To the Graduate Council:

I am submitting herewith a dissertation written by Carolyn Teresa Szetela entitled "Organisms and Identities: The Essentiality of Genetic Constitution at Origin." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Philosophy.

Glenn G. Graber, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor and
Dean of the Graduate School

ORGANISMS AND IDENTITIES:

THE ESSENTIALITY OF GENETIC CONSTITUTION AT ORIGIN

A Dissertation
Presented for the
Doctor of Philosophy
Degree
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Carolyn Teresa Szetela
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For my parents,

Therese Cecile Martel Szetela and Walter Frank Szetela

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ABSTRACT

The expanding scope of modern genetic theories and technologies have fueled controversies regarding the reducibility of organisms to their genetic properties. This work considers the defensibility of the view that an organism's identity is determined by the identity of its genetic constitution at origin, in an effort to add to the theoretical framework in which these controversies may be understood. I begin the study of identity conditions for individual organisms by considering Saul Kripke's view that a given human organism (i.e., the Queen) necessarily originates from the actual parents who contribute her particular sperm and egg of origin. This view is contrasted with Elliot and Gallois' assertion that identity of the material constitution of an organism's zygote of origin is sufficient to preserve its identity. I argue against Kripke's same-parents criterion in favor of a view that genetic constitution of origin, involving both configurative (genotypic) and material (genomic) specifications, is necessary and sufficient to identify the organism as a unique and enduring instance of a natural kind through changes and possible worlds. In the genetic constitution of origin is a unifying and fluid structural continuity that is passed along from the zygote to cellular progeny as the organism develops, and that establishes the range of appropriate changes that the organism may endure in the various environments that are compatible with its persistent life. Other conditions that must be satisfied in order for the organism to exist, including its non-genetic conditions of its origin, may be counterfactually altered without loss of the organism's identity. The influence of genetic properties upon an organism's identity has practical relevance for evaluating the genetic engineering of life, gametic and somatic cell genetic therapies, and the desire to have biologically related children. The view offered here may also direct us toward a better understanding of the ethical dimensions of genetic relationships. Finally, this work illuminates the explanatory uniqueness of all levels of material and experiential influence throughout an organism's development.

CONTENTS

INTRODUCTION

Have you ever thought about the infinitesimally unlikely occurrence of conditions that brought you into existence? The existence of any organism is produced by a lengthy causal history of physical conditions that lead to the fission or fertilization event of its origin. But in spite of the precise *actual* conditions that lead to an organism's existence, we may consider whether any *alternative* conditions might also have produced the same organism, such as being created from different material particles or being created by a sperm or egg of different parents. In this spirit, this work aims to consider the necessary and sufficient conditions of an organism's identity; conditions that comprise each organism's individual essence. These conditions, I shall conclude, are exclusively its genetic configuration (genotype) and genetic material (genome) of origin, which I together refer to as *genetic constitution of origin*. Here I offer an overview of this study.

Chapter One contextualizes the question of the genetic essence of organisms within the broader framework of practical and theoretical controversies regarding the reducibility of organisms to their genetic properties. Current trends in scientific and popular thought reflect an increasingly reductionist regard of organisms as genetic beings, and this view manifests itself in efforts to control the properties of organisms by genetic interventions. Perhaps at the core of this reductive regard of organisms are promises that genetic interventions will be used medically to diagnose, treat, cure, and enhance organisms. A strong social response has arisen, in turn, claiming that genetic reductionism is false, and that much of genetic science proceeds in order to advance inexplicit scientific, technological, and social agendas that cause harm to our society.

However, many of the criticisms that are directed at practices that are said to involve or to imply genetic reductionism do not offer a theoretical basis of the objection.

I show that genetic reductionism takes many forms, including methodological reductionism which boasts no theoretical commitments, and metaphysical reductionisms that hold that genetic characteristics can suffice to explain the nature of the whole organism, such as by causal primacy. In an effort to clarify the theoretical content of genetic reductionism as a basis for a clearer view of the practical controversies, this work offers an evaluation of a specific form of reductive genetic explanation which holds that the essence of an organism is its genetic constitution. According to this view, an organism's identity is determined by the identity of its genetic constitution at origin, and the other conditions that must be satisfied in order for the organism to exist may be altered (provided that the alterations are compatible with life of the organism) without loss of the organism's identity.

Chapter Two offers a conceptual framework for evaluating the essentiality of the relationship between organisms and their genetic constitutions of origin. I begin with a discussion of the causal interdependence of genetic and non-genetic properties of organisms. The concept of causal genetic primacy is defeated by the interaction of genes with organismic and ecosystemic environments, as well as by the emergence of properties at successively greater integrations of organismic functioning, and by the randomness of physical processes that affect genetic constitutions, which are further reproduced in subsequent cells.

The rest of this chapter is devoted to \definitions and methodologies for our search for the essential properties of organisms. Although many of our examples appeal to the identity of human organisms and therefore may not apply directly to non-meiotically reproducing organisms, I aim to consider organismic identity broadly to include non-human organisms alike. In particular, criteria for the *personal identities* (in the philosophical sense) of those organisms characterized by consciousness are not sought by this study. I argue that organisms comprise a natural kind, and that among the properties that constitute their distinct membership in the *class* of organisms, we may find the specific properties of their *individual* identities. The identity-conditions of organisms must successfully *individuate* them: they must be broad enough to overlook no identical organisms, and specific enough to insure that no 'counterfeit' organisms are mistaken for identicals. The primary method for evaluating candidates for essential properties of organisms is to suggest specific alterations of a given organism's properties in a possible world, and then consider whether this alteration changes or preserves the given organism's identity.

In Chapter Three, I begin the search for identity conditions by considering Saul Kripke's view that a given human organism (i.e., Queen Elizabeth II of England) necessarily originates from the actual parents who contribute her particular sperm and egg of origin. In contrast to Kripke's view, Elliot and Gallois offer a counterexample to illustrate that identity of the material constitution of an organism's zygote of origin is sufficient to preserve its identity, even when the zygote is produced in alternative parents.

A "same-parents" identity criterion is also offered by Colin McGinn, who explains that parental identity is necessary for the identity of the offspring because it is a component of "d-continuity." By d-continuity, McGinn refers to continuity of the diachronic and developmental conditions that contribute to the organism's origin. (These may be better understood as continuities of time and place, and of development as governed by biological principles.) However, Husain Sarkar argues that McGinn's d-continuity criterion is insufficient, because identical d-continuities can counterfactually produce a genetically distinct organism; say, if an organism's gametes of origin are counterfactually irradiated to produce an offspring of opposite sex. In response to Sarkar, I suggest that McGinn's d-continuity criterion may be understood by a fuller concept that I call "biological place," which requires the appropriateness of the organism's biological development and the identity of its place in evolutionary history.

In Chapter Four, I change the focus to a constitutive identity criterion for measure against the biological place criterion. Beginning with Aristotle's theory of a unifying inner principle of change, I suggest that genetic configuration of origin (i.e., genotype) serves this essential role for organisms. In the original genotype is a unifying structural continuity transmitted to all cellular progeny as the organism develops, and that establishes the range of appropriate changes that the organism may endure in the various environments that are compatible with its persistent life. The genotype is *fluid* in the sense of determining a range of possible responses to environmental conditions, and *unifying* as an initiating cause of the enduring self-organization that directs the organism through appropriate changes. Other original configurative criteria, I suggest, are non-essential, such as the number of ribosomes within the cell, its turgor pressure, and the specific curves of the endoplasmic reticuli, etc. These configurations are in constant flux within the cell and are successively dispersed and removed by subsequent generations of cells; and, although some forms of these components are necessary for zygotic viability, their specific configurations do not affect the enduring nature of the organism.

Returning then to the biological place criterion, I argue that evolutionary history does not contribute essentially to the organism's identity. As the actual path that evolution takes is produced in part by random processes, and is contingent, it appears also that the path that leads to a given organism can be arrived at by alternative means. Furthermore, evolutionary relations (such as are imparted by origin in a given set of parents) do not inhere in the physical properties of the organism. A final shortcoming of the biological place criterion is its failure as an individuating property between organisms who share identical genotypes, such as identical twins. The properties to which a continuity-criterion must appeal for the individuation of twins are all properties that could be changed without loss of the organism's identity. As a criterion that requires identity of an organism's complete line of ancestors, biological place severely restricts the counterfactual possibilities that an organism can endure and has little to offer that is not accomplished by the genotypic criterion.

Yet the problem of individuation among genotypic identicals remains. This problem is solved by adding a criterion of material genetic (genomic) identity of origin. Twins are distinct because their genetic constitutions of origin at the time twinning are composed of nonidentical material. As an organism's material (genomic) and configurative (genotypic) compositions play distinct roles in constituting organismic identity, we see how one zygote of origin can be identical with two organisms in cases involving twinning. Twins share identical genetic constitutions of origin until the twinning event occurs, whereupon genomic (material) distinctness offers them a second, individuating origin.

I thus conclude that an organism's genetic constitution of origin can be conceived alone as the necessary and sufficient condition of its identity through change and possible worlds. This theory is good news for people who would hope that their imaginings to exist in counterfactual worlds in which they are created by different parents are metaphysically defensible.

Chapter Five discusses the implications of this theory upon conceptual and ethical possibilities. Most fundamentally, the theory that the essences of individual organisms are their genetic constitutions of origin offers a limited sense in which genetic reductionism is defensible. This work may accordingly help to clarify both practical and theoretical controversies about genetic reductionism. Two other implications are also discussed. Because the particles of original genetic constitution are essential, an organism would not exist in case its parent(s) consume different food particles that, through the same gametogenetic processes, constitute different particles in the zygote's otherwise identical genetic constitution. This seemingly insignificant change indeed alters the offspring's identity because, as is commonly accepted with regard to non-living objects, organisms identities also depend upon material identity; though in the case of organisms, this identity is required only at origin. Secondly, this view leaves open the problem of individuating between multiple instantiations of identical genetic constitutions of origin, as more than one organism may theoretically share constitutively identical origins. A given organism is identified by the biological continuity that characterizes its persistent life, but the identity-criteria identified on this view fail to individuate among multiple counterfactual organisms that share a genetic constitution of origin. While it may be the case that identity in these circumstances cannot be discerned except by stipulation, avenues for resolving this problem warrant further attention.

The theory offered in this work provides a foundation for evaluating the social applications of genetic knowledge. Knowing what constitutes the essence of an organism, the most fundamental ethical question is how this essence may contribute to the organism's moral value. With respect to specific issues, the implication that biological parenting allows the parents to participate in an act of conferring part of their own essences, via the partial transmission of their own genetic constitutions to their biological offspring, may help us to morally evaluate parents' desires to have biologically related children. This theory can also instruct us about whether gamete and somatic-cell genetic alterations change the organism's identity. Furthermore, this work offers a basis for evaluating the concept of moral partiality to close genetic relations, that must be seen in light of the continuum of genetic relatedness among humans and across species.

Although the theory proposed here is a form of genetic reductionism, it is consistent with the appropriateness of a regard of organisms that integrates the explanatory uniqueness of all levels of material and experiential influence.

CHAPTER ONE

The Problem of Genetic Reductionism:

Toward an Essentialist Investigation

> *Introducing DNA... It's the reason you have your father's eyes, your mother's smile and... bijan's perfume. From $42 to $250.*[1]

Section I: Genetic Reductionism as a Social Phenomenon

What is the relationship between an organism and the genetic constitution from which it originates? Most of us correctly learn that we would not exist without our genes. But it appears that we are also learning that we *are* our genes; ultimately *defined* at the moment our genetic make-up is specified during the 23 chromosomal tangos of human conception. In this last decade of the Twentieth Century, genetic science delivers possibilities that would have appeared almost ludicrous only years ago. Research to develop headless humans as organ banks; proposals to exhume and identify Unknown Soldiers and other persons whose confirmed identities are thought to be of public interest; the prospect of cloning humans either simultaneously or across generations, so that parents might bear children who are their genetic identicals–these possibilities seem to foretell a future of strange genetic control. Other potentials for genetic interventions have more ready appeal. We are promised that genetic sciences will allow us to

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[1] Advertisement for DNA perfume, 1991. (The advertisement notes that the perfume does not contain actual DNA.)

save endangered species, to trace the migratory paths of ancient civilizations, to predict, prevent, and cure common and rare illnesses, and to assure select desired characteristics in our offspring. Underlying this expansive potential of modern genetics are challenges to our concepts of individual identity and social management. Evelyn Shuster notes the formidable significance that modern genetics has for our personal and social understandings:

> The view that humans can ultimately be accounted for solely from their molecular structure has been the central fear, and a reason for society's mistrust of the new biology. This is because reducing humans to molecular components, and the body (once cultural) to biochemical reactions, changes the way we think about ourselves as unique individuals, lessens the value of life, and undermines the notions of individual worth, freedom, and responsibility.[2]

An exclusively genetic view of biological objects is presently emerging in scientific and social thought.

Characterizations of humans as essentially genetic beings are a familiar product of modern science. The public is frequently exposed to claims that genes determine our bodies, our social practices, and our thoughts. Evelyn Fox Keller suggests the influence of these genetic characterizations, "Today we are being told–and judging from media accounts, we are apparently coming to believe–that what makes us human is our genes."[3] We might say that society is coming to believe that a person is equivalent to his or her 3-billion-long chain of A's, C's, G's and T's.[4] Indeed, there is clearly an element of hyperbole in this characterization of ourselves

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[2] Evelyne Shuster, "Determinism and Reductionism: A Greater Threat Because of the Human Genome Project?" in George Annas and Sherman Elias, eds. *Gene Mapping: Using Law and Ethics as Guides* (New York: Oxford University Press, 1992). p. 116.

[3] Evelyn Fox Keller, "Nature, Nurture, and the Human Genome Project," in Daniel J. Kevles and Leroy Hood, eds. *The Code of Codes: Scientific and Social Issues in the Human Genome Project* (Cambridge, Mass.: Harvard University Press, 1992). p. 297.

[4] These letters represent the nucleotide building blocks of DNA (deoxyribonucleic acid): adenine, cytosine, guanine, and thymine.

and other organisms. Yet the emerging reductive model has a strong bearing upon social practices, including medicine, reproduction, public support for biological research, and general moral valuations. Our conception of genetic explanations has accordingly become subject to controversy.

I begin this project by illustrating the prevalence of a loosely defined genetic reductionism in our society. As I shall illustrate, this phenomenon takes place at many levels, which in turn reflect diverse philosophical commitments. I offer examples ranging from over-simplifications of the breadth of genetic explanations and the practice of reductive scientific methodologies, to deeply conceptual beliefs about the explanatory reducibility of higher-level biological processes, and even claims that nongenetic properties of organisms can be removed without loss of the organism itself. While reductive practices and views are diverse and typically occur outside of a recognized conceptual framework, I refer to genetic reductionism for general purposes as any practice or view which, defensibly or indefensibly, suggests that an organism's genome can completely represent the organism. This definition begs for refinement (offered in Section II), as genomes clearly cannot do all that organisms can; unless you have ever seen a genome, say, read a book as you are doing now. If a genetic characterization can replace a reference to an organism, then it can be justifiable only for some specific purpose(s). My aim is to consider whether in some sense genetic properties supply such complete explanatory force that an organism may be accurately represented by its genome alone. Against this measure, we can critique the legitimacy of reductionist claims about genetics and the consequences of such claims as they continue to arise.

Genetic Reductionism in the Biological Sciences

The belief that a genetic characterization is sufficient to describe an organism is well established in the biological sciences.[5] Many scientists view organisms as essentially genetic beings, whose embodied and environmental qualities are mere contingencies. Walter Gilbert notes, "the molecular biologist's view is that this organism is defined by its DNA."[6] Ernest Mayr reports a Nobel laureate in biochemistry as saying, "there is only one biology, and it is molecular biology."[7] If molecular biology can completely capture the entire organism, then the work of systems biologists is rendered redundant. Though few scientists view reductionism from a well-considered theoretical stance, their methodologies and dialogue imply that by understanding genetic mechanisms, all other levels of organismic functioning will be unraveled. Mayr notes,

> explanatory reductionism... claims that one cannot understand a whole until one has dissected it into its components, and again these components into theirs, down to the lowest hierarchical level of integration. In biological phenomena it would mean reducing the study of all phenomena to the molecular level, that is, "molecular biology is all of biology."[8]

The special attention paid to genes toward better understanding organisms is a part of a more general success of reductionist practices in Twentieth Century science. As recently as this century, explanations of life were dominated by vitalistic theories of animating forces, including ensoulment, and the theory of preformation, whereby it is thought that inside each human embryo

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[5] Of course, not all scientists, or even geneticists, are genetic reductionists.

[6] Walter Gilbert, "A Vision of the Grail," in Kevles and Hood, eds. (1992). p. 84.

[7] Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance* (Cambridge, Mass.: Harvard University Press, 1982). p. 65. Mayr does not note this person's name.

[8] *Ibid.*, p. 60.

dwells a tiny person whose development is implicit.[9] These beliefs are now replaced in science by the recognition that all natural objects, including organisms, act according to intelligible physical processes. Accordingly, the universal natural laws governing organismic processes are thought to be best discerned by studying their most fundamental parts. Stuart Newman notes,

> science has advanced in large part by its ability to "demystify" qualitative differences among objects. In particular, new theories have often demonstrated how distinct qualities can be understood as aspects of a uniform underlying process.[10]

In the life sciences, these "underlying processes" which are asserted to be responsible for organisms as wholes remain largely undiscovered. But success at the molecular level of explanation gives biologists confidence that complete genetic explanations may be achieved. To be sure, not all genetic studies and explanations should be regarded with disapprobation, nor does merely looking at parts commit the observer to the view that those specific parts may represent the whole in a philosophical sense. Yet scientists appear at least at times to hold that their investigations of genetic properties are sufficient to explain the nature and dynamics of the whole organism. And even when scientists explicitly reject such a view, their activities frequently suggest to the public that genes single-handedly explain life.

The senses in which scientists regard genetic explanations to substitute for the whole organism reflect how they conceive of the nature of the gene. Ernest Schrodinger suggests how genetic mechanisms may be thought to represent the whole organism in his influential 1945 book, *What Is Life?:*

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[9] See Richard Strohman, "Ancient Genomes, Wise Bodies, Unhealthy People: Limits of a Genetic Paradigm in Biology and Medicine," *Perspectives in Biology and Medicine*, vol. 37, no. 1, 1993. Mayr (*op. cit.*) notes that vitalism was a favorite explanation of life even in the present century, p. 66.

[10] Stuart A. Newman, "Idealist Biology," *Perspectives in Biology and Medicine*, vol. 31, no. 3, 1988. p. 354.

> the chromosome structures are instrumental in bringing about the development they foreshadow. They are the law-code and executive power–or to use another simile, they are the architect's plan and builder's craft in one.[11]

Genes are regarded as the "lowest hierarchical level of integration" of organisms, constituting the first level of organization which catalyzes the development of organisms in appropriate conditions. This power to generate life is twofold, involving the prescription of a viable collection of organismic characteristics (the architect's plan), and their role as replicators to cause life (the builder's craft). Below the level of genetic organization, random atoms and molecules cannot serve these specific functions; and above the level of genetic organization, nongenetic organismic structures (cellular organelles, organs, organismic networks) carry out specific tasks while lacking the mechanistic power to naturally prescribe or generate a complete life-form.[12] While we might add that the organism as a whole also fulfills these functions, the reductionist may respond that this status is conferred by its embodiment of its particular genetic composition.

Many fields of genetic science are premised upon or are complementary to reductive perspectives. Molecular genetics contributes to reductionism as it strives to explain the organism by revealing the mechanisms of genetic causation at all levels of organismic functioning. Sociobiology tells us that all animal behavior is ultimately determined by genetic influences, claiming that morphology, function, and behavior in all animal species are maximizing strategies

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[11] Ernest Schrondinger, *What is Life?* (Cambridge: Cambridge University Press, 1944). (Cited in Newman, *ibid.*, p. 360). This book inspired many early modern geneticists in the race to unlock the "secret of life."

[12] The cloning of a sheep from a mammary cell demonstrates that somatic cells also have life-generating potential. Again, the genetic complement can be conceived of as the life-conferring level of organization.

for the transmission of genes.[13] In contrast with these fields, developmental genetics approaches the organism with an integrative focus on the interactions between genes and among nongenetic levels of organization, neither of which is conceived as explanatorily primary in contributing to organismic processes. This branch of biology presses the point that genetic studies and explanations are necessarily incomplete representations of organisms, and in this respect it shares company with many other scientific perspectives and activities.

The field of sociobiology, originating with E.O. Wilson's 1975 popular textbook, *Sociobiology: The New Synthesis*, sometimes takes genetic reductionism to its determinist extreme, in "the systematic study of the biological basis of all social behavior."[14] Sociobiologist Richard Dawkins explains that the gene is "the fundamental unit of self-interest"[15] in determining all organismic functioning, including individual and social behavior. Dawkins explains,

> Genes are master programmers, and they are programming for their lives. They are judged according to the success of their programs in coping with all the hazards that life throws at their survival machines [the organisms in which they reside], and the judge is the ruthless judge of the court of survival.[16]

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[13] For example, the alleged human male tendency toward infidelity is said to be a genetically driven urge to proliferate one's genes with maximum success. Non-human behaviors are also characterized as gene maximizing, such as expressions of "altruism" in non-human species. A gazelle's stotting (leaping) behavior to warn its group when a predator is viewed puts the gazelle at increased risk, but is said to be an ultimately useful strategy to proliferate its genes. By protecting its family members who share its genes and can in turn transmit them, as well as by benefiting from the stotting behavior of other gazelles in the group, the gazelle group produces for each the greatest overall likelihood that its genes will be maximally replicated.

[14] E.O. Wilson, *Sociobiology: the New Synthesis* (Cambridge, Mass.: Harvard University Press, 1975). p. 4.

[15] Richard Dawkins. *The Selfish Gene*, New Edition (New York: Oxford University Press, 1989). p. 33.

[16] *Ibid.*, p. 62. Kim Sterelny and Philip Kitcher ("The Return of the Gene," *Journal of Philosophy* vol. LXXXV, no. 7, 1988), argue that Dawkins softens his stance about genetic

Richard Lewontin, a critic of sociobiology, explains genetic determinism, with respect to humans, as the view that "human lives and actions are inevitable consequences of the biochemical properties of the cells that make up the individual; and these characteristics are in turn uniquely determined by the constituents of the genes possessed by each individual."[17] While sociobiologists sometimes temper their reductionist claims by acknowledging human conscious abilities to choose behavior that does not maximize the transmission of genes, they are often unrelenting in their characterizations of behavior as genetically determined. Thus xenophobia, aggression, and indoctrinability among humans are to be expected,[18] and "we must even expect that children will deceive their parents, that husbands will cheat on wives, and that brother will lie to brother."[19] The behavioral methods of sociobiology are also reductionist. Dawkins says, for example, "I am not concerned with the psychology of motives."[20] While Dawkins does not deny the existence of subjective phenomena, these he views as subsumable under the survivalist goal encoded in the genome, so that only the material processes which ultimately contribute to genetic replication are of interest. Consciousness is a special product of natural selection that acts as an optimal tool of organismic survival, which is yet capable of superceding its genetic basis.

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causation in his later book, *The Extended Phenotype*. His latter view, they claim, often accommodates "alternative, equally adequate representations of selection processes," whereby the units of genetic causation include genetic mechanisms other than individual genes.

[17] Richard Lewontin, Steven Rose, and Leon J. Kamin, *Not in our Genes: Biology, Ideology, and Human Nature* (New York: Pantheon Books, 1984). p. 6

[18] E.O. Wilson (1975).

[19] Richard Dawkins (1989), p. 65.

[20] *Ibid.*, p. 4.

> Human survival machines (are) executive decision-takers from their ultimate masters, the genes.... They even have the power to rebel against the dictates of genes, for instance in refusing to have as many children as they are able to.[21]

Even the conscious rebellion against one's 'genetic destiny' must be viewed as merely an anomalous by-product of one's genetic empowerment, where the genetic mechanism for replication is undermined by the complete genetic package, which enables humans to make choices that generally aid in the organism's survival but which can also be used to undermine reproduction.

