however, is not the case with either Descartes or Malebranche, for example, and Hein also recognizes that some mechanists also conceive of matter as passive. But they believe that laws of external motion which act as efficient cause for all of nature act as efficient cause in the phenomena of life as well. For the mechanist, these phenomena arise simply because of the particular arrangement of the parts of passive matter brought about by the laws of motion. True, this is a particularly interesting arrangement, but life phenomena are no less the result of the structure of matter than are any other phenomena in nature. In the early moderns, this is first clearly found in Descartes (Hein 1972, 164). Mechanism is quite unlike vitalism, then, given that the vital principle is the mark of life and only living beings have this.

Driesch’s approach to the issue in his The History and Theory of Vitalism (Driesch 1914) focuses on teleology as a critical element of vitalism. Like Hein, Driesch applies vitalism only to biological theories. And he, too, includes a motley collection of characters, together with their various and different theories about life and generation, in the class of vitalists: from Aristotle through Jean Baptiste van Helmont, Harvey and Stahl into the eighteenth-century group of Pierre Maupertuis, John Turberville Needham, Wolff and Johann Friedrich Blumenbach.

Lest an error be made in the sort of teleology he attributes to living beings, Driesch draws a contrast between what he calls static or purely descriptive teleology and dynamic teleology (Driesch 1914, 4–6). Static teleology is the sort of teleology one might find in a machine — apparent purposive behaviour that arises wholly from the structure and order of the underlying mechanical parts of that machine. If one were to claim that living individuals are teleological in this purely structural way, this
would not be a claim to vitalism because the laws that apply to such a being are the same that apply to the rest of the material world. We may be able to pick out living from non-living things at the phenomenal level, but this would be due wholly to the fact that living things have a particular structure or combination of parts that gives rise to the phenomena of life but which nonetheless behave according to the same laws found everywhere else in nature. The distinction between living and non-living things, then, would not represent an unbridgeable gap; the former could be reduced to the latter. However, static teleology cannot provide an answer as to how this order among parts comes into being in the first place. Driesch indicates that the inability of static teleology to answer this question forces one to admit dynamic teleology.

Dynamic teleology is vitalism proper because it represents an "unanalysable autonomy" of living beings. This kind of teleology does not merely describe the fact of living beings; Driesch believes it acts as the explanatory principle for their generation and living maintenance. Although this is more than merely structurally descriptive teleology, it is not to be taken as an expression of an intentional purpose but merely of a goal (Driesch 1914, 2). Ernst Mayr, a twentieth-century defender of the concept of teleology as applied to living beings, also distinguishes between goal-directed teleology as non-intentional, and purposive teleology as intentional, and he also indicates the former as the appropriate sort of teleology to apply to life (Mayr 1992, 123). Mayr, though, is not a vitalist while Driesch is. Mayr appeals to the encoded, and wholly material, genetic program as containing the eventual goal of a living being. Driesch appeals to a vital principle as the cause of the structural order of organisms; the form does not pre-exist in the matter at all, not even in a fashion which will undergo significant transformations (as a genetic code becomes an organism). The vital principle itself cannot be analysed in terms of physical and chemical parts or laws applicable to such parts. Thus there is an irreducible dualism between life and non-life.

Interestingly, while Driesch's dynamic teleology indeed 'explains' the origin of life forms in the sense that it posits a cause of them (the vital principle), it hardly explains what that cause is and how it operates. To reiterate the point made above, vitalists usually posit a principle in order to
explain life phenomena that cannot be explained, they believe, by the mechanist, but this is not an explanation that would satisfy most mechanists.

IV. Mechanism, vitalism and organicism: the breakdown of the preformation-epigenesis dichotomy

I think the picture offered above is not enough to substantiate the idea that preformation is naturally a mechanical theory of generation while epigenesis is naturally a vitalistic theory of generation. One reason is that offered by Needham: “there are too many exceptions to this rule to make it helpful” (Needham 1959, 207). Another reason is the myriad of meanings attached to mechanism and vitalism. This makes it very hard to make such neat parallels. Yet another reason is the blur between the two theories of generation. Finally, the motivation for preformation I have developed in this work -- the fact that preformation is meant to account for material unity of the organism and also more fundamentally of matter itself -- suggests that there is a third option to be added to mechanism and vitalism, and this option is organicism. I shall deal with these various points in turn.

The sketch offered above of Driesch’s position on vitalism comes from the first pages of his book before he turns to a history of what he takes to be some vitalist positions. This history is telling because if all the thinkers he indicates as vitalists endorse what he calls “dynamic teleology” then there is much variation in that notion. For one thing, purpose, and not mere non-intentional goal-directedness, would seem to sometimes be a part of this sort of teleology. A quick examination of just three in his list of vitalists -- Aristotle, Stahl and Wolff -- underscores this point.

