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"Preformationism and the Dobbs Decision: Why the History of Science Matters"*

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(unpublished MS, Please do not circulate beyond Notre Dame without permission)

Introduction

The purpose of this paper is to assist in developing a new level of dialogue, both locally and outside of Notre Dame, concerning issues related to abortion and its public discussions in the wake of the recent Supreme Court decision, Dobbs vs. Mississippi Planned Parenthood, issued in July of 2022. This decision overturned the constitutional right to abortion established in the Roe vs Wade decision of 1973 and its reaffirmation in the Casey decision of 1992.

To develop this discussion, it is essential to set some parameters to my inquiry. I emphasize at the outset that there are two different issues involved in my discussion, only one of which I will attempt to address in any detail. The first concerns the jurisprudential issue surrounding the decisions of the Supreme Court concerning the existence of a constitutional "right" to abortion based on the interpretation of the Ninth and Fourteenth Amendments to the US Constitution and subsequent case law based on these constitutional sources. I am not claiming to resolve this question.

The second issue is the use of historical information and legal precedent in both Roe v Wade and Dobbs to back up decisions in both cases. On this my discussion will bear directly. My intent is also to bring out some of the important developments in life science that make untenable some of the positions critiqued by developmental biologist Scott Gilbert in a recent discussion of the misuse of scientific data in the abortion debates.[1]

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* I wish to thank Scott Gilbert, Lenny Moss, David Depew, Stephen O'Neil, Tim Collier, Katherine Kersten, Mark Johnson and members of the International Circle for the Philosophy of Biology for valuable comments on earlier versions of this essay.

[1] Scott Gilbert, "Pseudoembryology and Personhood: How Embryological Pseudo-science Helps Structure the American Abortion Debate," *Natural Sciences*, Nov. 2022, DOI:10.1002/ntls.20220041.

Relevant Historical Documentation

The original Roe v Wade decision was based on a thin body of historical research on the background of abortion permission which existed at the time of its issuance.[2] The historical source research utilized in the Dobbs decision had the advantage of fifty years of public discussion and debate since the Roe v. Wade decision, and was able to draw heavily upon the massively documented survey (1283 pages) by Joseph W. Dellapenna, Professor of Law at Villanova University, *Dispelling the Myths of Abortion History*.[3] This source substantially surpasses the thin historical documentation utilized in Roe v. Wade, and represents 15 years of research by Dellapenna on the legal aspects of the topic over its history, with primary focus on the history since 1600.

The problem with Dellapenna's deep historical survey is that facing legal "originalism" itself—the judicial philosophy that appeals to the exact language of original documents and statements from the past, including the "intended meaning" of the historical actors, in making its decisions. As all historians are well-aware, defining such "intended meanings" of historical authors of documents is a complex hermeneutical task. Dellapenna, as a legal scholar, is clearly familiar with the historical documentation in the stated laws and statutes of the past. The degree to which these can simply be read without deeper contextualization is a problem he does not address. Elucidation of this background and its relevance for some of the claims of Dobbs is the focus of my discussion.[4]

I am aware that Dobbs explicitly considered as irrelevant the efforts in Roe v. Wade to bring historical issues into its decision on abortion in 1973.[5] But Dobbs

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[2] The primary sources used in the historical analysis in Roe include the two-part article byEugene Quay, "Justifiable Abortion—Medical and Legal Foundations, *Georgetown Law Journal* 49 (Spring 1961), 173-256; 395-538, republished as *Justifiable Abortion: Medical and Legal Foundations* (Family Life Bureau: National Catholic Welfare Conference, 1961) , and discussions in Arturo Castiglioni, *History of Medicine*, 2nd ed. (1947), and Ludwig Edelstein, *The Hippocratic Oath,* Supplement to the *Bulletin of the History of Medicine* No. 1 (Baltimore: Johns Hopkins University Press, 1943), with some additional support from John Noonan (ed.), *The Morality of Abortion: Legal and Historical Perspectives* (Cambridge, MA: Harvard U Press, 1970). It does not reference non-English sources or the main English language texts on the history of embryological theory such as Joseph Needham's standard *History of Embryology*, 2nd. ed. (Cambridge: CUP, 1959)

[3] Joseph Dellapenna, *Dispelling the Myths of Abortion History* (Durham:Carolina Academic Press, 2006).

[4] Apart from a brief survey of a small body of the critical literature on this topic (pp. 256 ff), there is little awareness displayed in the Dellapenna survey of the complex history of embryological theory since the Middle Ages. This paucity of historical knowledge is reflected in the fact that there is no entry in the index, for example, to such topics as "preformation," "preexistence," "epigenesis," "capacitation" or to any of the literature of recent developmental biology. Nor are their entries to the main works of Caspar Friederich Wolff, Johann Blumenbach, Karl Ernst von Baer, Joseph Needham, Hans Spemann, or any of the other architects of modern embryological theory. There is a single entry to "Gene Therapy," and some limited discussion of genetic engineering, which quickly associates it with Nazi Eugenics (pp. 920ff).

[5] "Not only did this [historical] scheme resemble the work of a legislature, but the Court made little effort to explain how these rules could be deduced from any of the sources on which constitutional decisions are usually based. . . . *Roe* featured a lengthy survey of

on the other hand makes a strong appeal to the history of legal opinion and specific case law since the early modern period as warrant for its overturn of Roe to support the conclusion that only in the late 20th century do we see an unprecedented liberalization of abortion laws.

My argument is that the history of scientific discussion taking place in the background of legal discourse is not irrelevant, and that for further productive discussion, it is necessary to understand accurately the historical changes that have taken place since the seventeenth century to assess the force of the reasoning in Dobbs. This decision remands to the states the historical legislative research that might be involved in state laws that will ultimately result from its decision. This would seem to require that state decisions be informed by some accurate knowledge of the past history and transformations in the understanding of biological development since the seventeenth century.

Developmental Theory in Late Medieval and Renaissance Discussion

Space will not allow detailed development of this history and those interested are directed to sources indicated.[6] A few summary points can be drawn from recent historical studies that have revealed the complexity of the discussions of the issues surrounding embryology, development, ensoulment, and biological generation theory before the seventeenth century. The discussions that took place in Western Latin and Greek traditions were erected upon the theoretical reflections and treatises of the medical and biological thinkers of Antiquity, treatises that included the Hippocratic medical texts,[7] the major theoretical treatises of Aristotle, particularly his *On the Generation of Animals*, and Books VI-VII of his *History of Animals*, and the later Hellenistic texts of the Greek physician Galen (129-ca. 216 AD). These, along with Biblical sources, formed a context in which reflections of the Fathers of the Christian tradition, especially Ambrose, Origen, Clement of Alexandria, Tertullian, Lactantius and Augustine developed theological analyses of these issues. Studies have shown that these authors drew different conclusions on

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history, but much of its discussion was irrelevant, and the Court made no effort to explain why it was included." "Dobbs V. Jackson Women's Health Organization," Section III.B.1.b as available at https://www.law.cornell.edu/supremecourt/text/19-1392. All further citations to this edition.

[6] See especially the study by Christian ethicist David Albert Jones *The Soul of the Embryo: An Enquiry into the Status of the Human. Embryo in the Christian Tradition* (New York: Continuum 2004). In addition to Jones, see Linda Deer Richardson, *Academic Theories of Generation in the Renaissance: The Contemporaries and Successors of Jean Fernel (1697-1558)* ; History and Philosophy of Life Sciences No. 22 (London: Springer, 2018); Jacques Roger, *Les sciences de la vie dans la pensée française du xviiième siècle*, 3rd ed. (Paris: Colin, 1997), translated in part by Robert Ellrich as *The Life Sciences in Eighteenth-Century French Thought* (Palo Alto: Stanford University Press, 1997), esp. Pt 1.

[7] Particularly the Hippocratic texts, "On the Seed," and "On the Nature of the Child," translated in by I. M. Lonie in G.E.R. Lloyd (ed.), *Hippocratic Writings* (New York: Penguin, 1978).

such issues as the timing of ensoulment and the degree to which abortion was to be criminalized and ecclesiastical penalties assessed, while maintaining generally a prohibition against abortion.

With the transmission and translation of the major texts of the texts of Hippocrates, Aristotle and Galen in the twelfth and thirteenth centuries to the Latin West, accompanied by extended Arabic medical and philosophical commentaries, particularly the writings of Ibn-Sina (Avicenna), these helped define a framework of late Medieval and early modern discussion by theologians, legal scholars, and medical professionals of embryological development and its legal implications.