As a theory of animal, including human, behavior, sociobiology presents some of the most disturbing and controversial facets of genetic reductionism. Although the reduction and determinism appear to be closely allied, genetic reductionists who are not sociobiologists may try to dissociate themselves from determinism by limiting their views to defined parameters. Though sociobiology attempts to explain human behavior without seeking to justify it, it may be seen to confer legitimacy upon predominantly harmful behaviors as "natural." For instance, a *TIME Magazine* cover story entitled "Infidelity: It may be in our genes," offers natural selection as the explanation for male infidelity in humans, as well as for the murder of stepchildren by stepfathers.[22] Indeed, sociobiologists hold that the surprising frequency of such reproachable behaviors *supports* the truth of the genetic 'force', which acts to replicate itself in progeny to the disregard of non-kin. Wilson offers:

> Human behavior–like the deepest capacities for emotional response which drive and guide it–is the circuitous technique by which human genetic material has

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[21] *Ibid.*, p. 58-59.

[22] Robert Wright, "Our Cheating Hearts," *Time*, August 15, 1994. This issue is discussed in Chapter Two, Section I.

> been and will be kept intact. Morality has no other demonstrable ultimate function.[23]

The breadth which genetic reductionism may claim as its domain reveals some curious and profound suggestions for science. Robert Sinsheimer suggests that genetics can replace the imprecise revelations of astrology: "(we now) seek not in the stars but in our genes for the herald of our fate."[24] Some reductionist views appear to equate an organism, not with the embodied organism as a consequent of its genes or with the actual genome, but merely with its representative genetic *code*. Walter Gilbert predicts a future in which "one will be able to pull a CD (of one's own genetic code) out of one's pocket and say, 'Here is a human being; it's me!'"[25] And Robert Shapiro proposes that by preserving our genetic code for future generations to regenerate, we may achieve immortality:

> Shall each of us have a chance to preserve for the future a record of our total biological identity and life history with the expectation that we, or at least the plan that gave rise to us, will someday be recalled?[26]

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[23] Edward O. Wilson, *On Human Nature*, (Cambridge, Mass.: Harvard University Press, 1978). (Cited in Charles Taylor, *Sources of the Self: The Making of the Modern Identity* (Cambridge, Mass.: Harvard University Press, 1989).

[24] Robert Sinsheimer, "The Prospect of Designed Genetic Change," *Engineering and Science* vol. 32, 1969. (Cited in Alexander Morgan Capron, "Which Ills to Bear?: Reevaluating the "Threat" of Modern Genetics," *Emory Law Journal* vol. 39, 1990. p. 57.)

[25] Walter Gilbert (1992), p. 96.

[26] Robert Shapiro, *The Human Blueprint: The Race to Unlock the Secrets of Our Genetic Code*, (Bantam Books, 1991). p. 355. The founder of Clonaid echoes Shapiro's view in marketing its cloning services on the Internet: "cloning will enable mankind to reach eternal life." (Gina Kolata, "Physicist in Spotlight With Plan for a Clinic to Clone Humans," *New York Times*, January 8, 1998, p. A12.)

Reductionist thinking in genetics is, furthermore, often accompanied by the view that living beings are best measured genetically. Shapiro suggests the management of human limitations by genetic manipulation with a poetic flourish:

> As a species, some of us will choose to say, Thank you, Mother Evolution, for having brought us thus far. We now have the plans and will take responsibility on our own for the maintenance, improvement, and redesign (if we wish) of the bodies that you were so kind as to provide us with.[27]

Here human potential is portrayed as strictly genetic in nature, evoking the seemingly unfettered social implications of reductionist thinking in genetics.

The Human Genome Project

The Human Genome Project (HGP) is a centerpiece in reductionist genetics, and is a main force behind its portrayal to the public. The project is a remarkable success story of the power of scientists to acquire the endorsement of public institutions, originating in proprietary controversies about which scientific organizations (and potentially competing nations) would take credit for an obvious, albeit momentous, research program merely awaiting humanpower and resources for its undertaking. The origins of this dispute in the United States are with the Department of Energy (DOE), which sought a human "genetic blueprint" to evaluate the mutagenic effects of radiation, as used in national defense and defense research; and the National Institutes of Health (NIH), which claimed jurisdiction over biological research of broad human interest. In resolution to this scientific controversy, the HGP was initiated quickly under joint jurisdiction of the DOE and the NIH, in part to prevent other competitors from appropriating the agenda; yet it is also a novel experiment in public access to research results and the international sharing of science.

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[27] *Ibid.*, p. 215.

The aim of the HGP is simply to map and sequence a "representative" human genome.[28] Each of the approximately 3 billion nucleotide pairs is to be identified, and the chromosome locations of each of the genes determined.[29] The project itself is humanpowered by repetitive laboratory tasks of discriminating chromosome sections into their nucleotide ingredients, and identifying specific genes as well as the "junk" DNA – those chromosomal sections which do not encode proteins. More interesting research is occurring in technology and procedure development, so that the mundane and resource-intensive tasks of mapping and sequencing can be completed efficiently. Hubbard and Wald comment that the HGP

> is reductionism at its most extreme, as genome scientists will be constructing a hypothetical sequence of submicroscopic pieces of DNA molecules, and will then declare that sequence to be the essence of humanity.[30]

Assuredly, the ultimate purpose of the HGP is to provide a template for learning about genetic processes, a goal which has begun to unfold with magnificent surprises. The interactions among genes and also with regulatory "junk," the function and transmission of mitochondrial DNA, the interactions between genes and higher-level organismic processes; these all reflect a beauty and wonder which lead us to believe that therein are revealed the "secrets of life." Ironically perhaps, studies of marketable genetic modalities occur outside of the HGP's primary domain, and so private industries may focus their resources to construct profitable genetic interventions based upon the publicly funded work revealed in HGP databases.

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[28] "The" human genome is actually a composite of parts of many individuals' genomes.

[29] Some genes are found at alternative chromosomal locations in different individuals.

[30] Elizabeth Hubbard and Elijah Wald, *Exploding the Gene Myth: how genetic information is produced and manipulated by scientists, physicians, employers, insurance companies, educators, and law enforcers* (Boston: Beacon Press, 1993). p.3.

The need generated in the 1980's and 90's for public endorsement of genetic science is largely responsible for cultivating reductionist understandings of genetics. The Human Genome Project is hailed as a "Holy Grail"[31] by which social problems can be managed most efficiently. Government and consumer subsidization of genetic research is largely contingent upon social acceptance that genetic research and practices fulfill a "need."[32] The huge public costs of genetic research and technologies, including significant environmental costs resulting from the waste products of radioactive materials used in genetic analysis, are rarely noted to the public. Therefore, scientists, corporations, and health care industries involved in genetics have been blamed for cultivating a regard of humans and other organisms as objects for genetic management in a "public relations effort to maintain their prosperity."[33] Tauber and Sarkar lament: "the HGP is the ultimate product of an extreme reductionist vision of biology that has held that *to understand better one need only to go smaller.*"[34]

Despite theoretical complexities that may accompany genetic reductionism, it becomes a part of ordinary self-perception to the extent that scientific claims influence public beliefs. The public also receives, and in turn spreads, genetic reductionism through a multitude of other sources, including education and media portrayals of genetic medicine.

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[31] Walter Gilbert (1992).

[32] Abby Lippman (1991).

[33] Richard Lewontin, *Biology as Ideology: The Doctrine of DNA* (New York: HarperPerrenial: 1991). p. 4.

[34] Alfred Tauber and Sahotra Sarkar, "The Human Genome Project: Has Blind Reductionism Gone Too Far?" *Perspectives in Biology and Medicine*, vol. 35, no. 2, 1992. p. 228.

Genetic Reductionism in Public Education

The spread of genetic reductionism through education is prominent in the national effort to educate high-school students about the social implications of the "new genetics." Every high school biology teacher in the United States has been sent a copy of *Mapping and Sequencing the Human Genome: Science, Ethics, and Public Policy,*[35] a book of teaching exercises for the integration of issues associated with the Human Genome Project into high school curricula. The book is divided into four exercises, the first of which develops an understanding of genetics and genetic sequencing. The next three chapters deal with social and conceptual issues involving deep suggestions towards genetic characterizations of ourselves.

The first of these exercises, "do our genes determine our future?" asks students to investigate the relationship between genotype and a good career choice. The second exercise, "The case of Nathaniel Wu," asks students to imagine themselves to be employers facing a prospective employee found to have a 60% likelihood of carrying the gene for Huntington's Disease, a lethal adult-onset disease which causes progressive degeneration of the nervous system. Finally, the exercise, "Genetics and Alcoholism," asks students to develop a policy regarding whether persons with genetic predispositions to alcoholism ought to be prevented from purchasing and drinking alcohol. These questions are indeed provocative for capturing the interest of high school students regarding ethical issues regarding human genetics, and the program counsels teachers to be non-prescriptive in classroom discussions and to seek diverse views in class discussions. However, the questions themselves suggest that genetic information may be used directly and readily to human benefit, and to prevent undesired behaviors in–and

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[35] BSCS and the American Medical Association. *Mapping and Sequencing the Human Genome: Science, Ethics, and Public Policy* (A Free Monograph for the High School Biology Classroom; BSCS and the American Medical Association, 1992).

relationships with–others. Uses of genetic information to prejudge one's own capabilities, to exclude people with genetic predispositions from employment opportunities, and to attribute to genetic influences social ills such as alcoholism (a list to which we might add aggression, homosexuality, psychological illness, and numerous other stigmatized characteristics) exhibit a clear oppressive potential. The conclusions we may safely draw from genetic information are seldom as direct as these exercises make them appear.

When the personal and social contexts which influence our own and others' health and abilities are duly emphasized, the magical potential of genetic solutions diminishes. And although the high-school program is commendable for raising issues regarding the social consequences of new genetic knowledge, the exercises reflect an over-simplified model of genetic control. The appeal to genetics for social interventions without the explicit presentation of issues regarding alternatives over-simplifies the power of genetic explanations and neglects alternative modes of causal and ethical explanation. As a further consequence, the program may legitimize the misuse of genetic information in the minds of students, who will shape the future use of such information.

Genetic Reductionism in Medicine

The science and practice of genetic medicine are not inherently committed to reductive explanations. Medical geneticists may seek health improvements through genetic interventions without asserting that exclusively genetic processes can explain all levels of organization within the organism. Nevertheless, genetic medicine may be the most influential source of public perceptions that genetic characterizations can completely describe an organism. Indeed, it is not too surprising that genetic explanations of health and illness are routinely reported without representing non-genetic levels of influence. Medical geneticists whose investigations take place at the molecular level may be unaccustomed to higher levels of explanation, and furthermore, few of us aside from scientists may have much time or tolerance for hearing out the precise details of biological interactions that might otherwise correct genetic simplifications.

In some instances, purely genetic explanations may be the best explanations. Consider the predisposing cause of sickle-cell anemia in individuals. This condition originates with a remarkably simple and well-defined genetic arrangement. Whereas the "normal" genetic sequence of the beta-globin gene on chromosome 11 contains the codon sequence GAG (specifying the amino acid glutamic acid), the sickle-cell alternative contains the sequence GTG (specifying valine).[36] As a consequence, the red blood cell contains a weakness in its protein structure that allows the cell to collapse under conditions of stress into a sickle shape, which inhibits its ability to transport oxygen and its smooth passage through the blood vessels. Assuredly, a more extensive and complex genetic explanation could also be given. We recall that the prevalence of the sickle-cell anemia mutation originates with its selectionist advantage in geographies where malaria threatens, and the genetic influence upon the biochemical processes leading to sickling can be offered with minute detail. However, genetic explanations do not ordinarily address questions of how environmental and other non-genetic conditions contribute to the sickling process as it occurs, why its expression varies among different persons, or how sickle-cell is experienced by individuals. Naturally, looking at medical conditions from only the aperture of genetics can result in misunderstandings. Following the deaths of four black army recruits in 1968-69 which appeared to be related to sickle-cell anemia, the United States Air Force Academy banned all individuals who carry the recessive sickle-cell *trait* from piloting (all

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[36] Richard Shapiro (1992) offers an illuminating account of the genetic properties of this disease (see Chapter 7, "The Red of the Blood").

of whom were black persons), ignoring the actual health of these carriers whose blood will carry oxygen without undue risk at high altitudes.[37] Furthermore, the inability of medical geneticists to cure or to satisfactorily treat this simplest of genetic aberrations, long since Vernon Ingram determined the genetic source of the disease in 1956, is in my view a discouraging example of the real potential of genetic therapies to treat and cure with widespread application. Such a reserved view of the potential of genetic medicine is occasionally represented in scientific journals.[38]

Meanwhile, the hoped-for potentials of genetic medicine receive their fair share of attention. Prospects for medical genetics as a source of predictive, preventive, and curative medicine are generating mounting enthusiasm, as a new genetic paradigm in medicine is declared.[39] Genetic modalities already offer effective techniques in diagnostic medicine and in reproductive interventions, and are arguably in some cases the most probable means of developing *therapeutic* techniques as well. Researchers have fed the public's hopes for treatments or cures for diseases ranging from one-nucleotide influenced sickle-cell anemia and one-gene influenced Cystic Fibrosis, to polygenically influenced diseases and cancer. In the

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[37] See Daniel J. Kevles, *In the Name of Eugenics: Genetics and the Uses of Human Heredity* (Berkeley: University of California Press, 1985). p. 278. Since sickle-cell anemia is a recessive genetic disease, only persons who inherit the aberrant gene from both parents acquire it.

[38] Gail Ross *et. al.* find that predictions of future medical benefit from genetic therapies are premature given the state of progress to date ("Gene Therapy in the United States: A Five-Year Status Report," *Human Gene Therapy* vol. 7, no. 14, 1996. As Jeff Goldberg reports in *Discover* magazine's "A Head Full of Hope," (April 1998), "after more than 100 clinical gene therapy trials at a cost of well over $200 million a year, there was still no unambiguous evidence that genetic treatment has produced therapeutic benefits."

[39] See Gordon Edlin, "Inappropriate Use of Genetic Terminology in Medical Research: A Public Health Issue," *Perspectives in Biology and Medicine*, vol. 31, 1987; and Patricia Baird, "Genetics and Health Care: A Paradigm Shift," *Perspectives in Biology and Medicine*, vol. 33, no. 2, 1990.

"gene of the week" phenomenon, new genes are identified and portrayed to the public in rapid succession as momentous breakthroughs. E. D. Garber states that "incredible advances at a rapid pace… (have) made the molecular approach to biomedical specialties almost an imperative."[40] The vast list of physical conditions for which genetic treatments are proposed offers great encouragement to the public who are eager to believe that cures for human illnesses are within sight. Assuredly, our collective interests in overcoming illnesses reflect compassionate desires to minimize suffering, and deserve to be pursued wherever the correlate hazards are proportionally acceptable. But promises of genetic remedies also feed inclinations to equate persons with their genotypes. For instance, Ian Wilmut, leader of the team that first cloned a mammal (using the nucleus of an adult sheep udder cell[41]), reports the hope of some parents who have suffered the death of a child that "we could bring their child back" by cloning.[42]

Many geneticists would have us believe that their discoveries will immanently offer widespread benefits to humankind. French Anderson and his team's pioneering efforts at gene therapy for Severe Combined Immune Deficiency (SCID, the disease portrayed in the movie, *The Boy in the Plastic Bubble*) have received a wealth of publicity and high hopes, but the benefits of this intervention remain indiscernible after several years.[43] Meanwhile, drug therapies and reasonable precautions have turned the expectations for children with this once-fatal disease into

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[40] E.D. Garber, "Exploring Genetic Mechanisms," *Perspectives in Biology and Medicine*, Vol. 41, no. 1, 1997. p. 153.

[41] This fact is in some dispute. See Jerome Kasiser and Nadia Rosenthal, "Should Human Cloning Research Be Off Limits?" *New England Journal of Medicine*, vol. 338, no. 13, 1998. p. 905.

[42] Richard Gwyn, "Control of our biology at hand," *Toronto Star*, November 19, 1997. p. A24.

[43] See Gail Ross *et. al.* (1996).

hopes for healthy lives. To be sure, the lack of positive outcomes for gene therapies in their present infancy should not undermine our regard of their distant potential. We may imagine that even genetic illnesses with the most complex of genetic and environmental influences may be remedied by the insertion of healthy genes into needed sites. "Simply" *adding or replacing* healthy genes to targeted sites within tissues may avert the unwieldy alternative of *reconstructing* flawed genes. However, potential modes of transport for healthy genes to targeted sites may prove to be beyond our powers of intervention for most health conditions. Richard Strohman alerts us to a further cause for skepticism regarding the potential for genetic therapies to work effectively, especially on common diseases, such as hypertension: "Most of the physiological pathways in hypertension are already known, and... various sub-functions will be modulated by environmental variance and epigenetic adaptation."[44] Where genetic influence is complex and involves the interaction among multiple genes and environments, genetic therapy may have limited promise; and genetic mapping has decreased utility where the biochemical processes involved in disease are independently known. The disposition to invite simplistic understandings of the influence of genes upon organisms is an error that awaits correction, regardless of how fruitful genetic modalities may prove to be.

Genetic information regarding diseases with environmental influences usually can reveal only *tendencies* towards disease in the organism. Genetic interaction among multiple genes, with cellular and higher-level organismic influences, and with environments do not fall under the simple "one gene equals one trait" model that once predominated. The difficulty in representing and interpreting probabilistic statistics about predispositions to illnesses, even among health care

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[44] Richard Strohman (1993), p. 125. Epigenetic adaptation refers to traits which involve both single-gene and multi-gene interactions, as well as responsiveness to environmental variations.

professionals themselves, is often a cause for undue concern and alarm regarding an individual's prospects for health. This calls into question the utility and moral appropriateness in many cases of presenting such information to pregnant parents concerning the health of a fetus, and to asymptomatic adults who have (as we all do) increased susceptibilities to certain illnesses.[45]

Quite certainly, most genetic interventions will be more anxiety-ridden and less "miraculous" than portrayed in the public image of cure. At present, the greatest impact of genetic medicine is, and will become increasingly, the availability and standardization of prenatal genetic screening for selective abortions to avoid diseased or undesired offspring. As HGP mapping and sequencing identifies genetic defects before disease processes are understood, intervention takes the form of determining the presence or absence of specific genetic anomalies, whereafter selective abortion is the only "treatment" option. In another form of medical genetics which is sure to find common application, prediagnostic testing will allow us to alter our health habits with respect to a select list of genetic predispositions, as is already practiced in specific cases such as certain genetic predispositions to breast cancer. While the bulk of medical genetics is likely to consist of merely *predictive* interventions (at least in the visible future), geneticists are not generally inclined to clarify these reasonably expected limitations.

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[45] Regarding problems invited by the probabilistic nature of prediagnostic genetic screening, see Seymour Kessler and Eleanor Levine, "Psychological Aspects of Genetic Counseling. IV. The Subjective Assessment of Probability," *American Journal of Medical Genetics* vol. 28, 1987; and Charles MacKay, "The Effects of Uncertainty on the Physician-Patient Relationship in Predictive Genetic Testing," *Journal of Clinical Medicine*, vol.2, no. 4, 1991. p.249. McKay demonstrates physicians' discomfort with statistics and traces it to a "mechanistic paradigm" that seeks clear-cut solutions in spite of medical uncertainties. McKay proposes as a mode of redress, rather, a "probabilistic paradigm,"according to which "events are multicausal and the presence of one or more causes does not always produce the event; hypotheses are tried and refined to accommodate observations and events; the subjective and objective are not dichotomous."

Charles Cantor, in extolling the ability of the HGP to decrease the health care costs of managing schizophrenia, was taken to task. According to Fox Keller, "when asked how such a (cost) saving could be effected he could only say: 'by preventing the birth' of schizophrenics."[46] Here Cantor oversimplifies both schizophrenia management and the ability to diagnose the disease genetically. It is not possible to prevent the birth of schizophrenics, since people are not born with the disease. Schizophrenia is developed later in life in a subset of persons who are apparently genetically predisposed to it. It is unclear that anyone is destined to acquire schizophrenia due to their genes, as genetic predispositions to the disease appear to involve variable expressivity, or "penetrance." This is most readily apparent from cases of monozygotic (identical) twins where only one twin acquires schizophrenia.[47] If a polygenetic predisposition(s) for schizophrenia is effectively isolated, only some humans with those genes will acquire the disease. Thus if Cantor's suggestion to abort selectively fetuses with such a predisposition becomes possible, many children who might grow up without the disease would be aborted as well. This may be a risk that many prospective parents would be willing to accept, but some parents have expressed dismay at feeling social and medical coercion to abort fetuses for whom genetic tests predict specific illnesses, and in some cases diagnoses that are expressed as certainties are shown to be mistaken.[48] Furthermore, persons who develop schizophrenia

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[46] Cited in Evelyn Fox Keller (1991), p. 296.

[47] Richard Strohman (1993, p. 54) notes: "monozygotic twin studies show nonconcordance of 50% for schizophrenia."

[48] This kind of occurrence was expressed by an audience member at the January 23, 1993 conference, *Politics of the Human Body: Assault on Dignity* (Vanderbilt University, Nashville, Tennessee). This person chose not to abort her fetus against medical suggestions, and her baby turned out to be healthy. See Barbara Katz Rothman, *The Tentative Pregnancy: How Amniocentesis Changes the Experience of Motherhood* (New York: W.W. Norton & Co.,

typically appreciate their own lives, and make the best of their mental illness with available social and pharmaco-mecical methods of management.[49] The desire to "avoid the birth of schizophrenics" cannot be justified straightforwardly by concern for the offspring, but may also reflect the difficult positions of parents with ill and disabled children.

The availability of prenatal genetic testing adds new pressures to the decisions of pregnant parents that are not always desired or "enabling," and may ultimately discourage social responses to share in the process of facilitating the life of a child with a genetic disorder. For instance, Barbara Katz Rothman illustrates that "a woman who chooses not to use the testing has in some sense come to be seen as having 'chosen' to have a child with a disability."[50] The availability of prenatal screening appears to bring with it an implicit sense of social imperative: for instance, Vardya Burtsyn reports hearing from a woman "that she was treated 'like a social traitor' by a specialist when she refused to have an amnio for her 'high-risk' pregnancy at the age of thirty-eight."[51] While society must continue to aim to prevent undue suffering and illness, we must also foster a social environment which enables the psychologically and physically ill to thrive to the best of their potentials, and in this aim the greatest impediments are social perceptions and agendas rather than the nature of one's illness.

1993) for an analysis of how prenatal genetic testing influences the experience of pregnancy, including those cases where parents must respond to a bad prenatal diagnosis.

[49] The sentiment that not all illnesses and ill-persons should be conceived as objects for intervention is expressed by Anne Finger, who suffers from polio: "believe it or not, we are not all in a rush to be cured or prevented." (From a lecture at the University of Tennessee Medical Center, 1990.)

[50] Barbara Katz Rothman, "Not All That Glitters Is Gold," *Hastings Center Report*, vol. 22, no. 4, 1992. p. S14.

[51] Vardya Burstyn, "Breeding Discontent," *Saturday Night*, June, 1993. p. 66.

Public attitudes towards prenatal genetic screening appear to be substantially enthusiastic. Studies show a desire by many prospective parents to avoid the birth of a child with genetic indicators for conditions ranging from Down's Syndrome to a predisposition to obesity.[52] Dorothy Nelkin and Susan Lindee note 1992 survey results by the March of Dimes Birth Defects Foundation that "43 percent of Americans approved of using gene therapy to enhance the physical and behavioral traits of their children as well as for the treatment of disease."[53] Nelkin and Lindee suggest that this poll reflects a public lack of understanding about genetic science and the potential for such interventions to cause harm.[54] I also suspect that underlying these results are parental inconsistencies between their hopes for optimal health and aptitude in their own offspring, while at the same time feeling uncomfortable with permitting the practice of genetic enhancement on a widespread social scale. Nevertheless, our society may be steadily softening its reproach of overt eugenics for the prevention of undesired genotypes and the enhancement of others. Elizabeth Hubbard and Elijah Wald recount numerous examples of claims to a right to be born healthy and a corresponding duty to ensure the health of one's infants. They note, for instance, the statement by Bentley Glass upon retirement from presidency of the American Association for the Advancement of Science:

> In a world where each pair must be limited, on the average, to two offspring and no more, the right that must become paramount is... the right of every child to be born with a sound physical and mental constitution, based on a sound genotype.

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[52] According to New England Regional Genetics Group study, "11% of prospective parents "would abort a child predisposed to obesity." Cited in Geoffrey Cowley, "Made to Order Babies," *Newsweek*, 1989, Special Issue. p. 98.

[53] Dorothy Nelkin and Susan Lindee, *The DNA Mystique: the gene as a cultural icon*, (W. H. Freeman and Co., 1995) p.168.

[54] *Ibid.*, p. 168.

> No parents will in that future time have a right to burden society with a malformed or a mentally incompetent child.[55]

The genetic model of health and illness may be used to fortify ideologies that equate the value of life with the desirability of a genotype.