In De Anima, Aristotle distinguishes between living and non-living on the basis of the soul -- whatever has vegetative soul is living (413a20ff). Similarly Stahl locates the principle of life as the soul, specifically, the biomedical soul. But in their theories of generation, the vast difference between their conceptions of soul is made clear. In Aristotle’s theory, for example, the goal of a fully formed adult of the particular species is already implicit in the form that is passed on by the male before the process of generation and growth even begins. So no intentional, purposive agent is required to
construct the form anew where there is none. As the form of the individual, the soul is intrinsically united with matter and expresses its functions through the material body. Stahl’s bio-medical soul is both separate from matter and has, at least partly, an intentional nature. While not rational (defined by Stahl as the ability to draw conclusions from premises, to imagine and to recollect), the biomedical soul both causes and controls living bodies and their functions including their generation and growth. It “knows” what it does and acts purposively within the limited domain of its work, including the work of fashioning, developing and maintaining a living body from matter in which no hint of the final outcome is to be found (Rather 1961, 37; Hall 1969, I, 361ff). Both Aristotle and Stahl may provide examples of dynamic teleology, but the teleology of the former is mere goal-orientedness while that of the latter is purposive. Psychology, as intentionality, enters Stahl’s theory of generation in a way that it does not enter Aristotle’s (for whom, after all, psyche means something entirely different than intentionality or consciousness).

Wolff’s vitalism is entirely different. His vis essentialis is not a soul of any description. It remains truly unanalyzed throughout the bulk of his work on generation. It is simply the force posited to explain the brute phenomena of life. Since only living beings have this force (only living beings exhibit the brute phenomena of life), the vis essentialis is that wholly mysterious ontological factor which separates the living from the rest of nature. This, better than Aristotle’s form-soul or Stahl’s bio-medical soul, best captures the sense of vitalism as an unanalyzable, autonomous principle such as Driesch defines it.

Important in this brief sketch of just three of Driesch’s vitalists is a clear conflation of two concepts under the definition of vitalism. In Don Bates’ words, this is a conflation between self-moving forces and actively intelligent forces or between what is alive and what is awake: the conflation between pre-determined goals and determining purposes (Bates 1998). This is important for the question of preformation and epigenesis since if vitalism is somehow captured by the latter half of these dichotomies -- intelligent, awake, purposive, determining -- and epigenesis has a natural affinity with vitalism, then it is curious that generation by epigenesis is no less deterministic than
generation by preformation. Wolff himself recognizes this and rigorously denies he is a vitalist who conceives of nature as intelligent and purposive. But vitalism just is often taken to be purposive teleology. Both Sloan and Geneviève Rodis-Lewis equate Descartes’ rejection of the rational soul as an explanatory principle in the construction of the body (in the *Discourse*, for example: AT VI, 46/CSM I, 134) as a rejection of vitalism (Sloan 1977, 17; Rodis-Lewis 1978, 156). This may just be expected when vitalism in the pre-seventeenth period includes, in Sloan’s evaluation, a variety of “intrinsic vital causes — archei, faculties, substantial forms, animae” (Sloan 1977, 1), and vitalism in the eighteenth century widens the list of vital principles to include forces such as irritability and the *vis essentialis*; why not just add the rational soul to that grab-bag of potential vital principles?

Mechanism, too, is a complex notion. Here is Alan Gabbey, for example: were not “there several, perhaps mutually independent revolutions, or mini-revolutions [in mechanics] — in collision theory, in statics and the theory of machines, in hydrodynamics, in vibration theory, in the theories of central forces and of rigid body motions...?” (Gabbey 1990, 496). J.E. McGuire gives perhaps the most comprehensive list of possible meanings for “the mechanical philosophy”:

It is obvious that the term ‘mechanical’ meant many different things to thinkers of the seventeenth century: nature is governed by immutable geometric laws; contact action is the only mode of change; first principles are to integrated with experimental investigations; regularities are to be explained in mathematical form; that all phenomena arise from matter in motion, or matter and motion; that compound bodies are composed of vortices (Descartes), centers of force (Leibniz), or tiny bits of matter conceived as atoms or corpuscles; that changes in phenomena result from the way in which internal particles alter their configurations; that the ‘new science’ conceives nature dynamically in terms of motion rather than statically in terms solely of the size and shape of internal particles; that occult qualities are to be banished from explanations which must be based on sensory experience in terms of clear and distinct ideas; or that nature is be conceived in analogy to the operations of mechanical activities.... [W]hile they [mechanists] all agreed that contact action was a necessary condition for a mechanical explanation, there was no settled agreement as to sufficient conditions (McGuire 1972, 523n.2).

Bates also identifies contact action among elemental parts of matter as an important requirement for a mechanical explanations, but emphasizes that machine-mechanism cannot always be reduced to elemental-mechanism (Bates 1998). Others, too, have focussed on these two particular manifestations of the mechanical philosophy and have also stressed the fact that they are not equivalent. Fouke notes
that while mechanical philosophy may be theoretically conceived of as the interaction between material parts, in practice this is usually manifest as either the development of general laws of motion and impact or the quite different appeal to particular machinelike arrangements to explain particular phenomena (Fouke 1989, 366). And here is Gary Hatfield: “we must consider the punning sense of the word ‘mechanism’.... For ‘mechanism’ means not only blind causation according to natural laws - - it also means machinelike.... But machines are artefacts; the structure of a machine is identified by virtue of a conception of what counts as its proper functioning” (Hatfield 1992, 361).

