ARE HUMAN CELL LINES HUMAN?

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Abstract

Among the most novel and startling objects in the biological world discovered and developed by modern science is the phenomenon of human cell lines: living cells separated from living bodies and living and reproducing in laboratories over extended periods of time. This scientific status and utility of such cells is first reviewed, distinguishing cell cultures from cell strains and cell lines. Next, the ontological status of cell lines is reviewed in the tradition of *philosophia perennis*, and it is asserted that cell lines are neither formally human as extensions of human life or human parts, nor materially human in configuration; rather, they are new organisms animated by a vegetative soul, despite the biological continuity between a human being and a human cell line. Such cells can be conceptualized as having undergone substantial change from human part to individual vegetative life forms, or as virtually present in the human being with the potency like elements in a mixture to emerge from the composite and exist under highly specific and artificial conditions.

Keywords: Human cells lines, human

Introduction

Aristotle said that philosophical inquiry begins with wonder.[1] Neither doubt nor certitude can sustain the philosophical endeavor. Skepticism and rationalism cannot construct the edifice of a philosophical understanding of the world *as given*. "(A) sense of wonder and astonishment in the face of the vista presented by creation remains the foundation for all philosophical and theological enterprise."[2] The startling and strange specificity of the inanimate and animate world implies limitation and contingency: the world as finite and specific cannot account for itself. Yet inanimate and animate beings display order, which makes them accessible to

[1] Aristotle, *Metaphysics* (982^{b}12), in *The Complete Works of Aristotle*, Vol. 2, ed. J. Barnes (Princeton: Princeton University Press, 1984), 1554.
[2] Mark Armitage, "The Riddle of God and the Solutions of Man. Chesterton's Metaphysics of Wonder," *The Chesterton Review*, Vol. XXVII, No. 4 (November, 2001), 461.

the wondering human mind. Among the most novel and startling objects in the biological world discovered and developed by modern science is the phenomenon of human cell lines: living cells separated from living bodies and maintained alive and growing in laboratories over extended periods of time.

Human cells are used for many purposes, including research and the cultivation of vaccines. The cells constituting human cell lines have acquired the ability to endure and proliferate indefinitely, an ability referred to as immortalization. Some of these cells have been the subject of considerable controversy because they were derived from aborted human fetuses. Beyond the question of the moral illicitness of their use given their origin, there is an even more fundamental question as to their ontological status as living beings, in particular their relationship to the human soul. Are such cell lines some kind of extension of human life? As living beings, cells must have souls, but do they have human souls, or merely animal or vegetative souls? If the latter, do such cell lines constitute new life forms on the planet? Can new species be produced in the laboratory? Or do cell lines constitute a kind of virtual life within the organism? The following is an attempt to answer these questions while explicating the ontological status of human cell lines within the philosophical tradition of Aristotle and Aquinas, the tradition of *philosophia perennis*.

The Science

Before proceeding with a philosophical analysis, it is necessary to have a basic understanding of the science of human cell lines. Primary human *cell cultures* are cell populations derived from human tissue that have undergone no subcultivations.[3] Subcultivation occurs when cells growing and dividing in basic nutrients or growth media in a container are split into smaller portions and introduced into new containers and growth media.[4] *Cell strains* are cell populations that have the karyology, or the number and types of chromosomes, of the human tissue of origin and have a finite capacity to replicate.[5] They have been subcultivated more than once *in vitro*.[6] *Cell Lines* are cell populations that do not have the karyology of the human tissue of origin and grow *in vitro* by serial subcultivations for

[3] L. Hayflick, "History of Cell Substrates Used for Human Biologicals," *Symposium on Continuous Cell Lines as Substrates for Biologicals*, Develop. biol. Standard, Vol. 70 (1989), 12.
[4] Stephen S. Hall, *Merchants of Immortality* (Boston/New York: Houghton Mifflin, 2003), 23.
[5] L. Hayflick, "History of Cell Substrates," 12.
[6] L. Hayflick and P. S. Morehead, "The Serial Cultivation of Human Diploid Cell Strains," *Experimental Cell Research* 25 (December, 1961), 586.

indefinite periods of time.[7] Of note, cell strains do not produce tumors when inoculated into experimental animals, whereas cell lines may produce tumors.[8]