Medical genetics is reductionist to the extent that it is inattentive to non-genetic influences upon biological processes, exaggerates the reasonable potential of genetic interventions, and regards organisms as objects of genetic management rather than as responsive beings who function within complex interactive systems. Claims that conditions like obesity can be eliminated in one's offspring, or that the traits of one's offspring may be selected at a so-called "genetic supermarket"[56] have persuaded much of the public. Yet the requisite understanding and ability to manipulate the presently unknown and variable mechanisms of genes in polygenic, and even most monogenic predispositions are uncertain. Proposals for medical applications of genetics may falsely suggest that individual characteristics which are also influenced by the environment and by social perceptions are predominantly or entirely a consequence of genes. Richard Strohman comments,

> Many researchers in molecular biology truly believe their studies on gene cloning and regulation will provide important medical advances in line with the goals of the medical research paradigm.... Any survey of the lay population reveals a similar belief, so this paradigm has a firm hold in the minds of many people, and must have a major impact on the ongoing definition and design of our health care system.[57]

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[55] Bentley Glass, "Science: Endless Horizons or Golden Age?" *Science*, vol. 171, 1981. p 26.

[56] This idea is suggested by Johnathon Glover in *What Sort of People Should There Be? Genetic Engineering, Brain Control, and their Impact on our Future World* (New York: Penguin Books, 1984). pp. 47-50.

[57] Richard Strohman (1993), p. 117.

The potential for seemingly unlimited social and ethical consequences of reductionist models in genetics have provoked a vast patchwork of criticism in response.

Criticisms of the Genetic Paradigm

Ubiquitous criticisms of the genetic paradigm have arisen in visible contrast to the enthusiasm expressed about genetics. As a response to "deification" of the gene,[58] critical commentary regarding genetics is flourishing in proportion. The view that our genomes are the defining feature of our embodied selves is criticized as a virtually tyrannical model where the genome possesses and rules the organism, commanding it at its every level of organization for its own purpose: replication in the organism's offspring. Books are devoted to criticism of the genetic paradigm,[59] and the *Council for Responsible Genetics* has developed to respond to problems of genetic knowledge. Media portrayals of the cautions of genetic technologies regularly accompany revelations of new genetic discoveries, and have reached beyond newsprint and television to popular magazines.[60] The focus of concerns is that by looking at organisms at the genetic level, the organism's body, experiences, and relationships are not regarded as ends in themselves, and that genetic strategies are maximized to the detriment of these others. Mary Rosner and T.R. Johnson express concern about the distorted social values and power relations manifest in the HGP:

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[58] For example, see Alfred Tauber and Sahotra Sarkar, "The Human Genome Project: Has Blind Reductionism Gone Too Far?" *Perspectives in Biology and Medicine*, vol. 35, no. 2. p. 225.

[59] See, for example, Nelkin and Lindee (1995), and Hubbard and Wald (1993).

[60] See, for example, Jack Cohen and Ian Stewart, "Our Genes Aren't Us," *Discover*, April 1994, p. 78-84; John Sedgwick, "Genes R Us," *Self*, June 1994; and Sharon Begley, "Holes in Those Genes: Not even DNA can live up to all the hyped claims," *Newsweek* (Jan 15, 1996). p. 57.

> The values of the Human Genome Project... are hierarchical; the scientist seeks to overpower and demystify nature once-and-for-all. This domination of the Other is entirely complicit in the domination of women and minorities. As such the Project, as we've mentioned, is intrinsically eugenic and totalitarian.[61]

Because genetic science influences social processes, critics call for a non-reductive focus in genetics. And since genetic practices and theories are often only *implicitly* reductionist, critics are largely responsible for calling attention to and defining genetic reductionism.

Critics indeed share hopes for the eradication of illnesses, and would welcome the development of accessible genetic therapies for sickle-cell anemia, SCID, schizophrenia, heart disease and cancer, and all other illnesses that cause suffering. They are nevertheless concerned that genetic therapies are not optimally efficient means of producing improved health, and that the genetic model may devalue the lives of ill persons, thereby devaluing society. Their criticisms speak to the vast public resources expended upon genetic research under the rubric of social benefit, as well as the implicit disfavor of alternative, non-genetic programs which might achieve social benefits more equitably and readily.

The potential for genetic knowledge to reinforce current social and economic stratifications in society, perhaps particularly to the disadvantage of women (whose bodies are targets of prenatal testing), persons with disabilities, the poor, and the unpowerful have fueled the stance against geneticization. Abby Lippman introduces this term:

> Geneticization refers to an ongoing process by which differences between individuals are reduced to their DNA codes, with most disorders, behaviors and physiological variations defined, at least in part, as genetic in origin. It refers as well to the process by which interventions employing genetic technologies are adopted to manage problems of health. Through this process, human biology is

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[61] Mary Rosner and T. R. Johnson, "Telling Stories: Metaphors of the Human Genome Project," *Hypatia*, vol. 10, no 4, 1995. p. 126.

> incorrectly equated with human genetics, implying that the latter acts alone to make us each the organism she or he is.[62]

Genetic solutions are offered as enticing "quick-fixes" to costly medical and social problems. For instance, Daniel Koshland claims in an editorial for *Science* that the Human Genome Project will allow us to "apply a great new technology to aid the poor, the infirm, and the underprivileged,"[63] since many physical and mental illnesses are partly genetic in origin. Perhaps genetic knowledge will assist society in building social equality. But is this a reasonable expectation in general? Perhaps more likely, inequalities already manifest in health and health care utilization will be further reinforced, especially considering the tremendous expense of genetic technologies. In spite of promises for genetic treatments, the degree to which they can be developed and would be used equitably remains speculative. For instance, a 1980 study in Georgia found that among forty-plus year-old women choosing prenatal chromosomal diagnosis, use ranged from "60% among whites in two large urban counties to 0.5% among African Americans outside of the Augusta and Atlanta health districts."[64] Herbert Nickens predicts accordingly that genetic technologies will be used as an instrument to perpetuate and create underclasses of citizens, in

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[62] Abby Lippman, "Prenatal Genetic Testing and Screening: Constructing Needs and Reinforcing Inequities," *American Journal of Law & Medicine*, vol. XVII, 1991. p. 19.

[63] Daniel Koshland, "Sequences and Consequences of the Human Genome," *Science*, vol. 246,, 1989. p. 189.

[64] David Sokal et. al., "Prenatal Chromosomal Diagnosis: Racial and Geographic Variation for Older Women in Georgia," *Journal of the American Medical Association,* vol. 244, no. 12, 1980. p. 1355.

keeping with entrenched practices to this end.[65] Maxwell Mehlman makes a more vivid prediction:

> The impact on society of unequal access to genetic enhancements will be unprecedented.... Genetically enhanced individuals will gain overwhelming advantages over the non-enhanced. Equal opportunity will disappear.... Eventually the degree of disparity will dwarf the social distinctions that characterized feudalism, the caste system in India, and even human slavery.[66]

Supposing that efforts at genetic enhancement are successful, differential utilization of genetic technologies may lead to a weighted stratification of genetic illnesses to lower socio-economic classes, which may negatively affect the allocation of resources to manage these illnesses. Koshland's failure to acknowledge the traditional neglect of disadvantaged groups by American society and politics, coupled with the potentially oppressive uses of genetics, illustrates a lack of awareness that tends to contribute to, rather than remedy, such problems of disparity.

Genetic knowledge has begun to change human choices in some profound ways. No longer are persons with family occurrences of breast cancer or Huntington's Disease limited to only *hope* that they do not acquire the disease also. Now they may choose genetic testing to reveal whether they, too, are genetically predisposed to acquire the condition. The availability of such diagnostic foreknowledge offers a relief to many persons. Obviously, findings of genetic normalcy are hoped for, but others who receive a bad diagnosis may find some relief in the removal of uncertainty and the ability to anticipate their medical needs. But whether one chooses

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[65] Herbert Nickens, "The Genome Project and Health Services for Minority Populations," in Thomas Murray, Mark Rothstein, and Robert Murray, Jr., eds., *The Human Genome Project and the Future of Health Care* (Indiana University Press, 1996). pp. 58-78. (Cited in Faith Lagay, "Using genes to build (better people) and repair (social ills)," *Medical Humanities Review*, vol. 11, no. 2. p. 103.

[66] Maxwell Mehlman, "Access to the Genome and Federal Entitlement Programs," in Murray, et. al., eds., (*ibid.*). pp. 113-132. (Cited in Lagay (*ibid.*), p. 103-4.)

to use or to decline these technologies, the new availability of these techniques *forces* people to make this uncomfortable choice.

Ethically or cost/beneficially unoptimal uses of genetic knowledge may be fueled by "the technological imperative," which drives the use of technologies "because they are there". The activities of science and medicine assert quiet influences favoring the development and uses of technologies. Sedgwick illuminates the alliances between scientists and medical researchers and various forms of profit when their subject of research is viewed as beneficial and productive of technological interventions. He says, "the 'industrial-genetic complex' link(s) researchers to biotech firms and up(s) the ante for genetic claims."[67] Diane Paul offers an example of the uncritical acceptance of medical technologies by suggesting that PKU (phenylketonuria) screening is neither cost-beneficial as an economic measure nor as a strictly preventive health measure, although the screening is seldom questioned by medical practitioners or by new parents.[68] Kathleen Nolan notes that the fear of malpractice suits which commonly infiltrates medical decision-making is also responsible for the rise and appearance of utility of genetic interventions, such as prenatal diagnosis.[69] Doctors fear that a failure to diagnose a genetic illness prenatally may lead to lawsuits for wrongful life. Indeed, many individuals may find improved health from the proliferation of genetic technologies, but the collective significance of

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[67] John Sedgwick (1994), p. 144. Hubbard and Wald (1993) offer a more thorough account of the financial motivations that may cloud the achievement of public interests in much of genetic science: see "Genes for Sale," (pp. 117-127).

[68] Diane Paul, Symposium Panelist, "Policy Issues in Human Genetics," Philosophy of Science Association Meeting, October 16, 1994. Newborn PKU screening began in Massachusetts in 1963 and soon became standardized across the nation.

[69] Kathleen Nolan, "First Fruits: Genetic Screening," *Hastings Center Report*, vol. 22, no. 4, 1992. p. S3.

these technologies deserve to be weighed against individual gains before policies are set in place. Burtsyn argues, "the techno-industrial imperative... pre-empts any public discussion; the market and the medical systems usurp what should be a fully democratic process."[70] A solution to this "unnatural momentum" requires meeting the onerous challenge of greater awareness and activist mobilization among scientists and medical practitioners, as well as among the public.

Against this aim, the presumed objectivity and authority of the sciences allows scientific interests to progress with little intervention from internal or public accountability. Sylvia Tesh explains,

> scientific expertise becomes a shield against the effort to ensure public accountability. In this context, scientists who retreat behind the screen of pure science are passively abandoning their social responsibility; those who choose to become actively involved risk being seen as no longer "objective."[71]

Though the ideological interests and the impact upon society of scientific activity have become favorite issues in the philosophy of science, the view that science occurs independent of social influence remains implicit in scientific practices. Science's presumed objectivity and inaccessibility to the lay population are, in part, ideological constructs that allow scientists to influence society without accountability. Joshua Lederberg expresses the supposed value-neutrality of science, for instance, by noting that "the suppression of knowledge appears... unthinkable, not only on ideological, but merely on logical, grounds. How can the ignorant know

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[70] Vardya Burtsyn (1993), p. 66.

[71] Sylvia Tesh, *Hidden Arguments: Political Ideology and Disease Prevention Policy* (New Brunswick: Rutgers University Press, 1988). p. 171. Tesh attributes this view to Elizabeth Fee.

what they should not know?"[72] The claim that any scientific knowledge ought to be avoided because of its potential dangers repels many scientists. Indeed, one cannot fully know the possible value or harm of knowledge until the knowledge is acquired. However, scientific knowledge is most often purchased at public expense, and the knowledge itself often carries a momentum that affects society in ways that can be stopped only with difficulty.

Susan Wendell expresses the social context in which value-decisions about illness and potential illness are made:

> where illness is despised: suffering caused by the body, and the inability to control the body, are despised, pitied, and above all, feared. This fear, experienced individually, is also deeply embedded in our culture.[73]

Genetic reductionism reinforces our fears of illness by emphasizing an unrealistic sense of cure, and by providing a framework which removes illness from the subjectivity of the organism and attributes it to objective units. Nelkin and Lindee link the objectifying tendency of genetic reductionism with far-reaching social consequences: "so long as persons continue to be conceptualized as aggregates of physical attributes and as gene-transmitting agents, biology can be used as both a standard for opportunity and a justification for discrimination."[74]

Despite trends emphasizing the importance of genes in determining who a person is, and a tendency by the public to accept scientific claims without scrutiny, people are not *consistently* persuaded by reductive characterizations of themselves. While the public presently appear eager to head in the direction of a new "genetic paradigm," a clear and coherent reductionist model may

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[72] Joshua Lederberg, "Orthobiosis: The Perfection of Man," in A. Tiselieus and S. Nilsson, eds., *The Place of Value in a World of Facts,* 1970. (Cited in Alexander Capron, (1990). p. 48.)

[73] Susan Wendell, "Toward A Feminist Theory of Disability," *Hypatia*, vol. 4, no. 2.

[74] Nelkin and Lindee (1995), p. 168.

not emerge. Indeed, many people also harbor beliefs in direct conflict with the view. Many of us, for instance, continue to believe in a disembodied afterlife, though presumably our material bodies would no longer accompany us. Also, the prospect of genetic therapy seemingly has not challenged public intuitions about one's biological identity, as might be considered if people coherently viewed themselves as essentially genetic.[75] The issue is of practical importance as the public adoption of genetic reductionism makes way for *increasing social expectations of genetics*.

The glorification of genetic knowledge and technologies often involves a clear inattention to their potentials for ineffectiveness, misuse, and harm. Accordingly, much of the backlash against genetic reductionism has been based upon predominantly ethical, rather than deeply theoretical, reasoning. In many criticisms of genetic reductionism, it is hard to distinguish whether asserted social consequences of reductionism are rejected because reductionism is shown to be false, or whether reductionism is asserted to be false because asserted social consequences are shown to be undesirable. The seemingly exaggerated claims of genetic reductionism beg for a theoretical explanation of the basis upon which its truth is supposed. Of course, many expressions that "you are your genes" are not intended as serious philosophical axioms. These expressions are usually unaccompanied by theoretical support, as though scientific data revealed them directly and unproblematically. Geneticists have become aware of social concerns about reductionism and have responded by tempering their reductionist stance, at least in public forums. Geneticists are now less likely to claim that genes in isolation can replace the whole organism for

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[75] Mary Mahowald has pointed out, similarly, that the transplantation of fetal brain tissue into patients' brains has not even engendered a *philosophical* discussion regarding the patient's identity, much less a social discussion of this issue (presentation for the Society for Health and Human Values, 1992).

purposes beyond investigative methodology.[76] However, reductionist techniques and promises have not lost force. An explanation of the relationship between an organism and its genetic properties is needed to allow us evaluate the genetic reductionism at its theoretical core.

Section II: Is there Truth in the Reduction? A Question of Essentialism

The Concept of Genetic Reductionism

To say that a whole organism can be captured by a purely genetic description should incite our puzzlement. Our interest in evaluating the plausibility that may underlie reductionist claims about genetics begins by considering some of the various ways in which these claims might be defended.

Various forms and expressions of genetic reductionism involve diverse philosophical commitments. Most often, the assumptions which frame reductionist practices and propositions are inexplicit, and are merely implied by the context of the activity or of the speaker's statements or beliefs. This is not surprising, as the metaphysics of genetic reductionism is complex, making it more amenable to implication than explanation. Scientists and the general public may not notice or may be uninterested in the need for explaining a reductionist framework, and even philosophers, if my own experience is representative, will find it difficult to see through its complexities.

Walter Gilbert is among those geneticists to whom a reductionist view is commonly attributed. I am not aware that Gilbert himself explains his reductionist view that an organism

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[76] See, for example, Gina Kolata, "With an Eye on the Public, Scientists Choose Their Words," *New York Times,* January 6, 1998. Kolata offers the example that scientists replace the word 'cloning' with 'somatic cell nuclear transfer' to make it appear less objectionable.

may be completely characterized by its genome. Tauber and Sarkar explain his view in their own words:

> Once the sequence of any organism is available, its biology can emerge from being a purely experimental field to a theory-based science. The sequence can be stored in a computer database and the entire corresponding amino acid sequences of proteins read off, and theoretical analyses can begin. In principle, every control mechanism can be obtained from this information, thereby answering a fundamental question of biology. Next, the interaction of genes can also be obtained, and, finally, the entire behavior of the organism calculated.[77]

Here is an extreme account of what a genetic reductionist might claim, involving concepts of methodology, causation, behavioral determinism, and organizational primacy. Indeed, Gilbert's remarks at times suggest the extreme interpretation that the organism as a whole can be replaced without loss by its particular nucleotide sequence. However, there are also less extreme ways to be a genetic reductionist.

Constitutive and Methodological Reductionism

The claim that all objects, including the biological, are composed entirely of particulate matter is termed by Ernest Mayr *constitutive reductionism.* With the demise of vitalism, this view is non-controversial in modern science, though commonplace views of ensoulment and perhaps also 'quasi-scientific' views about psychic processes may take exception to it. Constitutive reductionism holds that organisms are made entirely of molecular components, not all of which are genetic molecules. Reductionism in this sense is a premise of mainstream science, and it aids our present analysis only to note that in this usage, reductionism is not a subject for dispute.

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[77] Tauber and Sarkar (1992), p. 222. The authors refer to a paper presented by Gilbert at a meeting on Historical and Social Study of the Human Genome Initiative (Department of the History of Science, Harvard University, Cambridge, June 15, 1990): "Current state of the HGI."

Methodological reductionism may pertain to genetics specifically but is not a deeply theoretical view. As expressed by Helen Longino, "Methodologically, reductionism is the practice of characterizing a system or process in terms of its smallest functional units."[78] Reductionism in this usage refers to a *practice* rather than a belief system, uncommitted to claims about complete explanatory reducibility. Wholes can be studied by examining their parts, and Longino notes the utility of this method in "guiding researchers to the mechanisms or material constituents of a process."[79] Part of the success of reductionist methods in biology is the ease of controlling the object of study. Molecular structures are more readily isolated from environmental influences and are easier to pay for and control than animals and living structures. One of the dangers of this method is accordingly the problem of applying findings to living systems, and the directness by which these extrapolations can be made is disputed.

Justification of *method* may be a question of its utility in achieving designated goals as well as of its broadly conceived consequences. Accordingly, much of the general criticism of genetic reductionism is criticism of method. Hubbard and Wald appear to offer a predominantly methodological interpretation of genetic reductionism in their general definition:

> The *process* of reducing objects or organisms to their smallest parts rather than *looking at* them as a whole is called reductionism.... In biology, reductionism fosters the belief that the behavior of an organism or a tissue can best be explained by studying its cells, molecules, and atoms and describing their constitution and function as accurately as possible (italics mine).[80]

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[78] Helen Longino, *Science as Social Knowledge* (Princeton: Princeton University Press, 1990). p. 226.

[79] *Ibid.*, p. 226.

[80] Hubbard and Wald (1993), p. 3.

Hubbard and Wald's criticisms of genetic reductionism appeal largely to consequences of misrepresenting the importance of genes, including especially the social harms that may follow from genetic manipulations. Though their analysis is not deeply theoretical, Hubbard and Wald's work responds to the most prevalent form of reductionist thought in science, allowing them to evaluate the scientific and consequential goals of genetics at the most practical level.

Tauber and Sarkar focus their criticisms of methodological genetic reductionism on what they assert is its disutility for most effectively revealing the nature of organisms. They hold that non-reductionist methods in the biological sciences will more directly reveal organisms as whole systems–the level at which biological knowledge is of most interest. Tauber and Sarkar recommend

> first exploit(ing) other (nonreductionist) experimental strategies. The design of complex integrative models of these phenomena cannot rely on the HGP to offer solutions to questions arising at these other levels of biological organization.[81]

Tauber and Sarkar do not argue that molecular genetics is unscientific, but that it consumes scientific resources which might be used more productively, and directs us to findings with unoptimal applicability to organisms as wholes.

Methodological reductionism is controversial for methodological reasons and not as an inaccurate representation of scientific reality or entities. While reductive *methods* may tend to invite reductive *explanations*, they are compatible with reductive, nonreductive, and holistic interpretations of what is *theoretically* fundamental about organisms. A theoretical framework to expound the relation between parts and wholes is not inherent in a system which merely permits the study of objects by understanding their constitutive parts.

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[81] Tauber and Sarkar (1992), p. 224.

Metaphysical Reductionism

The most curious implication of reductionist claims is their apparent assertion that genes can replace an organism in some real sense. Neither limited to a view about wholes having parts, nor to a view about how scientists might perform investigations, this position is about the explanatory content of molecular parts (genes) as extending beyond their own nature to some greater sense of the whole (organism); for instance, as expressed by Philip Kitcher:

> Hereditarian concepts are based on the reductionist view that genes are the ultimate unit of living matter and as such offer the ultimate explanation of all phenomena of living matter."[82]

Views which deduce such a special theoretical status of genes may be called *metaphysical reductionism*. Philosophers have made attempts to spell out this asserted power in a number of ways.

Metaphysical genetic reductionism may regard an organism to be the *causal* consequence of its genes:

> metaphysical or ontological reductionism argues that those smallest functional units are what is real and that all causal processes can ultimately be understood as a function of interactions among these least bits.[83]

As a view about the completeness of lower levels of causation, this is a strong position. Objects are governed by molecular processes which, taken collectively, interact to account for the entirety of causal pathways in an organism. This may be readily accepted when the objects in question are non-biological and molecules function with relative independence. However, in the case of organisms, causation also appears to occur "downwards," as environmental stimuli produce mutagenesis, organ structures cause molecular responses (i.e., the mechanical action of the

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[82] Philip Kitcher, *Vaulting Ambition: Sociobiology and the Quest for Human Nature* (Cambridge: MIT Press, 1987), p. 202.

[83] Helen Longino (1990). p. 226.

diaphragm contributing to the exchange of gases in the lungs), and thought processes produce intentional actions with molecular components, such as the electrical activation of muscle tissues. Why, then, is the genetic level of causation accorded special status? Lewontin et. al. note the concept of ontological priority implicit in reductive views of causation:

> reductionism is the claim that the compositional units of a whole are ontologically prior to the whole that the units comprise. That is, the units and their properties exist before the whole, and there is a chain of causation that runs from the units to the whole.[84]

While the claim that processes at the lowest level of causation within an organism are sufficient to account for all its relevant living processes may appear surprising and complicated upon reflection, at the same time it is a widely accepted theory. As Peter Menzies defines causal reductionism, he notes, "it is widely held among philosophers that macrolevel causal relations are reducible in some sense to microlevel causal relations."[85] Menzies remarks further that this common conception of reductionism is seldom explained. He asserts, "In spite of its widespread appeal... few philosophers... have tried to formulate explicitly the doctrine of causal reductionism."[86] Applied to genetics, causal reductionism asserts that genes are the level of integration which, in a unique and privileged sense, account for all organismic causal processes. The relevance of causation for evaluating the defensibility of genetic reductionism will be discussed in the next chapter.

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[84] Richard Lewontin *et. al.* (1984), p. 5-6.

[85] Peter Menzies, "Against Causal Reductionism," *Mind*, vol. xcvii, no. 388, 1988. p. 551.

[86] *Ibid.*, p. 553.

Metaphysical genetic reductionism may also take a *deductive* form, whereby it is claimed that knowledge about all of the intrinsic properties of organisms is theoretically deducible from knowledge of its genes:

> Although there is much controversy about the precise nature of reduction, popularly it is thought to imply the showing of the old theory as a deductive consequence of the new.[87]

Deductive reductionism is premised upon causal reductionism, from which it is further asserted that higher-level organismic processes could be completely deduced from knowledge of the physical processes of genetic causation. This is the stronger formulation of metaphysical genetic reductionism, as a theory of causation does not necessarily imply that causes always produce singular, predictable effects. Menzies also notes this distinction: "We should distinguish this (the doctrine that a macrolevel causal relation must fall under a microlevel physical law) from that of causal reductionism, since it is controversial whether every causal relation must instantiate a law of nature."[88] In this distinction is one way that metaphysical genetic reductionists (of the causal or essentialist type, which I explain under the next heading) may retreat from genetic determinism, which claims that all animal behavior, including mental behavior and will, is caused by the influence of genes. To say that an organism can be completely explained in some sense by reference to its genome is not necessarily to say that genes produce completely deterministic consequences within the organism that might be deducible from complete knowledge of causally

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[87] Michael Ruse, "Sociobiology: A Philosophical Analysis," in Arthur Caplan, ed., *The Sociobiology Debate: Readings on Ethical and Scientific Issues*, (New York: Harper and Row, 1978). p. 372.