This seems to be precisely one lesson of Driesch’s static teleology: that machines are not wholly captured by their constitutive elements in lawful motion because machines function in a particular way, determined by their purpose which is conceived of by their creators. Descartes himself in the Sixth Meditation identifies the difference between the two ideas of mechanism: “Yet a clock constructed with wheels and weights observes all the laws of nature when it is badly made and tells the wrong time as when it completely fulfills the wishes of the clockmaker” (AT VII, 84/CSM II, 58). Matter in motion according to laws of nature is indifferent to proper functioning; machines are not. Machines as material entities simply obey the laws of nature. Machines as functional entities behave otherwise as well.

Besides the multitude of meanings and varieties of vitalism and mechanism, the dichotomy between epogenesis and preformation along these lines is complicated by the fact that the two theories are not always easy to distinguish. Recall the discussion above in which I noted that Pinto-Correia, Hertwig and Weissmann contend that preformation and epigenesis endure as competing theories well beyond the early modern period (Pinto-Correia believing they still endure as dichotomous theories). Jane Maienschein takes a different approach, emphasizing the developments in biology rather than entertaining the possibility of static metaphysical foundations persisting despite these developments. She writes thus of the ‘contrast’ between Hertwig as epigenecist and August Weissmann as preformationist:

Though the terms [preformation and epigenesis] remained, the character of the
debate had changed. No longer did the preformationist appeal to the form of the type as already structurally embodied in the germ material and simply growing larger in any literal sense. Weissmann’s was instead a position of pre-determinism, where material determinants direct the development of differentiated parts.... thus Weissmann’s position moved somewhat toward epigenesis.... [According to] Hertwig’s epigenesis... the emerging organism begins as an organised germ cell.... This position thus moved toward embracing some pre-organisation of the egg material.... [T]hey were neither as extreme nor were they as distinctly separated as previous preformationist or epigenetic views (Maienschein 1985, 79).

Maienschein thus interprets the nineteenth-century history of so-called preformation and epigenesis quite differently from those who maintain explicitly or implicitly that there is a continuity in the fundamental concepts defining preformation and epigenesis, and that consequently the debate between those positions spans millennia. Maienschein, by contrast, takes the biological developments between the mid-eighteenth and late-nineteenth century to have altered the terms of this debate quite radically. No longer are preformation and epigenesis as clearly distinct as they were in the early modern period. Rather, the line between them in the Hertwig-Weissmann debate is blurred, and Maienschein implies that little more than the words “epigenesis” and “preformation” remain from the earlier debate.

I shall not approach directly the two related questions of whether controversies in developmental biology of the past century can be mapped onto the early modern dispute without doing violence to these positions, and whether science is marked by revolutions which represent radical epistemological breaks or rather is marked by solid continuity. Nor shall I approach the question of whether there is a way of reconciling revolution and continuity in science, and thus Maienschein’s position and that of Pinto-Correia et al.10

But I shall extract a more specific theme from the previous discussion for examination within the confines of early modern philosophy. This theme starts from Maienschein’s suggestion that the line between so-called preformation and epigenesis in the nineteenth century was not at all distinct. The same, I contend, can be said of the debate in the early moderns. This is not to suggest that the reasons for the blur are the same in the seventeenth century as they are in the late nineteenth century; I believe that too many developments in biology in the intervening period preclude this. But
Maienschein suggests that the doctrines in the seventeenth and eighteenth centuries are so clearly distinct because preformation is a theory about a fully-preformed, morphologically-complete, tiny organism -- a minute horse or human -- frequently called the "homunculus." This is not the only version of preformation to be found in the early moderns. As I have argued in this dissertation, there are different motivations for the preformation doctrine, and the motivation from unity as opposed to structural complexity, gives rise to different versions of the preformation doctrine. The line between this theory and its supposed rival, epigenesis, is not as distinct as most histories to date have suggested.

Indeed, Frederick B. Churchill rightly notes that in discussing the "awkward dichotomy" of preformation and epigenesis, "a thorough analysis must tangle with those intractable questions about the meaning of 'novelty,' 'emergence,' 'coming-to-be,' and 'form'" (Churchill 1970, 171). This point is made clear by at least two of the three thinkers dealt with in this work. Descartes (often called a mechanical epigenecist, though wrongly, I believe) definitely has a mechanical theory of generation, but if I am right about his theory of preformed matter -- a kind of inchoate preformation -- then the form pre-exists, even if in a different manifestation than its eventual form. Given Descartes' reluctance to admit increased perfection in the natural world, the form is transformed but not created anew. Similarly, Leibniz (often called both a vitalist and a preformationist) also posits pre-existing form, but his form undergoes radical transformations as well. Indeed, Leibniz blends aspects of the two great 'dichotomous' traditions that many commentators believe ground epigenesis and preformation. In the spirit of the Platonic tradition, Leibniz believes that the entire history is always contained within the metaphysical life and so that history is in some sense eternal. But from the Aristotelian tradition, Leibniz takes the idea of the substantial form sunk in matter and continuously changing in and through that matter. So Leibniz, like Descartes, combines elements from both preformation, strictly understood, and epigenesis, strictly understood.