Although detailed discussion is necessary to display important differences, it can be stated that the positions developed by both the Scholastic and medical authors before the middle of the seventeenth century accepted a fundamental account of human and animal development that can be characterized by William Harvey's later neologism as "epigenetic." By this is meant that embryonic development is a gradual process in which unformed matter is slowly organized into the form of the adult structure. The Hippocratic experiment which recommended the serial opening of fertile chicken eggs, repeated by Albertus Magnus and described in his work *De animalibus*, a work reprinted several times in the Renaissance period,[8] was an easy way for others to see this gradual development. Where disputes took place between physicians and philosophers and theologians centered on the differences between form-matter and two seeds theories, [9] and also which structures formed first. Was the first structure the heart, as Aristotelian's claimed, or was it the liver, as argued by Galenists?

These "gradualist" theories of development underlay the concept of "quickening" as an event taking place later in the developmental process — defined at around forty days for males and even 80 days for females— as the point after which "form" is achieved and the rational soul is imparted. The classic reference for this were the texts of Aristotle, particularly as these had been commented upon by the Arabic commentators.[10] Scholastic discussions also embraced the Galeno-Arabic

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[8] See Needham, *History of Embryology*, pp 86-92.

[9] The dispute between the physicians and the Aristotelian philosophers and theologians centered on the arguments of physicians, following Hippocrates and Galen, who argued for the formation of the embryo from two equivalent seeds contributed by males and females in coition, against the orthodox Aristotelian position, developed particularly in his *Generation of Animals.* There Aristotle argued for the contribution of the efficient, formal and final causes via the male semen, with the female only supplying the "matter" of generation in the form of menstrual blood. The Galenic position was widely endorsed in Renaissance medical literature, with physicians typically agreeing with the Galenic, rather than Aristotelian positions. See, for example, Jean Fernel, *Physiologia*, Bk. VII, chp. 6. I am using the English-Latin edition edited by John Forrester (Philadelphia: American Philosophical Society Press, 2003). .

[10] See Aristotle, *History of* Animals IX.3.583b1-30. This dating of quickening was particularly developed in the Mamluk era Islamic medical commentaries developing upon Avicenna and has been seen as a general consensus in the interpretation of certain verses in the Koran. See Avicenna, al-Hayawan IX. 5, 172.3-8, translated in J. McGinnis (ed.), *Interpreting Avicenna: Science and Philosophy*

theory of the serial ensoulment of the developing embryo, with vitalization moving through the stages of vegetative, animate and finally rational ensoulment. This view was also endorsed in a much-discussed passage by Thomas Aquinas in his *Summa contra gentiles*:

> For, although the generation of simple bodies does not proceed in serial order, since each of them possesses a form related immediately to prime matter, a progressive order must obtain in the generation of other bodies because of the many intermediate forms between the first elemental form and the ultimate form which is the object of the generative processes; so that there are many generations and corruptions following one another. . . Therefore, the more noble a form is and the further removed it is from the elemental form, the more numerous must be the intermediate forms, through which the ultimate form is reached step by step. . . .That is why, in the generation of an animal and a man, wherein the most perfect type of form exists, there are many intermediate forms and generations—and, hence, corruptions, because the generation of one thing is the corruption of another. Thus, the vegetative soul, which is present first (when the embryo lives the life of a plant), perishes, and is succeeded by a more perfect soul, both nutritive and sensitive in character, and then the embryo lives an animal life; and when this passes away it is succeeded by the rational soul introduced from without, while the preceding souls existed in virtue of the semen.[11]

It was this flexibility represented in the historical teachings of the major Abrahamic traditions, including the Roman Catholic, that is used as some of the

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in Medieval Islam, (Leiden and Boston: Brill, 2004), p. 54. I am indebted to the illuminating discussion of this point in Nayhan Fancy's "Generation in Medieval Islamic Medicine," pp. 129-140 in N. Hopwood, R. Flemming and L. Kassell (eds.), *Reproduction* (Cambridge: CUP, 2018). Fancy discusses the importance of Avicenna's reconceptualization of generation in distinct stages through a sequence of forms received instantaneously from the Giver of Forms. Aristotle suggests this serial ensoulment with the late addition of the rational soul in *Generation of Animals* II.3.736a30-736b30. This also had Islamic religious support as well, in accord with the claim of the *Koran* (Sura XXIII) where the formation of the human is described as moving through distinct historical stages with different forms succeeding one another. See also Basim Musallem, "The Human Embryo in Arabic Scientific and Religious Thought," Pp. 32-69:38 in G. R. Dunstan (ed), The *Human Embryo: Aristotle and the Arabic and European Tradition* (Exeter, U. K.: University of Exeter Press, 1990.). As one common translation of Sura XXII:6 reads: "O people! if you are in doubt about the raising, then surely We created you from dust, then from a small seed, then from a clot, then from a lump of flesh, complete in make and incomplete, that We may make clear to you; and We cause what We please to stay in the wombs till an appointed time, then We bring you forth as babies, then that you may attain your maturity; and of you is he who is caused to die, and of you is he who is brought back to the worst part of life, so that after having knowledge he does not know anything; and you see the earth sterile land, but when We send down on it the water, it stirs and swells and brings forth of every kind a beautiful herbage." (*The Noble Quran*, Shakir translation at http://quran.al-islam.org/. Accessed April 23, 2012.) As Musallem summarizes this point ("Human Embryo," p. 38), an acceptable Islamic interpretation of this text is: "The first stage of development, a period of forty days from conception, is the nufta (semen). The second also lasting forty days, is the 'alaqa ("blood-like clot"). And the third, another forty days, is the mugdha ("lump of flesh"). In these three early stages the fetus lacks the human soul and has only the life of plants and animals; but after 120 days from conception the fetus is ensouled."

[11] Thomas Aquinas, *Summa contra Gentiles*, trans. J. F. Anderson (New York: Doubleday, 1955), II: 89. 9-11. These arguments of Aquinas have reverberated in contemporary disputes over abortion and the concept of "serial animation" and are frequently cited by those arguing for a more liberal position in Catholic teaching. See J. F. Donceel, "Immediate Animation and Delayed Hominization," *Theological Studies* 31 (1970): 76–106, and Jean Porter, "Individuality, Personal Identity, and the Moral Status of the Preembryo: A Response to Mark Johnson," *Theological Studies* 56 (1995): 763–70. On Aquinas's views see Jones, *Human Embryo*, pp. 119-121 and in detail Melissa Bout, "Thomas Aquinas and the Generation of the Embryo: Being Human Before the Rational Soul," unpublished Doctoral Dissertation, Department of Philosophy, Boston College, 2013. Available electronically at http://hdl.handle.net/245/bc-ir:104090

historical justification for the original Roe V. Wade decision, and underlies its liberal policy on abortion through the first trimester.[12]

Early Modern Embryology and Mechanical Philosophy

The gradualist framework of pre-modern developmental theory which in all its manifestations was a picture of gradual development, including the appeal to such Aristotelian metaphysical concepts as "potentiality" and "actuality" to describe the gradual formation of the embryo, disappeared dramatically with the rise of modern mechanical philosophy, especially as systematized by Descartes first in his programmatic statement in the *Discourse on Method* and *Essays* of 1637, and subsequently in his main work on natural philosophy, the *Principles of Philosophy* (1644, 1647).

Unlike the other main architects of the new science of the seventeenth century, Descartes was also the leading natural philosopher most concerned to integrate into his systematic picture of the natural world living organisms and the human being, with the intent of deriving from his new physics "knowledge of nature from which we may derive rules in medicine which are more reliable than those we have had up till now."[13]

Other than proclaiming that his system would create a new medicine based on his physics as one of the "fruits" of the "tree of philosophy" sketched out in the author's letter to the second edition of the *Principles of Philosophy* in 1647, Descartes never considered himself ready to publish on these questions. The *Principles* simply jumps over the issue of the origin of living beings, including humans, in Book IV with the promise to publish subsequently on these matters, and deals only with the relations of the passions to physiology.[14]

Only posthumously, with the publication of a Latin manuscript of the *Treatise on Man* in 1662, and the publication of another French manuscript in 1664, did the public have access to his systematic exposition of human physiology. With the

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[12] See Roe v. Wade, note 22, available http://supcourt.ntis.gov/get_case.html?casename=Case%20Name:%20ROE%20V.%20WADE,%20410%20U.S.%20113%20&searchstring=mode=casename&cn_words1=roe&cn_words2=wade, accessed 17 April, 2012. The failure to acknowledge this long history in the Dobbs decision is behind its dismissal of the first trimester definition in Roe as "the Courts own brainchild" (Dobbs III.1.a).