It has been known since the early 1960's that normal human cells display a finite proliferative lifespan *in vitro* culminating in senescence, whereas most common carcinomas contain cells that can proliferate indefinitely.[9] Cell senescence and immortalization are two alternative cellular proliferation phenotypes.[10] Previously, the finite cell doublings of normal cell populations *in vitro* was attributed to poor culture technique or the number of subcultivations, not to an innate characteristic of the cells which corresponds to the natural lifespan of the organism as a whole.[11] Cell lines share properties with cancer cells, exhibiting, regardless of whether the tissue of origin was normal or cancerous, the extraordinary capacity to multiply indefinitely *in vitro*. Such cell lines can be regarded as "oncogenesis *in vitro*."[12] In fact, replicative senescence as a preprogrammed limitation to cellular growth may be a suppressor mechanism against malignant transformation.[13] Alternatively, "in many experimental systems immortalization appears to be an obligatory prerequisite for tumorigenic transformation."[14]

The goal of biotechnology is to make immortalization of cell lines not synonymous with malignant transformation. The goal is "to provide continuous cell lines from specific cell lineages that are safe to use and with phenotypic properties relevant to their tissue of origin".[15] Unlike rodent cells, a major limitation on the exploitation of human differentiated cells for research and medicine is their limited *in vitro* lifespan, likely reflecting their greater genomic stability.[16] Human dermal fibroblasts, for example, form vigorous cell cultures which can be subcultivated once or twice per week,

[7] L. Hayflick, "History of Cell Substrates, 12.
[8] Ibid., 12-13.
[9] E. K. Parkinson, "Human Keratinocyte Immortalization: Genetic Basis and Role in Squamous Cell Carcinoma Development," in *Culture of Immortalized Cells*, eds. R. Ian Freshney & Mary G. Freshney (New York: Wiley-Liss, 1996), 2.
[10] Robert F. Newbold and Andrew P. Cuthbert, "Mapping Human Senescence Genes Using Interspecific Monochrome transfer," in Freshney & Freshney, 54.
[11] L. Hayflick, "The Limited *In Vitro* Lifetime of Human Diploid Cell Strains," *Experimental Cell Research* 37 (1965), 614, 628-29, 634.
[12] Ibid., 628-29.
[13] Robert F. Newbold and Andrew P. Cuthbert, "Mapping Human Senescence Genes," 54.
[14] Emma L. Duncan, et al., "Immortalization of Human Mesothelial Cells," in Freshney & Freshney, 240.
[15] R. Ian Freshney, "Preface,"in Freshney & Freshney,, xi.
[16] L. V. Mayne, et al., "Development of Immortal Human Fibroblast Cell Lines," in Freshney & Freshney , 78; K. Mace, et al., "Human Hepatocyte," in *Culture of Immortalized Cells*, in Freshney & Freshney , 162.

but decline in growth rate and degenerate after approximately 60 population doublings.[17]

Human cell lines are valuable for many reasons. It is possible to do research on genetically identical cells for repeatable experiments, instead of using primary cells from multiple donors. The propensity of cell lines to form malignant transformations renders them useful for understanding the mechanism of cancer. They are useful for studying other disease states and for the study of wound healing. They are also cellular systems for the commercial production of differential cell proteins useful in medicine, such as hormones and growth factors.[18] They are also useful for the study of viruses – which can only replicate in living cells – and for vaccine production.[19] One famous cell strain derived from fetal lung tissue, called WI-38, revolutionized the manufacture of vaccines and was responsible for all the rubella vaccine produced in the Western Hemisphere, a vaccine mandatory for school admission in the U.S.[20] WI-38 or similar strains produce many other virus vaccines, including polio, adenovirus, rubeola, and rabies.[21]

There are also disadvantages to cell lines. Adult human cells may be teeming with viruses and may contain a latent cancer virus; as karyologically abnormal by definition, such cell lines may produce tumors when inoculated into animals or people.[22] To lower these risks, pristine virus-free human fetal tissue has been used instead of contaminated monkey cells. Yet cell strains like WI-38 will eventually die. Furthermore, WI-38 and other cells strains have been derived from aborted human beings, which has been a fundamental ethical issue regarding their production and use. This was reflected in the controversy surrounding President Bush's decision to not allow government funding for the development of new stem cell strains, while allowing the use of existing strains.[23] It should be noted that human embryonic cells are considerably prone to malignant transformation, as they represent a state of development which is dynamic and genetically unstable. Unlike embryonic stem cell research, adult stem cell research, using cells from adult tissues or umbilical cords, has led to the successful treatment of

