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by

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When does a new individual human life begin? Thinking about this question, and the integration of philosophy and science required to resolve it, led me to read Norman Ford's book, *When Did I Begin? Conception of the Human Individual in History, Philosophy and Science.*[1] Nestled within Ford's book is a remarkable series of scientific statements so potentially fruitful in answering the question of the origin of human life that I feel compelled to share my reading of them. We must follow Ford's insight and prepare a place of understanding by also considering the philosophical and historical dimensions of the question and its answers.

Science tells us that the materials for a new being are present as the sperm enters the outer membranes of the ovum and that the new complex of chromosomes exists twenty to twenty-four hours later at syngamy. This concludes fertilization and marks the beginning of the zygote.[2] There is then cell cleavage under the instruction of the mother's messenger RNA. This mRNA was within the ovum prior to fertilization. Recent research also tells us that the DNA in one of the daughter cells "switches on" when the zygote is between the two to four

cell stage.[3] From this moment forward to death the individual has internal self-directed development into an embryo, fetus, newborn baby, child, adult, and elderly person. Aristotle's definition of nature as an internal principle of activity and rest[4] leads to the conclusion that this moment of DNA activation is the likely beginning moment of a new human being.

In monozygotic twins, two cells "turn on" with subsequent parallel but separate development. The material DNA template is the same but the individuals are unique. Twinning remains a challenge to the presence of the human soul from the first moments of life because it can occur up to seven days after fertilization. This challenge is reduced but not eliminated with the scientific information that there is short term externally controlled development prior to the enlivening of the individual's's own DNA.

Human Nature and the Soul

Aristotle and his great medieval commentator, Thomas Aquinas, teach that each natural thing, living or non-living, is a substantial unity between matter and form.[5] Within the living, this substantial form that is so tightly knit to the body is the soul. The Greeks had a broad conception of soul as the principle of life.[6] But in the present day, when we say "soul", we usually mean: human soul. The human soul is different from the souls of other living beings because of its immateriality. William A. Wallace has devoted much scholarship to understanding nature and natural being within Thomistic tradition.[7] Of the human, he writes, "For the Thomist, man is a substantial unity resulting from a union between matter and spirit that is the most intimate possible. Man has a soul, which is spiritual...it intrinsically informs the body, vitalizes it, renders it capable of performing all of its psychic and psycho-somatic functions."[8]

According to Aristotle, nature can be said to be either matter or form but it is more properly said of form because it is form that determines matter to be of a particular kind. Thus, in the *Physics* nature is defined as "an internal source or cause of being moved and of being at rest in that to which it belongs primarily, in virtue of itself and not in virtue of a concomitant attribute."[9] Following this line of thought, human nature would include both matter and form, body and

soul; but, it is more properly the soul. As substantial form the soul is the determinate principle of human existence.[10] Thus it is the internal energizing rational principle enlivening each human being.

The human soul is immaterial and, as such, it cannot be generated by parents and transmitted to offspring. Thomas Aquinas follows Aristotle in requiring a divine origin for the rational soul because of the immateriality of human thought. However, Aquinas adds that a human soul is created ex nihilo and infused by God for each human individual.[11]

The question we are concerned with is when does this occur? When does a human being begin? Currently, there is little dispute that there is human biological life by the end of fertilization, often called the moment of conception.[12]

Fertilization results in a conceptus, also called the zygote. This is the single cell that results from the intertwining of chromosomes from the ovum and sperm called syngamy. Its DNA, RNA, cytoplasmic proteins and organelles are distinct from other organisms and, thus, identifiably human.[13] Philosophically, coming into existence is substantial change. Substantial change is the generation of a new entity as opposed to accidental change which is the development, augmentation, or diminishment of that which exists. Substantial change requires a form capable of actuating matter of the appropriate kind from within. This would be a substantial form. This brings about existence and it determines the type of being that is to result from the process of change.[14] Understanding substantial change as the moment that a new being comes into existence with its own internal principle of activity and rest (substantial form) calls into question the idea that there could be a new living being until there is such an internal power or force. If you delay this question you still have to ask, is what is conceived a human being, an organism with an intellectual soul? The conceptus is certainly not able to express such rational activities as reason and choice. Yet, the human infant is also not capable of these activities. The degree of development required before God would infuse a human soul into the growing organism has generated much controversy over the centuries of Christian thought. Currently the question appears as the issue of immediate or delayed hominization.