[13] Descartes, *Discourse on Method*, Trans. Robert Stoothoff in *The Philosophical Writings of Descartes*, ed. J. Cottingham, R. Stoothoff, and D. Murdoch (Cambridge: CUP, 1985), Vol. 1, p. 151. Further reference to this standard edition is as *CSM* and to the third *Correspondence* volume, edited by Anthony Kenny, as *CSMK*. Descartes even says late in his life in his letter to the Marquess of Newcastle of October, 1645 that "the preservation of health has always been the principle end of my studies." *CSMK,* III, 275.

[14] *Principles 2nd ed*, *CSM* I, 186, 279.

French edition was also published his manuscript treatise *On the Formation of the Fetus*. The result was a deep conceptual crisis in the Cartesian program itself, what historian Jacques Roger characterized as its apparent checkmate.[15]

The difficult was that the public was given two conflicting images of the formation of the organic body. The main picture given in the *Treatise on Man* was that of a divinely created machine. As the treatise opens:

> I suppose the body to be nothing but a statue or machine made of earth, which God forms with the explicit intention of making it as much as possible like us. Thus God not only gives it externally the colours and shapes of all the parts of our bodies, but also places inside it all the parts required to make it walk, eat, breathe, and indeed to imitate all those of our functions which can be imagined to proceed from matter and to depend solely on the dispositions of our organs.[16]

But the treatise on generation appended to the French edition gives a very different account of the origin of the body. In this manuscript, Descartes attempted to give a mechanistic interpretation of the Galenic "two seeds" theory, describing the formation of the embryo from equivalent "seeds" drawn from the male and female through the combination of heat, fermentation, and the presence in the blood of both coarser and etherial matter described in his *Principles*, with the Cartesian laws of nature organizing the formation.[17] Between the *Principles* and the publication of these posthumous texts had also been published William Harvey's remarkable *Observations on the Generation of Animals* of 1651, detailing empirical observations on the development of the chicken and the deer which seemed to disprove the empirical basis for *both* the Aristotelian form-matter and the Galenic two seeds theories of generation.[18] The result was to render Descartes's account of generation implausible even to his disciples.[19]

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[15] On this history especially Jacques Roger, *Les sciences de la vie dans la pensée française du xviiie siècle* 3rd. ed (Paris: Michel, 1993), pp 140-163, and Vincent Aucante, "Descartes's Experimental Method and the Generation of Animals," in Justin Smith (ed.), *The Problem of Animal Generation in Early Modern Philosophy* (Cambridge: CUP, 2006), 65-79.

[16] Descartes, *Treatise on Man*, *CSM* I, 99.

[17] Descartes, *L'Homme de René Descartes et la Formation du Foetus* 2nd ed. (Paris: Girard, 1677). The treatise on the formation of the fetus is a digression (Part 4) of what is later named the *Description du corps humain, et de toutes ses fonctions* (reprinted in *AT* XI, 252 ff)

[18] On the importance of Harvey's refutation of both theories, see Elizabeth Gasking, *Investigations into Generation, 1651-1828* (Baltimore: Johns Hopkins U Press, 1967).

[19] As Louis La Forge says in concluding his appended commentary to the French edition of the *Treatise on Man*, "…neither the dogmas of our Author, nor of good reason, would give me the courage to try to complete the second part [of his treatise]." *L'Homme* (Paris ed.), p. 368.

This difficulty in the Cartesian system, what Jacques Roger characterized as the "checkmate" of original Cartesian mechanism, forced another solution upon "mechanical" philosophers of the late seventeenth century. This was to opt for a strong preformationism, better named the "pre-existence" theory, which was given philosophical currency by French Oratorian priest Nicholas Malebranche (1638-1715) in 1674 in his *Search after Truth*, and strong scientific support by Leiden-trained physician and microscopist Jan Swammerdam (1637-1680) in his *General Treatise on the Bloodless Animals* (1669), and his posthumous *Bible of Nature* (1737).[20] The work of Regnier de Graff in 1672 which identified the follicles that form on the ovaries of female animals as the " female egg," provided a location of the preformed embryo, even though he did not claim as much.[21]

The close connection of the preformationist embryology that subsequently arises in the seventeenth century with the failure of Cartesian mechanism to explain development must be recognized for any historical understanding of the rise to dominance of strong preformationist embryology. This was the solution to an otherwise insoluble issue within the mechanistic program of early modern science, and was adopted by Cartesians, Italian iatromechanists, and Newtonians by the early eighteenth century.[22] Its eventual installation as the official scientific paradigm in the teaching traditions of the foremost medical schools of Northern Europe underlines the importance of this theory of generation as almost a scientific and medical consensus position.[23]

Theological changes also reinforced this connection. The collapse of neo-Aristotelian scholasticism in much of Europe after the Reformation, and the rise of the Calvinist Reform in Switzerland and the Dutch Republics, and Catholic Jansenism in France and the Spanish Lowlands, brought with it a new interest in Augustinian theology as an alternative to Aristotelian-Scholastic positions. Installed in institutions such as the French Oratory under the leadership of Cardinal Pierre de Bérulle (1575-1629), this strong Augustinian theology was in

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[20] On Malebranche's general revisions of Cartesianism see S. Gaukroger, *The Collapse of Mechanism and the Rise of Sensibility: Science and the Shaping of Modernity, 1680-1760* (Oxford: Clarendon, 2010), esp. p. 170 ff. See also Andrew Pyle, "Malebranche on Animal Generation: Preexistence and the Microscope," in Smith, *Problem*, pp. 194-214; see also Roger, *Les Sciences*, Part Two. For a generally sympathetic analysis of the history of preformationism, see Clara Pinto-Correia, *The Ovary of Eve: Egg and Sperm Preformation* (Chicago: University of Chicago Press, 1997).

[21] See B. P. Setchell, "The Contributions of Regnier de Graaf to Reproductive Biology," *European Journal of Obstetrics, Gynecology and Reproductive Biology* 4 (1974), 1-13. I thank Evan Ragland for this reference.

[22] Roger, *Les Sciences*,

[23] The primary exception is the medical theory and teaching of the University of Montpellier which had consistently defended some version of vitalism against the more general biomechanism of the period. I will not attempt to explore this option here. On the Montpellier tradition and guide to the literature see Charles Wolfe and M. Terada, "The Animal Economy as Object and Program in Montpellier Vitalism," *Science in Context* 21 (2008), 537-79. The other articles in this issue of *Science in Context* should also be consulted.

position to have a distinct influence on Descartes himself.[24] For many, Augustinianism seems to have been viewed as more compatible with the new mechanism than Aristotelian Scholasticism. The strong dualism of soul and body in Augustinianism bears several connections to Descartes's own dualistic solutions. That preformationism could provide and explanation for the transmission of Original Sin was another theological point of connection with Augustinianism.

Preexistence theory also had strong authority in the texts of Augustine himself. In his account of Biblical creation in Books III and IV of his *On the Literal Interpretation of Genesis*, Augustine develops a theory of the simultaneous creation of all things at one moment in time, organisms included, with inherent *rationes seminales* implanted at the first creation of all things. As he writes:

> If this can be maintained on the ground that in the liquid substance of the eggs there already existed all that grows and develops in the required course of days because there were already present the numerous reason principles [*rationes*] implanted in an incorporeal manner within corporeal creatures, why could not the same thing have been said before the appearance of eggs, when in the humid element these same reason-principles were produced, from which winged creatures might be born and develop in the time required for the growth of each species.[25]

Consequently, the developmental gradualism endorsed by the long tradition of discussion since Antiquity, and embraced in both Aristotelian and Galenic traditions, was abandoned in the early modern period. The Augustinian architects of the revised Cartesian mechanical philosophy, such as Nicholas Malebranche, instead appealed to immediate creationism with the soul immediately created by God and put into interaction with the body conceived as a divinely-crafted machine.[26]

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[24] On this interview see Adrian Baillet, *La Vie de Monsieur Des-Cartes contenant l'histoire de sa philosophie et des autres oeuvres*. 2 vols. (Paris, 1691) Online at http://gallica.bnf.fr/ark:/12148/bpt6k75559n. For general discussion of Descartes and Augustinianism see Stephen Menn, *Descartes and Augustine* (Cambridge: CUP, 1998). See also Roger, *Les Sciences*, Pt. II, chp. 3.