[88] *Op. cit.* p 551.

efficacious states.[89] Our discussion of the role of causation in evaluating genetic reductionism in the following chapter will likewise apply to the deductive theory premised upon causal reductionism.

A further "theory" warrants a moment's attention. In the earlier illustrations of reductionism in the biological sciences, we have heard claims that an organism is completely replaceable by its material genome, or by its formally encoded genotype, for purposes of self-characterization or even immortality. I shall name this metaphysical stance *eliminative genetic reductionism*. If this view were taken seriously, the whole organism would be redundant, and could be eliminated without loss in favor of its nucleotide sequence. Claims in this vein carry a dramatic flourish, but I doubt that anyone whose capacity for reason is intact would be willing to undergo the replacement that would be required to demonstrate this theory.

The present categories of reductionist stances are by no means exclusive. Other investigators have elucidated other usages of reductionism.[90] We shall pay particular attention to theories about causation, including the question of ontological primacy, as central to the shape of most controversies regarding metaphysical genetic reductionism. Yet my ultimate intent for the present categories is to show that views which claim to *explain* a whole by reference to its genetic parts, for whatever purpose, can be called metaphysical genetic reductionisms, and within this category I shall include a new framework for our investigation: essentialist genetic reductionism.

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[89] For instance, Lewontin suggests that physical laws cannot deducibly account for chance outcomes and the effects of developmental noise, as explained in Chapter 2, Section I.

[90] For instance, Mayr (1982) adds "theory reductionism," and J.D. Trout adds "predicate" and "law" reductionisms: "Reductionism and the Unity of Science," in Richard Boyd, Philip Gasper, and J. D. Trout, eds., *The Philosophy of Science* (Cambridge, Mass.: MIT Press, 1991).

The Question of Essentialism

As common as reductionist assumptions about genetics are, the infrequency of theoretical analysis of the subject is surprising. Debates regarding genetic causation and determinism (especially with respect to the field of sociobiology) have captured much of the philosophical attention to this problem, and offer an extensive groundwork for conceptualizing causal processes within organisms. But the defensibility of reductive genetic explanations is not exhaustively addressed by issues of genetic causation. Controversies about genetic reductionism may benefit from a different kind of analysis than has taken place.

I offer such an analysis under the framework of genetic essentialism. Although essentialism is not typically conceived under the rubric of reduction, I do so as a means to evaluate claims that are usually categorized within more generally reductionist language. Genetic essentialism can be conceptualized as another specialized type of reduction, as essentialism represents a larger thing by some parts of it (or a subset of its properties) for the specific explanatory purpose of identifying it under any real or theoretical conditions.

Genetic essentialism is a metaphysical stance that an organism's genetic composition is a necessary and sufficient property for the purpose of individuating that organism in all possible worlds. It claims that genetic qualities alone are completely identifying, such that "an individual essence is a property that necessarily characterizes a single individual"[91] (a theory of individual essence), rather than the lesser claim that genes are among a larger set of necessary identifying properties (a theory of essential properties), such that "a property P is an essential property of an

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[91] Michael Losonsky, "Individual Essences," *American Philosophical Quarterly* vol. 24, no. 3, 1987. p. 253.

object x iff x could not exist and lack P."[92] A version of this view is expressed by Michael Losonsky, who holds that genetic origin determines an organism's identity by offering parameters for its unified development:

> Consider the essence *being the human being that grows from Alpha in suitable environments*, where Alpha is the particular zygote out of which I grew. The casual power I have in virtue of this property is the ability to grow from Alpha, and to grow according to the genetic structure of that zygote.[93]

The essentialist interpretation of genetic relations is unique in its focus on non-substitutable and substitutable properties of particular organisms for purposes of preserving identity. Related to Longino's explanation of reductionism, this view holds that organisms can be completely identified by reference to genetic characteristics, with, in some sense, "external or social factors act(ing) merely as stimuli."[94] A theory that individual organisms can be identified and individuated by their genetic properties must also accommodate the nongenetic properties of organisms as alterable in possible worlds without loss of the organism's identity. Therefore, our study will attend in depth to the relationship between an organism and its genetic *as well as its nongenetic* properties.

To be sure, reductionist claims about genetics seldom appear to be intended as claims about essential properties for organismic identity. As we have seen, such claims are seldom couched within a clear explanatory framework at all. By this essentialist investigation, I propose new conceptual tools for evaluating the reductionist controversy which may underlie some of the

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[92] Graeme Forbes, "In Defense of Absolute Essentialism," in Peter French, Theodore Uehling, Jr., and Howard Wettstein, eds., *Midwest Studies in Philosophy Volume XI: Studies in Essentialism* (Minneapolis: University of Minnesota Press, 1986). p. 3.

[93] *Op. cit.*, p. 256.

[94] Helen Longino (1990). p. 227.

reductionist's claims, even if only vaguely recognized in reductionist practices and beliefs. As a systematic metaphysical analysis of genetic essentialism, I hope to offer a more fundamental direction than has been present in discussions of reductionism and its consequences.

Before embarking upon the investigation which follows, we should be aware that the term, "genetic essentialism," has various usages, some of which diverge from the strict philosophical definition that I further explain in chapter two. The term is commonly used as an alternative to "genetic reductionism," loosely denoting any number of purposes for which genetic explanations are offered. To illustrate a broadly defined use of the term, Ronald Bailey reports of the bioethicist John Fletcher, "Fletcher says polls indicate that some 30 percent to 40 percent of Americans are genetic essentialists, who believe that genes almost completely determine who a person is."[95] Also, Nelkin and Lindee refer generally to beliefs that animal development and behavior is genetically determined when they discuss genetic essentialism in *The DNA Mystique*.[96] Indeed, diverse usages of 'genetic essentialism' may each serve contextual aims, and my philosophical analysis is a specific attempt to reveal one of these usages precisely.

Section III: The Practical Value of an Essentialist Resolution

While this project focuses on abstract metaphysical issues of essentialism, I am motivated to solve these questions by conceptual and ethical issues that people really confront, including those discussed in earlier sections. Thomas Fogle anticipates the need for such a framework to help us grasp the meaning of genetic information: "the importance and deep concern by many for

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[95] Ronald Bailey, "The Twin Paradox: what exactly is wrong with cloning people?" *Reason Magazine* (website): http://www.reasonmag.com/9705/col.bailey.html

[96] Nelkin and Lindee (1995), Chapter 8: "Genetic Essentialism Applied."

a philosophical link between DNA and human nature is not fully appreciated by geneticists."[97] Here I suggest some of the practical issues upon which this metaphysical study will bear, anticipating brief reflection upon these issues in Chapter Five. Readers should keep these issues in mind throughout the study that follows, toward developing their personal responses to the network of conceptual and ethical issues that surround a view of genetic essentialism.

Identity and Possibility

My first practical aim for this work is to clarify some of logic (and illogic) of reductionist claims about genetics. We will then be in a better position to respond to the reductionist statements and beliefs that have become so common. Though this study does not provide an exhaustive critique of genetic reductionism generally, I hope to add some conceptual answers from which to contextualize discussions of the influence of genetic reductionism upon social beliefs and practices.

A second conceptual implication of this study will be its findings regarding the alterations that we could sustain in counter-factual worlds. We routinely suppose ourselves and each other to exist through counter-factual possibilities, both with respect to future choices, and with respect to alternative situations in which we may have originated. To take an example, Mike Wallace asked opera singer, Thomas Qwasthoff, about a presumed counter-factual alternative on *60 Minutes.* Disabled by his mother's use of thalidomide during pregnancy, Qwasthoff was asked if he would wish to have been born without his disability if it meant the loss of his singing

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[97] Thomas Fogle, "Information Metaphors and the Human Genome Project," *Perspectives in Biology and Medicine* vol. 38, no. 4, 1995. p. 537.

talent.[98] Does it make sense to imagine enduring such a counter-factual alteration without altered identity of the organism? As Qwasthoff's disability is not condition caused by original genetic constitution, does this affect the possibility that he might exist through this counterfactual alteration? We may compare this *congenital* (non-genetic) alternative with alterations of *genetic* origin. For instance, for a person with Down Syndrome (Trisomy 21) to have been born without this condition would require the absence of an entire chromosome in its zygote of origin. These questions play a central role in our investigation. If one's genome of origin is a necessary and uniquely identifying property, then alterations of the original genome will not be compatible with one's existence in alternative worlds, whereas congenital and other developmental alterations may be.

The way that humans regard genetic relationships is also deeply implicated in practical issues. Though it is beyond the scope of this work to *answer* how this project bears upon ethical issues, I wish to make a few remarks to anticipate the relevance of these issues.

Genetic Relationship with Oneself

This investigation will help us understand the relationship between an organism and its own genetic make-up. When we learn of our own genetic properties, are we learning the totality of our essence, or of part of our essence, or of merely contingent qualities? Certainly our biological identities are usually apparent to us in our biologically continuous bodies. However, alterations of one's genetic origin will be shown, if genetic essentialism is true, to alter the

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[98] "Big Man Big Voice," *60 Minutes* (television broadcast), November 2, 1997. Qwasthoff answered that he would prefer to stay as he is.

organism's biological identity.[99] Thus, as medicine offers genetic solutions for undesired conditions, our understanding of the role of genes in establishing our biological identities acquires practical relevance.

Prospects for medical genetic therapies usually fall into the distinct categories of somatic-cell alterations, and germ-cell alterations. The former involves changing the genotype of body cells within an individual to produce a targeted phenotypic change, whereas the latter involves altering a potential parent's gametes so as to affect an intended alteration in as yet non-existent offspring. As these latter changes will perpetuate themselves in the future generations of the parent organism, the practice of germ-line alterations have a greater consequential, and ultimately ethical, influence. Do germ-cell alterations involve, furthermore, reconstructing the essences of future organisms, and if this is the case, how ought it to influence the eugenic practice of germ-cell therapies?

Genetic Relationships with Others

Our investigation of genetic essentialism might also shed light upon the meaning of our genetic relationships with others. If our genetic make-ups passed on to us by our parents determine our unique essences, this may provide a context for us to understand the special *meanings* of family relationships. The genetic endowments inherited from parent to child already have profound personal and social meanings in subjective experiences. Also, the genotypic identity of origin shared among monozygotic multiple births (twins, triplets) often has a special significance for those persons. An inquiry into genetic essentialism may help to reveal whether there is a metaphysically objective basis for the meaning of this relationship. Genetic

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[99] The distinction between organismic identity and personal identity (which, as defined in philosophy, pertains to conscious beings alone) is explained in Chapter Two, Section II.

relationships are also appealed to by legal principles involving maternity, paternity, adoption, and inheritance. Nelkin and Lindee note, for instance, "in legal disputes over the custody of children, genetic ties increasingly take precedence over emotional or social ties." They quote a biological father's perspective in a custody dispute, "Adoptive parents can replace the kid. For biological parents, it's not so easy. Your own kid is your own kid."[100] To be sure, there are a wealth of excellent reasons for valuing family relationships. But do shared genetic relations impart a valuable property which is not shared among adoptive family members? We all have genetic origins, and if these origins are essential are genetic relations therefore also of moral value?

Because this investigation will focus on the original genetic make-up that is determined at fertilization, it may shed light upon the implications for organismic identity of various ways to engineer the genotype of an original zygote. Among the more exotic applications of our study is the prospect to contribute a framework for evaluating the moral appropriateness of cloning. The conceptual issues regarding cloning are profoundly social and ethical, and policy does not substantially reflect the social unease about cloning, which may be based largely upon religious and other evaluative assumptions about the "proper" origins of human life. Indeed, these concerns have been raised with respect to other means of reproductive technologies, and in these arenas the justifiability of the interventions is (rather) broadly socially accepted in favor of the value of the lives of the babies produced. In this vein, Dr. Richard Seed predicts that our aversion to human cloning will be eliminated when we see the happy bouncing babies that cloning is sure

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[100] Nelkin and Lindee (1995), p. 151 and 154. This book offers many examples of how genetic relationships are appealed to in legal disputes: see Chapter 8: "Genetic Essentialism Applied."

to produce.[101] Lee Silver defends the genetic manipulation of one's children's genomes as on a moral par with choosing one's partner with whom to have children:

> "people choose a mate, either consciously or subconsciously, based on their genes," through their preferences for partners who are fat or thin or blonde or brunette.... "So we choose the genes we're going to put into our children right from the start."[102]

However, the equal human worth of reproductively assisted babies and parents' hopes for their children's abilities do not remove the burden of evaluating the worth of the technologies that are used to produce them. Carson Strong is among those who have begun to suggest a framework for evaluating the justifiability of cloning, by elucidating good reasons that parents might have for desiring genetically related children, which in some cases may not be feasible except by cloning. However, this type of framework might be criticized if it implicitly or explicitly endorses the gains of individual and privileged parents without benefiting children overall as a group.[103] While a framework for conceiving of identity is surely insufficient for resolving regulatory and ethical issues about cloning, concerns about the identities of cloned offspring are among the more puzzling facets of these ethical and social questions. If we accept a conclusion that genetic engineering fabricates essence, we must still ask ourselves whether such a fabrication is morally permissible. Direction on the issue of identity may be helpful as a groundwork for asking the higher level questions of justifiability.

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[101] *Nightline* (television broadcast), January 7, 1998.

[102] Rick Weiss, "Engineering the Unborn," *Washington Post*, March 22, 1998, page A01.

[103] Maura Ryan argues that artificial means of reproduction can contribute to an objectification of children and demean the value of human reproduction in: "The Argument for Unlimited Procreative Liberty: A Feminist Critique," *Hastings Center Report*, vol. 20, no. 4, 1990.

Finally, genetic similarities are shared among all humans, and to a lesser extent between humans and non-human species. Ethical theories of kin, racial, and species partiality may appeal to contextual issues about reciprocity within moral communities and the breadth of moral obligations. Yet the evolutionary principle that genes replicate themselves identically has offered further weight to arguments which support ethical partiality, in the view that humans are biologically, and hence ethically, meant to ensure the successful replication of themselves and those who match their genetic make-ups most closely.[104] Our study thus leads us to ask whether moral partiality to kin is supported by how closely other organisms resemble one's own genetic essence. Does the identifying essence of an organism tell us to protect those who are most essentially alike to us, or does it support an ethical system which cares for all organisms, who, one might say, share the general property of originating from individual genetic plans?

The ethical implications of a theory of organismic essentialism do not directly unfold themselves.[105] A determination of essential characteristics does not necessarily entail particular outcomes regarding the evaluative personal and social meanings of genetic relationships, and may be open to diverse interpretations. I hope to address these issues in future projects. For the present, our investigation is but a small step forward.

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[104] For discussions, see John Mackie, "The Law of the Jungle," *Philosophy*, vol. 53, 1978; and Elliott Sober, *From A Biological Point of View: Essays in Evolutionary Philosophy*, (Cambridge University Press, 1994), Chapter 5: "Prospects for an evolutionary ethics." For a theory of the evolutionary determination of morality, see Robert Wright, *The Moral Animal:Evolutionary Psychology and Everyday Life* (New York: Pantheon Books, 1994).

[105] For a model of how such implications might be drawn, see John Post, "Getting an Ought from a Biological Is," (Manuscript, 1998).

CHAPTER TWO

Framing the Essentialist Investigation:

Methodological Tools for Evaluating the Gene-Organism Relation

Almost any child perceives that a dog or a bug or a tree is alive and a rock is not. We can recognize life without defining it.[106]

Section I: Genetic Causation

Metaphysical genetic reductionism can be characterized in several ways, but is most commonly regarded as a causal thesis.[107] So much controversy and analysis has surrounded the reducibility of organisms to genetic causes that the present overview greatly simplifies its depth and significance. The playing fields of controversy include issues of primacy regarding nature vs. nurture, the legitimacy of sociobiology as a scientific field, and professional antagonisms between developmental and molecular biologists. And so naturally, the formulations of what is at stake and the tools of analysis are diverse. The unity of these issues may be expressed by the question, "do the processes of genetic causation explain the complete organism?" Since evolution produces organisms by genetic transmission, genes may be viewed as the driving force of life, and genetic integration as the level of causal power upon which all other organismic properties depend.

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[106] Neil Campbell, *Biology*, Second Edition (New York: Benjamin/Cummings, 1990). p. 2.

[107] The causal thesis is often called *genetic determinism*.

Genetic Causation and Behavior: Volatile Questions

The volatility of genetic causal explanations is especially manifest in efforts to explain human behavior, as practiced in the fields of sociobiology and evolutionary psychology. Evolution and genes profoundly influence all animal behavior. For humans, genetic causes are at least largely responsible for behaviors ranging from infant suckling to adult lust. Other genetic explanations for behavior are, to some people, both implausible and repugnant. This is the case with the example of murder and sexual abuse of stepchildren by stepfathers, discussed by Jane Brody for the *New York Times*.[108]

In this article, Brody presents a sociobiological explanation for findings that infanticide of stepchildren occurs at an incidence sixty times greater, and sexual abuse of stepchildren at eight times greater, than rates for biologically related children. According to "the evolutionists," "the underlying trigger... lies within inherently selfish genes, which are biologically driven to perpetuate themselves." As practiced by male animals of other species, human stepfathers may also have biological urges to kill stepchildren rather than aid in supporting them, in order to direct their parenting resources toward the preservation and maximization of their *own* genetic offspring or potential offspring. Though we do not applaud these practices, the sociobiological explanation suggests an "unconscious force that underlies many of the difficulties encountered in stepfamilies."

The sociobiological explanation appears implausible to the extent that it replaces, in the case of stepfathering, the more typical explanations of murder and sexual abuse where the transmission of one's genes is not at issue. Other explanations are more familiar, including the

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[108] Jane Brody, "Genetic Ties May Be Factor in Violence in Stepfamilies," New York Times, February 10, 1998. pp. B9,12. The citations that follow are from this source. See also Robert Wright, 1994a.

causes of "economic stress, low socioeconomic status and emotional instability" that accompany some second and subsequent marriages (and unmarried partnerships) involving previous children. Further, stepfathers live in unusual proximity to children whom they may resent due to their social responsibilities to them without the prior opportunity to develop appropriate parental bonds. Some stepfathers may also have acquired a culturally *learned* disvalue for stepchildren. As a moral issue, we may be more pleased with explanations offered by sociologists, who "tend to reject such intimations of genetic determinism, citing the fact that humans have minds that can override the forces of genetics. They also note the relatively low rates of abuse or other violence in families with adopted children, who share none of their adoptive parents' genes."

Sociobiologists are not equipped to reveal the genetically driven biophysical processes thought to be directly involved in such stepparental aggression, as the molecular components of most animal behaviors are at present poorly understood. These links are inferred by comparison with the behavior of other animals and by statistical analyses that demonstrate how specific traits have contributed historically to successful genetic transmission.[109] It is as though "survival of the fittest" is tautologous, and because organisms are the effects of genetic causes, no other ultimate explanatory course is available.[110] Accordingly, we do not have a revulsion to the common but poorly evidenced belief that people who are depressed and crave chocolate are expressing a genetically encoded and unconscious need for a chemical substance. Here the genetic explanation may be seen as a relief to chocolate lovers!

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[109] For example, male lions sometimes kill the cubs in a pride which they have recently joined.

[110] See Elliott Sober, *The Nature of Selection: Evolutionary Theory in Philosophical Focus.* (Cambridge, Mass.: MIT Press, 1984): Chapter Two, "The Tautology Problem," pp. 61-85.

In contrast with our reaction to the chocolate example, we may be repulsed by the sociobiological explanation of harm to stepchildren because it appears to be justificatory. To be sure, sociobiologists acknowledge human abilities to use reason and ethics to modify our behavior in ways that discord with the usual evolutionary-genetic 'maximization of genetic transmission' methodologies.[111] However, they persist in the view that genes ultimately explain behavior, such that these discordances are byproducts of the human's advanced rational capacities that have shown to be evolutionarily advantageous when all behavior is taken into account. Even so, the evolutionary-genetic explanation need not be regarded as justificatory when the satisfaction of genetically caused urges is deemed reprehensible on separate grounds. (I, for example, get urges to strangle people who chew gum with their mouths open.) However, sociobiology does not always limit itself to a role of discerning genetic causes for behavior, taking on the further task of discerning the ethical truths that are revealed by our genetic natures. For instance, Kitcher illustrates that the founding sociobiologist, E.O Wilson, appears to accept the broad agenda that:

> sociobiology can lead us to revise our system of ethical principles, not simply by leading us to accept new derivative statements... but by teaching us new fundamental normative principles. In short, sociobiology is not just a source of facts but a source of norms.[112]

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[111] Social behavior among animals is explained by appeals to *memes* (units of cultural transmission in evolutionary processes: see Richard Dawkins (1976), p. 192) and *culturegens* ("transmissible behaviors, mentifacts, and artifacts": see C. Lumsden and E.O Wilson, *Genes, Mind, and Culture* (Cambridge, Mass.: Harvard University Press, 1981), p. 7). For example, among groups of the same primate species, some will have learned to insert a stick into ant-colonies to draw them up for snacking. Only groups who learn this behavior from other groups practice it. Such a learned practice might be called a meme or a culturegen. (This example also shows the importance of preserving diverse populations of the same species to collectively enhance the long-term survival potential for the species as a whole.)

[112] Philip Kitcher, "Four Ways of "Biologicizing" Ethics," in Elliott Sober, ed., *Conceptual Issues in Evolutionary Biology* (Cambridge: MIT Press: 1994). p. 440.

The practice of evolutionary ethics is a summit of causal genetic reductionism, and has motivated much of the contempt for sociobiology. Among the refutations of causal genetic reductionism, many are responses to the field of sociobiology.

Questions about the Demonstrability of Causal Genetic Reductionism

One way to defend causal genetic reductionism is to assert that all properties of organisms are produced by the evolutionary-genetic mechanisms of fitness and that all other biological causation is derived from its accordance with the principles of genetic transmission. The works of sociobiology offer an interesting and vast mass of evidence of the fitness-maximization of animal morphologies, functions, and behaviors. Alternatively, causal genetic reductionism may be characterized as a view that "an identical genotype invariably produces an identical phenotype."[113] This view regards an organism's environmental conditions as variables that allow its given genes to determine the single phenotypic (and/or behavioral) outcome appropriate for those conditions. Kitcher offers the further characterization of genetic reductionism as a view that biological explanation proceeds from the smaller to the bigger: "descriptions of cells and their constituents are always explained in terms of descriptions about genes, descriptions of tissue geometry are always explained in terms of descriptions about cells, and so forth."[114] Though these characterizations of causal genetic reductionism may be shown to be distinct, they are all derived from facts about genetic processes, from which causal *completeness* is extrapolated.

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[113] Stewart Newman (1988), p. 122.

[114] Philip Kitcher, "1953 and All That: A Tale of Two Sciences," *Philosophical Review*, vol. 93, 1984. Also in Elliott Sober, ed., (1994), p. 397.

To infer from empirical findings that *all* animal properties are derivative of genetic causation goes beyond mere demonstration. Even the knowledge of all scientists put together would fail to characterize fully the properties of an ameba by reference to genetic causation. Given the complexity of even "simple" organisms, our knowledge of the actual mechanisms of genetic causation is only fractional. Reductionists maintain that such a complete understanding is attainable at least in theory. This leaves causal genetic reductionism open to critique on empirical and theoretical fronts. According to Tauber and Sarker, "although it is traditional among philosophers of science to emphasize the "in principle" possibility of reductionist explanations... such claims... do not provide actual explanations (of biological phenomena)."[115]

Hubbard and Wald aim to discredit genetic reductionism as a practice involving unjustifiable social consequences, primarily by demonstrating the interactive influence of genetic and non-genetic (often represented as *environmental*) causation, and how geneticists manipulate genes and society in order to promote a largely harmful and narrow agenda. Their illustration of the discordance between genetic sciences and social interests is important and compelling. However, their critique of genetic reductionism is weak, as empirical criticisms of genetic reductionism must do more than demonstrate that organisms are produced by the interactions of genes and environments. Reductionists also assert that the transmission and expression of genes relies upon interaction with the organismic environment, which at no level is controlled exclusively by genes. Rather, empirical arguments regarding genetic reductionism must address the concept of *explanatory primacy* of genetic causation, and this consideration is often inadequately met in discourses about genetic reductionism.