[17] L. V. Mayne, et al., "Development of Immortal Human Fibroblast Cell Lines," 78.
[18] Robert F. Newbold and Andrew P. Cuthbert, "Mapping Human Senescence," 54.
[19] Stephen S. Hall, *Merchants of Immortality*, 21, 24.
[20] Ibid., 24, 30-31, 33.
[21] L. Hayflick, "History of Cell Substrates," 22
[22] Ibid., 24.
[23] Stephen S. Hall, *Merchants of Immortality*, 22-23, 297.

more than 70 kinds of cancer and autoimmune disorders; such cells are part of the adult body's natural repair mechanism.[24]

The development of an immortalized phenotype, or actual cell lines versus cell strains, requires a number of genetic changes. "In general, normal rodent cells in culture readily generate immortal variants, unlike their human counterparts, which are completely resistant to spontaneous immortalization and can be induced only to generate immortal variants (by carcinogens or DNA tumor virus early genes) with great difficulty.[25] The most common and successful method for deriving immortal human fibroblasts is through the expression of Simian virus 40 (SV-40) t-antigen.[26] Yet this *in vitro* gene insertion means that every cell line produced has the oncogene integrated into different sites in the genome, which means that so-called identical cell lines can express different levels of oncogene product and different behaviors.[27]

The effect of SV-40 T-antigen expression extends *in vitro* lifespan, although it does not directly prevent cell senescence. At the end of this extended lifespan, the cells enter a degenerative phase known as "crisis." SV-40 T antigen also destabilizes the genome, affecting chromosome stability and ploidy (the number of sets of chromosomes), which may favor *secondary* genetic changes relieving restrictions on imposed lifespan.[28] Rarely, foci of dividing cells may appear at a frequency of 10^{-5} to 10^{-9}.[29] These cells may or may not have undergone crisis themselves, but appear to have accumulated enough genetic changes to permit immortal growth: they have emerged from crisis.[30]

There are advantages and disadvantages to such genetic manipulation for the production of cell lines. Advantages include avoiding the cytotoxic effects of carcinogens. Also, virus-transformed cells express many of the phenotypic or differential properties of the untransformed host, which makes them valuable as cell lines, providing large quantities of *in vitro* biomaterial for the study of normal functioning and disease.[31] Disadvantages include the

[24] Tadeusz Pacholczyk, "The Ten Great Myths in the Debate Over Stem Cell Research," http://www.crossroadsinitiative.com/library_article/964/Ten_Great_Myths_in_the_Debate_Over_Stem_Cell_Research.html (accessed June 21, 2012); Steve Weatherbe. 2012. Fetal Stem Cells Treat More Diseases? *National Catholic Register*. June 17-30.
[25] Robert F. Nebold and Andrew P. Cuthbert, "Mapping Human Senescence," 55.
[26] L. V. Mayne, et al., "Development of Immortal Human Fibroblast Cell Lines," 78.
[27] M. Nobel and Susan C. Barnett, "Production and Growth of Conditionally Immortal Primary Glial Cell Cultures and Cell Lines," in Freshney & Freshney, 339.
[28] L. V. Mayne et al., "Development of Immortal Human Fibroblast Cell Lines," 78-79.
[29] Emma L. Duncan et al., "Immortalization of Human Mesothelial Cells," 241.
[30] L. V. Mayne et al., "Development of Human Fibroblast Cell Lines," 90-92.
[31] Mark L. Sternberg, "Immortalization of Human Epidermal Karatinocytes by SV 40," in Freshney & Freshney , 96.

difficulty targeting rare cells and difficulty promoting cell division and the ongoing functioning of the immortalizing gene. There is also the need to grow such cells extensively *in vitro* before there are enough for experimental or commercial use.[32] "Unfortunately most successful immortalizing genes (particularly SV 40 T) have pleiotropic actions and may perturb the growth and differentiation states of the cell to such an extent that it ceases to be a valid representation of the normal."[33] An immortalizing gene by definition prevents cells from terminally differentiating and "can also alter the response of cells to exogenous signals, such as mitogens or regulators of differentiation."[34] In general, increased proliferative potential occurs at the price of increased karyotypic changes. Accordingly, to varying degrees, *in vitro* cell lines become unlike *in vivo* human cells.

Human Soul?