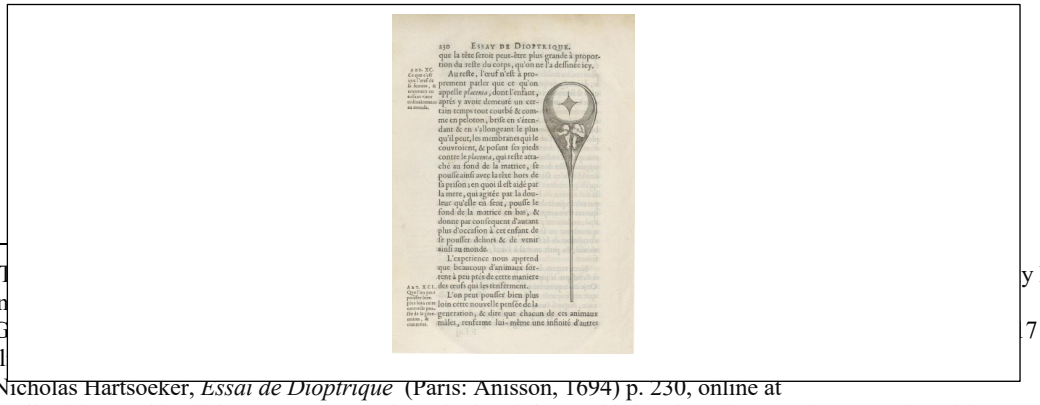
[25] See Augustine, *On The Literal Meaning of Genesis*, trans. J. H. Taylor (New York: Paulist Press, 1982), vol. I, Bk. IV, chp 33, p. 142. I emphasize that it is the *combination of* mechanism with Augustinianism that is creating the strong preexistence reading of these texts. Later readers were even to see in these statements of Augustine the thesis of evolution! See on this Ernan McMullin "Introduction" to E. McMullin (ed.) *Evolution and Creation* (Notre Dame: University of Notre Dame Press, 1985), pp. 11-16.

[26] See Malebranche, *La Récherche de la verité*, Book 1, chp. 6 available on Wikisource at https://fr.wikisource.org/wiki/De_la_recherche_de_la_v%C3%A9rit%C3%A9/Livre_I. "Nous devons donc penser outre cela que tous les corps des hommes et des animaux qui naîtront jusqu'à la consommation des siècles, ont peut-être été produits des la création du monde; Je veux dire que les femelles des premiers animaux ont peut-être été créées avec tous ceux de même espèce qu'ils ont engendrés, et qui devaient d'engendrer dans la suite des temps." (Book I, chp. 6, p. 30).

This combination of mechanical philosophy, theological Augustinianism, and new empirical research made possible by the improvement of the microscope, all worked to establish the framework for what by the late seventeenth century became the thesis that the primordia of all the individuals of all species, and not just those of humans, existed from the historical moment of divine creation simply as miniature forms or as "seminal reasons," which then emerged or unfolded in historical time under proper conditions.[27] Illustrating all of these themes is the summary in an influential late seventeenth-century review article on the topic of generation, published in 1691 in the prestigious *Philosophical Transactions of the Royal Society* by Aberdeen physician George Garden:

> And indeed all the Laws of Motion which are as yet discovered, can give but a very lame account of the forming of a Plant or Animal. We see how wretchedly *Des Cartes* came off when he began to apply them to this subject; they are form'd by Laws yet unknown to Mankind, and it seems most probable that the *Stamina* of all the Plants and Animals that have ever been, or ever shall be in the World, have been formed *ab Origine Mundi* [from the foundation of the world] by the Almighty Creator within the first of each respective kind.[28]

In its most explicit versions, the Russian-doll theory or *emboîtment*, this envisioned an infinite series of preexistent individuals created at a single moment in time and encased in its original version in female egg, identified at the time with the Graffian follicles on the ovary. After 1677 following the discovery by Anton van Leeuwenhoek of male spermatozoa, the option of a preformation of the individual in the sperm spread rapidly, with the spermatozoon containing the infinite series of encased embryos as in the famous illustration from Cartesian Nicholas Hartsoeker's work of 1694.[29] For Cartesians, the infinite divisibility of matter allowed for this series of endless encasements.



[27] T… y have held that there are prin…

[28] G… .7 (1691), 476-77. Onl…

[29] Nicholas Hartsoeker, *Essai de Dioptrique* (Paris: Anisson, 1694) p. 230, online at https://archive.org/details/BIUSante_07012/page/n3/mode/2up. This is primarily a treatise on optics with extensive discussion of an improved design of the microscope. He has not claimed to have seen this homunculus, but only postulated that if microscopes were better, this is likely what would be seen. On Hartsoeker, see Roger, *Les Sciences*, pp. 294-304.

Debates between "vermists" and "ovists" characterizes some of the embryological disputes of the early eighteenth century, with the "vermist" view version taught authoritatively by the great Hermann Boerhaave at the University of Leiden, and from their spread to Utrecht, Edinburgh and other major teaching medical schools.[30] The following quote from an important medical textbook by Leiden and Padua-trained British Court physician, Sir Richard Mead (1673-1754), illustrates the long endurance of many of these themes at the middle of the eighteenth century:

> Geometricians have been long intent on contriving a machine that may be endued with perpetual motion; but. . . it is God alone who can complete such a machine; and was pleased that our body should be a fabric of that sort, but disposing all its powers in such a manner, that they should form a kind of circle, in which at the same time that they perform their respective functions, they should constantly and mutually repair each other.
>
> Hence it manifestly appears, that the animal machine is made, not by parts, but all together; seeing it is impossible, that a circle of motions, some of which depend on others, be compleated, without all their instruments being in their proper places. . . .Wherefore the animalcula [i.e. spermatazoa], which by the help of microscopes we discover *swiming* [sic] in the *semen masculinum*, are really little men; which being received into the womb, are there cherished as in a nest, and grow in due time to a proper size for exclusion."[31]

As we see in this quote, the origin of the individual organism is at the first divine creation in essentially complete, but miniature form, with the embryo simply unfolding and increasing in historical time under proper conditions. Furthermore, we see the close ties of this theory with one common meaning of

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[30] On these distinctions, and the ensuing debates between "ovists" and "vermists," see especially Pinto Correia, *Ovary of Eve*, chps. 1-2.

[31] Richard Mead, *Medical Precepts and Cautions,* trans. from the Latin by T. Stack [London: Brindley, 1751], pp. 10-11. Mead was the personal physician to George II, and was trained originally in medicine at the University of Leiden, where he was a fellow student with Hermann Boerhaave. He became one of the leading physicians in early Enlightenment England.

"mechanism."[32] This assumes that the body is divinely crafted like a fine watch or machine, with an intricate interrelation of parts and functions, each one implying the existence of the other. The third claim is that the individual spermatozoa are themselves miniature human beings, even before their enclosure in the female uterus where they then develop.

It is important to realize that preexistence embryological theory in all its versions was a solution to a fundamental difficulty in the *mechanical philosophy* itself in dealing with the explanation of living beings. It appeared to be the only plausible solution to the question of origins, with continued empirical support coming from the best microscopists of the age, such as Henry Baker, Leeuwenhoek, Hartsoeker, Swammerdam and many others.[33] It is embedded in the main teaching texts, research articles, and other expositions of development in the late seventeenth and early eighteenth century.

Relevance to Legal Questions:

Of relevance to my larger argument is the claim that this theory of origins and development in some form also constituted the medical and scientific backdrop to the *legal* discussions of abortion, ensoulment, and the nature of human life of the early modern period, even when this was not explicitly mentioned in legal briefs. Like "evolution" in our own time, it formed part of a conceptual background of assumptions that flowed from science indirectly into the legal and political thinking of the period and into popular discourse. Some form of the pre-existence theory remained part of a general scientific consensus into the 1760s, and aspects of it survive into the 1790s. This forms the historical scientific and medical context behind early modern Common Law legal statements on abortion. There is, therefore, little surprise that one finds the equation of abortion at any stage with murder in early-modern Common Law. Indeed, I am more startled by the long maintenance of appeals to forty-day "quickening" in the laws up until the latter eighteenth century when the medical and scientific background in Aristotelian and Galeno-Arabic theories of gradual ensoulment and the language of potency and act had largely disappeared from philosophical discourse.