Immediate Hominization

Proponents of immediate hominization argue that human rational life begins with human biological life. Benedict M. Ashley[15] and William E. May[16] hold that this is so because there is a continuous identity from the nucleus of the zygote to the cortex of the infant. The nucleus of the zygote is, then, the primordial organ of rational expression. This central organ is responsible for development and differentiation. This epigenetic identity allows for no substantial change after conception and so hominization must have occurred at the moment when fertilization was complete.

Jerome J. Lejeune[17] and Diane N. Irving[18] hold that the biologically human tissues of the zygote and embryo must signal the presence of the human rational soul from the completion of fertilization, syngamy. Irving argues that to accept that there is only a vegetative and then a sensitive soul present in the early embryo is to destroy the unity of the soul. The products of the self-development of the organism, i.e., enzymes, proteins, tissues and organs, are scientifically identified as specifically human matter. If the soul does not contain parts and , I would add, if there is an integral unity of body and soul, then human matter could not be present without a human soul.[19]

Similarly, Agneta Sutton[20] argues that even though the early embryo does not appear to be differentiated, it is the selfsame organism that goes on to become differentiated and actually does this itself. Thus, "A being possessing abilities associated with rationality must always have possessed a nature inherent in which was an original active capacity to develop such abilities...a rational nature."[21] This is the third century argument of Tertullian of Carthage, "He is a human being (*homo*) who will be one; the whole fruit is actually in the seed."[22] The scientific evidence that we are considering, that the DNA of one cell switches on at the two to four cell stage, asks these proponents of immediate hominization to reconsider the moment of origin of a new human life. One has to ask, could there be a new life before there was an active internal principle of development?

Monozygotic Twinning and Delayed Hominization

While himself holding for delayed hominization, Norman M. Ford admits that

> There are good reasons for believing the same ontological identity is retained throughout every stage of growth and development of the human person from fertilization. In fact, fertilization is the most biologically significant stage in the whole process of the transmission of human life. There does not appear to be any other comparable discontinuity in the process of reproduction to warrant settling on any other stage to mark the beginning of the life of an individual human being.[23]

However, Ford asserts that this continuity is not sufficient. There is not necessarily a continuing ontological identity for all zygotes.

An ontological individual is defined as "a distinct being that is not an aggregate of smaller things nor merely a part of a greater whole."[24] All adults are able to trace a continued existence to their origins. That is, from the end it is clear that there was ontological identity from the beginning. But, there is not ontological continuity from conception to birth. Some zygotes divide into two or more embryos which become identical twins or triplets. With Ford[25] and Wallace[26], Joseph F. Donceel[27] holds that God would not infuse a rational soul until the organism was an irreversibly existent ontological individual. The possibility of individual existence being interrupted, as evidenced by monozygotic twinning, prevents them from accepting that each human person begins at fertilization. It is clear that the zygote and early embryo are biologically human and living; what is not clear is whether they are irreversibly individual, and this in view of the fact that the embryo might divide into two or more embryos with the same set of chromosomes (also called the genome). Even though the resulting embryos have genetic identity, each has its own human soul and develops as an ontologically distinct individual.

Ford and Donceel suggest that the zygote develops epigenetically from nutritive to sensitive life, and finally to intellectual life. The nutritive nature is present at syngamy. This nature then gives way to a sensitive nature, which further controls growth and development. When the organism has developed to the point where it can support human life, God creates and infuses the intellectual soul

with its distinctive powers of intellect and will. This soul subsumes the nutritive and sensitive powers as now serving the more demanding needs of human life.

Monozygotic twinning can occur until the primitive streak is formed at about 14 days after fertilization. Before this time embryonic chromosomes remain sufficiently undifferentiated to be totipotent and to produce another individual if splitting of the early cells occurs. In this way, identical twins provide evidence that biological or genetic individuality is not identical with ontological individuality.

Differentiation and Delayed Hominization

Proponents of delayed hominization hold that God would not infuse a rational soul into materials unable to support a human life. The minimum requirement is differentiation, organization, and at least the primordium of a central nervous system. For Ford, the early formation of the primitive streak immediately after differentiation meets this requirement. Donceel requires, in addition, the formation of the cerebral cortex, which takes place at approximately eight weeks.