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[115] Tauber and Sarkar (1992), p. 232.

Thus there is an onus upon causal genetic reductionists to support their claims that genetic primacy can be demonstrated at an evolutionary or an individual level, but their efforts are beset by empirical limitations. Newman cautions, "the "genetic programming" viewpoint conceals our lack of predictive knowledge about the relationship of genetic change to biological qualities in general."[116] It is not possible to study genetic causality in isolation from environmental input as though we could thus achieve complete understanding of genetic causation. Elliott Sober argues that since genetic and environmental influences can be studied only as *variables* by holding each other as constant factors, the causal primacy of genes can not be demonstrated.[117] Kitcher poses a further problem for claims that animal behavior is fundamentally caused by evolutionary pressures:

> Not only are the mechanisms and developmental processes underlying behavior often unknown, but we are usually ignorant about the appropriate classifications of animal behavior. It is one thing to describe a moth as speckled or dark, but another to claim that it is "'defending its territory' or that baboons are 'appeasing a dominant member of the troop'".[118]

The classification of human behavior may be equally ambiguous. For instance, the Anne Campbell compares female and male hostility and concludes,

> Women tend to view crime as work rather than adventure.... For example, women spend more of the proceeds of non-violent crimes on staples rather than luxuries. And women often commit violent crimes against other women with the very pragmatic purpose of attracting the protection and financial support of a "well-resourced" man.[119]

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[116] Stewart Newman (1988), p. 366.

[117] Elliott Sober, "Apportioning Causal Responsibility," *Journal of Philosophy* (1988).

[118] Philip Kitcher (1987), p. 123.

[119] Abigail Zuger, "A Fistful of Hostility Is Discovered Among Women," *New York Times*, July 28, 1998. p. B12.

Campbell's explanations of female crime may fit our available evidence, but we may wonder on what grounds violence against rival suitors of a man is categorized as protection-seeking rather than based upon reasons offered for male violence against rival suitors. In turn, how can we determine how much of the gender disparity for violence is contributed genetically and how much is a product of different social roles and opportunities? Questions about genetic causation are similarly tangled up with questions about non-genetic causes. Michael Meany describes efforts to distinguish genetic causes from others as "like asking which contributes more to the area of a rectangle-its length or its width."[120] Altogether, the data that would be required to demonstrate genetic primacy are largely ill defined and undemonstrable. On the other hand, many philosophers and biologists claim that the *failure* of genetic primacy can be demonstrated.

Non-Genetic Causation: Interactionism, Randomness, Emergence

Antireductionists maintain that the nature of the interaction between genes and nongenetic causes is based on integrated levels of causation. An array of non-genetic causes has each been said to undermine the primacy of genetic causation. These include the causative roles of non-genetic cellular components,[121] parents and gestational nurturing,[122] motivation,

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[120] Geoffrey Cowley (1989), p. 98.

[121] Richard Lewontin (1991).

[122] Cohen and Stewart (1994), pp. 78-84.

thought, and emotion,[123] hierarchical levels of organization,[124] and the anti-causal role of chance.[125] These causes work together as a process in which no element can be considered as an end-product from which all other causes are derived or in whose service all other causes act. Lewontin illustrates that a phenotype that works well in a given environment may serve poorly in another, so that environmental input determines the outcome of genetic transmission.[126] And while environments influence genes, organisms are constantly transforming their own environments by acts of consumption (i.e., food, energy, and air intake) and production (i.e., heat and waste). The process is never static and is not driven toward an end product.[127] Lewontin expresses the dependence of genes upon environments: "In a very important sense, the physical forces of the world, insofar as they are relevant to living beings, are encoded in those beings' genes."[128]

Genetic interactions with other causes involve a great deal of variance in outcome. The sexes of several animals, including anglerfish and bonnelia, are derived from their environmental contexts.[129] Other traits are determined by an array of genetic properties. For instance, Cystic

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[123] John Compton, "Human Science, Human Action, and Human Nature," Tulane Studies in Philosophy (1979); and P.F. Strawson, "Freedom and Resentment," Proceedings of the British Academy, vol. 187, no. 210 (1962).

[124] Ethel Tolbach, "The Methodology of Sociobiology from the Viewpoint of a Comparative Psychologist." in Arthur Caplan (1978).

[125] Richard Lewontin (1991).

[126] *Ibid.*, p. 28.

[127] Thomas Fogle (1995), p. 543.

[128] *Op. cit.*, p. 117.

[129] Cohen and Stewart (1994).

Fibrosis is caused by a variety of genetic anomalies, some of which produce lesser manifestations of the disease. A small number of mutations account for the majority of Cystic Fibrosis, while, according to Francis Collins, "the remaining 25-30% (of cases of CF) is accounted for by more than 100 other mutations, only a few of which reach individual frequencies higher than 1 percent of CF chromosomes."[130] Causes of organisms do not all originate with genetic processes, and are not derived entirely from genetic causes. Organisms are products of interactions among diverse conditions and in turn influence the conditions of their own and others' lives.

A further consideration against causal genetic reductionism is the involvement of random phenomena among genetic and organismic processes. Such phenomena lie outside the realm of deterministic natural laws, and include chance physical events at all levels of physical organization. Degrees of randomness may influence particulate movement that may, for example, produce ionization, as well as the progression of thought processes and even the outcomes of vast physical events. Lewontin concludes, "even if I knew the genes of a developing organism and the complete sequence of its environments, I could not specify the organism"[131]

Perhaps implicit in many antireductionist appeals to integrated levels of causation is the recently developed concept of emergence. This concept refers to the layering of properties of complex objects, where successive levels of integration manifest properties that cannot be

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[130] Francis Collins, "Medical and Ethical Consequences of the Human Genome Project," *Journal of Clinical Ethics*, vol. 2.

[131] Richard Lewontin (1991), p. 26. The concept of physical randomness is discussed at length in Chapter Four, Section II.

understood when the properties of component parts are compiled together.[132] This view has recently gained credence among many philosophers of biology. Mayr holds,

> systems almost always have the peculiarity that the characteristics of the whole cannot (not even in theory) be deduced from the most complete knowledge of the components, taken separately or in other particle combinations.... Explanatory reduction is incomplete, since new and previously unpredictable characters emerge at higher levels of complexity in hierarchical systems.[133]

Finally, Kitcher explains that antireductionism is defensible both "as the thesis that there are *autonomous levels of biological explanation*" and as

> a stronger doctrine... [that] resist[s] the weaker reductionist view that explanation always flows from the level up... resist[ing] the picture of a unidirectional flow of explanation. Understanding the phenotypic manifestation of a gene, [antireductionists] will maintain, requires constant shifting back and forth across levels. Because developmental processes are complex and because changes in the timing of embryological events may produce a cascade of effects at several different levels, one sometimes uses descriptions at higher levels to explain what goes on at a more fundamental level.[134]

The mechanisms of genetic causation appear to be mutually integrated with other forms of organismic causation. If any level of causal organization is to be regarded as primary, it is the level of complete organismic integration that allows each cause to exert itself.[135]

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[132] For an explanation of the concept of emergence, see R.W. Sperry, "Structure and Significance of the Consciousness Revolution," *Journal of Mind and Behavior*, vol. 8, no. 1, 1987. Discussions from philosophy of mind offer a useful resource for conceptualizing biological causation. Offering a view of biological causation as macrodeterminist and involving emergent properties, Sperry claims, "Is the consciousness revolution a revolution for all science? I believe it is and that the behavioral sciences may be leading the way to a more valid paradigm for science in general" (p. 46).

[133] Ernst Mayr (1982), p. 63-64. See also Varda Burstyn (1993).

[134] Philip Kitcher (1994), p. 397.

[135] According to John Dupre, "we have much better reasons for believing in the genuine causal efficacy of macroscopic objects than we have for insisting on the causal completeness of the microphysical." ("The Disorder of Things: Metaphysical Foundations of the Disunity of

Unresolved Questions

Controversies about the primacy of genetic causation are certain to persist as genetic explanations move ahead with great momentum. A cartoon illustrates the puzzling character of efforts to discern genetic primacy. A man in a labcoat explains to his colleagues, "Dr. Farnsworth is attempting to isolate the gene that makes people do this sort of thing for a living."[136] But to assert that genetic explanations are not the whole picture does not complete the task of the antireductionist. The complex concepts of genetic interaction, physical randomness, emergent properties, and explanatory levels "obviously cry out for explanation," to borrow Kitcher's phrase.[137] The apparent failure of causal genetic reductionism does not undermine the utility of reductive methodologies that assist geneticists in offering *partial* explanations of life-processes. Similarly, our consideration of genetic explanations of organismic *identities* may proceed without repeating the errors of causal reductionism. Perhaps genetic properties essentially constitute the persistence of organisms through change, while interacting with other kinds of irreducible causes. Here geneticist Barbara McClintock's view resonates, groundbreaking in its time, and here described by Fox Keller:

> a view of DNA in delicate interaction with the cellular environment – an organismic view... [where] no longer is a master control to be found in a single

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Science" (Precis of Books), *Proceedings and Addresses of the American Philosophical Association*, vol. 68, no. 3, 1995. p. 85).

[136] Thomas Fogle (1995), p. 536.

[137] Philip Kitcher (1994), p. 398.

component of the cells; rather control resides in the complex interaction of the entire system.[138]

Section II: Definitional Clarifications Regarding "Organism"

Organism as a Biological Sortal

To note the imprecision and disparate intentions by which people understand biological terms might lead one to doubt that biological entities exist. Philosophers notwithstanding, few people seriously doubt (except perhaps in amusement) the determinate existence of the scientific world, in spite of our frequent failures to grasp it clearly. Simply put, our conceptual confusions regarding biological entities reflect upon *us*, and not upon a deficiency in the perceived world itself. As David Wiggins remarks, "it was there before we picked it out–its *modus essendi* is prior to its *modus intelligendi.*"[139] Indeed, imprecise usage of scientific terms like "black hole," and "relativity" may be expected of non-scientists, as these things are complex and remote from common understanding. Yet how can we explain our confusions regarding the various terms and concepts for *ourselves* and each other–biological objects which are immediate to us? Our understandings of terms like "human organism," "homo sapiens," "human being," "man," "woman," and "person" are normally sufficiently clear for the uses of common discourse. But as these objects are conceptualized in popular discourse, their meanings may become obscured by

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[138] Evelyn Fox Keller, "Feminism and Science," in Nannerl Keohane, Michelle Rosaldo, and Barbara Gilip, eds., *Feminist Theory: A Critique of Ideology* (Chicago: University of Chicago Press, 1982), p. 125. Cited in Sylvia Tesh (1988).

[139] David Wiggins, *Identity and Spatio-Temporal Continuity* (Oxford: Basil Blackwell, 1967). p. 42.

evaluative issues regarding the *meaning* of human existence. Since the same biological object may be interpreted variously within distinct sorts of categories–body (a general object), homo sapiens (a member of a biological species), drunkard (an object of behavioral judgement)–my intent here is to be clear that the sortal by which we are considering the object whose essence we aim to consider is the *individual organism, conceived biologically.*

The biological concept of human organism is frequently obscured by the importance of regarding humans also as special psychological beings whose persistence is "of life or death importance." Philosophy devotes a distinct discipline to this concept, developing the specialized term, "person," for use in the sense of a unified and persistent psychological being. For our purposes, however, a strictly biological regard of organisms allows us to circumvent the distinct and possibly intractable issues concerning psychological identity, such as when the death of the "person" occurs. These questions are also interesting and important, but the present investigation allows us to ground our focus on biological relationships in empirical discovery. By clarifying our usage of the term *organism,* we ensure that our search for identity conditions does not wander among distinct conceptions that may not be coextensive in all cases, thereby leading us to incompatibilities.

"Brain-death" as an Illustration of the Sortal Problem

Discussions regarding the revision of criteria for human death illustrate the conflation of biological terms with non-biological considerations. The redefinition of human death in America in 1968[140] was occasioned by the moral dilemma concerning patients whose integrated bodily

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[140] Report of the Ad Hoc Committee of the Harvard Medical School to Examine the Definition of Brain Death: "A Definition of Irreversible Coma," *Journal of the American Medical Association*, vol. 205, no. 6, 1968. pp. 85-88.

functioning was maintained by respirators, though they have suffered irreversible loss of consciousness.[141] These bodies were unavailable for organ donation and the removal of life-support was regarded as morally problematic, since the patient was not dead according to traditional criteria, although the removal of life-support would produce immanent cessation of the patient's integrated functioning. (The maintenance of life-support for permanently unconscious organ donors is necessary to maintain blood-perfusion, thus preserving optimal integrity of the donor organs). As a consequence, the medical community responded by replacing the former definition of death with a new concept of "brain-death" for these patients. Though technological assistance allows brain-dead patients to breathe, pump blood, and maintain homeostasis, they would now be declared "dead;" thus inappropriate life-support measures could cease, and their organs could be made available to recipients as appropriate. In a move differentiating the process of human death from the deaths of other organisms, peculiarly human needs were invoked to justify parting with the former species-unspecific definition. Michael Lavin notes,

> Against the traditional definition of death, revisionists offered an alternative. Patients, the new story went, ought not to be viewed as mere organisms. Even though traditionalists recognized that patients are animals, they had forgotten that they are magic animals.[142]

Lavin is critical of the infusion of moral criteria into what he regards as a properly universal process in (at least multi-cellular) animals: "the basic problem with the mentalist definition is that it attempts to make a particular biological change, death, coincide with a change in moral

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[141] Lawrence Becker, "Human Being: The Boundaries of the Concept," *A Philosophy and Public Affairs Reader*, p. 356; also in M. Cohen, T. Nagel and T. Scanlon (eds.), *Medicine and Moral Philosophy* (New Jersey: Princeton University Press, 1982). This definition was also necessary to allow for medical experimentation on brain dead patients who, unlike cadaveric subjects, have integrated functioning.

[142] Michael Lavin, "Separating Death from Mind and Morals," *Public Affairs Quarterly*, vol. 3, 1989. p. 38.

standing."[143] Yet, he acknowledges the moral importance that "the current practice of declaring brain-dead patients dead has had a beneficial influence on medical practice."[144]

Lavin and other critics of the redefinition of human death insist that while the moral (im)propriety of sustaining patients who have suffered irreversible loss of consciousness must be confronted, the concept of death itself belongs to the domain of biological rather than moral authorities.[145] Green and Wikler contest this need to defer to biologists, regarding death as a conceptual rather than a strictly objective phenomenon:

> Scientists command autonomy in setting some definitions, whether in the course of paradigm shifts or in ordinary science.... The change in the definition of death, however, does not seem to be the sort of response to scientific needs that commands our allegiance.[146]

Green and Wikler appeal to concordance with common understandings of death and of the concept of personal identity to support the revised definition. They assert, for instance, that "our analysis of the matter will vindicate the common intuition that Karen Quinlan was already dead while what was once her body continued to live."[147] Indeed, Green and Wikler's characterization of public sentiment is not unproblematic. Against their claim, Lavin suggests,

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[143] *Ibid.*, p. 45.

[144] *Ibid.*, p. 35.

[145] See also Lawrence Becker. David Lamb, who endorses the adoption of brain-death criteria for death, also maintains that his definition is properly biological, though his construal of the biological relations constituting death accords with the brain-death criterion (*Death, Brain Death and Ethics* (Albany: State University of New York Press, 1985)).

[146] Michael B. Green and Daniel Wikler, "Brain Death and Personal Identity," *Philosophy and Public Affairs Reader*, vol. 9, 1982. p. 56; also in M. Cohen *et. al.* (1982).

[147] *Ibid.*, p. 51.

"people take their life to be the life of a human being, not of a brain or even of a conscious human being."[148] Robert Truog suggests a final resolution to this dispute which does not cater to the contingencies of medical regulations. He offers:

> The concept of "brain death" remains incoherent in theory and confused in practice. Moreover, the only purpose served by the concept is to facilitate the procurement of transplantable organs.[149]

Truog recommends that the redefinition itself should be "put to rest."

The many terms of the language of human life, death, and brain-death all arise in order to invoke useful divides. And though distinctions between classes of human and other organisms often appeal to real distinctions in nature, these distinctions are invoked for ideological purposes in the redefinition of death. The attempt to replace the concept of human death with "brain death" mischaracterizes a process that we share with other animals.[150] Though the term is useful for characterizing the permanent loss of brain function, death of this single organ is not identical with death of the organism in cases where artificial life-support maintains the integrated integrity of the body. "Upper brain-death" may indeed indicate death of the stipulated "person," but the human organism may still be alive. This organic nature of death is obscured when philosophers and physicians infuse peculiarly human concerns with a more broadly biological process.

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[148] Michael Lavin (1989), p. 43.

[149] Robert Truog, "Is It Time to Abandon Brain Death?", *Hastings Center Report*, vol. 27, no. 1, 1997. p. 29.

[150] As noted by Robert S. Morison ("Death: Process or Event?", *Science*, vol. 173 (1971), an understanding of animal death depends upon the kind of animal in question; for instance, "the conventional concept (of death) has usually not been applied to organisms that reproduce themselves by simple fission."

In this project, I regard human organisms in a biological sense, without infusing evaluative qualities that attend exclusively to the rational or experiencing nature of organisms into the concept. Whatever more we may be, humans are all organisms, and the conditions of organismic identity are at issue even if the identity of the psychological being is not always maintained therein.[151]

The Empirical Organism: Organisms as Class, Species as Class, Organisms as Individuals

Our understanding of what an organism is appears to be basic, and plays an important role in human activity. The ability to recognize family, community, animals and plants is indeed integral to many animals' survival. For our ordinary needs, we need not consult with biologists to identify these objects. We readily identify something as an organism in the senses of distinguishing it from non-organisms (identifying them as objects belonging to the class or group, *organism*), and of noting its identity through time and change (identifying them as particular *individuals*). We also identify individual organisms as members of species (objects belonging to this class or group, *species*), but the layperson's ability to distinguish among the approximately 10 million species of organisms is less successful. As we shall see, assertions that each of these classes of organisms have essences demand different standards of justification. Our ultimate concern is the identity of organisms as *individuals*: what about the organism allows us to note it as a singular persisting individual?

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[151] Eli Hirsch makes a similar distinction in "Essence and Identity," in Milton Munitz (ed.), *Identity and Individuation* (New York: New York University Press, 1971): "It is intended that the expression 'physical object' should exclude from consideration persons... which would introduce special difficulties" (p. 31).

The Class of Organisms: Our ability to classify organisms without the aid of advanced biology reflects natural distinctions in them. Young children are able to identify animal and plant life, and Aristotle's empirical studies more than two millennia past led him to classify organisms into categories similar to those which we use today. He says, "of natural bodies, some have life and some do not; and it is self-nourishment, growth, and decay that we speak of as life." Our success in segregating organisms from non-organisms is facilitated by their distinctiveness as individual objects, whereby they avail themselves to be classified. The category of organisms is thus said to belong to the class of "natural kinds," objects whose natural properties determine objective principles of classification, and which in Plato's words, "cut nature at her joints." This compares, for instance, with constellations, which although comprised of natural objects, are organized into categories by artifice. Natural kind objects thus have certain properties necessarily which constitute their membership in the group, as defined by Baruch Brody:

> we shall say that any property had essentially by some object and accidentally by none determines a natural kind, and that the set of objects having that property is a natural kind.[152]

Although we shall not determine the property/ies which constitute the essence of organisms as a natural kind (class), it is thought that if the existence of natural kinds is defensible, plants and animals are among their clearest exemplars. Some candidates for the class of organisms are less than clear, however. Stony corals may at first appear to be rocks. It is by studying them more closely that we, perhaps aided by biological scientists, discern properties which reveal them to be living. In general, an organism's specific and complex organization tells us beyond doubt that "this object belongs to the class of living things." This premise allows us to

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[152] Baruch Brody, *Identity and Essence* (Princeton: Princeton University Press: 1980). p. 131. Indeed, some philosophers reject the concept of natural kinds by denying the concept of essential properties.

ask whether, for given organisms, as well as belonging essentially to the kind *organism*, there exists a common principle determining their *individual essences*.[153] According to Husain Sarkar,

> While individual essences are sufficient to individuate the bearers of those essences, general essences are not, although they presumably individuate natural kinds and such.[154]

Biologists offer several criteria which can suffice to determine whether an object is an organism, ultimately the most complex of objects known. Accrediting biology with both justification of method and with general success, we can begin our investigation from "a biological point of view."[155] Many biologists define organisms by their genetic properties, but others resist efforts to define them. All agree that a number of unique features, taken together, are sufficient to ensure the presence of an organism.[156] The distinctiveness of the class of organisms is supported by the typical coalescence in them of several complex and interdependent qualities, a few of which I now offer.

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[153] The natural kind to which an organism belongs is also thought to contribute to its individual essence. That is, for the individual to exist, it must remain a member of its natural kind (i.e., organism). See Baruch Brody (1980) and David Wiggins (1967). Aristotle says, "it is not by accident that man has animal for one of its elements" (*Metaphysics*, Book VII, Chapter 14, 1039b 7-8).

[154] Husain Sarkar, "Origins and Identities," *Australasian Journal of Philosophy*, vol. 60, no. 2, 1982. p. 148. Sarkar defines general essences as "certain properties as being necessarily true of certain objects," so that one may seek, for instance, the essence of *being a table* (p. 148).

[155] This is the title of Elliott Sober's 1994 book.

[156] Aristotle's Greek language did not include a noun paralleling the meaning of our term, *organism*. His expression, "empsuche somatos" designates a 'living body,' and in this sense it captures a sense of *process* which many biologists claim is preferable to the use of an object-noun. Although the term organism is often equated with life, or life-form, organisms need not be alive at all times in their existence. To call a *dead organism* such, of course, is derivative of its having been alive earlier in its existence.

Organisms are material beings. Whether or not we may be able to conceive of, or enjoy, disembodied life, the concept of organism always implies *embodiment.* Other characteristics of organisms distinguish them from other material objects, representing particular aspects of biological organization. This organization manifests itself in part/whole causal interrelations that function at microscopic, and when the organism is large enough, macroscopic levels.[157] The list here is incomplete, but should suffice to identify organisms as a natural kind.

First, organisms are comprised of cells (at least one cell). Helena Curtis stresses the importance of cell theory:

> The cell theory is of tremendous and central importance to biology because it emphasized the basic sameness of all living systems and so brought an underlying unity to widely varied studies involving many different kinds of organisms.[158]

Second, organisms manifest developmental processes, such as growth, nourishment, and decay.[159] Here the organism is not a *mere* organization of matter, but matter with a tendency for futureward behavior.[160] Further, this property derives from within the organism itself rather than being imposed by another object, such as the developmental nature of a machine. Curtis notes,

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[157] Elliott Sober, *Philosophy of Biology* (Boulder, Colo.: Westview Press, 1993), p. 150.

[158] Helena Curtis, *Biology*, Second Edition (New York: Worth Publishers, 1976). p. 90.

[159] This list originates with Aristotle.

[160] See Chapter Four, Section I, for a consideration of the *teleonomic* conception of organisms, in contrast with the teleological view which Aristotle offers.

> Living things contain within themselves the information by which they create their own organization and by which they carry out the other functions characteristic of living things.[161]

Third, organisms possess genetic organization which functions in their development. According to Mayr,

> except for the twilight zone of the origin of life, the possession of a genetic program provides for an absolute difference between organisms and inanimate matter.[162]

Genetic matter may be present in different modes of organization within the organism's cells: it may be dispersed in cell, as is the case in prokaryotes; and in eukaryotes the genetic material is found in the nucleus and the mitochondria, as is the case with humans. To be sure, viruses also possess genetic programs, and biologists have asked whether they are also organisms. Their exclusion of viruses from this class is based, in part, on the absence of cellular organization and the inability of viruses to function without "borrowing" the developmental structures present in a host organism whom, as we say, they "infect."

This selection of properties, taken together, should leave scarce doubt about whether an actual object is or is not an organism. If we find, nevertheless, that the qualities which serve to identify organisms are also possessed by viruses, we may say that they share the *identifying principle* of organisms (i.e., supposing that this principle regards a type of genetic origin shared by organisms and viruses) without saying also that they *are* organisms.

It is a premise of this project that a class of organisms exists for which we seek to establish identity conditions. The objective reality of species-classifications is unnecessary for

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[161] Helena Curtis (1976), p. 90.