Although most of the early modern Common Law voices appealed to in the Dobbs decision— Henry de Bracton (d. 1268), Edward Coke (1552-1634), and William Blackstone (1723-1780)— have not disclosed their more general

[32] For analysis of the early-modern meanings of "mechanism, "see Domenico Bertoloni-Meli, *Mechanism: a Visual, Lexical, and Conceptual History* (Baltimore: University of Pittsburgh Press, 2019).
[33] See Pinto-Correia, *Embryo of Eve*, for numerous examples.

theoretical views on human development, one of these, Sir Matthew Hale (1609-1676) is an exception, and he is also one of the most frequently cited authorities in Dobbs.[34] Hale did in fact deal with some of these issues on a more theoretical level in his treatise, *The Primitive Origination of Mankind* (1677). In this he discusses the origin of the world, the principles of life, the origin of species, and the embryonic beginnings of humankind. After reviewing various theories, he gives his endorsement to a version of Augustine's theory of the immediate creation at one moment of time of the primordia of all species as "seeds" or "germs" which then emerge in historical time:

> 4. That they [human embryos] were made in the first instant of their Constitution in the full perfection and complement and stature of their individual and specifical nature, and did not gradually increase according to the procedure of animal augmentation at this day: and the reason is, because those gradual augmentations arise from the Seminal Principle which gradually expands itself to the full growth; but here they arose not from any such Seminal Principle, but the Hen was before the Egg.
>
> 5. There was no mean portion of Time between their Formation and Animation, but both were together, they were living Beings, and living Souls, and living Creatures as soon as they were formed.
>
> 6. That consequently the Formation of the Body of these Animals was not as now it is, by the Formative Power of the Soul, which must needs be gradual and successive, as we see it is, and must be at this day in all natural Generations; but the Formation and Information of them was by virtue of the immediate *Fiat,* Determination, or Ordination of the Divine Will.
>
> **********
>
> Therefore although now in settled Nature, and according to the standing Laws of the Divine Wisdom Man is first conceived *ex semine,* then lodgeth 10 Months *in utero muliebri,* wherein during that time he is gradually formed and perfected; and then after his Birth gradually increaseth, passeth through the impotency of Infancy, the weaknesses of Childhood, and the follies of Youth before he comes to a ripe and full age, yet it was not so here; in the same moment the Body is formed in its full and perfect nature,

[34] Hale is cited in some context 123 times in the final text.

> and the Animal Soul and Faculties together with it and the Rational Soul infused in the same moment, without any priority of Time, but only of Order and Nature: So that Man was at the very same moment a perfect Organical Body, with all his Nerves, Veins, *Viscera,* Bones, and Parts conformed, a Vital and Sensitive Nature joyned with it, and a Rational Soul infused, without first living the Life of a Plant, then of an Animal, then of a Man; the whole Scene was performed in one moment, and so it became both the Greatness of the Divine Majesty and Power; and so it was necessary to be in the first production of Man, although in the succeeding procedure of natural Generations it must be and was otherwise, because the supreme Wisdom and Will judged it so.[35]

As we see in these quotations, Hale is holding positions similar to those articulated by Augustine. These include to an immediate creation of the first member of each species as completed at one moment in time in miniature or as a "seminal principle" which simply expands and develops in historical time. He denies the common scholastic notion of serial ensoulment, and holds that vegetative, animate and rational souls are given all at once. None of this is surprising in a text from 1677. It reflects a growing consensus position in natural philosophy and medical theory at this very time.

The connections of such view with his legal opinions has immediate bearing on the claim in Dobbs "that the common law did not condone even pre- quickening abortions is confirmed by what one might call a proto-felony-murder rule. Hale and Blackstone explained a way in which a pre-quickening abortion could rise to the level of a homicide."[36] Read against the background we have developed, this is not surprising. With pre-existence the primary theory of embryology, intentional destruction of embryonic life at any point would be equivalent to a form of homicide, and it is not surprising that there is no allowance for the traditional time of "quickening" as a criterion for moral significance in embryonic life.

The theoretical background which made such claims in the late seventeenth and early decades of the eighteenth century a consensus position in the biomedical discussions was to alter dramatically after 1740. This would

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[35] Matthew Hale, *The Primitive Origination of Mankind, Considered and Examined According to the Light of Nature* (London: Godbid, 1677), Section IV, Chp. 3, pp. 310 ff. online at https://archive.org/details/halemankind/mode/1up

[36] Dobbs 2.1

reinstate epigenetic embryology and transform many other issues in the life and physical sciences.

Philosophical Vitalism and the Recovery of Epigenesis:

The breakdown of preformationist assumptions around the 1750s is a complex story that is part of the general "revitalization" of nature and the ending of the dominance of mechanical philosophy in physics as well as biology. This transformation re-introduced concepts of immanent teleology, new conceptions of matter, and the introduction of vital forces of various denominations as principles of causal explanation.[37] These new conceptual ingredients transformed the biomedical sciences in the period between 1750 and 1800, with manifestations in medical theory, general discussions of "life," and even the philosophy of history as we find in the writings of Johann Herder.[38] It marks a major turning point in the history of modern life science from which emerged not only new theories of generation, but also new medical theories. It was critical for the development of the early theory of evolution.[39] This meant a widespread replacement of mechanistic models of the organism with explanatory frameworks that appealed to new vital matters, special vital forces, or new "vital" laws. These all led to the definition of a new science of life— "biology"— by 1800.

This breakdown of seventeenth-century versions of "mechanism," in life science was driven by empirical issues. One was the failure of mechanistic accounts to explain such phenomena as the production of vital heat in birds and mammals. There was also the failure of mechanistic medical theory, based on the flow of fluids, solids and pressures, to produce any practical medical results. And with reference to issue of the generation of organisms and embryological formation, the discovery of self-regenerative powers of various invertebrates, especially that of the fresh water polyp, reported in 1740 by the Swiss naturalist Abraham Trembley (1710-1784), generated a conceptual crisis in the life sciences. Trembley's demonstration that each

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[37] See Peter H. Reill, *Vitalizing Nature in the Enlightenment* (Berkeley: University of California Press, 2005); John Zammito, *The Gestation of German Biology: Philosophy and Physiology from Stahl to* Schelling (Chicago: University of Chicago Press, 2018); Guido Cimino and François Duchesneau (eds.), *Vitalisms: From Haller to the Cell* Theory (Firenze: Olschki, 1997); Cécelia Bognon-Küss and Charles Wolfe (eds.) *The Philosophy of Biology Before Biology* (New York: Routledge, 2019); Gaukroger, *Collapse of Mechanism*.

[38] See his appeal to the work of Harvey and Caspar Friederich Wolff in setting forth his theory of the *Genetische-* or *LebensKraft* that underlies the development of both the cosmos and human history in the first volume of his *Ideen zur Philosophie der Geschichte der Menscheit* (1784), reprint edition Berlin: Aufbau-Verlag, 1965), I, 169.

[39] For relevance to evolutionary theory see my "Evolutionary Thought Before Darwin,"*The Stanford Encyclopedia of Philosophy* (Winter 2019 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/win2019/entries/evolution-before-darwin/>

section of a chopped-up polyp was capable of becoming a whole new adult, dramatically undermined the preexistence theory of generation. Trembley's discovery would affect literature, philosophy and even theology. The international discussion stimulated by Trembley's discovery and its extensions into philosophical reflections turned the attention of several natural philosophers and physicians to issues of generation, vitality, matter theory, and the failures of mechanism in the sciences of life.[40]

On the empirical level, the subsequent revival of epigenetic theories of development followed in short order. In 1759 was published the detailed study of development in both plants and the chicken by the young University of Halle medical student, Caspar Friederich Wolff (1733-1794). His work reported microscopic studies that supported the claim that the embryo forms gradually from unstructured matter under the action of an inherent teleological force (*vis essentialis*). Although there was substantial controversy over the claims of Wolff's pure epigenetic account for several years,[41] his account was generally endorsed by Göttingen theorist Johann Blumenbach, and by the 1780s the concept that the embryo develops gradually over time without preformation of parts was generally established as the new paradigm, with some kind of vital force or power—*Bildungstrieb*, *Lebenskraft*, *sensibilité*, or "vital force" as the explanation of how this directional development takes place. [42]

These developments laid the groundwork in the eighteenth century for the major embryological studies of Karl Ernst Von Baer (1792-1876), set forth in his massive *Developmental History of Animals* (1828-1837).