Human cell lines are alive, therefore they have souls. According to Aristotle, the soul is the cause or source of the living body: "It is the source of movement, it is the end, it is the essence of the whole living body."[35] According to Aquinas, the human soul is the principle of human life and all human acts.[36] As living beings derived from, but living apart from, a human being, the existence of cell lines begs the question as to their relationship to the human soul, the principle of life in the being of their origin. Are human cell lines an extension of human life? Another way of stating the question philosophically is to ask whether or not the change from cells living in a human being to cells living in a container of growth medium represents substantial change, or merely a change in quality or location.

According to Aristotle, there are six kinds of change: generation, destruction, increase, diminution, alteration, and change of place, which can be reduced to change in substance, quantity, quality and place.[37] Material being is changeable being (*ens mobile*). Change is the act of that existing in potentiality.[38] A material being is a composite being comprised of a purely potential or determinable principle (prime matter), by which it is individuated and capable of change, and a determining principle (form) by

[32] M. Noble and Susan C. Barnett, "Production and Growth," 339.
[33] David Wynford-Thomas, "Thyroid Epithelium," in Frehsney & Freshney, 197.
[34] M. Nobel and Susan C. Barnett, "Production and Growth," 336.
[35] Aristotle, *De anima* ($415^{b}10$) in Vol. 1, Barnes, 661.
[36] Thomas Aquinas, *Summa Theologiae*, trans. by Fathers of the English Dominican Province (1911; repr. Westminster, MD: Christian Classics, 1981), Ia, q. 75, a. 1; Ia, q. 76, a. 4, ad. 1.
[37] Aristotle, *Categoria* ($15^{a}14$) in Barnes, 23.
[38] Thomas Aquinas, *De Trinitate* (V, 4, response) in *The Trinity and the Unicity of the Intellect*, trans. Sr. Rose Emanuella Brennan, S.H.N (St. Louis: Herder, 1946), 163.

which it is actual and remains what it is.[39] To change, something must both 'be' and 'become;' that is, something must obviously change, yet something must also stay the same, or it would not be the same being undergoing change. Accordingly, a changeable being is a being in potency. Change is the actualization of the potency of an actual, composite material being. Pure potency cannot exist in itself, whereas pure act, namely God, cannot not exist and is utterly unchangeable. A material being can undergo both accidental change in quality or size and the more fundamental substantial change for which prime matter is the substrate.[40]

Wherever there is life, there the soul must be present.[41] The cell is the biological unit of life; therefore the soul must be present in every cell of the body. The body is composed of cells, so the soul must be present throughout the entire body.[42] Yet the soul as the substantial form of the body has no parts. The soul in man possesses the simple, indivisible immaterial quality of its highest operations, namely intellect and will, which must in turn correspond to the immaterial quality of their objects, namely universal class-essences.[43] Substantial form and prime matter are *ultimate, immeasurable* co-principles of a material being, irreducible to anything else, not existing without the other, and constitutive of one material substance.[44] They are concreated with the composite, that is, they follow immediately upon the creation of the composite.[45] Yet the human soul is spiritual and so must come from outside matter; accordingly, it can survive the death of the composite. The human brain may be necessary for intellection in the composite creature which is man, but it is insufficient to account for intellection, which is a spiritual act. The human soul as a special type of substantial form is described by Aquinas:

A form which has an activity thanks to one of its powers or faculties in which its matter does not participate has existence of itself. It does not exist simply because its composite does, as in the case with other forms, but rather the composite exists thanks to it. Therefore, the composite being destroyed, a form which exists thanks to the existence of the

[39] *New Catholic Encyclopedia*, s.v. "Knowledge, Theories of – Greek Origins of the Problem."
[40] Celstine N. Bittle, *From Aether to Cosmos: Cosmology* (Milwaukee: Bruce Publishing, 1941), 243, 289.
[41] Ibid., 515.
[42] Celestine N. Bittle, *From Aether to Cosmos: Cosmology* (Milwaukee: Bruce Publishing, 1941), 516.
[43] Mortimer J. Adler, "Universal and Particular," in *The Great Ideas* (New York: MacMillan Publishing, 1952), 887.
[44] J. F. Donceel, *Philosophical Psychology* (New York: Sheed & Ward, 1955), 36.
[45] Thomas Aquinas, *SummaTheologiae*, Ia, q. 44, a. 2, ad. 3; Augistine Regan, "The Human Conceptus and Personhood," *Studia Moralia* 30.1 (1992): 116.