The last point I shall address in challenging this dichotomy is the fact that this overlooks a third model for explaining life. Vitalism is often understood to be a theory that ensures unity of the
organism in a way that mechanism cannot (e.g. Farley 1977, 30; Driesch 1914, 4-6). A classic expression of this is offered by Alice Levine Baxter. She claims that preformation is a morphological approach to embryology, emphasizing the material form, while epigenesis is a physiological approach to embryology, rejecting the materialism of preformation and rather stressing “the unbreakable unity of the organism, which, as a whole, was somehow greater than the sum of its parts” (Baxter 1976, 37). The dynamic, vital principle serves to hold the organism together and to keep it functioning as a whole in the way passive matter on its own cannot do. But this solution to the problem of unity locates the source of unity in something external to the parts of the organism itself. Conversely, preformation, when the argument for the theory starts from the fact of the unity of the whole based in the well-integrated nature of essential organic parts, locates the source of unity in the interrelatedness of the organism itself. Furthermore, preformationists just do take epigenesis as a theory that breaks this ‘unbreakable’ unity by positing the successive emergence of parts that consequently can be found (according to epigenesis) without each other.

Let me propose that there are at least three, and not two, broad theories of the individual organism at work even in the early moderns. One, which is usually associated with the term “vitalism”, understands the organism to be an assemblage of material parts plus an external vital principle (whatever that might be) which is responsible at least for the maintenance of the organization of parts and probably for the fact of this organization in the first place. It is a dualistic theory. A second, usually associated with the term “mechanism”, understands the organism to be simply an organization of material parts and nothing more. A third, which I shall call “organicism” following Alfred North Whitehead, starts from the idea of the whole organism, not its material parts, and from this starting point determines that the parts of this whole are altered by the fact that they belong to a whole, unified organism (Whitehead 1925, 80). As Hein notes, even “the crassest of mechanists is ready to acknowledge a discernible difference between the living and the non-living” (Hein 1972, 161). The brute fact that living beings, but not non-living things, are self-replicating and self-maintaining, and appear to be goal-oriented, is not in question. There is a difference between a
non-living and a living machine. But organicism better than mechanism represents this difference.

Some decades after Whitehead, Ann Plamondon identified the same three positions, contrasting vitalism and organicism based on the fact that former depends on an extrinsic superadded principle, while organicism depends on internal relations among parts belonging to a whole. Mechanism, she argues, is usually associated with external relations among its parts but no added principle (Plamondon 1975, 214ff). Plamondon’s aim in the article is to show that organicism and mechanism can be reconciled in modern biology, though this would be impossible, she believes, on earlier mechanical models. This is because earlier mechanism starts from a theory about the nature of matter and its parts, a theory which can allow only external relations among those parts. Plamondon suggests that contemporary mechanism, in order to be reconciled with organicism and thus in order to be able to account for the subject matter of biology, must start from the acceptance of an internally related whole, not from a theory of the material parts which comprise organic individuals and which forces a theory of the organism as externally related parts, not a whole (Plamondon 1975, 221).

Two points from Plamondon’s work are of especial interest here. The first is that for a wholly material individual to be regarded as a being of internal and not external relations, the starting point of investigation must be the whole organic individual. We must assume a unit within which there is multiplicity and complexity internally related. This must be treated as, in Russell’s words, “not so much a problem as a postulate” (Russell 1930, 6). The starting point of investigation cannot be the parts of the whole, since this turns the discussion into a question of external relations among parts. The second point of interest is Plamondon’s assumption that such a starting point is a modern and not early modern possibility because the early modern understanding of mechanism is based on the nature of matter not on relations. This is not true, and the two ideals of mechanism noted above emphasize this. Mechanism as inherently passive matter in contact motion may certainly require a theory of external relations, but mechanism as machinelike may take the machine as a whole and investigate it as a thing of internal relations. And once again, the theory of preformation, so often wrongly taken to be merely a particulate, mechanical theory of the organism rather than an organic
and unified theory of the organism (e.g. Russell 1930, 3) proves a challenge to this understanding of early modern mechanism as passive matter moving in external relations.

Once again, our three thinkers underscore this. Descartes certainly thinks that living machines can be understood in mechanical terms, but he also takes the living being to be an individual and not an aggregate of parts. This is, material parts come and go from the organism, thereby constantly losing all external relations to each other altogether. But the organism as one whole, internally related, persists. This idea of mutually dependent and internally referred relations among parts grounds one of Malebranche’s arguments for preformation. But the model of organicism is found most clearly in Leibniz’s metaphysical definition of life. This vision of life refuses altogether to see the organism in terms of material parts. When we conceive of the organism in terms of parts, says Leibniz, we conceive of it as mere matter, but in order to conceive of it as a substance, we need to think of it as a single whole (comments on Fardella: AG 105).