Von Baer's work, often viewed as the founding work of modern embryology, established the main detail of the epigenetic stages of embryological development both of the chicken and also of the more difficult to observe development of the microscopic mammalian fertilized egg which he first reported having discovered in 1827. Von Baer also formulated the main principles of embryological development in law-like

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[40] See Virginia P. Dawson, *Nature's Enigma: The Problem of the Polyp in the Letters of Bonnet, Trembley and Réaumur*, Memoirs of the American Philosophical Society; v. 174 (Philadelphia: American Philosophical Society, 1987). For drawing my attention to the broader implications of Trembley's discovery for political discourse I am indebted to the unpublished manuscript of my colleague Emma Planinc, "Regenerative Politics," (personal communication.)

[41] See on this Shirley Roe, *Matter, Life and Generation: 18th Century Embryology and the Haller-Wolff Debate* (Cambridge: CUP, 1981).

[42] Vitalistic medical theory, particularly influenced by the anti-mechanist theories of major theorists at the University of Montpellier medical faculty, emerged to prominence in French medicine at the same time. See Charles Wolfe and M. Terada, "The Animal Economy as Object and Program in Montpellier Vitalism," *Science in Context* 21 (2008), 537-79. The other articles in this issue of *Science in Context* should also be consulted.

statements that still hold some general validity, such as the claim that the developmental stages of different species—and here vertebrates are especially relevant—are most similar at earlier stages, and then undergo successive divergence from one another as they develop the more general structures, and then as specific species and even individuals.[43]

From these nineteenth-century foundations, the great work of modern embryology by the students of Ernst Haeckel, Hans Driesch, Hans Spemann, Paul Weiss, Joseph Needham and many others has given us modern embryological science. Detail on these developments is not essential except to acknowledge that this work has reinforced the claim of modern embryology since the nineteenth century in support of a profoundly epigenetic theory of development. The degree to which some kind of preformationism is still in play in modern developmental theory is a significant issue in assessing its implications for moral assessments of human development at all stages.

Genetics and Embryological Development

The recovery and renewed appreciation of Gregor Mendel's 1866 paper, "Experiments on Plant Hybridization," in 1900 simultaneously by three independent investigators— the German botanist Carl Correns (1864-1933), the Austrian agronomist Erich Tschermak (1871-1962), and the Dutch experimental botanist Hugo DeVries (1848-1935)—opened a new era in the exploration of inheritance in plants and animals that complicated the image of a pure "Aristotelian" epigenesis as developed by Von Baer and his successors.[44] For Mendelism seemed to show that inheritance was transmitted in accord with mathematical laws involving what Mendel himself termed simply "factors" (*Factoren*). This complicated pure epigenesis with what many developmental biologists in the early twentieth century were to interpret as undesirable "preformationist" ingredients. The nature of this "genetic" preformationism needs careful clarification because of its ubiquity in contemporary discussions.

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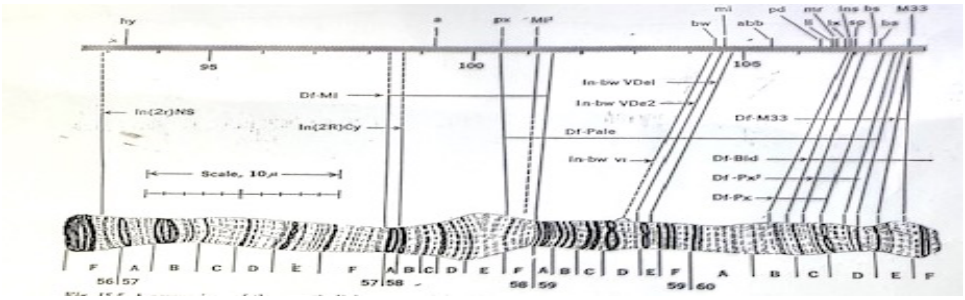
[43] It is for this reason that a student of descriptive embryology can smoothly transition from the study of the development of the chicken to that of a pig at early stages with surprisingly little difficulty, and then subsequently to that of the human being. The author went through this experience as a pre-medical student in the 1950s studying developmental embryology.

[44] A good "philosophical" window into the pre-genetic discussions of embryonic formation is available in the writings of embryologist turned philosopher Hans Driesch (1867-1941) in such works as the first edition of his *Science and Philosophy of the Organism* (1908), where he primarily develops an Aristotelian argument for epigenetic embryological development that is guided by an immaterial teleological *entelechy*.

The concept of the "gene" as the name for these Mendelian factors, introduced into the literature in 1909 by Danish biologist Wilhelm Johanssen, opened the door to the conceptualizing the "gene" in the popular early understanding of genetics as a material particle passed unchanged to offspring and envisioned to stand in a deterministic relation to individual phenotypic features. In this version, it bears many preformationist dimensions.[45] The individual to develop the research into gene transmission into a dynamic research Program was Thomas Hunt Morgan (1866-1945) of Columbia University. Morgan had originally opposed the new genetics as "preformationist," but following his analysis of sex-linked inheritance in fruitflies (1910), he became a strong advocate of the concept of genes as borne on the visible chromosomes in the nucleus of the cell. With this "chromosome theory" as the foundation, Morgan and his pupils at Columbia formed a dynamic research program centered in the fruit fly, *Drosophila melanogaster*, that was to dominate genetics into the 1950s.[46] One of his pupils, Alfred Sturtevant (1891-1970) also developed the method of gene mapping by which the physical location of genes on the chromosomes was made possible through crossing experiments. These led to the development of precise chromosome Maps in the late 20s and 30s in which the linear location of genes on the chromosome of the fruitfly was developed in detail.



Chromosome Map, Calvin Bridges,"Correspondence Between Linkage Maps," *Cytologia* (1937), p.750

[45] For a valuable analysis of this hardening of conceptualization of the gene, see Lenny Moss, *What Genes Can't Do* (Boston: MIT Press, 2003).
[46] See Robert Kohler, *Lords of the Fly: Drosophila Genetics and the Experimental Life* (Chicago: UC Press, 1994).

Developments in biochemistry and analytic cell biology in the 1930s and 40s enabled sections of the chromosomes to be analyzed which disclosed the presence of both protein and dexoyribonucleic acid (DNA). While the protein molecule with a structure that allowed numerous possible arrangements of up to twenty amino acids attached to a carbon-nitrogen chain, and for this reason capable of carrying a great deal of "information," the DNA molecule, with only four nucleotide bases in its structure was considered to be lacking in specificity, and served only as a "spacing" molecule, with the gene itself a complex protein molecule.[47]

Recent Genetics and Development:

In a story that has been told several times,[48] the protein theory of the gene—dominant until the 1950s— was eventually replaced by focus on the other non-protein component of the chromosome, deoxyribonucleic acid. This was eventually understood as the primary genetic material through the combined work of Maurice Wilkins, Linus Pauling, Rosalind Franklin, and finally James Watson and Francis Crick, who published on both the structure of DNA and also made suggestions for its implications for genetics in the spring of 1953.

For this new claim to hold, however, a long and complex effort by several research groups was needed to explain how DNA, composed of a sequence of four nucleotide bases—thymine, guanine, cytocine and adenine— and held together by a phosphodiester backbone, could be related causally to protein synthesis, involving a chain of carbon and nitrogen bonds with side structures composed of a variety of 20 amino acids, none of which resemble the structure of the DNA molecule. Crick had himself proposed as a theoretical research problem in 1957 the pursuit of the option that DNA did this through the intermediary of its related ribonucleic acid, which did not form helical chains and differed by having the nucleotide base, uracil, in place of thymine. This is captured in what became known as "Crick's Central Dogma" of molecular genetics:

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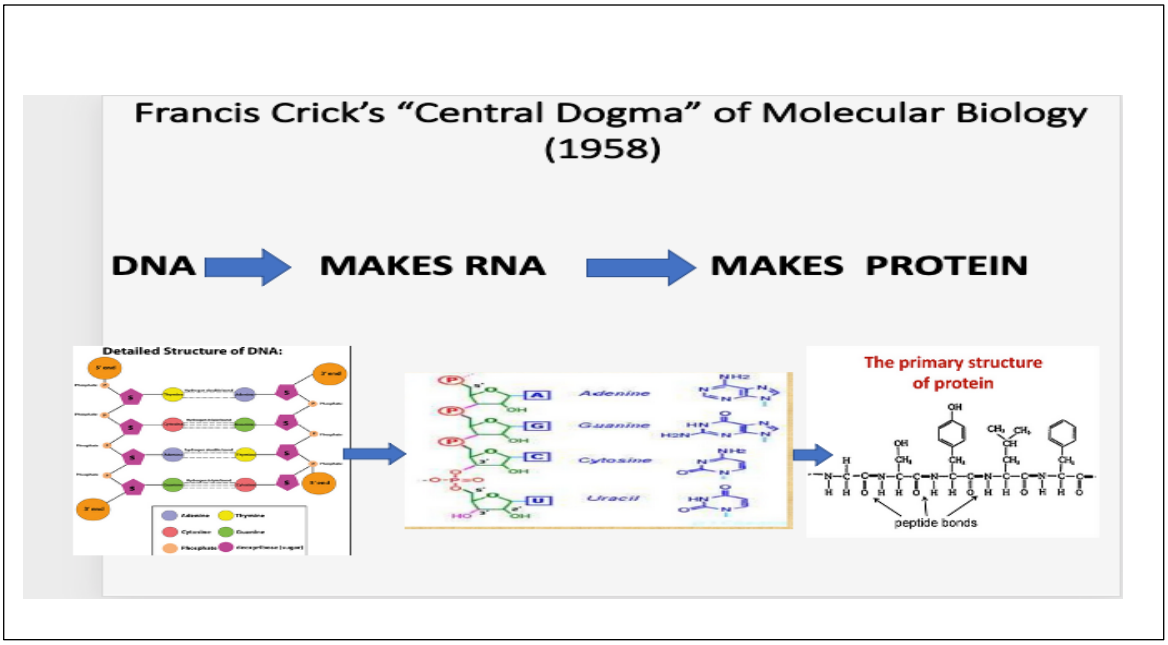
[47] A valuable review article on this protein conception of the gene is A. Gulick, "What are Genes," *Quarterly Review of Biology* 13 (1938), 1-18, 140-168..

[48] See Robert Olby, *The Path to the Double Helix* (Seattle: University of Washington Press, 1974).



To supply convincing empirical warrant for this proposed relationship constituted a complex theoretical problem that involved for its solution the work of cryptographers, biochemists, mathematicians, biophysicists and geneticists. The Nobel-prize winning work of François Jacob and Jacques Monod in 1961 on the relation of intermediate forms of RNA and a form known as "messenger" RNA in the cytoplasm of the cell to protein synthesis was one critical link in this story. The problem was only resolved in the late 1960s in a way that finally gave empirical support to Francis Crick's theoretical postulate.[49] This was represented in the determination of the table that related what are known as "codons"—three base units of messenger RNA— to specific amino acids was finally published, a table that will appear in any genetics textbook today.

Genetic Codon Chart

	U		C		A		G	
U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys	U
	UUC	Phe	UCC	Ser	UAC	Tyr	UGC	Cys	C
	UUA	Leu	UCA	Ser	UAA	Stop	UGA	Stop	A
	UUG	Leu	UCG	Ser	UAG	Stop	UGG	Trp	G
C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg	U
	CUC	Leu	CCC	Pro	CAC	His	CGC	Arg	C
	CUA	Leu	CCA	Pro	CAA	Gln	CGA	Arg	A
	CUG	Leu	CCG	Pro	CAG	Gln	CGG	Arg	G
A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser	U
	AUC	Ile	ACC	Thr	AAC	Asn	AGC	Ser	C
	AUA	Ile	ACA	Thr	AAA	Lys	AGA	Arg	A
	AUG	Met	ACG	Thr	AAG	Lys	AGG	Arg	G
G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly	U
	GUC	Val	GCC	Ala	GAC	Asp	GGC	Gly	C
	GUA	Val	GCA	Ala	GAA	Glu	GGA	Gly	A
	GUG	Val	GCG	Ala	GAG	Glu	GGG	Gly	G

Translation START codon
Translation STOP codon
Positively charged amino acids
Negatively charged amino acids
Hydrophobic amnio acids
Hydrophilic non-charged amino acids
Cysteine

[49]

Source: Open Source: Internet

DNA Preformationism:

The "story" of DNA has captured the public imagination through film, news articles, books, and podcasts to the point that it is ubiquitous in contemporary culture.[50] Since the Human Genome Project and its publication of the entire DNA composition of the twenty-three paired human chromosomes in 2000, claims are often made that this has been the discovery of the "secret of life" the "code of codes," the "holy grail" of biology, with this seeming to imply a deterministic, causal relation between the structural properties of DNA and the phenotypic features of the adult organism.[51] Subsequently, this "DNA essentialism," apparently with the sanction of leading molecular biologists, has become a prominent feature of not only of popular discourse, but also of discussions in ethics, law and theology.

This concept of "DNA essentialism" has been critiqued repeatedly by those working in developmental embryology.[52] Such characterizations ignore the inherent plasticity that holds between the base-nucleotide sequences on the DNA molecule, and the biochemically complex process that leads from exons, transfer and messenger RNA molecules, to ribosomes and finally to the synthesis of the twenty different amino acids that form the proteins in the cytoplasm of the cell from which actual embryonic structures are formed.

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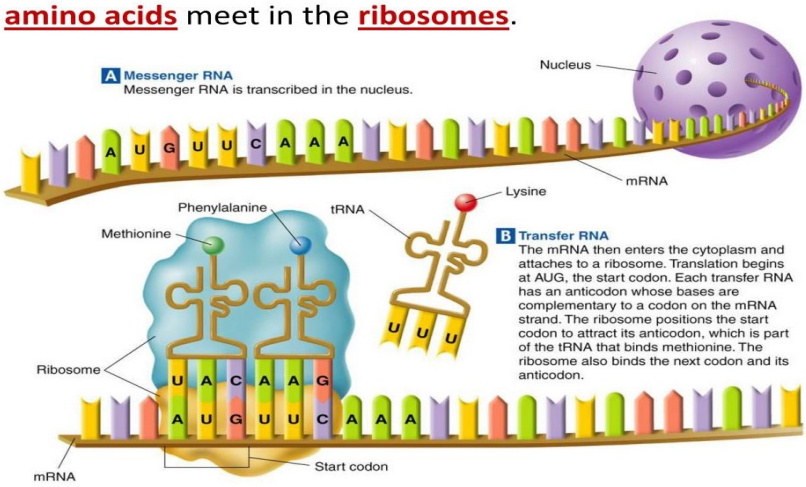
[50] See Dorothy Nelkin and Susan Lindee, *The DNA Mystique: The Gene as a Cultural Icon* (New York: Freeman, 1995).

[51] On this transfer of metaphors and terminology from information science and early computerization into genetic discourse, see Lily Kay, *Who Wrote the Book of Life? A History of the Genetic Code* (Palo Alto: Stanford U. Press, 2000). The language of "code" itself is misleading. In a genuine code like the Morse Code, there is a one-one correspondence of the code symbol and its correspondent letter. But there is no such simple correspondence between a section of the four bases of DNA and the resultant amino acid, let alone of the resultant protein.

[52] See Gilbert, "Pseudo-Embryology."

Attention to the RNA codon-amino acid relationships in the table above show the reasons for this critique. As can be seen, there are several ways in which the RNA codons can be linked to the corresponding amino acid. Argenine, for example, can be linked to six different RNA codons—CGU, CGA, CGG, CGC, AGA, AGG. Similar redundancies can be seen for the other amino acids. What this means is that there is *no* simple one-one relationship that holds between specific sections of DNA structure, subsequently replicated in nuclear RNA ("introns') and then transmitted to the cytoplasm from the nucleus to the cytoplasm ("exons"), where they are then linked in a complex way with cytoplasmic "transfer" RNA three-base codons that in turn tie in to specific amino acids. These codons bearing the specific amino acids are then synthesized by the microscopic ribosomes of the cell cytoplasm that "read off" the messenger RNA to produce long protein chains. It is these that synthesize the tissues and eventually attain phenotypic expression. Most molecular genetics texts will have cartoons similar to the following as illustrations of this complex relationship:

- mRNA carrying the **DNA instructions** and tRNA carrying **amino acids** meet in the **ribosomes**.



Source: internet open access

What this deeply complex cellular process entails is a "soft" preformationism. There are indeed preformed elements that are passed on materially in generation that have a complex causal relation to the structures of the new generation. But there is no simple one-one linkage of DNA structure and phenotype. The latter arises from a complex process in which an end result can be reached by several different pathways.