composite is destroyed, whereas a form through whose existence the composite exists, not vice versa, need not be destroyed when the composite is destroyed.[46]

That the human soul could endure in cell lines, thereby precluding substantial change, is not inconceivable given the nature of the presence of the soul in the composite. This mysterious presence is called *definitive presence*, and is distinguished from the *circumscriptive presence* of bodies, in which the whole is in the whole and the proportionate part in every proportionate part, and *omnipresence*, reserved to God, in which there is no being to which He is not present.[47] The human soul's definitive presence in the composite ensouled body is a non-quantitative presence: it is a presence of a simple, unextended substantial co-principle in place, in which it is entire in each part and entire in the whole. This type of presence cannot be imagined, but it can be conceived. It is present in discontinuous parts of the composite without sacrificing its indivisibility; it can also exercise some but not all of its powers in a given part.[48] Plant and animal souls are actually undivided but indirectly divisible and potentially multiple. Subject to certain conditions, plant bodies can be divided and each animated part can function as a whole plant without a need for assuming the generation of a new soul. Plants with grafts, on the other hand, have two souls. Some animals, such as the hydra, can be divided with each developing into a complete individual. Such souls appear to be indivisible *per se*, but divisible *per accidens*. Unlike the human soul, plant and animal souls are completely immersed in matter and intrinsically dependent upon matter: they are essentially material souls.[49] Plant and animal souls exist by means of the composite, whereas the human soul *makes* the composite – including the body.[50]

The human soul's entire definitive presence in each cell makes it at least conceivable that its presence continues in living cells separated from the body. Because it is not possible to observe or measure the soul, evidence for its presence or absence is indirect and inferential, based upon what can be observed with regard to the material composite being. If the human soul persists in separated cell lines, such cells would not have undergone substantial change, would not represent new individual human beings, since the human soul is indivisible, and would be formally the same as the human

[46] Thomas Aquinas, *De Unitate Intellectus*, par. 38, http://josephkenny.joyeurs.com/CDtexts/DeUnitateIntellectus.htm (accessed June 21, 2012).
[47] *Catholic Encyclopedia*, s.v. "Bilocation."
[48] Celestine N. Bittle, *The Whole Man: Psychology* (Milwaukee: Bruce Publishing, 1945), 516-17.
[49] Ibid., 490; 492-93.
[50] Ibid., 493; Augustine Regan, "The Human Conceptus," 122.

being from which they were separated and derived. This would constitute a kind of 'biological bilocation.'

Two empiric observations support the possibility of the ongoing presence of the human soul in human cell lines. First, there is a seamless continuity of life from the human being to the derivative cells. Usually in nature, living organisms that undergo instantaneous substantial change corrupt or die; they do not immediately evolve into a specifically different kind of living being. Secondly, defective or damaged human bodies do not preclude the presence of the human soul. Human beings who never develop higher cognitive operations, as with the retarded, are still considered to be human beings. People who have had strokes are still human. In other words, the fact that certain human bodies either do not develop, or develop and then lose the neuronal foundation for rational operations, does not mean that the rational soul is absent and a human being has undergone substantial change to a non-rational animal being. A defective body is not a different body. The rational soul is simply not able to actualize the higher intellectual operations, but the potency for such operations remains. As explained by Aquinas, "understanding is said to be the act of the composite, not essentially but accidentally, insofar as its object, the phantasm, is in a bodily organ and not because this activity is exercised through a bodily organ.[51] Cell lines could be a kind of defective human body still animated by the rational soul.

The argument against the enduring presence of the human soul in cell lines is stronger and more persuasive than the one in its favor, and is also consistent with common sense. If the human being who is the source of the cells constituting the cell line is dead, the presence of that soul in the derivative cell lines would mean that, on the contrary, he is not dead, which would constitute a violation of the principle of noncontradiction. The Catholic Church, for example, allows organ donation in the case of true brain death. The organ(s) transplanted must be alive, even though the donor is dead. The donor is not still alive through the transplanted organ. For a man to die, the rational soul must separate from the body, resulting in the substantial change of the human body to an entirely different substance: a corpse. What is true for organs should also be true for tissues and cells; namely, that their ongoing animation when separated from a dead body does not constitute an extension of human life in a kind of constricted body. If the cells in human cell lines do not possess a human rational soul, they cannot reasonably be called human beings.