V. Preformation, chance and spontaneous generation

There is another area in the history of science that can benefit from this new reading of preformation, and the issue of material unity which is at the core of this new reading. This is the history of spontaneous generation. In his book, The Spontaneous Generation Controversy from Descartes to Oparin, John Farley argues that spontaneous generation tended to be popular whenever epigenesis was popular, and that when preformation tended to reign, the acceptance of spontaneous generation waned. He also picks up on the problem of organic unity, and he associates this with vitalism, epigenesis and spontaneous generation:

... the complex nature of living organisms implied a basic instability that necessitated the continual presence of a ‘vital spirit’ in order to preserve integrity of organization. Without it the organism would disintegrate or corrupt. To George-Ernest Stahl... it was the soul that continually directed living and generative processes.... Nature, to [Caspar] Wolff, was not a machine, thus the concept of [preformation] was based on an utterly untenable foundation. Growth, change, and development were the very essence of the natural world.... The acceptance of epigenesis and spontaneous generation was essential to these beliefs [in unity and development] (Farley 1977, 30).
These lines point to familiar and new themes. In fact, Farley embraces the dichotomy between epigenesis and preformation along the lines of vitalism and mechanism and adds some new elements. He associates spontaneous generation with vitalism, epigenesis, the general aliveness of the natural world which is thus able to grow and develop on its own, and the unity of organisms. On the other side are a competing set of ideas: the rejection of spontaneous generation, mechanism, preformation, a “dead” and mechanical world, the inability to explain organic unity, and what Farley calls an “abhorrence of chance” (Farley 1977, chpt. two).

Spontaneous generation had a long hold on the scientific imagination. As Carl Burdach says, “those who defend the doctrine of spontaneous generation do so through experience” (Burdach 1832, I, 8); animals just do appear to spring forth arbitrarily from the earth, rotten meat and such. But this did not, of course, lead to universal acceptance of the doctrine. As Farley notes, the spontaneous generation debate, like many in science, is rooted in extra-observational, extra-experimental concerns, and these concerns dictate the interpretation of the observational and experimental data (Farley 1977, 6). So, the mere phenomenon of spontaneous generation need not necessarily be taken as proof for its truth just as experiments providing evidence against spontaneous generation were not always interpreted as proof against such generation -- witness the succession of experiments offered by Francesco Redi (seventeenth century), Lazzaro Spallanzani (eighteenth century) and Louis Pasteur (nineteenth century) before spontaneous generation finally began to lose its attraction.

But in fact while advocates of spontaneous generation were often able to explain away the most recent experiments intended to lay rest to the theory, it seems far more difficult for supporters of preformation, for example, to deny the phenomena and to make their theory able to account for those phenomena. The reason is this. Farley believes that whatever variations one finds within the different theories of spontaneous generation, all are marked by two necessary features: it is generation without parents, and it is generation by chance (Farley 1977, 1). Depending on the theory of preformation favoured (ovism, animalculism and panspermism), either one (chance) or both of these criteria seem in direct opposition to the preformation doctrine. Let me expand on this, starting with the issue of
chance.

Farley believes that the idea of chance can mean different things, but in an era which did not recognize probability, chance events “were accidental, exceptional, unlawful, unknowable events” to be contrasted with the only other choice -- lawful events resulting from lawful causes (Farley 1977, 1, 11). In this feature, spontaneous generation stands in stark contrast to the idea prevalent in the seventeenth century of nature governed by universal, immutable and strictly deterministic laws instituted by God. Indeed, it suggests a capriciousness ill-suited to the work of God. In Farley’s view, the theological commitment which lurks behind the rejection of spontaneous generation is also one of the prime motivations for the acceptance of preformation. Preformation removes chance entirely -- literally once and for all -- from the question of generation because God determines the history of all generation at Creation. Thus, the rejection of the theory of spontaneous generation tends to coincide with the acceptance of the theory of preformation (Farley 1977, 22). Elizabeth Gasking goes so far as to claim that preformation and spontaneous generation are mutually exclusive (Gasking 1967, 63).

The two *emboîtement* theories seem most especially opposed to spontaneous generation. This is because in addition to the rejection of the idea of chance, these two theories demand parents for generation. Recall that these theories posit that either the female (ovism) or the male (animalculism) of each species houses the germs for all future members of their lineage. This most certainly cannot account for generation without parents. But the case of panspermism adds a complication to this picture. Recall that this theory maintains that the germs of tiny living beings are found everywhere in nature -- floating in the air, in food, in puddles and mud and so forth. This theory, unlike the *emboîtement* theories, does not seem to require parents for generation to occur. But does it allow generation by chance? More critically, does Farley’s claim that preformation is against the idea of generation by chance translate into the converse -- that spontaneous generation, together with its ally epigenesis, are favourable to generation by chance?

This certainly does not follow, and neither does Farley really seem to thinks so, for while the theologically-motivated “abhorrence of chance” is, Farley believes, at the foundation of the
acceptance of preformation, he does not exactly claim that the converse -- an increased tolerance of unknowable, accidental and unlawful natural activity -- grounds the acceptance of epigenesis, and therefore of spontaneous generation. Rather, these two theories tend to rise in popularity together, claims Farley, because they are grounded in an acceptance of active matter. Thus, in post-Newtonian matter theory, the "implications of the force concept on ideas of generation were considerable, since its presence bestowed on matter a dynamic attribute that was inconceivable to the Cartesian mechanist. It led, for example, to the reappearance of the theory of epigenesis..." (Farley 1977, 22), and to the "triumph of spontaneous generation" (Farley 1977, 30).