[162] Ernst Mayr (1982), p. 55.

our study. While the concept of organisms as natural kinds requires (merely) the *existence* of some group of objects which share property of life, for species to be natural kinds requires a further principle of *how* organisms are objectively segregated into distinct groups by nature; a requirement that is challenged by contingencies implicit in evolutionary processes. Indeed, the concept of species as natural kinds is a subject of significant philosophical controversy, though we all appeal to species classifications to serve our needs.

The Class of Species: The concept that species are natural kinds has many critics whose arguments are based upon the failure of evolutionary principles to segregate organisms into absolutely distinct groups. The concept of objective species-classification by evolution originates with Charles Darwin who claims,

> From the most remote period in the history of the world organic beings have been found to resemble each other in descending degrees, so that they can be classed in groups under groups. This classification is not arbitrary like the grouping of the stars in constellations."[163]

David B. Kitts and David J. Kitts argue more recently that species are real and that genetic matter serves as the underlying trait of individuals objectively united in species membership.[164] Others have claimed that by reconceptualizing species as individuals, problems regarding species-essences are overcome so that the essentiality of species groupings may be preserved.[165]

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[163] Charles Darwin, *The Origin of the Species by Means of Natural Selection or the Preservation of Favored Races in the Struggle for Life*, Modern Library (New York: Random House, year not given), Chapter XIV, p. 318. (First Edition: 1859.)

[164] David B. Kitts and David J. Kitts, "Biological Species as Natural Kinds," *Philosophy of Science*, vol. 46, 1979.

[165] See D. Hull, "A Matter of Individuality," *Philosophy of Science*, vol. 45, 1976; and M. T. Ghiselin, "A Radical Solution to the Species Problem," *Systematic Zoology*, vol. 23, 1975. For refutations of this view, see Kitts and Kitts (*ibid.*); Marc Ereshefsky, "Species, Higher Taxa,

However, the randomness involved in evolutionary processes seems to undermine the reality of species essences. Perhaps Aristotle is the originator of the view of the continuous gradations between species; in his mention of 580 kinds of animals he notes borderline cases where proper classification is indistinct.[166] John Dupre argues that although it is appropriate to stipulate distinctions between species to achieve the benefits of a classification scheme, the lines of distinction do not express essential lines in nature but contingent groupings of select characteristics. He says, "there is nothing more to the discovery of a [species] kind than the discovery of the correlations of properties characteristic of the members of the kind."[167] Because evolution involves random processes of mutation and interbreeding, its outcome is not neatly cut up into distinct groups. For instance, genetic properties may vary as much between some members of the same species as they do among individuals separated into distinct species. Reproductive isolation is not definitive of species, as members of distinct species may successfully mate, and because this isolation is produced largely by contingencies of geographic separation. Furthermore, evolutionary pathways are never static and do not normally involve

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and the Units of Evolution," *Philosophy of Science*, vol. 58, 1989; and Robert McIntosh, "The Myth of Community as Organism," *Perspectives in Biology and Medicine*, vol. 41, no. 3, 1998.

[166] Aristotle's classification scheme is hierarchical, and admits of possible "in-betweens" classifications: "sponges are hardly more than plants; ascidians (sea-squirts) have more of animal nature... they cannot live detached but have a fleshy substance and so are probably capable of some kind of sensation (*Parts of Animals*, 681a9-12, 25-28).

Helena Curtis (1976, p. 286) also notes, for instance, that "at the one-celled level of life, there are no useful criteria for separating plants from animals. One finds two species of single-celled motile organisms almost identical in most useful respects except that one has chloroplasts and one does not." Some such organisms with chloroplasts can lose them from time to time and still continue to survive and reproduce indefinitely.

[167] John Dupre, "Sex, Gender, and Essence," in Peter French, *et. al.*, (1986), p. 441. Dupre's argument may also be used to undermine the concept of objectively real racial classifications.

determinate points of segregation between given populations.[168] As a result, the set of properties by which a species is defined must be stipulated as needed to result in a useful segregation.[169] Dupre summarizes: "It is not that there are no "joints" at which nature can be carved; it is rather that there are too many."[170] The contingencies of species-classification may become more evident when likened to more forced efforts to find common features; for instance, "the botanist Cesalpino compared the roots of plants with the stomach of mammals, the stem with the heart, and so forth, because the equivalent organs had similar functions."[171] Saul Kripke shares the sense that species do not have essences, regarding species-terms as "cluster concepts," where sufficient satisfaction of properties in the cluster is constitutive of belonging to the group.[172] Elliott Sober adds, "biologists treat species as *historical entities*. They do not conceptualize species as natural kinds."[173] While the stipulation of species categories is assuredly purposeful, the membership of an organism in a species is not of necessary relevance to the determination of its individual essence.

The Individual Organism: When regarding organisms at the level of *individuals*, further problems may arise when we consider their *individuality*. Many species challenge our efforts to

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[168] The relation between evolutionary processes and organismic identity is explored in depth in Chapter Four, Section II.

[169] John Dupre, "Natural Kinds and Biological Taxa," *Philosophical Review*, vol. XC (1981).

[170] John Dupre (1995), p. 85.

[171] Ernst Mayr (1982), p. 457.

[172] Saul Kripke (1972), p. 120.

[173] Elliott Sober (1993), p. 148.

discern boundaries constitutive of a single organism. Stony corals, for instance, may be over a meter across, but they are actually composites of thousands of individual organisms. Their colonization aids each in its survival, and in a sense the collection appears to function as a single organism. Even humans are collections of numerous organisms, as microorganisms such as the e. *coli* that inhabit our digestive tracts are necessary for our survival; yet this symbiotic relationship does not make all members a single organism. On the other hand, what appears to be many organisms may be only one. Groves of thousands of aspen trees may be said to be a single organism, as "parent" trees spread roots that surface the ground to produce new trees, resulting in near genetic identity among all trees produced by the same original source.[174] (Genetic mutations will result in minor differences among the trees, as well as among the cells of a given tree.) A closer examination of the biological properties of organisms will in most cases suffice to distinguish each individual. In remaining cases where established principles of organic life do not decisively answer the question "how many organisms?", our ability to determine identifying conditions of the individual may be impaired. Individual identifying essences presuppose that the object is one.

A further problem for the determination of individuality that applies to every species is the indeterminacy of time at which organisms come into and go out of existence. Death, as well as the origination of organisms, is a process rather than a momentary event.[175] This leads us to the problem of determining whether, during the time-span of origination or death, the organism does or does not exist. However, as the case of death makes unpleasantly clear, the absence of a momentary defining event does not preclude a distinctive reality.

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[174] *Ibid.*, p. 151.

[175] See Robert Morrison (1971).

A final problem for determining the individuality of an organism is its potential for fission into two or more. Problems that fission may pose for individuation are well-known in analyses of personal identity, where fission of the "person" is a predominantly theoretical/ futuristic possibility. The potential for future fissions is a less speculative problem for organisms. Mitotically reproducing organisms directly produce two organisms from one. And meiotic reproduction may also produce two from one in monozygotic twinning processes early in embryonic development. Perhaps even more vexing for the concept of individuation, meiotically producing organisms may be cloned even in adulthood as shown by the case of Dolly the sheep, so that "final singularity" of an organism may never be knowable with certainty. Again, these problems of individuation do not undermine the natural kindness of organisms, but must be considered in our efforts to determine how the identity of individual organisms is discerned. In inconclusive cases, we may appeal to Elliott Sober's principle:

> I suspect that no scientific concept is absolutely precise; that is, for every concept, a situation can be described in which the concept's application is indeterminate. Essentialism can tolerate imprecisions of this sort.[176]

Indeed, the natural kind uniqueness of organisms does not provide an answer for every question regarding individuality. Where boundaries cannot be drawn according to natural and decisive divisions, an identifying essence may elude us.

Some Further Distinctions: Genotype and Genome, Nuclear and Extranuclear DNA, Mitosis and Meiosis

Before we investigate the relationship between an organism and its genetic make-up, we need to clarify some characteristics of DNA in its cellular environment that will arise in our

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[176] *Op. cit.*, p. 148.

search for organismic essence. Most important for our needs is a clarification of our usage of *genotype* and *genome*.

The words genotype and genome are often used imprecisely to refer to some aspect(s) of genetic constitution, and for general purposes imprecise usage is adequate to convey the intentions of the speaker. But genetic constitution has distinguishable facets, and involves different components according to differing regards of the organism. In its standard usage, both genotype and genome normally refer to genetic constitution *in the context of a cell*, and our present needs are in keeping with this regard.[177]

The genetic material in a cell can be characterized both as a representation of a formal code, and as the embodied matter present in an individual. *Genotype* represents a formal genetic code which produces a particular range of phenotypes in appropriate conditions, and thus can be represented by code. The genotype of the multicellular organism is thought of as deriving with the originating cell of the organism: "strictly speaking, the genotype describes the complete set of genes inherited by an individual."[178] Though actual genotypes are based upon embodied organisms, they are abstractions of genetic configuration, and so can be shared among organisms: "organisms share the same genotype if they have the same set of genes."[179] While geneticists do

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[177] Alternative uses may refer to the genetic constitution of a virus (not a cell); to genetic constitution separated from a cell (as in chromosomal analysis of genetic fragments that are not *in situ*); or to the genetic constitution of an entire multi-cellular organism (whose cells may contain different genetic constitutions due to mutations). Uses of *genome* and *genotype* in these specialized contexts may lead to some confusions; for instance if it is intended to refer to the whole multicellular organism it contributes to a misleading conception that the organism's genetic constitution is identical in each of its cells.

[178] Anthony Griffiths, Jefrey Miller, David Suzuki, Richard Lewontin, and William Gelbart, *An Introduction to Genetic Analysis*, Fifth Edition, (New York: W.H. Freeman and Company, 1993). p. 12.

[179] *Ibid.*, p. 12.

not focus upon genotype as a multiply instantiable configuration, but rather for its effects upon the organism(s), the concept of formal configuration becomes central as our investigation proceeds. *Genome*, on the other hand, represents a cell's entire collection of genetic matter, and is materially present within a given cell: "each cell in an organism has one or two sets of the basic DNA complement, called a genome. The genome itself is *made up of* one or more extremely long molecules of DNA that are called chromosomes."[180] Again, though the cells of a multicellular organism may contain nonidentical genomes due to mutations, the genome of the originating cell from which descendent cellular genomes are produced may be regarded as the genome representing the whole organism. (The issue does not ordinarily arise since the genomes of each cell in the organism are overwhelmingly similar; except, e.g., in cases of irradiated or cancerous cells which are thus distinguished from the 'normal' organismic genome.) So while the genotype is conceived as the formalized genetic structure of a cell, the genome involves the situated matter of the cell's genetic constitution. To be sure, a genome always expresses a genotype, and though these cannot function independently of each other even in theory, the configurative and material aspects that make up an organism's genetic qualities can be distinguished. In sum, genetic constitution involves both genotypic (configurative) and genomic (material) aspects. I use the terms *genetic constitution* and *genetic make-up* to include each of these specific aspects.

Interestingly, the genetic constitution of cells is not isolated in their nuclei (here we speak only of eukariotic cells, as prokariotic cells such as bacteria lack nucleus partitions for chromosomal material). Mitochondrial DNA is present in the mitochondria of animals, and thus in the extranuclear cell. Mitochondrial DNA encodes for proteins which the mitochondrion uses

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[180] *Ibid.*, p. 2.

in the synthesis of energy, and functions much like nuclear DNA; in fact, "some specific subunits are encoded by mtDNA in one organism but by nuclear DNA in another."[181] Although we may not think of cellular mitochondria when we think of genotypes and genomes, mitochondrial DNA serves as crucial a role in protein synthesis as DNA present in the nucleus, and anomalies in mitochondrial DNA can produce disease. However, it is unique from nuclear DNA in that it is not inherited by meiosis but from the mother, who contributes an organism's extracellular origin with the contents of the egg. In plants, chloroplasts also contain extranuclear DNA that is transmitted by the maternal plant.

The significance of the presence of extranuclear genetic material in cells is that the organism's genotype and genome do not exist in complete distinction from the extranucleic environment; nor do they manifest a uniform means of transmission to an offspring. Whatever role genetic constitution may play in the identity of an organism, it cannot be regarded as independent from the complete functioning cell.

The distinction between meiotic (sexual, two-parent) and mitotic (asexual, one "parent") generation of organisms does not play a central role in this study. Most philosophical literature considering the essence of organisms attends foremost to the human organism, and so may be thought to apply directly only to meiotically reproducing organisms. However, authors may not specify whether they are considering the essence of animals alone or of plants as well, and seldom distinguish between meiotically and mitotically reproducing organisms. While we ought to keep in mind the class(es) of organisms which authors whom we consider discuss in developing their own views and theories, our own interests need not distinguish between meiotic and mitotic generation of organisms. Provided that an organism has a definable origin involving

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[181] *Ibid.*, p. 620.

a genetic process of generation, the principles that we shall appeal to as essence-conferring appeal to organisms *generally* as a natural kind.

In considering the essence of individual organisms all together, I hope to invite a greater sense of unity between human and other forms of life. Our tendency to subordinate the biological world to human intent has engendered a moral neglect of our ecosystems and contributed to wasteful practices which our planet cannot long endure. This investigation embodies an effort to reject an anthropocentric point of view. As humans, frogs, and trees are grouped together by the premise of genetic origins, our study achieves wide applicability and appreciates *common*, as well as distinct properties we share with all of our living cohabitants on this planet.

Section III: The Essentialist Method

Individual Essences

Husain Sarkar says, "the essentialist doctrine of individual essences claims that some or all objects have properties which are so intimately associated with the object that nothing else could have precisely those properties without being that object."[182] Some philosophers reject this doctrine.[183] However, living beings tend to be such specialized and discreet objects that many of us share the expectation that properties can be discerned that constitute their individual essences.

The question of organismic essence arises when we consider the sorts of possible and counterfactual circumstances that an organism may endure without altering its identity. Kripke

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[182] Husain Sarkar (1982), p. 148.

[183] For example, see W.V.O. Quine, *Word and Object* (Cambridge, Mass.: MIT Press, 1960).

says, "the question of essential properties so-called is supposed to be equivalent (and it is equivalent) to the question of 'identity across possible worlds'."[184] The determination of an organism's essence involves both the given organism and a counterfactual organism(s) to which the given organism is compared, where properties of the organism(s) are carefully defined to discriminate necessary and sufficient identity conditions from those conditions that are contingent. In the function of individuation, an organism's essence specifically serves to distinguish it from all others. Losonsky offers:

> An individual essence is a property that can be exemplified, that cannot be exemplified by more than one object, and whatever individual exemplifies it must exemplify it if the individual exists. In short, we will say that an individual essence is a property that necessarily characterizes a single individual.[185]

Individuation leaves no room for ambiguity regarding the necessary and sufficient conditions of a single individual's identity.

This work considers candidates for the individual essences of organisms, with a final aim of evaluating whether an organism's genetic constitution of origin (both configurative (genotypic) and material (genomic)) serves as its essence. This proposal can be characterized as the biconditional: trans-world organisms are identical if and only if they share an identical genetic constitution of origin. It may also be expressed in logical notation as follows, where O represents *an organism*, G represents *a genetic constitution*, and Gxy represents *x has genetic constitution y*: $\forall x\forall y((\mathrm{O}x \,\&\, \mathrm{G}xy)\supset (\mathrm{G}xy \,\&\, \forall z((\mathrm{O}z \,\&\, \mathrm{G}zy)\supset(z=x))))$. That is, for all x and all z, if x is an

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[184] Saul Kripke (1972), p. 42. Kripke remarks about the complexities involved in philosophical uses of possible worlds that "statements of identity should seem very simple but they are somehow very puzzling to philosophers... Some philosophers have found the relation so confusing that they change it" (p. 107).

[185] Michael Losonsky (1987), p. 253.

organism of genetic constitution *y*, then necessary *x* has genetic constitution *y*, and for all *z*, if *z* is an organism with genetic constitution *y*, then *z* is identical with *x*.

Possible Worlds Methodology

The use of possible worlds can be tricky. The actual world is the only possible world for which we have direct evidence, so suppositions that other worlds are possible raise a number of problems of justification. When we appeal to possible worlds to ask whether organisms are identical, how do we determine that the world is possible? The outer range of possible worlds is at issue, for instance, in Christopher Hughes conjecture:

> Although I realize this supposition is not beyond controversy, I think God's making something from nothing is a possible state of affairs. God could make a wooden table out of nothing at all.[186]

Hughes offers an expansive regard of possibility. But in spite of many unsettled questions about the outer ranges of possible worlds, many are clearly defensible.

Kripke suggests thinking of possible worlds in the more familiar terms of theoretical probabilities, such as when we consider the possible outcomes of a cast of die. John Post also suggests that possible worlds lurk within a familiar framework: "counterfactual situations are or can be construed as possible worlds."[187] Indeed, appeal to possible worlds is a common conceptual practice, such as when we consider among hypothetical or possible alternatives; i.e., whether to select angioplasty or heart bypass surgery, or how the air would feel if we were in our favorite mountains. The specific possibilities that we may consider must be contextualized within a greater state of affairs that support them. This greater state of affairs is ordinarily the state of

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[186] Christopher Hughes, "Essentiality of Origin and the Individuation of Events," *Philosophical Quarterly*, vol. 44, no. 174, 1994.

[187] John Post (1995), p. 88.

the actual world, in so far as it may be compatible with the possibility being considered. Kripke thus suggests how to describe possible worlds without specifying an entire world of details:

> 'Possible worlds' are total 'ways the world might have been', or states or histories of the entire world. To think of the totality of all of them involves much more idealization, and more mind-boggling questions, than the less ambitious elementary school analogue [regarding possible outcomes of die throws]. Certainly the philosopher of 'possible worlds' must take care that his technical apparatus not push him to ask questions whose meaningfulness is not supported by our original intuitions of possibility that gave the apparatus its point. Further, in practice we cannot describe a complete counterfactual course of events and have no need to do so. A practical description of the extent to which the 'counterfactual situation' differs in the relevant way from the actual facts is sufficient.[188]

In this fashion, our search for the essential properties of organisms begins with the actual identities of individual organisms, and then considers whether specific counterfactual alterations of properties are compatible with their identities. Before considering alterations of an organism's genetic properties of origin, we shall evaluate the influences of altered environment, time, and (non-genetic) constitution of origin, and of altered parental identities and evolutionary histories. Alterations that are incompatible with the organism's existence involve its essential properties.

We are now prepared to begin our search for the essential properties that unambiguously identify and individuate individual organisms, keeping J.M.E. Moravcsik's advice in mind:

> the discernibility of identicals [is] not to be merely a matter of arbitrary semantic convention, nor merely a matter of intuitions, but a matter of working out the best theory for facts concerning development, growth, and potentiality.[189]

Though organisms are highly complex objects, we may hope that the natural processes that account for their individuality are intelligible and will allow us to comprehend their essences.

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[188] Saul Kripke (1972), p. 18.

[189] J.M.E. Moravcsik, "The Discernibility of Identicals," *Journal of Philosophy,* 1976. p. 594.

CHAPTER THREE

Organisms and the "Same Parents" Identity Criterion

Uniqueness, indeed, is the outstanding characteristic of any event in evolutionary history.[190]

Section I: The Problem of the Queen's Identity

The search for essential properties of the organism requires us to conceptually disentangle various organismic qualities from the organism as a whole, and launches us into territory scarce in empirical guidance. Kripke's proposal for an essential property of the Queen (i.e., Queen Elizabeth II) is an instructive case for exploring candidate identity-conditions for organisms across possible worlds.[191] In his view, in no possible world could the Queen be born of "different parents from the parents from whom she actually came;"[192] for instance, President and Mrs. Truman. What Kripke means by the necessity of particular parentage for maintaining the Queen's identity is unclear. If, as is at first most apparent, he means necessity of *actual biological parents*, his view requires further explanation in its defense than he offers. On the

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[190] Ernst Mayr (1982), p. 71.

[191] The example is originally from Timothy Sprigge, "Internal and External Properties," *Mind* vol. 71, 1962. pp. 202-203. While Kripke's example can be extended to all meiotically reproducing organisms, it cannot be directly applied to organisms which reproduce by mitosis and thus have no 'parents'. Though Kripke does not specify the sortal by which he regards the Queen (i.e., organism or person?), his discussion supports an organismic regard.

[192] Saul Kripke (1972), p. 112.

other hand, Kripke's implicit view may be of the necessity of the *offspring's actual genetic origin*, which may allow parental identity to be contingent despite the fact that to date in the case of meiotic organisms, genetic origin is always actually contributed by parents. This view, if Kripke's own, would also warrant further defense than he offers. As we clarify the relation between these views, this investigation will come to involve other interrelated candidates for essential original qualities of organisms. Whichever of these regards of essential features of organisms is Kripke's own, what *is* clear *and* defensible is Kripke's subscription to a general theory of the essentiality of some aspect of origin for individuals of at least some natural kinds.

However Kripke's proposal is to be spelled out, these two interpretations shall set us upon a complex investigation. Both views implicate other original organismic features as essential. In what follows, I distinguish several aspects of origin and their implications for an organism's identity, as an effort to sharpen and modify Kripke's proposal. I begin by considering the essentiality of an organism's biological **parents**, and oppose it to the view that considerations of **zygotic constitution** are essential; then I consider the general role of the zygote's **environmental and material history**, and **time** of origin and the bearing of parental identity upon what I term "**biological place**" of origin. In the following chapter, I examine the essentiality of the **structural genotype** and **material genome**, each in its own respect. Could we do away with any of these original features and preserve the identity and individuality of the organism?

Kripke's discussion of essential features of the Queen's origin is imprecise, as his primary purpose here merely is to show that some property/ies of human organisms appear to be essential. Indeed, Kripke doubts that necessary and sufficient conditions for an object's identity–exactly what we now seek for organisms–will be readily established:

> Really, adequate necessary and sufficient conditions for identity which do not beg the question are very rare in any case.... I don't know of such conditions for identity of material objects over time, or for people.[193]

Though definitive answers may be more than we can expect, Kripke himself finds purpose in these questions of essence, and we may assure ourselves that he would encourage our inquiry.

Kripke's Apparent "Same Parents" Identity Criterion

Kripke alternates between speaking of the essentiality of parents and the essentiality of gametes (egg and sperm) as conditions of the Queen's identity across possible worlds. Consider how he asks the question: "how could a person originating from different parents, from a totally different sperm and egg, be this very woman?"[194] He speaks as though origin from certain parents and origin in a certain egg and sperm are two aspects of the same thing, without distinguishing whether parents, gametes, or both together are the fundamental criterion at work. Kripke cannot be faulted for failing to make this distinction in so far as he defines parents as those who contribute an offspring's gametes, so that sameness of actual parents and sameness of actual sperm and egg become logically interdependent. He stipulates,

> Not to go into too many complications here about what a parent is, let's suppose that the parents are the people whose body tissues are sources of the biological sperm and egg.[195]

Kripke appears to be aware of the haste which he makes of this otherwise salient distinction. Our present interest is to clarify this imprecision regarding whether parental origin or gametic origin

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[193] *Ibid.*, p. 43. Mathematics, he says, is an exception.

[194] *Ibid.*, p. 113.

[195] *Ibid.*, p. 112.

(or some aspect thereof), is the more defensible identity criterion.[196]

Perhaps the most obvious interpretation of where Kripke would stand on this distinction is that the Queen's actual biological parents are essential to preserve her identity.[197] Again, Kripke specifies essentiality of origin in terms of the Queen's parents:

> What is harder to imagine is her (the Queen) being born of different parents. It seems to me that anything coming from a different origin would not be this object.[198]

Kripke does not suggest that origin in identical parents is *sufficient* to insure identity of the offspring. Parents might in another possible world produce an offspring other than an actual one by the conjunction of a different egg and/or sperm, even at the same moment of the original conception. The Queen could not be said to exist if another egg or sperm of origin were substituted for the ones from which she actually came (though *part* of her might be said to survive if one original gamete is used).

The insufficiency of parental origin alone to maintain the identity of an organism (as is also obvious from the case of siblings) is accommodated by Kripke's definition of parents as the sources of the offspring's actual sperm and egg. By requiring the sameness of gametes, Kripke ensures that an additional original material identity criterion is satisfied. He says,

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[196] In the following chapter I discuss how a gametic criterion may be interpreted as suggestive of the essentiality of genetic constitution.

[197] Here I abbreviate with Kripke, using the term 'biological parents' to indicate parents whose bodily tissues generate the egg and sperm cells from which the zygote develops. Other biological contributions, such as a uterine environment which may be of a person distinct from the female contributor of the egg, are excluded from this usage. The notion of biological parenthood will meet increasing challenges with the developing possibilities for more than one individual to contribute to a single egg or sperm prior to conception (for example, an egg may be produced from one woman's ovum nucleus and another woman's extra-nucleic ovum cell).