If the cells in human cell lines are not complete human beings, are they still human parts? Certainly cells in the living human body are parts of the body. Cells separated from the living body and growing artificially in

[51] Thomas Aquinas, *De Unitate Intellectus*, par. 40.

culture are still alive and still materially or accidentally human, otherwise they would not be sought after for research or therapeutics. They still possess the same DNA and differentiated structure of their tissue of origin. They are not defective bodies *as cells*. Yet they do not possess the capacity *essentially* and *per se* to grow and develop as human beings (cloning would represent a capacity *per accidens*); their body is not apt for rational ensoulment. Furthermore, they are no longer functioning as parts, both serving the body and directed by it. Accordingly, Aristotle encourages the natural scientist to be informed about the soul, "seeing at any rate that when the soul departs, what is left is no longer an animal, and that none of the parts remain what they were before, excepting in mere configuration, like the animals that in the fable are turned to stone."[52] Liver or skin cells living for years in a culture medium have become entities *per se*, not *in alio*. No longer living parts, they are living wholes. As they are no longer formally human parts, they cannot be animated by a human soul. As an integrated organism, each cell must have its *own* soul, as the soul is for the organism, not the part.[53] Accordingly, living human cells can exist in different states, displaying different formal organizations and thus different natures. Living beings with different natures have different kinds of souls, generically and/or specifically. Cells in the living human body are parts animated by the rational soul; they are true human parts.

Differentiated cells in the developed human being may be contrasted with cells in the very early human embryo. Totipotent stem cells are also living human cells. Like other cells in the human body, they are parts animated by the human rational soul and therefore true parts of an individual human being. However, unlike differentiated human cells, totipotent stem cells have the intrinsic capacity under certain circumstances to become new individuals of the human species. Twinning is essentially natural cloning and involves these early cells. A twin is animated by his own rational soul, or he would not be a distinct and unified individual. Accordingly, certain "cells separated from one life system are still toti- or pluri-potential, and thus have a natural exigency to grow and develop in another life system, thus animated by a new soul or life principle."[54] It should be noted that this is not the same as the potential divisibility of material souls in plants and certain animals; rather, a *new* soul is present with twinning. Furthermore, as a new *rational* soul with a power independent of matter, it does not come into existence by means of the existence of the new composite individual; rather, the new composite individual exists through the new subsistent rational soul.

[52] Aristotle, *De Partibus Animalium* (641[a]19), in Vol. 1, Barnes, 997.
[53] Celestine N. Bittle, *The Whole Man*, 493.
[54] Augustine Regan, "The Human Conceptus," 124.

Therefore, the existence of the new rational soul must be from a source other than the new living body. As life comes from life, and the effect must be commensurate with the cause, the source of the new rational soul must be from a living spiritual being, "ever solicitous for the work of His hands."[55]

The cells constituting human cell cultures and strains are also living cells with human cell configuration. Unlike other cells in the human body, they are no longer parts of the body. Unlike totipotent stem cells, they do not have the intrinsic capacity to grow and develop as new individual human beings animated by a new rational soul or life principle. They are living, individual, whole organisms not animated by a human soul and therefore not formally human. Accordingly, they must be new individuals of a new *species*.

What is true for living cells separated from the human body must be true for living tissues and organs so separated. In transplant medicine, a living liver or heart is separated from a presumptively dead human body (living liver donation is an exception). Unlike cell strains and lines, such organs have a very limited capacity to survive outside a living human body. Unlike cell strains and lines, they cannot reproduce. Until the organ is attached to the body of the recipient, becoming a part again animated by the soul of that person, it is a living individual not animated by a human soul and, apparently, a new kind of animate being. The same would seem to be the case for those parts of the human body which grow for awhile after death.

Vegetative Soul?