There is historical precedence for delayed hominization in the teachings of Thomas Aquinas, Augustine, and Alphonsus Liguori, among others.[28] Aquinas held that the organic materials prepared by the parents must reach a certain level of development through a succession of souls before God would infuse a human soul. It was believed that the semen remained with the embryo as a formative power until the body was sufficiently developed for God to provide the human soul as the principle of self-development.

The theory of immediate hominization came into vogue after the early microscopists of the eighteenth century such as Anton von Leeuwenhoek and James Cooke thought they saw fully formed miniature humans (*homunculi*) within the sperm. If such were present, then there already was an organized body waiting to be enlivened by God and nourished by the maternal womb.[29] But, it should be noted that current proponents of immediate hominization base their positions on Aquinas's requirement for an integral unity between body and soul and on the understanding of the generation of new life as substantial change.[30] They believe that if Thomas had access to the findings of modern science he would alter his position and would now support

immediate hominization.[31]

The Philosophical Principles of Thomas Aquinas

Two important Thomistic philosophical principles are identified by Heaney and are agreed upon by all of the philosophers we have mentioned. The first is that "the human intellectual soul is produced immediately by God and not through another agency since, as immaterial, it cannot come from a change in matter." It is also agreed that "the human soul is infused, that is, produced directly in a body as the body's natural perfection."[32] Donceel provides another Thomistic principle upon which all agree, namely, "the soul is substantial form of man." This means that the soul is the form of the body. It is nature as human, the rational principle of human life. Ironically, it is this very principle that calls into question Donceel's view that there is a delay in the infusion of the soul. However, Donceel points to yet another principle, namely, "a substantial form can exist only in matter capable of receiving it." A plant soul does not belong in a stone nor an animal soul in a plant. This must not be confounded with the animal soul's having the powers found in lower natures. "In the case of man's soul this means: the human soul can exist only in a highly organized body."[33] That is, one capable of human intellectual functions.

Given the scientific data of his day and the requirement of a body being highly organized to receive an intellectual soul it was reasonable for Thomas to hold a doctrine of delayed hominization. The question before us is whether or not there is now evidence from modern science that would encourage Thomas either to retain or to change his position. This sounds simple enough, but each side sees the principles of Thomas and modern embryology as supporting its own view.

Proponents of immediate hominization point to the controlling influence of chromosomal DNA, the continuity and organization of the conceptus, with its increasing complexity and self-determination and self-development through morula, blastula, implantation and differentiation to the formation of the primitive streak and finally the child, as evidence for the presence of the rational soul from conception onward. The controlling Thomistic principle is taken to be that the soul is the form of the body and that substantial change has already occurred with the first presence of new life.

Proponents of delayed hominization point to the totipotentiality of cells within the morula, the apparent positional control of cells during blastocyst formation, and the potential for twinning until differentiation with formation of the primitive streak. The controlling principle here is the requirement for the body to have reached a state of development commensurate with the kind of soul that informs it.

Embryonic DNA Activation

As an alternative to the positions that have been presented, and consistent with the purposes of this article, we need to now consider the scientific information presented by Ford that indicates another perspective. Ford describes that during early cell cleavage, between the 2- to 4-cell stage, the DNA of one of the daughter cells "switches on" first. Quoting Ford,

> It is well known that maternally derived messenger RNA in the cytoplasm of the ovum controls development of the zygote at least up to the two-cell stage, before which time the embryo's genes have not yet been expressed or its genome 'switched-on' genetically.[34]

Ford also writes,

> ...the embryonic genome is not switched on or activated in the human before the two-cell stage, and probably not before the four-cell stage, even though the embryonic genetic programme is established at the completion of fertilization...The human individual who is ontologically identical with the future adult could hardly be said to exist before the embryonic genome, including the paternal genes, is switched on. If the embryo's own genome is not activated or expressed, or it is suppressed, no human individual or offspring results.[35]

This identification of one cell that is first to be internally activated, "switched on", is interesting because in vitro studies of early cleavage have shown that the cell that "switches on" first contributes more to the inner cell mass of the blastula. Ford writes,

> It was found that cells divide asynchronously and that the progeny of the first blastomere to divide at the two-cell stage became more advanced and tended to contribute more than its proportionate

share to the formation of the ICM.[36]

Studies have also shown that the embryo body comes from the inner cell mass. After discussing embryological experiments on animals, Ford asserts,

> There is good reason to apply these conclusions to the human zygote and the early preimplanted human embryo. This is so because the fetus is finally derived from some cells that make up the ICM [inner cell mass].[37]

The remaining inner cell mass cells and the other cells that formed the blastocyst (trophoblasts) become the membranes and placenta that support the intrauterine life of the embryo.