[198] Saul Kripke (1972), p. 113.

> A principle suggested by these examples is: If a material object has its origin from a certain hunk of matter, it could not have had its origin in any other hunk of matter.[199]

An identity criterion in addition to same-parents must be involved in maintaining an organism's identity. Added to the same-parents criterion, a material same-gametes criterion serves to distinguish among organisms begotten of different eggs or sperm by the same parents. However, in some counter-factual worlds, originating from certain parents and originating from a certain egg and sperm appear to be separable, and Kripke's view must account for the possible separation of these criteria.

The Elliot-Galois Counterexample

Elliot and Gallois challenge Kripke's parental origin criterion, asserting that sameness of parental origin is not necessary to maintain the Queen's identity in possible worlds. What matters, instead, is the constitutive identity of the matter from which the organism originates. A materially identical egg and sperm might conceivably coalesce in different parents, ultimately producing a materially identical zygote. They illustrate this as follows:

> The particles which constituted the gamete provided by the Queen's actual father could have become incorporated in Mr Truman and could have arranged themselves in exactly the way in which they were arranged in the Queen's actual father. A parallel story could have been true of the particles forming the gamete provided by the Queen's actual mother, finding their way into Mrs Truman's body.[200]

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[199] *Ibid.*, p. 114. Kripke notes that the requisite amount of material for preserving identity is vague.

[200] Robert Elliot and Andre Gallois, "Would It Have Been Me? (Against the Necessity of Origin)," *Australasian Journal of Philosophy*, vol. 62, no. 3 (1984). pp. 292-293. The subtitle may be regarded as misleading: Elliott and Gallois agree with the general principle of essentiality of origin; it is specifically the view of essentiality of parental origin with which they are at odds. Note that this example does not disrupt the spatial or temporal continuity of the particles which coalesce in this alternative manner. Although Elliott and Gallois make no

Elliot and Gallois add that these gametes form a zygote and develop into an offspring with the same developmental constitution as the Queen, concluding that this individual "would have been the very same individual as the Queen."[201] Thus they claim to dispel Kripke's same parents criterion in favor of a same gametic constitution criterion.

The Elliot-Gallois example carries strong intuitive weight[202] and answers a need for clarification shared by many of Kripke's readers regarding the peculiarity of his emphasis on parents. At least at first glance, the "re-creation" of the Queen's gametes appears to many readers to be both plausible and to not undermine her identity as an organism. Would not this possible world preserve the Queen, albeit no longer of royal lineage?

Before pursuing this example, we should address an empirical problem which might otherwise undermine its credibility. Though we lack verification of the Queen's parents' and Mr. and Mrs. Truman's actual genotypes, there is virtually no chance that the Trumans' genotypes would allow them to produce, through natural gametogenesis, an egg and sperm of identical material and structural constitution as the Queen's gametes of origin.[203] The Elliot-Gallois example contradicts the physical mechanisms of genetic transmission, relying upon what might

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mention of how the particulate rearrangement is thought to be achieved, presumably the particles take an alternative spatial path into the bodies of Mr. and Mrs. Truman, where gametogenesis takes place in a similar fashion as occurs in the Queen's parents in the actual world.

[201] *Ibid.*, p. 293.

[202] In a decidedly unscientific study, I asked fellow philosophers and students, "would it be you if the gametes from which you originated had instead coalesced in other parents?" Most people concurred that their organismic identity would be preserved.

[203] Of course, the error is inherited from Kripke (1972), p. 112.

be considered as an act of "immaculate gametogenesis." Such an inexplicable occurrence casts suspicion upon their alleged possible world.

Given the diversity of human genetic constitutions, virtually identical parental genotypes would be necessary to exactly replicate a given pair of gametes by gametogenesis. An average 10% of genes (thus roughly 7, 500) vary among unrelated humans, in addition to even greater variation in the vast non-coding parts of the genome. While the Trumans can supply an offspring with some complete set of life-sustaining genes, they do not have all of the Queen's genetic structures to transmit. Genotypic incompatibilities between the Trumans and the Queen's genotype of origin would prevent them from being capable of replicating her genotype, and whether this problem occurs to Elliot and Gallois is unclear.

However, some gamete recoalescence to which the Elliot-Gallois argument appeals is possible by qualifying their example in either of two ways. This allows us to accept their possible world, and pursue our evaluation of whether the counterfactual offspring is identical with the Queen.

As may be Elliot and Gallois' intention, we may suppose that this empirical impediment is surmounted. In evolutionary convergence, the same characteristics develop independently in different species through distinct and non-interbreeding evolutionary pathways.[204] Imagine, similarly, that as the Trumans and the Queen's parents are not close relations, they have independently evolved sufficiently similar genotypes for the purposes of the Elliot-Gallois example. We might call this evolutionary convergence of individual genotypes, and though its

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[204] Echolocation in bats and dolphins is one such example. Another is the separate evolution of flight in pterosaurs, insects, birds, and bats: according to Cohen and Stewart (1994, p. 81), "[these] creatures... do not possess some common DNA sequence that produces wings." Later I suggest that identical genotypes might also evolve distinctly.

occurrence would be phenomenally remote, we may suppose in this theoretical sense that these counterfactual Truman parents could produce the gametes intended by the example.

A second alternative for Elliot and Gallois' purposes would be to reconstruct their example by replacing the Truman parents with other individuals who are genetically similar enough to the actual queen's parents to allow them to create the proposed gametes. We might say, for instance, that the alternative parents are counterfactual monozygotic twins of the Queen's actual parents. In any case, it is the gametic recoalescence in alternative parents that is at issue rather than the gametogenic potential of the Trumans.

So, while we may say that the Queen's gametic particles "might have become incorporated in different human bodies to those in which they were actually incorporated," it is overwhelmingly improbable that these different human bodies could have been the Trumans. In what follows, I preserve the given language of *the Trumans*, as the empirical objection does not interfere with the purposes of the example.

Elliot and Gallois' "Identical Constitution of Origin" Criterion

And so we return to the question of the identity of the Truman offspring. Is parental identity necessary to preserve offspring identity? This question may be illuminated by examples where the biological sources of an offspring's gametes are detached from the usual practice(s) of conceiving, gestating and raising the child. As in the Elliot-Gallois example, the practice of sperm and egg donation for in vitro fertilization (IVF) allows us to consider "alternative" histories of eggs and sperm prior to an offspring's origin at conception. Is the identity of an offspring conceived through IVF regarded to be distinct from the organism which would have been produced if conception involving the same egg and sperm had occurred in the "old fashioned" way? Even here an answer is not readily apparent, but some judgments suggest themselves. The familiar occurrence of custody disputes by donor parents who claim that they have some right of entitlement over offspring produced by their donated eggs or sperm suggests that the physical relationship of biological parentage constitutes a permanent and non-substitutable connection with the child, perhaps sensed as an essential determination of the offspring's identity. On the other hand, the separation of the biological parents from the offspring does not produce a distinct organism, so that the parenting role normally associated with biological parentage is substitutable without loss of the organism's identity. That is, the offspring is not numerically distinct from the one which would have been created if the same gametes had been instead conjoined at the same moment by "natural" reproduction among the couple which actually contributes the gametes. A second and more unusual example involves a dispute over rights to social security benefits for a child produced by IVF with the sperm of her mother's deceased husband, whereupon a court determined (upon appeal of an initially contrary ruling) that the daughter merits his social security benefits.[205] This ruling might be said to derive (in part) from a view that the biological parentage establishes a relationship that supercedes the importance of the relationship involved in the role of parenting. However, this ruling may also be thought to support the view that it is the constitution of gametes that produces the same organism regardless of their prior histories. Well, we might be unwise to expect social security disputes to offer a clear or rational picture of organismic identity, and these examples may be construed in defense of *either* a same parents *or* a same gametic constitution identity criterion. Though the histories of an organism's gametes may endure counterfactual alternatives without altering its identity, these examples naturally fail

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[205] Associated Press, "SS denies aid to girl conceived with stored sperm," *Knoxville News-Sentinel*, Friday, Dec 1, 1995, p. A11. The amount of the benefits was based upon the work history of her father.

to illustrate the implications of *counterfactual* biological parentage. Thus the identity of the Elliot and Gallois "re-creation" of the Queen's gametic constitution is still at issue.

As provocative as the Elliot-Gallois counterexample is, it does not decisively knock-down Kripke's view. Kripke might offer either of two defenses to account for the Elliot-Gallois counterexample. First, Kripke might re-state his view to eliminate the interpretation that he holds a same parents criterion, and instead clarify his view to include only the same-gametes criterion for organismic identity. Indeed, Kripke is aware of the inconsistencies which transplants engender for the same parents criterion. He explicitly notes the possibility of gamete transplants, and excludes them (presumably for the sake of brevity) by his stipulated definition of parents as only those people who contribute the offspring's gametes:

> So you get rid of such *recherche* possibilities as transplants of the sperm from the father, or the egg from the mother into other bodies, so that in one sense other people might have been her parents.[206]

Kripke clearly holds such transplants to be, in some sense, exceptions the same parents criterion, and could consistently withdraw the language of parental identity in response to the Elliot-Gallois counterexample.

Elliot and Gallois claim, "we do not think that our counter-example falls into this category (of Kripke's exceptions),"[207] but they neither explain how their counter-example is a relevantly distinct from Kripke's noted exceptions, nor do they consider Kripke's possible reasons for these exceptions and why they ostensibly would not apply to their own "unique" re-location of egg and sperm. The Elliot-Gallois distinction is based merely upon the view that in some possible world, gametes of identical constitution with an organism's actual gametes may be

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[206] Saul Kripke (1972), p. 112.

[207] Elliot and Gallois (1984), p. 292.

contributed by alternative parents. All might agree that, as Elliot and Gallois point out, *if* identical gametes were reassigned to other parents, the offspring could still maintain its identity; and that, as potentially intended by Kripke's stipulation, *if* gametes could not be reassigned to other parents, the Elliott-Gallois gamete reconstruction is ruled out. Kripke's own "same hunk of matter" criterion accords with Elliott and Gallois' claim that, "necessarily, one develops from a particular configuration of particular elementary particles."[208] Elliot and Gallois' efforts emphasize Kripke's need to clarify whether he means to subordinate the parental criterion to the preservation of gametic identity, but as it rests, their example does not undermine Kripke's intended view.

While the Elliot-Gallois counterexample does not necessarily reveal an error on Kripke's part, it prompts us to seek a defense of Kripke's same parents criterion other than the concession to the counter-example proposed above. Kripke might instead wish to rebut the counter-example on the basis of a distinction between it and the exceptions which he stipulates. One distinction to which Kripke may wish to appeal to support the same parents criterion is the divergence in prior historical origin of the Elliot-Gallois possible world from the actual world.

Section II: The Case for Parental Origin

Prior Historic Criteria: The Apparent Contingency of Some Alterations in Prior Constitution and Environment

In order to satisfy the required links between an object in the actual world and itself in a possible world, to what extent must the object's prior history at its time of origin be identical as well? At issue here is whether the Elliott-Gallois alteration of parents preserves the identity of

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[208] *Ibid.*, p. 293.

the *sperm and egg* from which the Queen originates, since if the identity of either of these is altered, then the Truman offspring's identity with the Queen comes into question regardless of their otherwise exact similarities. Speaking generally, the problem is whether the identity of an object throughout its own existence is also dependent upon non-constitutive relations *prior* to its existence. So we shall begin first by considering how the issue of past identities may be of use to Kripke in overcoming Elliott and Gallois' counterargument.

In spite of making suggestions regarding the influence of prior history of origin on an object's identity, neither Kripke not Elliott and Gallois discuss it other than cursorily. In Elliot and Gallois' view, the *historical* source of the Queen's gametes need not be preserved to produce an identical organism: they imagine that "the history of these particular particles could have been different."[209] What matters, in their view, is somehow implicit in the complete material and structural identity of the Queen's zygote of origin which is preserved by their counterexample. On the other hand, Kripke's remark by way of footnote about the necessity of identity of the material from which an object originates suggests a great concern about the role of history:

> Obviously this question [of a table's identity] is related to the necessity of the origin of the table from a given block of wood and whether that block, too, is essentially wood.... Thus it is ordinarily impossible to imagine the table made from any substance other than the one of which it is actually made without going back through the entire history of the universe.[210]

If my understanding is correct, this consideration asserts that a consecutive process contributes to identity, such that one object's essence is born upon by the essential identity of those objects from

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[209] *Ibid.*, p. 292.

[210] Saul Kripke (1972), p. 115.

which it originates, as far back as the object's origin stretches.[211] Though Kripke recognizes that to apply this proposed historical condition of identity would involve a "mind-boggling feat" of the imagination, this consolation would be more satisfying if he were to offer any direction on his understanding of how the criterion might work.[212] Earnest Mayr provides an illustration of how past history bears essentially upon an organism's taxonomic classification, saying,

> One result of having an inherited genetic program is that classes of living organisms are not primarily assembled or recognized by similarity but by common descent, that is, by a set of joint properties due to a common history.[213]

This case does not illuminate the bearing of past history upon an individual's identity. Mayr cautions us not to regard a class as an individual, which he considers a common misapplication of logic upon biology;[214] and an aggregational hierarchy such as a taxonomic category, he adds, is a learning device[215] and ought not to be regarded as an essential property of organisms themselves. So we must look elsewhere for an explanation by which to regard prior history. If prior history proves critical to an object's identity, we may find that Elliott and Gallois distort the prior history of the Queen's origin in such as a way as to produce a non-identical organism.

Lacking Kripke's own reasoning, how are we to understand his claim that prior historical essences can bear upon the identity of a subsequent individual? Simply choosing an example by

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[211] This is not to say that an object necessarily *shares* the essential qualities of its predecessors; merely that the predecessors may contribute to its essence *in some respect.*

[212] In contrast with Elliott and Gallois, Kripke's reasoning is *explicitly* absent, as he continues, "A full discussion of the problems of essential properties of particulars is impossible here." (1972), p. 115.

[213] Ernst Mayr (1982), p. 56.

[214] *Ibid.*, p 57.

[215] *Ibid.*, p. 65.

which to test this claim is a first challenge. Recalling the discussion of sortals, different kinds of individuals and different regards of the same individual may entail different identity requirements, and we may expect aspects of prior history to be diversely relevant depending upon the type of thing in question. A rock, an organism, and a 'person' may demand different types of conditions from their material predecessors for purposes of possible world identity. Aware of this concern, let us consider the following logically possible world as an instructive model as we seek to apply Kripke's proposal to the Elliott-Gallois example.

> At t0, all that exists is a homogenous mass of particles in space. These particles coalesce as the result of a prolonged process into a sun and a planet upon which are calcium carbonate deposits at approximately t1, whereupon at approximately t2 some calcium carbonate transforms into limestone. From this limestone mass, a limestone rock, 'R', individuates by breaking off at t3. At t4, this rock is carved into a figure, 'F', by person P.

We can abbreviate the material history of origin on the pathway to F as:

t0: diffuse particles
t1: calcium carbonate
t2: limestone
t3: R
t4: F.

Now, we may say that like the Queen, the individuals R and F have certain essential properties without which they would not exist. Kripke's suggestion leads us to ask what changes in the 'ancestors' of these individuals could be sustained while still resulting in their existence. Do their essential properties depend upon the identity of the essential properties of the material from which they originate, and does this extend as far back as the material from which they ultimately originate at t0? And distinctly, do the identity conditions of a carved figure depend upon the essential features of the person(s) who contributes its form? Our ultimate concern is whether an organism's identity depends upon the identity of the parents who contribute both its matter and form.

To begin our resolution with a tautology, we can say that an object's history of origin must allow that object to have those essential qualities which it actually has. Of course this claim begs the question of what the object's essential qualities are, and so does not allow us to determine independently an object's identity conditions. What this tautology *can* contribute, given that the organism' is implicit in its essence, is a method for determining whether the object's essential properties could not be instantiated given an alternative prior history. Consider a possible world in which a species of tree evolves its fruit to mimic the appearance of limestone rocks in order to avoid being harvested by certain animals that share its ecosystem. In this world we find an object which appears identical upon close surface examination to rock R whose existence we have stipulated of another possible world, and we wish to determine whether this object is identical with R. In this case, knowledge that the object has a *biological* prior history tells us that is non-identical with R, whose appearance it mimics, without a further need to investigate the object's cotemporal features such as its internal configuration. Here prior history gives us one way to learn that these possible worlds contain distinct objects–one a life-form and one not. We thus see how knowledge of prior history of origin can be instructive regarding an object's identity; as it tells us about the qualities of the object ("is it organic or inorganic?") during its existence.

To the issue of sameness of egg and sperm, Kripke's remarks suggest that the prior history of origin of the Elliott-Gallois offspring may, of its own merit, contribute some essential properties to the identity of the offspring herself. He appears to suppose that essential qualities of the prior historical material of origin, including sufficient material of origin, must be identical in order to result in an identical object. The Elliott-Gallois example preserves the Queen's material of origin, and we may add a specification that the history of the particles constituting her egg and sperm is as alike as possible to the history of the particles of the Queen's actual egg and sperm of origin.[216] Under these conditions, does the Elliot-Gallois example alter the identity of the egg and sperm?

This question is complicated by the added alteration of the offspring's parents in the Elliott-Gallois example. To isolate the problem of the re-coalesced egg and sperm from the issue of altered parents, consider how re-coalescence would affect the identity of the inorganic object, R. Suppose that the particles constituting the limestone formation from which R breaks off have an alternative history. Though we may stipulate that the particles were identically dispersed throughout the universe at t0 as they are in R's case, let us say that before they gather to "arrange themselves in exactly the way in which they were arranged in the actual limestone"[217] at t3, the historic places of the particles which actually constitute R are different, and ultimately the particles gather together at an alternative position, adjacent to the original one. And so, the differences between the original R and this individual rock are: different prior paths of the particles before their coalescence into particulate configurations identical with the original, and different spatial relations to a distinct external environment, consequent upon the object's different position. These differences are shared by the particles that become the egg and sperm of Elliott and Gallois' example.

Here we can see the importance of prior history upon an object's identity, for if prior history of origin of apparently identical objects in two possible worlds is significantly distinct, it is unclear whether those items can be one and the same even in spite of complete cotemporal

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[216] So we rule out alternative counter-factual possibilities which are unnecessary for the example and which would distract us from the possible similarities between the Queen's origin and the origin of the Truman offspring.

[217] Here I recall Elliot and Gallois' formulation (1984), p. 292.

constitutive qualities.[218] To claim such a non-identity would ask of us to demonstrate some sense in which an object's prior history may be an intrinsic, rather than an extrinsic property. Indeed, it may appear odd to ask how the identifying properties of a former individual might affect the identifying properties of a consequent individual where the latter's constitutive properties are identical in either case. Is it possible to imagine some such example?

First, common sense supports the conclusion that an individual might have *some alteration* in its prior history of origin in a possible world. Suppose that the immediate predecessor of a given individual is altered by changes in its own particles and/or environment. Kripke himself maintains that there may be identity where such alterations in prior history of origin occur; he notes about *particulate* change: "I might have been deformed if the fertilized egg from which I originated had been damaged in certain ways, even though I presumably did not exist at that time."[219] Though this example suffers from a failure to clearly demarcate the

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[218] Even identical relational features may be stipulated in spite of alternative past histories. The Elliott-Gallois counter-example does not preserve complete identity of all co-temporal relations, as the offspring is born to different parents in a different environment. Yet the example could be reconstructed to accommodate identity of these relations; the parents might have been identical twins of the Queen's actual parents, and the time and place of birth and the developmental environment need not be altered from the original. Any other features altered by the Elliott-Gallois counterexample could be similarly reconstructed.

[219] Saul Kripke (1972), p. 115. This quote suggests that the sortal by which Kripke understands the Queen is not an organism defined (as for our purposes) as an individual which originates at conception, but rather as a type of individual which does not come into existence until some point well after. We might suppose accordingly that Kripke is considering the Queen as a *person*, since persons are commonly understood philosophically to originate after conception, such as at or beyond sentience. If Kripke's discussion of the identity of the Queen regards her as *person* rather than organism, we could not attribute to him the view that an *organism* necessarily originates from its given parents. On the other hand, Kripke suggests an organismic regard by his attention to natural kinds and biological conditions of identity (such as species categorization, (p. 111) and biological origin). The organismic view is the recognized interpretation (Forbes (1986), p. 7: "Kripke's well-known essentialism about the origin of organisms"). As we have noted, the concepts both of organism and person are often used with an unrecognized lack of clarity, and this problem adds to the ambiguity of interpreting Kripke.

altered preceding individual (the "fertilized egg," or zygote) from the individual natural-kind object which follows (Kripke himself), an alternative particulate configuration could as well characterize the more clearly demarcated egg or sperm from which an organism derives at fertilization. Kripke indicates that either the egg or the sperm might be 'damaged in certain ways' in a possible world, and yet unite to create an identical offspring as one produced by undamaged gametes.[220]

The IVF example shows that a change in the *environment* of a preceding individual(s) may not alter the following object's identity. Suppose that an individual conceived through intercourse were instead fertilized in vitro, at the exact time and using the exact egg and sperm which were actually involved. This zygote is then implanted into the mother who gestated the actual offspring. Someone born in the age of IVF technology might indeed find out that they were conceived in this manner, contrary to their prior belief. Of course, such news would not change a person's sense that they are '*this organism*', but might they also consider at a conceptual level that they may be in fact a different organism (produced by different identity-constituting conditions) than they formerly understood? While this might cause one to re-conceive their relationship with their parents in evaluative terms, we do not suppose that this alternative history of origin produces a distinct organism from one produced by "natural" conception.[221] In both this example regarding altered environment and the former example regarding altered constitution, the changes do not appear to influence the produced individual(s)'s *essence*. Both

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[220] Both of these examples may involve changes in the material prior to an organism's origin as well as co-temporal changes in the organism.

[221] People do not always identify themselves by essential properties, so that the a person's actual failure to regard environment of origin as essential, as in this example, may not demonstrate that environment of origin is actually non-essential to an organism's identity. In any case, the example illustrates the common-sense view that an organism can sustain some kinds of environmental change in its prior history of origin consistent with its identity.

cases satisfy the sort of possible world identity that almost everyone who tolerates inferences from possible worlds accepts.

The Apparent Contingency of Some Alterations in Time of Origin

Attempts to alter the *time* of an individual's origin cause further unexpected problems for identity, even when the objects whose identity is in question manifest constitutive and environmental identity in alternative possible worlds. Kripke would allow for changes in time of origin to the extent that parental and gametic identity may persist through alterations in time and place.[222] At least some alterations in the environment of an organism's prior history of origin (as well as its later history) appear to be consistent with its existence, so the alterations in environment that are ordinarily concurrent with altered time of origin should not automatically preclude the sustainability of identity through changes in time. To the contrary, Dummett holds the strong essentialist position that

> In the case of a human being, his parentage and even the *moment of his conception* seem absolutely necessary to his identity (italics mine).[223]

If time of origin proves to be an essential property of organisms, even our common imaginative alterations of our own times of origin are in conceptual error.

Kripke remarks that when making assertions about possible worlds, we ought to be careful about the influence of time upon identity when worlds diverge:

> Ordinarily when we ask intuitively whether something might have happened to a given object, we ask whether the universe could have gone on as it actually did up to a certain time, but diverge in its history from that point forward so that the

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[222] Colin McGinn, "On the Necessity of Origin," *Journal of Philosophy*, vol. 73, no. 1 (1976). p. 131.

[223] Michael Dummett, *Frege: Philosophy of Language* (New York: Harper: 1973). p. 131.

> vicissitudes of that object would have been different from that time forth.
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> Perhaps this feature should be erected into a general principle about essence.[224]

Here Kripke proposes that the state of a given world should be maintained in an alternative world up to a stipulated and purposeful point in time. He allows that an object's precursors may differ in possible worlds *before* one and the same object comes into existence, as seen in his example of the damaged zygote: "note that the time in which the divergence from actual history occurs may be sometime before the object itself is actually created."[225] Divergence from a given actual or possible world before an object is created is not thought necessarily to alter its own time of origin, which is our present concern. The problem involves the essentiality of the relationship between time and origin given the agreement among philosophers that, "origin (is) singled out as essential and life-history counted contingent."[226] Before considering further candidates for essence which may be influenced by time of an organism's origin, we are inclined to say that at least in some circumstances an actual organism could originate at a different time. If parents were to conceive a child one hour later than is the actual case, of identical and unaltered gametes as in the actual world, few would doubt that the organism's identity is preserved.[227]

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[224] Saul Kripke (1972), p. 115.