Summary of Scientific Issues

The purpose of this quick foray into the history of developmental biology has been intended to clarify some important points that are intended to assist in developing a new level of dialogue about the issue of abortion and ethics. I will summarize my claims in the following points:

First, modern developmental biology is profoundly epigenetic in the sense that development is seen as taking place in gradual stages in which novel structures and functions are developed in time. "Preexistence" embryology of the seventeenth-century variety is not tenable, and attempts to revive it in "personhood" arguments run into the difficulties that faced the original versions of this.

Second, the form of "preformationism" that is involved in the combination of epigenesis and molecular genetics allows for a "soft" preformationism which may have varying levels of relationship between phenotypic expression and DNA structure. This rules out "DNA Essentialism" in the form commonly referred to in popular discourse and even more technical discussions.[53]

Finding a Way Forward

My argument to this point has been intended primarily to illuminate relevant historical developments in life science that form a changing background against which legal opinion and even common discourse have been formed.

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[53] This is not to deny the many ways in which there is a causal connection that is often very close. Much of this has to do with the issue of gene "penetrance," with some structural DNA sequences having virtually 100% expression. Here a recognition of a revised form of Aristotelian teleology as involved in this process would seem a defensible solution. Hans Driesch was making something like this argument in his interpretation of his famous half-embryo experiments with the concept of "harmonious equipotentiality" in which similar goals are reached by different pathways (see his *Science and Philosophy of the Organism* (note 34). As an example, the protein involved in vision, rhodopsin A, is almost identical in zebrafish and humans. But because of the overlap and redundances in coding, these two proteins may be produced by DNA structures in fish and man that may have only 25% identity in actual base sequences (personal conversation with Prof. David Hyde, Notre Dame department of life science.)

Thus although Dobbs claims to be simply developing an "originalist" interpretation of the law, and doing this with a substantial documentary base, it also displays its lack of awareness, or at least it ignores, the changing structure of developmental embryology since the seventeenth century that has formed the scientific background against which legal decisions on abortion have occurred. This background today is very different than that which prevailed in the seventeenth and eighteenth centuries.

Given that Dobbs has been decided, and that the issue of abortion access has been returned to the deliberations within the individual states, what is now needed is a more informed dialogue about the issues that must now be worked out in a complex public dialogue with strong opinions and public forces on both sides. If these matters are to be decided by means other than brute political force, we require a new level of understanding of the complexities of the process of development, and a clear recognition of the proper philosophical level at which issues are to be discussed. Too often we simply experience debates in the broader public arena between parties arguing from different premises without clear definition of the relevant issues or informed information about some important scientific matters.

I suggest some of the following parameters for developing this discussion:

First, it is necessary to recognize the long and complex history of discussions surrounding questions of ensoulment, vitalization, and its relevance to embryonic development and the permissibility of abortion since Antiquity, and especially since the seventeenth century. Historical study shows that there has been no simple unitary view on issues of vitalization, ensoulment, or specific stages of moral significance, even within the Christian tradition, and there are significant differences between Christian, Jewish and Islamic conclusions within the Abrahamic religious tradition. Conclusions developed on the grounds of biological and philosophical naturalism strongly in vogue today further complicate the issues for any legal solution within a diverse democratic system.

Second, historical analysis reveals a changing background in natural philosophy that renders the current context very different than that which underlies the Common Law origins of British and American legal precedent appealed to strongly in the Dobbs decision. This scientific context precludes strong preformationism either of the seventeenth century variety,

or the DNA Essentialism that is often now being appealed to by some parties.

Thirdly, within some larger scientific limitations, I will argue that science and empirical arguments cannot decide questions related to the moral status of embryonic life in its different stages of development.[54] These are questions that must be resolved by discussions involving ethical theory, metaphysics, epistemology, anthropology, and religious and non-religious commitments.

To advance such inquiries, we need new structures for the analysis of the critical issues raised by modern life science that can bring into dialogue diverse perspectives from medical, scientific, ethical, theological and legal perspectives. I suggest that Notre Dame is ideally a location where such conversations can be conducted. Although often criticized—wrongly so in my view—for being a politically-conservative think tank, the kind of national discussion forum provided by the now-defunct President's Council on Bioethics, headed by Leon Kass during the Bush II administration, supplies a model for how this discussion might be advanced significantly at the university, governmental and state levels. Such discussion must engage the secular world of research science and non-theistically grounded discussion as well as that carried out in a theistic context.

Fourth, I suggest there is a strong need for the development of a philosophical anthropology adequate to meet the challenges of new biological research. This bears not simply on matters of abortion, but on the larger range of issues presented by the pervasive reductionism that is resulting from the convergence of molecular biology, artificial intelligence, sociobiology, cognitive neuroscience, and the reductive biophysical understanding of life. This convergence within the life sciences, particularly prominent over the last seventy years, poses deep challenges to almost all

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[54] As an example of efforts to develop more metaphysically-grounded arguments for moral status by Patrick Lee, Christopher Tollefsen and Robert George see exchange with biologist Jason Z. Morris, "Misconceptions Inherent in the Substance Ontology Approach to Assigning Moral Status: A Reply to Patrick Lee, Christopher Tollefsen and Robert George, *Journal of Medicine and Philosophy* 43 (2018), 159-96 and the reply in Lee, Tollefsen and George, "The Ontological Status of Embryos: A Reply to Jason Morris," *Journal of Medicine and Philosophy* 39 (2014), 483-504. The appeal to the concept of "organism" as an entity formed from the moment of conception is not, however, a claim questioned by developmental biologists who would be the first to criticize simple views of the organism as a bag of enzymes and DNA. But this does not, in my view, resolve the issue of when, in the process of epigenetic embryonic development, we can speak of moral status and legal "personhood." This is an issue that in my view must be resolved on non-scientific grounds. Theologically I might argue, as a Catholic Christian, that I accept this as beginning at conception, but that is a theological and philosophical position, not a dictate of scientific evidence.

traditional notions of human distinctness and dignity from the standpoint of pure scientific naturalism.

Professor Carter Snead in his recent book spoke of the need for a new anthropology of caring and mutual support that can ground a positive ethic of life and create a new context for the abortion discussion.[55] I endorse this, and seek ways to begin to build this with a reframed conversation. This requires, in my view, a concerted effort to restore the place of the human being in the development of modern life science. Without this, there is little reason to hope that the future will not hold for us the exploitation of embryonic human life for medical and scientific purposes.[56]

Phenomenological philosopher Herbert Spiegelberg has suggested that a key to this a richer anthropology requires the recovery and recognition of the thinking, reflective human being who stands at the center of the world of scientific inquiry:

> A full realization of the range and richness of this world is bound to lead to a new sense of the wonder and dignity of the microcosm which is man. In our superficial everyday and scientific view of man we are only too apt to look upon him as a self-enclosed physico-chemical system. . . .How far are we awake to the fact that each such organism is the center of a world, and that [one] would not be a human being without this world . . . Moreover, not only does he include his own world. In including other people as parts of this world, he also includes their worlds. . . . How much could a live awareness of this situation add to our respect, if not reverence for man?; How much more could it add to our realization that in destroying one human life we destroy his world also with him. . . .But what is ultimately even more important is the fuller realization of the depth of the self at the center of these worlds.[57]

With this recognition, we discover, or perhaps better *re-discover*, that inner freedom which allows us to raise reflective ethical questions about our science that cannot be addressed by neurophysiology, deterministic genetics, sociobiology, artificial intelligence, or any of the other reductive simplifications commonly offered to us as conclusions of contemporary scientific understanding.

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[55] O. Carter Snead, *What it Means to be Human: The Care for the Body in Public Bioethics* (Cambridge, MA: Harvard U Press, 2020).
[56] See for example, A. Aguilera-Castrejon, B. Oldak,…J. Hanna, "Ex Utero Mouse Embryogenesis from Pre-Gastrulation to Late Organogenesis," *Nature* 593 (17 March 2021), 119-124.
[57] H. Spiegelberg, "On Some Human Uses of Phenomenology," in: F. J .Smith (ed.), *Phenomenology in Perspective* (The Hague: Martinus Nijhoff, 1970), p. 23

And in this re-discovery can lie some answers to the issue of how we are to view and respect human life from its earliest stages.

Developing this vision in detail must be the topic of another inquiry. My hope is that with these options we can begin another kind of discourse about the issues raised by abortion and abortion politics.

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