If further research supports the current data that maternal RNA controls cleavage until the chromosomes of a zygote "switch on", and that this cell forms the inner cell mass, and that the fetal body comes from this inner cell mass, then, this "switch on" of DNA would be a clear indicator of hominization. It would unite the time of substantial change and the moment when God infuses the human soul. This switching on is at least 30 to 40 hours after the sperm first reaches the ovum and may be as long as 50 hours if the chromosome activation occurs at 4-cells. Chromosomal DNA in the zygote would be the primitive center of control. The maternal mRNA that informed the first cell divisions would have a role guiding development of the new organism parallel to the role Aquinas previously saw for the sperm. This early mRNA control allows for DNA stabilization before the reception of a human soul. This diminishes the problem of twinning.

R.G. Edwards reports that 32% of identical or monozygotic twins begin at the two-blastomere stage. At this time, the DNA of the zygote would not have been activated. However, according to Edwards, 68% of identical twinning occurs between three to eight days after fertilization.[38] This is clearly after the critical point of DNA activation. Heredity is one source of twinning. With heredity it can be said that the two souls were present from the activation of the DNA. Sutton holds that "The incidence of monozygotic twinning, the same in all human populations, is a mere 0.36% of live births [1:270], indicating that the tendency to twin is genetically determined and peculiar to a very small percentage of embryos."[39] Another source of twins, cited by Ford, is accidents to the inner cell mass, as when the

blastulocyst is hatching from the zona pellucida just before implantation. We become aware of very late accidents when twins share some or most of the same body as in Siamese twins. The generation of a new human after one of these accidents is small and can be accounted for if one were to argue that with an accident that ruptures the inner cell mass, God can choose to let the cells be reabsorbed, or He can choose to create a new soul. If this accounted for about 30 to 40 percent of the cases, and this is an extremely high figure, we would be indicating about one occurrence of twinning for every seven or eight hundred live births (0.35 of 1:270 = 771). This suggests that the force of the argument from twinning against early hominization will need reevaluation if one holds that substantial change and the infusion of the human soul occur at the moment the embryonic DNA switches on and established the internal control of new human life.[40]

Within this view of hominization at DNA activation, the new zygote is vegetative and under the power or information control of the maternal mRNA until it becomes animated. Initial animation is by the human intellectual soul. Thus, there is not a succession of souls in the way Thomas thought. There is, however, a delayed hominization with prolonged parental control, even though it falls to the ovum rather than the sperm. This control ceases when the new human becomes self-developing. This is consistent with the soul being the substantial form of the body. It enters into union with the matter of the body at the origin of new life (substantial change) when the new set of chromosomes is empowered. In this scenario the intellectual soul is initially expressed as nuclear control of self-development.

Substantial Change

This discussion will conclude with a brief look at substance and substantial change. We have previously said that a substance is a union of matter and form. Considered in another way, a natural body can be said to be composed of substance and accidents. The initial substance is formed from substantial form and primary matter. Accidents are of secondary or accidental form and secondary or accidental matter. Substance is what the new being is, horse, cat, or human. Substantial form and primary matter are united in substantial change to generate the new entity. Accidents are the nine categories of being identified by

Aristotle that vary with the individual and can be attributed to or predicated of substance. These are quantity, quality, relation, place, time, position, state, action, or affection.[41]

In "Nature and Medical Ethics", Wallace writes, "Thus the SF (substantial form) not only informs PM (primary matter) and makes of it a complete substance, but it also makes the substance be what it is, that is, it organizes and specifies it. Substantial form confers on protomatter a stable mode of being, so that the natural substance underlies its accidents in more than a transitory fashion."[42] Thus substantial form, the soul, makes complete, stabilizes, organizes, and specifies. The existence of accidents is dependent on the prior existence of substance. They are modifications of substance.