Farley's implicit contrast between the "abhorrence of chance" and the activity of matter seems to be based on the belief that the attribution of such activity makes the possibility of unlawful activity within that matter more plausible. But there is no credible reason for this connection. In is based partly, I believe, in the same conflation between intelligence and mere activity in matter which Bates identifies and which I explored above. That is, it is based on a conflation between determining purposes (which may be wilful, unpredictable and thus unknowable) and determined goals (which can be none of these things). But the epigenecist's account of generation is as deterministic and law-like as the preformationist's. It is a slip, and an instructive one for the study of the early modern history of generation, to move from the idea of dynamic matter to the claim that "[t]o supporters of epigenesis, organic matter had the potential to spontaneously generate a living organism" (Farley 1977, 22, emphasis added). It is a two-fold slip: first from the dynamic to the organic, and second, from the organic to the spontaneous, if this means chancy. Just because matter is self-moving does not mean it is organic or alive. And just because something is organic and alive does not mean it will act in a capricious or chancy fashion.

Let us return to panspermism and the issue of chance. The case of panspermism seems to undermine Gasking's strong claim that preformation and spontaneous generation are mutually exclusive. In fact, panspermism is particularly interesting for the theory of spontaneous generation, its relation to preformation and the issue of chance. A main problem with panspermism is its apparent
difficulty in explaining the blatant phenomenon of species generating only their own kind. It is an inelegant and complex theory in the case of sexual generation. For sexual generation to occur, for example, the germs must be breathed in or consumed in food either by the male or the female before they can begin to grow. The theory met pervasive opposition due to its complexity in working out the details of how the germs survive the digestive process (the observation of intestinal worms, often believed to be the preformed germs, did lend support here), how the germs make it to the genital organs and grow only upon coitus (Roger [1963] 1997, 279).

Further, there is difficulty lurking behind Claude Perrault’s own claim (Perrault is an advocate of panspermism) that with so many and such variety of preformed animals scattered through nature, it is no wonder generation never fails to take place (Perrault 1721, 485). This fecundity may be helpful in the case of spontaneous generation, but it is precisely the problem in cases of sexual generation in which like kinds produce like kinds; except in rare cases of monstrous births and hybrids (which are infertile anyway), an animal always gives birth to one which resembles itself in species and often also in familial traits. The problem is how the right germ ends up with the right parent at the right time. *Emboîtement* theories solve this, but they solve the problem only because they depend on the foresight and pre-determination of God. There is no reason, however, why these same divine qualities cannot apply in the case of panspermism. And if it does apply in the case of panspermism for sexual generation, then it can apply in the case of spontaneous generation as well. That is, spontaneous generation can just as well be governed by God no less than sexual generation, and the former need not be generation by chance at all.

The panspermist might claim, for example, that not only does God preform the germ, but he also determines at Creation the history of each germ regardless of where it is stored -- that it will be ingested or breathed in by the appropriate parent at the appropriate time, or that it will arise from soil or rotten meat at the appropriate time and so on. In keeping with the spirit of the age, the panspermist might even propose that God instituted laws to govern this. Certainly this is a more complex, less elegant theory of sexual generation than is *emboîtement*, and certainly the laws governing it would
seem to be greater in number and on the whole more complex, but it would be serviceable nonetheless. Indeed, Leibniz would seem to have concocted something like this system given than he believes organisms are found absolutely everywhere, including in ash and in chalk, and given that he believes that every organism is rules by an internal laws that is an expression of the one, universal law.

John Ray, a seventeenth-century advocate of preformation, makes the consequence of the panspermist theory for spontaneous generation clear when claiming that “Spontaneous Generation of Animals and Plants upon due examination will be found to be nothing less than a Creation of them” (Ray 1717, 300). What appears to be true generation is not. It cannot be because generation just is creation on any rendition of preformation. Thus we find support for Farley’s own (surprising) contention that preformation in its panspermist guise was first put forward to explain the undeniable appearance of spontaneous generation in a way which would be acceptable to the prevalent seventeenth century conception of nature lawfully governed because God so instituted (Farley 1977, 12), and that only later was preformation adapted to sexual generation. Note, however, that this compatibility of panspermism and the appearance of spontaneous generation means there really is not spontaneous generation properly defined. There may be generation without parents, but given the possibility of God’s involvement, it is not necessarily generation by chance.