If the living cells constituting human cell cultures and strains are not formally human, but only accidentally so, or with respect to configuration, what about the cells constituting cell lines? Recall that cell lines share properties with cancer cells and that the price of immortalization may by malignant transformation. The genetic changes necessary for a human cell line *in vitro* make the cells to a greater or lesser extent unlike human cells *in vivo*. Accordingly, human cell lines may not even be human in configuration. The more genetic changes there are, the greater the material discontinuity with normal human cells. In Scholastic thinking, whether mediated directly or indirectly, material properties can be "so remodeled or redisposed that they are no longer apt to inhere in their previous substance or substances but call for a new ontological basis, and so induce a new substantial form which reindividualizes the prime matter and individualizes itself in the process."[56] A type of substantial change necessary for human

[55] Ibid.
[56] Augustine Regan, "The Human Conceptus," 115.

life is the digestion and assimilation of dead biological material from different species as food. A type of substantial change which could be destructive to human life is the tumorgenic potential of cells from cell lines inoculated into human beings. Although there is a certain biological continuity between a human being and a human cell line, it is not the continuity of individual human life, or of a human part, or even of the same biological material configuration.

As previously noted, the cells of cell strains and lines are no longer living parts but living wholes. The new life of cell lines is characterized by nutrition, growth, and reproduction, not sensation or locomotion. Generically, such organisms are vegetative; accordingly, such cells must have material vegetative souls. The biological continuity between a human being and cell lines covers an underlying substantial change and the induction of a new substantial form or soul individualizing prime matter, resulting not just in a new individual, but in a new biologic composite being. There has been a substantial change of a remarkable kind resulting in a new individual substance of a different species.

Virtual Life

Are there philosophical obstacles to biological substantial change from higher to lower being, from spiritual to material soul, as with cell strains? In the production of cell strains or lines, a living *part* becomes a whole. It is not problematic that a spiritual soul be suddenly replaced by a material soul, which does have a certain proximate affinity to the living human body. The reason has to do with the hierarchy of forms in which the lower forms are virtually contained in the higher, not higher forms in lower ones. The rational soul has the powers of vegetative and sentient souls.[57] According to Aquinas, "there is nothing absurd about the effect of a higher agent having the power that the effect of a lower agent has, even more so. Hence the intellective soul, although it is from an external agent, nonetheless has the powers had by the vegetative and sensitive souls which are produced by inferior agents."[58]

In the hierarchy of forms, the inferior form completely sacrifices or sublimates its substantiality for the sake of the higher form. Yet the inferior form retains a type of presence. According to Aristotle, constituents in compounds "neither *persist* actually, as body and white persist; nor are they *destroyed* (either one of them or both), for their potentiality is preserved."[59] The lower forms are virtually present in the higher composite, but not

[57] Celestine N. Bittle, *The Whole Man*, 499-500.
[58] Thomas Aquinas, *De Unitate Intellectus*, par. 49.
[59] Aristotle, *De Generatione et Corruptione* (327^b 29-31), in Vol. 1, Barnes, 536.

actually so. As there can be no medium between substance and accident according to Aquinas, this virtual presence must be a kind of accidental presence in which "the proper qualities of the elements remain, though modified; and in them is the power of the elementary forms."[60]

Like elements in a mixture, cells have the ability to 'come out' of the body into their own substantiality in specific or finite ways. Unlike the virtual presence of elements in a mixture, cells in the human body are derived from one original cell, which replicates into other cells that also replicate while differentiating into specialized cells, accounting for both the growth of the body and secondary organization into tissues and organs. The notion of virtual presence may be used analogously to convey that individual cells in a human being are not formally present as a perfection or substance, just as the substantiality of individual atoms are subsumed in the molecule or compound, yet still have a potential to come out of the whole as wholes and to have a kind of preserved power or presence in the whole. Ancient and modern materialism tends to view atoms as the actual substances and configurations thereof as accidental.

Conclusion

Among the most novel and startling objects in the biological world discovered and developed by modern science is the phenomenon of human cell lines, cells which have acquired the ability to endure and proliferate indefinitely. It has been the contention of this philosophical inquiry into the ontological status of cell lines in the tradition of *philosophia perennis* that such cells are not formally human or an extension of human life, and so not animated by the human rational soul. Such cells appear to be the product of biological substantial change, the terminus of which are cells animated by a vegetative soul. A qualification to considering such cells as simply having undergone substantial change to new individuals of a new species is to consider at least human cell cultures and stains as having entered a new mode of being, from virtual individual biological life in the spiritually ensouled human body to actual individual life as separated cells. Such cells are occasions for wonder in the face of the world as given, such wonder being the start and sustenance of the philosophical endeavor.

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[60] Thomas Aquinas, *Summa Theologiae* Ia, q. 76, a. 4, ad. 4. See also Thomas Aquinas, *Summa contra Gentiles*, II, ch. 56, 4.

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