"Matter signed with quantity" was for Thomas the principle of individuation, the origination of a new individual. Within this understanding, substantial change is the reception of a form by primary matter through the mediation of quantity, which brings a new being into existence. Following quantity comes all the other accidents. The mediation of quantity or quantitative dispositions is actually the Thomistic basis for delayed hominization. As presented above, in this view, the incipient embryo does not have sufficient complexity or quantitative development to be the recipient of a rational nature; moreover, its lack of stability indicates that a stabilizing natural form is not yet present.[43] The notion of stabilization of the new human being by the reception of its substantial form brings us back to the original question, when does a new human life begin? We have considered three alternatives: stability at fertilization (conception) with no time elapsed, transition to stability with DNA activation at less than 50 hours, and transition to stability with primal streak formation (differentiation) at 14 days.

This article has considered reasons given in support of immediate hominization and reasons to accept delayed hominization, be that 50 hours or two weeks. Both positions claim Thomas and modern science as their source. It has argued for hominization at substantial change, the very first moment that there is a new individual with an internal principle of activity and rest. The integration of a philosophical understanding of nature and substantial change with the scientific results in Norman Ford's book, *When Did I Begin?* , delays hominization from conception to the activation of the DNA that

controls future development of the new human. One might also say it has advanced hominization from primal streak formation with the awareness that the newly formed and activated DNA evidences the presence of the immaterial intellectual soul.

References

1. Cambridge: Cambridge University Press, 1991.

2. Ford, p. 102 ff.

3. Ford, p. 113.

4. *Physics* 192b21-23.

5. *Metaphysics* VII.

6. Aristotle, *De Anima* II, 1, 412a18-23.

7. See "Nature as Animating: The Soul in the Human Sciences", *The Thomist,* 49, 4 (October, 1985), 612-648, or, more recently, *The Modeling of Nature: Philosophy of Science and Philosophy of Nature in Synthesis,* Washington, D.C., The Catholic University of America Press, 1996.

8. *From a Realist Point of View. Essays on the Philosophy of Science,* Washington, D.C.: University Press of America, 1979, p. 226.

9. 192b21-23. Translated by R.P. Hardie and R.K. Gaye, in *The Basic Works of Aristotle*, Richard McKeon, editor. New York: Random House, 1941.

10. Aristotle, *De Anima* II, 1, 412a`8-23, *Metaphysics* VII, 1041b6 and VIII, 1043a35; *Physics* II, 193a27-193b8. For Thomas Aquinas see the respective commentaries and *Summa Theologica* Q44 a 2 and Q46 a 1.

11. *Summa Theologicae* I, 90, 3 and 4.

12. Actually the phrase "moment of conception" is not clear. Conception includes fertilization and implantation because the word includes acceptance or reception of the conceptus. "The simple primitive insight expressed by *conception* is that of a female mammal holding on to the semen which in some mysterious way leads to the start of a new life and thereby enables her to bear offspring in her womb." (Ford, P. 8) However, most persons using the phrase today are using it as synonymous with fertilization. Fertilization is also not occurring in a momentary fashion. When the

head of the sperm touches the outer membranes of the ovum, the corona radiata, there is a potential that develops and prevents entry of other sperm into the zona pellucida. Over the next 20-24 hours the ovum forms another pronucleus with 23 chromosomes and finally the two sets of chromosomes line up and merge in syngamy. Thus, fertilization is a process requiring 20-24 hours. (Carlson, pp. 29-31, and Ford, pp. 102-1-8).

13. B.M. Carlson, *Human Embryology and Developmental Biology.* St. Louis: Mosby Year-Book, Inc. 1994, especially chapters 2, "Transport of Gametes and Fertilization", and 3, "Cleavage and Implantation."

14. For a summary of these teachings of Aristotle, see Ford, esp. pp. 25-42.

15. B. Ashley, "A Critique of the Theory of Delayed Hominization", in *An Ethical Evaluation of Fetal Experimentation: An Interdisciplinary Study,* edited by D.G. McCarthy and A.S. Moraczewski. St. Louis: Pope John XXIII Medical-Moral Research and Education Center, 1976, Appendix I, pp. 113-133, esp. p. 125.

16. W.E. May, "The Moral Status of the Embryo", *Linacre Quarterly*, 59:4 (November, 1992) pp. 76-83.

17. J.J. Lejeune, Testimony in the circuit court for Blount County, Tennessee, at Maryville, Equity Division, (Div I), 1989.

18. D.N. Irving, "Scientific and Philosophical Expertise: An Evaluation of the Arguments on 'Personhood' ", *Linacre Quarterly* 60:1 (February, 1993) pp. 18-46.