Even without the panspermist option casting doubt upon Farley’s dichotomy, however, his association of spontaneous generation with epigenesis and vitalism is suspect on two further grounds. The first starts from Perrault’s claim that panspermism can explain the fecundity of nature which spontaneous generation indicates. But nature is not fecund without limit. And the limits of nature’s fecundity only bolster the possibility that spontaneous generation is not necessarily generation by chance but rather obeys at least some sorts of laws. The point is made, albeit unintentionally, by Needham who, like Farley, views the joint popularity of epigenesis and spontaneous generation as indicative of a shared understanding of nature. He writes: “... whatever the case might be in the higher animals, if it were true that the lower ones could rise de novo out of slime, mud or meat
infusion, for instance, then their parts at least must have been made by epigenesis and not in any other way, for it could hardly be held that a homogenous infusion had any structure of that kind.\textsuperscript{13} And if epigenesis could occur in the lower animals, then the thin edge of the wedge had been driven in, and it might occur among the higher ones as well” (Needham 1959, 206-7). The problem is, of course, that if lower animals can generate from matter such as slime, mud or meat, then why cannot the higher animals generate from this too? Even if we assume that this just is one of the marks that divide the lower from the higher, why do the lower, spontaneously-generated animals respect natural kinds? If organic matter has the capacity to create something as well-wrought as an insect (microscopic studies of insects had convinced the early modern naturalist of their extraordinary complexity) then why does this creativity not just run wild and produce wildly irregular forms never before nor never again seen?

The second, and far bigger, problem for Farley’s association of spontaneous generation with epigenesis and vitalism is the fact that he relates all of these to a general “aliveness” of nature: “Growth, change, and development were the very essence of the natural world...” (Farley 1977, 30). The problem is that the ideas that the natural world is marked by growth, change and development, and that the matter of the natural world is organic (Farley 1977, 22), on the one hand, do not fall neatly in line with the idea of life as it applies to living, individual organisms which exhibit specific behaviours, on the other hand. It is not clear why living matter is especially able to generate living individuals. What is living matter or living substance? If the concept of life must somehow take account of the behaviours commonly associated with living individual organisms, then in what way can homogenous matter be deemed alive? And even if we agree that it is alive in a different sense, perhaps due to some kind of dynamic, active principle, then how does this simple form of “life” create the very specific and complex form of life found in an organized, unified individual which is self-maintaining, able to generate and so on?

Panspermism, with its premise of a whole organism, complex, integrated and unified, and therefore already prepared to perform the functions unique to living individuals, is in fact in a better
position to explain the appearance of exactly this sort of organism from soil, meat and so on than is epigenesis. Once again, the recognition that preformation is not just a theory about how living beings generate on a mechanical philosophy, but that it is also a theory about how to explain unity, including organic unity, helps solve a problem in spontaneous generation that is more difficult for epigenesis to deal with. This new reading of preformation requires a new reading of spontaneous generation as part of the bigger picture of generation in the early modern period.

VI. Concluding remarks

These are just some of the various areas of potential research opened up by framing the theory of preformation in terms of material unity; there are surely others. As I noted at the outset of this work, the “received” view of the emergence of preformation is not necessarily wrong. In fact, preformation does help to explain how organisms are generated given the nascent and unsophisticated brand of mechanism of the early modern period. But this is only part of the story. I have told another part of that story, the part that links preformation with the existence and endurance of material individuals. And this gives us a richer understanding of the problem of generation and its place in the natural philosophy of the early modern period.
Endnotes

1. In the case of Roe, the reasons for this are important given that she is examining the work of thinkers whose emphasis is on natural history more so than on philosophy.

2. I discuss metaphysics as if it is quite separate from natural philosophy for the early moderns, though this is not the case. In fact, my interest in examining the interplay between the realms of natural philosophy and metaphysics is premised on the assumption that they cannot be isolated from each other without missing important subtleties in the early moderns. Even the terminology used exposes the difficulty with separating the two. The temptation is to distinguish metaphysics and science (or even philosophy and science), but the term “science” does not mean for the early moderns what it means for us. Indeed, there is no thing in the early moderns which is equivalent to our science, though what they call “natural philosophy” may be the closest. Even so, as Margaret J. Osler notes, “[n]atural philosophy encompasses many topics now considered theological or metaphysical — such as the immortality of the soul or the study of divine providence in nature — and excluded others — such as mixed mathematics — which are now considered to be scientific” (Osler 1998, 92). It is hardly surprising, then, that an area of concern in natural philosophy, no matter how apparently minor (e.g. preformation) would provide important insights into metaphysics.

3. Stuart Brown also notes that the two share doctrines only, but that this indicates no deep metaphysical affinity (S. Brown 1990). Brown does not, however, connect his discussion with generation, and nor does he locate the fundamental split in their divergent ideas of the individual.

4. The early modern “preformation” was often called “evolution” in a pre-Darwinian meaning of that term. See Bowler (1975) for history’s various meanings of the term “evolution”.

5. Gould suggests this option: “Preformationism, I learned, was... espoused by men who could not bear to give up the dream of a static world order ruled by an omnipotent God...” (Gould 1997, xiv), a dream, Gould suggests, now virtually abandoned in scientific research.

6. It is doubtful that Aristotle can fairly be called an epigeneticist as many commentators claim of him. This is true if for no other reason than the fact that Harvey coined the term, and Harvey’s theory of generation is markedly different from Aristotle’s. Harvey posits that sometime after conception the speck of blood in the eventual individual is a sort of primordium or egg that self-generates organ after organ from within itself (Harvey [1651] 1981, 204). He is adamant in rejecting Aristotle’s proposal that the male passes on the form to the matter provided by the female (Harvey [1651] 1981, 152, 158, 224). Harvey takes this to be a theory of metempsychosis which incoherently demands that a second, unembodied, soul be present in the female before it (somehow) informs the egg (Harvey [1651] 1981, 217-18).