19. Irving, p. 26.

20. A. Sutton, "Ten Years After the Warnock Report: Is the Human Neo-Conceptus a Person?", *Linacre Quarterly* 62:2 (May 1995) pp. 63-74.

21. Sutton, p. 70

22. *Apologeticus* 9, 8, quoted in G.H. Williams, "Religious Residues and Presuppositions in the American Debate on Abortion," in *Theological Studies* 31:1 (March 1970) p. 25.

23. Ford, p. 110.

24. Ford, pp. xv.

25. This is the main thesis of Ford's book *When Did I Begin?* but it is the focus of pp. 91-101.

26. "Nature and Human Nature as the Norm in Medical Ethics" in *Catholic Perspectives on Medical Morals*, edited by E.D. Pellegrino, J.P. Langan, and J.C. Harvey. Dordrecht: Kluwer Academic Publishers, 1989, pp. 23-53; and "Aquinas's Legacy on Individuation, Cogitation, and Hominization", in *Thomas Aquinas and His Legacy*, editor D. Gallagher, Washington, D.C.: The Catholic University of America Press, 1994, pp. 173-193.

27. "Immediate Animation and Delayed Hominization", *Theological Studies* 31:1 (March 1970) pp. 76-105.

28. For a review of historical positions see George H. Williams, "Religious Residues and Presuppositions in the American Debate on Abortion", *Theological Studies* 31:1 (March 1970) pp. 10-75. A thorough review of Aquinas may be found in Stephen J. Heaney, "Aquinas and the Presence of the Human Rational Soul in the Early Embryo", *The Thomist* 56:1 (January, 1992) pp. 19-48; or see Wallace, "Aquinas's Legacy", p. 193, n.26. All of the authors we have referred to invoke the teaching of Thomas Aquinas.

29. Ford, p. 49; Williams, p. 47.

30. Heaney, p. 23 ff.

31. Ashley, 121-125; and Heaney. This is the main thesis of Heaney's article.

32. p. 20. These principles are based on Thomas Aquinas, *Summa Theologicae* I, 90, 3 and 4.

33. p. 79. Cf. Aquinas, *Summa Theologica* I, q. 118, a. 2, ad 2; *Summa Contra Gentiles* 2, 89.

34. Ford, p. 113

35. Ford, p. 118. These claims are supported by the following: C.R. Austin, 'The Egg' in *Germ Cells and Fertilization*, Book 1, *Reproduction in Mammals,* eds. C.R. Austin & R.V Short, Cambridge University Press, 1982, pp. 52-4; A. McLaren, 'The Embryo' in *Embryonic and Fetal Development,* Book 2, *Reproduction in Mammals*. pp. 12-4. The four-cell stage is suggested for the expression of the human embryonic genome by P. R. Braude, V.N. Bolton, and M.H. Johnson in 'The use of human pre-embryos for research', in *Human Embryo Research: Yes or No?*, the CIBA Foundation, London: Tavistock Publications, 1986, p. 68.

36. Ford, p. 147.

37. Ford, p. 145.

38. *Conception in the Human Female,* London: Academic Press, 1980, 931-3. Cited in Ford, p. 133. These figures are determined by whether or not the chorionic membranes are shared by the twins.

39. p. 67.

40. Further research and evaluation are required, but it is interesting that scientific data points to a 50% loss of early embryos before implantation is completed. Most of these are from genetic errors. See Shannon and Wolter, p. 618-9; Allen C. Enders, "Implantation (Embryology)", in *Encyclopedia of Human Biology*, Vol. 4. Editor-in-Chief R. Dulbecco. San Diego: Academic Press, Inc. 1991, p. 429-30; and A.J. Wilcox, C.R. Weinberg, J.F. O'Connor, D.D. Baird, J.P. Schlatterer, R.E. Canfield, E.G. Armstrong, and B.C. Nisula, "Incidence of Early Loss of Pregnancy", *The New England Journal of Medicine* 319:4 (July 1988) pp. 189-194.

41. Aristotle's *Categories,* 1a25-7. Translated by E.M. Edghill. In *The Basic Works of Aristotle,* R. McKeon, editor, New York: Random House, 1941.

42. "Nature and ...Medical Ethics", P. 29.

43. Aquinas: "Natural form...requires determinate quantity." *In physics,* n. 1067, BAST, 529. Aristotle: "Distinct forms require distinct matter." *Physics* 194b 8-10, Apostle tr. 29.