8. T.H. Hall suggests that the later phase of ‘vitalism’ tends to be more ‘mechanical’ because it relies heavily upon the very mechanical idea of Newtonian force (Hall 1968).

9. There are problems with this interpretation. There has been much recent work examining the historical utility of the notion of a seventeenth-century Scientific Revolution. One reason for this is the myriad of ways this period has been understood by historians. For a comprehensive recent history of the historiography of the Scientific Revolution, covering the most seminal works attempting to define and assign causes of the Revolution, see H. Flores Cohen’s The Scientific Revolution: A Historiographical Inquiry (1991). Another reason why this general story is troublesome is that there
have also been recent challenges to the whole idea that the seventeenth century represents a radical break with the past which is captured by the idea that the world view was “mechanized” in this century. Challenges run in both directions: the seventeenth century is not entirely new, and the ancient world is not entirely lacking in the sort of developments typically attributed to the moderns. For example, a number of studies investigating the liveliness and persistence of various forms of Aristotelianism, Scholasticism and Medieval Neo-Platonism in minor and major figures of the ‘new’ era have lately been joined by other studies of ancient influence on the early moderns, most notably, the influence of the Stoics. Charles B Schmitt’s extensive work on Aristotelian and Scholastic influences in the Renaissance (e.g. 1981 and 1983) has been extended to the early moderns, perhaps most notably by Christia Mercer (e.g. 1989, 1990 and 1993). For examples of the revival of Neo-Platonism in early modern philosophy, see Politella (1938) and S. Brown (1997). Frances Yates’ much debated thesis that “behind the great exoteric movement typified by Newton’s achievements in... mathematics and physics, there was also an esoteric movement, connected with the exoteric movement... through alchemy...” (Yates 1972, 235ff), and that Newton himself was deeply entrenched in alchemical interests, challenges the idea of Newton’s unwavering attachment to the mechanical study of nature. Examinations of Medieval Arabic advancements in natural philosophy usually thought to be initiated by the early moderns have also been undertaken (e.g. Barker and Ariew 1991). And more than a few traces of mechanical thinking have been located in ancient writing (e.g. Price 1964, Solmsen 1963).

Other problems with this thesis regarding a general vitalism-mechanism-vitalism trend are found in specific thinkers, both with regards to their understanding of nature generally and with regards to their understanding of life. The contention that Aristotle is a vitalist may tempt a neglect of the use he makes of mechanical analogies, even as explanatory devices in his biological writings. Most conspicuous is his reliance on the idea of a “miraculous automatic puppet” which realizes determined goals as an analogy for the generation of organisms (GA 734b10ff). Two recent writers who have examined the mechanical aspect of Aristotle’s thoughts on nature and life are Graham (1986) and von Staden (1997). Moreover, given that vitalism is usually understood as a theory which posits an ontological gap between life and non-life (see later this section), and given that Aristotle locates this gap as that between beings that have soul and no soul, some account ought to be given of Aristotle’s own occasional doubts on this discontinuity: “Nature passes in a continuous gradation from lifeless things to animals... with the result that one class is so close to the next that the difference seems infinitesimal” (PA 681a11-13; see also History of Animals, 588b4ff).

Harvey is another curious blend of mechanism and vitalism. When Thomson writes that the human heart was converted into a hydraulic machine, this is Harvey’s innovation to which he refers. Largely because of his likening of the human body and its parts to machines, Harvey has frequently been interpreted as a mechanist (Passmore 1958, 86; Gillispie 1960, 73). But others interpret Harvey as a vitalist (Pagel 1967; Needham 1959, 140ff), perhaps swayed by comments from Harvey himself such as the following: Those “who make all things out of atoms, like Democritus, or out of element, like Empedocles” are at fault because generation, for example, is much more “than a mere separation, or assemblage or ordering of things” (Harvey [1651] 1981, 65). Galileo too, frequently taken as a classic example of the New Scientist of the mechanical age, appeals to the efficient cause of an inherent anima to explain animal motion (Galileo [1632] 1962, 272). And Haller has been interpreted as both mechanist (Roe 1981, 2) and vitalist (Needham 1959, 207).


11. Pinto-Correia claims that the word “homunculus” was not used in reference to the pre-formed germ until Cole did so in the 1930s. None of the advocates for preformation themselves use the word
(Pinto-Correia 1997, chpt. 6).

12. Farley's claim that there was no room for probability in the early moderns finds challenges in Hacking (1975) and Shapiro (1983).

13. This was held, of course, by some panspermists, as well as by Gassendi and even Harvey. The idea that what merely appears to be homogeneous may nonetheless hide tiny and therefore heterogeneous germs is one of the counter-attacks of the preformationists against the epigeneticist in theories of sexual generation, and so could apply in the case of spontaneous generation as well.
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