[225] *Ibid.*, p. 115. McGinn interprets Mackie to defend essentiality of origin by the claim, false in McGinn's view, that the identity of organisms with distinct prior histories (backwards divergence) cannot occur (1976), p. 128-131.

[226] Colin McGinn (1976), p. 129. Of course, philosophers who reject the concept of essence fail to share in this agreement.

[227] The intuitions expressed by this judgment must be reconcilable with the changing nature of biological matter, for we cannot suppose that gametes will remain unaltered by the passage of an hour. Baruch Brody (1980, p. 104) also supports the nonessentiality of time of organismic origin.

At present, we may suggest the unremarkable conclusion that an organism can sustain *some* changes prior to its origin; whether these involve alterations of prior material, environment, or time of origin, as well as changes that alter its original material or environmental properties, where those changes are non-essential in certain and yet unspecified ways.

The Continuity Criterion: The Incompleteness of McGinn's Theory of D-Continuity

Turning again to the Elliott-Gallois example, some readers are certain to remain unsatisfied by the claim that the envisioned Truman offspring is not essentially transformed by its alternative prior history, regardless of its constitutive identity at origin with the Queen. Colin McGinn expresses the view that while an organism in some cases may remain identical through possible world alterations of place and environment in its history of origin (for instance if the sexual union occurs "on the other side of the bed"), the Elliott-Gallois example changes some essential biological continuity of the offspring contributed by its particular parents. He objects to Elliott and Gallois' judgment of identity on two grounds: that an organism's actual biological parentage is essential to it, and that an organism's actual matter of origin is not essential to it.

For those who are convinced by Elliot and Gallois' gametic reconstitution example, the problem of parental identity may be given new force by exaggerating their example as follows. Suppose that up to a certain point about five years prior to the birth of the Queen, the world follows its actual course. At this point certain events diverge: those exact particles which in the actual world would later coalesce to constitute the Queen's egg and sperm of origin are each individually "abducted" by extra-terrestrial beings who wish to construct a human organism to spy upon the Truman family. (Perhaps they want to know if Truman will develop a space program.) These aliens irradiate and otherwise alter and manipulate these particles at length until they finally restore them to create an egg and sperm of the exact material and configurative constitution as in the actual world. Fertilization occurs at the same time of the Queen's actual fertilization, and the zygote is implanted into an unsuspecting Mrs. Truman who goes on to believe that her pregnancy is normal. In the end the aliens abandon their espionage intent and have no further contact with the child, and for all appearances, the child is unaffected by her unusual origin.[228]

Would not such a possible reconstitution give pause to the actual Queen, whose particles of origin are confiscated for our wanton musings? To consider the identity of this child of alien crafting with the Queen, several differences in origin caused by its alternative 'parentage' are noteworthy. While matter and particulate configuration of the Truman offspring are preserved, changes occur in the prior particulate history of origin (abducted, irradiated, etc.), the means of origin (engineered by aliens), the historical purpose of origin (espionage), and the agents of origin (extra-terrestrial beings). Can identical constitution of origin suffice to preserve the Queen's identity with *this* being?

Now, this extreme example may bring into relief concerns about the importance of actual parents for purposes of an offspring's identity for those who might originally have been satisfied by Elliot and Gallois example. One might object that the alien-abduction case pushes the limits of admissible possible worlds, and I would not wish to imagine how a secret implantation of Mrs. Truman could be said to occur. However, with respect to parental identity, the example is meant primarily to highlight concerns about Elliott and Gallois' own example, so that appreciation of the concern about parents should not hinge upon accepting scheming extra-terrestrial scientific wizards into a possible world. The present problem in either case is the altered identity of the

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[228] M.S. Price offers a similar example of a manufactured organism in "On the Non-Necessity of Origin," *Canadian Journal of Philosophy*, vol. XII, no. 1 (1982). p. 35.

biological parents and its influence upon the identity of the offspring, though the alien-offspring serves also to suggest further candidates for essential alterations in biological relations.

One might hold that a sufficient criterion of non-identity in this example as well as in the somewhat less incredible possible world of Elliott and Gallois is the alteration of actual biological parents. Unlike the example of counter-factual IVF with the same egg and sperm, this case alters biological parentage, and it may appear that the IVF case involves a contingent change in the organism while the Elliott-Gallois example changes the organism essentially. What of essence might be conveyed upon an offspring by its particular parents, which could not be substituted in any possible world without them? McGinn illuminates this problem by a further example which demonstrates both the common-sense appeal of the identical parents view as well as its metaphysical challenge to a prevalent concept of identity requiring at least some identity of material origin.

In proposing that identical matter of origin is not a necessary condition of an organism's identity in favor of the biological parenthood criterion where these might conflict, McGinn suggests the following type of case. Starting with parents of a given offspring in the actual world, we may imagine that in an alternative world they have a different dietary intake, resulting in entirely alternative particles composing the gametes which their bodies produce. If these parents conceive a child from gametes whose alternative particles share the exact configuration as the actual offspring's gametes of origin, McGinn suggests that the organism satisfies the necessary conditions of identity with the actual offspring:

> It is a general truth about biological entities that they are not essentially composed of their actual matter: in some sense of 'matter' my gametes could have been made of different matter–e.g., if my parents had been composed of different matter owing to different material intake.[229]

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[229] McGinn (1976), p. 133.

In light of its contrast with the postulate of at least some minimum of identical material of origin for identity across possible worlds, an explication in defense of this conclusion would be revealing indeed. To be sure, while parents may have concerns about the effects that their diets may have upon a zygote's health, no one worries that alternative diets will produce distinct offspring. But the issue of offspring identity does not arise for parents, who typically desire whichever particular child they in fact have above any child of identical original configuration which they might merely have in a possible world. Although I would deplore it as a general rule, in this case inattention to problems of identity may be appropriate.

As organisms maintain spatio-temporal continuity and fulfill appropriate biological changes, no question typically arises regarding their persistent identity. Material flux is characteristic of all living organisms and cells. Organisms endure dramatic changes of matter and configuration through time as they expend, replenish, and develop their material constitutions. In this sense the particular matter which constitutes an organism at a given time is a contingent property, and altered matter is not merely endurable, but crucial, for an organism's persistence. Similarly, the matter comprising an identical sperm and egg changes as the gametes persist through time, so the identity of the zygote which originates from them may appear equally independent of the particular matter of which they are composed. Accordingly, one might hold matter of origin to be substitutable without loss of identity.

McGinn argues further that an organism's particular zygotic, gametic, parental and even ancestral origin are essential to it (as are original kinships also). He bases his argument on what he calls diachronic and developmental ("d-" continuity). In more common terms, d-continuity refers to the continuity of biological development in space and with the passage of time, both through an organism's own life and from one life to another. It represents a special kind of spatio-temporal continuity particular to biological objects–the successional biological continuities that are ordinarily regarded as foundational to the possibility for life as organisms manifest "an organized, law-governed, causally unified process of development."[230]

McGinn's case begins by noting that an organism's unified persistence through time is a result of a biological continuity that includes its zygotic origin: "any attempt to break the obvious biological continuity here would surely be arbitrary."[231] By positing this unified-organism premise as a first axiom ("explanans"), he claims to avoid problems of circularity. The human organism may be conceived as an object unified through time from the original zygote stage to the developed being, but such a conception detaches the object from its unifying essence: "the demand for an ultimate sortal covering the putative individual for the duration of its existence can be met either by appropriating or inventing one, e.g., *human being*."[232] Based upon the principle of continuity providing an organism's internal unification, he continues,

> Just as you must have come from the zygote you came from because you are diachronically and developmentally continuous with it, so you must have come from the gametes you came from because you are similarly continuous with them.[233]

The essentiality of parents is similarly posited; "it seems essential to the identity of a given gamete that it spring from the animal it actually sprang from."[234]

We naturally wonder where the essential role of this d-continuity can be regarded to stop. McGinn continues, "the d-continuity principle applied to human beings predicts the necessity of

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[230] *Ibid.*, p. 134.

[231] *Ibid.*, p. 132.

[232] *Ibid.*, p. 132.

[233] *Ibid.*, p. 133.

[234] *Ibid.*, p. 134.

their ancestry," and further, "a person's position in a field of kinship relations is an essential property of him."[235] We arrive at a view which maintains great essentialist breadth: a given organism may not exist except in a world which preserves the identities of its every ancestor, and its gametes and zygote of origin. Contrary to many philosophical and popular (if not vague) intuitions about the possibility of relocating an organism to counterfactual worlds, d-continuity is a vastly restrictive principle of identity. However, other criteria must be added to biological continuity through space and time if it is to distinguish the identity of organisms across possible worlds.

McGinn offers the following logic to introduce d-continuity as a (presumably sufficient) criterion of biological identity:

> Suppose, with a view to *reductio*, that I come from Nixon's actual gametes, i.e., consider a world in which this occurs. Now, what is surely compossible with the first supposition, add my actual gametes to the aforementioned world and suppose they develop into an adult.... The reason for preferring the actual gametes of a person as a criterion of identity is, I surmise, a matter of a certain sort of spatio-temporal *continuity*.[236]

This illustration is assuredly weak evidence for an identifying role of the d-continuity criterion. The problem of identity across possible worlds is not ordinarily expressed as one in which we seek criteria to determine whether an organism may in a counterfactual world be identical with an organism whose *distinct* gametic origin is already stipulated (as Nixon's gametes). McGinn fails to persuade us that actual gametes are privileged in virtue of d-continuity rather than in virtue of other properties, by positing that the counterfactual gametes which produce an organism compete against an organism's actual gametes. All other things being equal, a counterfactual

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[235] *Ibid.*, p. 134.

[236] *Ibid.*, p. 132.

reconstruction of actual gametic relations are assuredly preferable to other candidates for which no evidence of relatedness is offered, and the preference of the actual parents in the example is not obviously a specific result of d-continuous relations. As McGinn's non-actual gametes lose by definition, his reductio fails to be instructive.

Husain Sarkar offers a further criticism of McGinn's view. If d-continuity alone is identifying, then an identical biological d-continuous path could not produce a distinct organism. However, a counter-factual alteration in an identical d-continuous egg and/or sperm may result in a non-identical counterfactual organism. Sarkar proposes that an actual human sperm and egg are counterfactually irradiated, and produce (at the actual time), rather than the actual boy, a girl.[237] While the counterfactual girl is d-continuously identical with the actual boy, she is, according to Sarkar, non-identical with the boy.

Well, I presume that gamete irradiation could never actually be specific enough to produce a viable organism whose Y chromosome has been zapped into an X. But Sarkar's example reflects a real indeterminacy of outcome in biologically d-continuous organisms. Though reproduction is bound by plenty of laws, a single random counterfactual alteration at the material level of ancestral precedents, no matter how minute, in the production of organismic outcome can manifest an apparent indeterminacy of d-continuous outcome. Unless McGinn can offer some feature of d-continuity that precludes the apparently identical d-continuity in Sarkar's example, his theory fails to identify completely, and d-continuity cannot necessarily *and sufficiently* constitute an organism's essence. Differences in the cotemporal *properties* of d-continuously identical organisms across possible worlds is a first problem that the d-continuity

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[237] Husain Sarkar (1982), p. 144.

theory must meet. Is there something in the gametes, presupposed as identifying in the "reductio" example, that can be said to inhere in d-continuity, and which defeats the Sarkar objection?

McGinn offers no hint in *On the Necessity of Origin* of the involvement in identity of any other requirements than d-continuity itself, as McGinn appears to hold that d-continuity is a *necessary and sufficient* identity criterion for individual organisms. Whether d-continuity is a sufficient principle of an organism's identity depends upon whether an identical d-continuity assuredly produces an identical organism and that the organism may be produced by no other d-continuity. However, the case of monozygotic twinning also suggests that the properties involved in d-continuity do not individuate in every case.

McGinn claims that d-continuity is implicit in the essentiality of origin for organisms produced by fission, such as monozygotic twins:

> the entities that result from a given entity by fission couldn't have come into existence by the fission of a distinct entity, or indeed in any other way. When an amoeba splits, itself ceasing to exist in the process, the resulting amoebas are such that they couldn't have come from any other amoeba.... the relation I am calling d-continuity;... it is this that confers rigidity on the relations involved, thus accounting for the necessity of origin. In each case we have a kind of spatio-temporal continuity different from, yet sharing many of the characteristics of, the sort of transtemporal identity exhibited by biological things... in each case the individuation of the entity, or entities, concerned turns on its, or their, d-continuity relations with other entities.[238]

The question remains regarding whether developmental, spatial, or temporal continuities can distinguish among these biological products of fission, such as twins. Twinned "offspring" appear to share identical temporal and developmental histories until twinning occurs, and difference in spatial location appears to be the only distinction in continuity between them at the time of fission. Yet spatial location does not appear to be an essential property of organisms, and McGinn rejects spatial location of origin as necessary for identity. Furthermore, McGinn rejects

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[238] *Op. cit.*, p. 134.

appeal to material identity conditions for organisms.[239] The generation of individual suns, by contrast, exemplifies developmental as well as spatio-temporal continuities as a sun's individual particles are pulled together by gravity to form a single object; yet suns are regarded to be identifiable across possible worlds only with the assistance of other (i.e., material) criteria. This issue of *individuation between twins* (and other genetic identicals at origin) is a second problem that the theory of d-continuity must meet.

McGinn's answer to these problems of identity and individuation may lie in his definition of d-continuity as a specifically *biological* principle ("a certain sort of spatiotemporal *continuity*"[240]), which he may intend to provide some identifying criterion that does not apply for nonbiological objects. Some further characteristic of biological d-continuity may add a condition for organismic identity, implicit in specifically biological continuities. In Sarkar's interpretation "the key concept capturing the intuitive content of this relation is *coming from* or *evolve*."[241] This interpretation accords with McGinn's notion that ancestral history is inherent in d-continuity, and which I develop as the concept of "biological place."

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[239] Colin McGinn (1976, p. 133) claims that at a collective level, non-biological objects do not share the identity criteria of biological objects: "for non-biological groups of objects, constitution is necessary for identity; for biological groups of objects it is not." For biological individuals, McGinn extends his theory of d-continuity from the individual to the collective, as species. As his arguments for the principles implicit in identifying kinds is based upon the principles implicit in identifying individuals, we may assume that McGinn regards constitutional requirements to be as irrelevant to individual organisms as he claims them to be for species. Sarkar (1982) notes, accordingly, that McGinn does not distinguish individual essence from general essence.

[240] Colin McGinn (1976), p. 132. Italics are McGinn's; underlining is mine.

[241] Husain Sarkar (1982), p. 143. Italics are Sarkar's.

The "Biological Place" Criterion

Can we offer more substantive arguments for the essentiality of parentage? The identity of an organism does not depend upon its biological parents after conception, so why would they matter before? The claim to essentiality of actual parents may be best explained as a consideration of the biological context in which a life is generated, and which I term "biological place." This view attends to the singularity of conditions that allow life to be passed along from one organism to another. Parents contribute an organism's context in a biological scheme, including its relations with the evolutionary process as a whole. Can these particular complex interconnections be regarded as essential qualities of individual organisms? An organism can maintain its identity as a persisting object, at least in part, by cotemporal continuities, but they first depend upon a biological history, regarding which parents have much to offer.

The biological circumstances which motivate McGinn's view need further explication. Continuity alone does not constitute an individuating principle, as d-continuous genealogical paths may drastically diverge in alternative worlds. We are left wanting a positive explanation of specific other criteria that must be involved to allow for the identification of organisms. The distinctness of an organism's position in the evolutionary process supplies one such principle. Biological place captures a uniqueness that characterizes every individual organism–its evolutionary history and future evolutionary influence, the randomness of processes which engender its unique qualities, and its own biological nature. Mayr accordingly characterizes each organism's genetic program as distinguished by broad evolutionary influences as "the result of a history that goes back to the origin of life and thus incorporates the "experiences" of all ancestors."[242]

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[242] Ernst Mayr (1982), p. 56.

In positing the essentiality of biological place, we assert that biology supplies organisms with a historical and familial embeddedness not shared by inorganic objects. An organism's origin in particular parents embodies a vortex of biological relationships which, under other biological parentage, would be necessarily destroyed. These relationships are as broad as the evolutionary history which makes life possible, and as befits the species, in some cases provide the opportunity for life-supporting interactions with its parent(s). Each organism is the product of billions of years of evolution, which as a result of environmental and chance factors that incidentally result in both its species type and its individual existence. It appears to be an implication of McGinn's theory of d-continuity that this biological context which allows a particular organism to exist constitutes an essential property conferred upon the organism, so that the role played by a given set of parents cannot be substituted by others.

Consider the biological context in which is created the counterfactual organism conceived from parents whose diet is altered. The identity of the parents' gamete-producing processes, rather than the material constitution of the gametes, is responsible for the asserted identity of the egg and sperm produced. The possible-world parents and their genetic complements remain identical, their bodies manifesting the same meiotic processes which produced the actual gametes. After all, the meiotic process does not discriminate between exactly similar particles as it produces a gamete, so any configuratively identical substitution of material may result in a viable gamete of the same organismic relations and potentials. Even the altered offspring's own later development and progeny may have identical material configurations to those of the original. Except for the stipulated difference between the offsprings' particles of origin, there will be no necessary difference between the actual and the counterfactual offspring. While a given fertilization generated from two individuals' haploid genetic complements will result in only one among countless possible genomic combinations in their offspring, one might say that an actual child has thereby an ex post facto[243] special position in the life process. A zygote of particular relations and potentials thereby attains a biological place which no other parents could provide.

Parents, and their offspring, manifest an evolutionary role transmitted by the course of their ancestry. Parents are only the immediate bearers of this historical role to their offspring, allowing them in turn to influence the future evolutionary balance. Whether or not a particular organism bears offspring, procreation is a function necessary to the evolutionary history that leads to the organism's own existence and which allows for a species to endure. Without claiming that reproduction is an organism's *purpose* (and thus begging the conceptual question regarding whether evolutionary processes constitute part of the organism's inherent nature), its evolutionary history precedes the existence of a given organism.[244] Given the pivotal role of each organism in the evolutionary process, parents offer their offspring a unique and improbable place in biological history.

Furthermore, the concept of biological place accommodates the social relations which humans appeal to when we say that a particular parent or offspring could not be substituted without a loss of something crucially involved in identity. In some species, a parent may enjoy social relations with its children, in many cases involving nurture and in some cases involving love. As with distant evolutionary history, the local qualities of love and social relations between parent and offspring of certain species manifest evolutionary influences, and in turn contribute to its evolutionary future. While social relations between all organisms have an intrinsic moral

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[243] In Saul Kripke's sense (1972), it may be regarded as a necessary *a posteriori* truth. Once it becomes the case, it could not have been otherwise, though it is not the consequence of *a priori* determination.

[244] This topic will play a central role in the following chapter.

value independent of evolutionary processes, potentials for these relations are produced by evolution, which is in this sense responsible for the special interpersonal and interspecies meanings of parent-child relations. Whether or not desirable social relations are achieved, the organism's position along an evolutionary path may be offered as a principle supporting the view that an offspring's identity is conferred by its particular parents.

The role of evolution in comprising identity is now at issue. The continuity and evolutionary criteria involved in this view of identity are sensitive to a uniqueness and integration of biological context which Elliott and Gallois' view does not accommodate. Does organismic identity derive from this greater biological placement of the individual organism? Evolution is not a purposeful phenomenon, although its occurrence is attributable to a web of principles involving means and ends whereby it achieves self-perpetuation. Caution still allows us to inquire: are these limitations upon the identity of an evolutionary process also limitations upon the identity of the offspring which emanates from a given evolutionary history? Organisms always do originate from a particular evolutionary path, but is there no other path of origin which would do? If biological place is essential, then the conditions of organismic identity across possible worlds are restrictive indeed, and one may not endure separation from their given biological parents in any possible world.

As apparent from Kripke, an identical parents criterion does not preclude a sufficient constitutive identity criterion as well. As identity is an all-or-nothing issue, must these views be logically exclusive of each other, or might this be an instance of equally valid regards of the same thing? The distinct claims to essentiality of parental origin and essentiality of material origin will be considered in the next chapter in the context of a new criterion for essence: self-organizing organismic plan.

Toward Constitutive Criteria

The proposal of biological place to support McGinn's principle of d-continuity as the sole criterion of organismic identity adds a principle of constitution which McGinn does not explicitly offer. If identical parents are a necessary condition of organismic identity, they are not sufficient, as told by the non-identity of full biological siblings. Siblings, McGinn would note, are not d-continuous, for the egg and sperm that constitute sibling zygotes (except in cases of monozygotic multiple embryos whose d-continuities diverge at the later point of embryo individuation) originate at different times and from distinct developmental paths. However, Sarkar's example shows that identity of d-continuity does not necessarily preserve identity of biological place, for the particles which constitute any zygote along an identical diachronic and developmental evolutionary trail may be substituted or manifest different configurations, producing organisms of distinct biological potential. An identical developmental process may produce distinct outcomes in different possible worlds. In short, zygotic constitution is not necessarily preserved by d-continuity alone, and zygotes of sufficiently different constitution are different organisms. We next investigate the extent to which organismic identity involves zygotic constitution.

CHAPTER FOUR

Organisms and the Genetic Identity Criterion

If origins are unique and essential, then successful genetic explanations will tell us something about the natures of the individuals around us.[245]

Section I: The "Genetic Plan" Criterion

If organisms have individual essences, some constitutive conditions must be satisfied where identity occurs. Matter produces all properties within the organism, comprising the distinctions between identical and non-identical organisms. This is an expression of physicalism, the view that "everything whatever is determined by the physical."[246]

The material *constitution* of any object consists in the presence of particular particles of matter coalesced in particular arrangements. We may thus distinguish between the *configurative* and the *material* components of the object–as identical matter may be differently configured (say, the same legos which form an airplane are disassembled to form a forest), and identical configurations may derive from different material parts (say, new legos are used to build a new forest, identical in arrangement). Here the segregation of genetic constitution into genotypic (configurative) and genomic (embodied material) aspects will play a central role (see chapter two,

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[245] Michael Losonsky (1987), p. 258.

[246] John F. Post, "'Global' Supervenient Determination: Too Permissive?" in Elias Savellos and Umit Yalcin, eds., *Essays on Supervenience* (Cambridge, Mass.: Cambridge University Press: 1995). p. 73.

section II). Indeed, a principle of sufficiently similar configuration of origin appears to underlie the various proposals for the essence of individual organisms which we have considered. As the specifics of a constitutive identity criterion have been absent from these views, my present aim is to offer an account of what kind of constitutive identity must be preserved for the identity of organisms across possible worlds (configurative and/or material), and from what property of the organism this derives. We are particularly interested in whether a plausible constitutive identity-criterion will involve us in *material* identity criteria that we have seen some philosophers require and others reject.

Organisms as objects of appropriate change: an Aristotelian view

Aristotle offers some early insight into how we can make sense of the individuality of organisms. In Aristotle's view, organisms have individual essences, which are relative to their species,[247] and consist in an actual ability, or causal power, to develop in appropriate ways. He says,

> Some things are due to nature; for others there are other causes. Of the former sort are animals and their parts, plants, and simple bodies like earth, fire, air and water–for we say that these and things like them are due to nature. All these things plainly differ from things which are not constituted naturally: each has in itself a source of change and staying unchanged, whether in respect of place, or growth and decay, or alteration.... This suggests that nature is a sort of source and cause of change and remaining unchanged in that to which it belongs primarily and of itself.[248]

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[247] J.M.E. Moravcsik (1976, p. 595) says, "According to Aristotle, individuals are neither "coat-hangers" nor bundles of qualities. They derive their being from belonging to a genus. Thus the individual is fundamental for Aristotle, but e.g., Socrates derives his essence from being a man."

[248] Aristotle, *Physics*, Book II, Chapter 1, 192b, 10-16, 20-22. (J.L. Ackrill, ed.: *A New Aristotle Reader* (Princeton: Princeton University Press, 1987). p. 93.)

While an inner principle of change determines the identity of an organism, its environment offers a medium for the organism to express its unified nature. Different conditions and environments may contribute to a man's development (e.g.) either as a teacher or a builder, but his enduring nature is not altered by such alternatives. Jonathan Lear explains:

> Natural organisms are loci of reality and self-determination. Because each has in itself a principle of change, there is an objective basis for distinguishing it from the rest of the environment.... Moreover, the principle which directs the growth, development, and characteristic activity of a natural organism exists in the organism itself. The environment only supplies a backdrop against which an organism acts out the drama of its life.[249]

Aristotle captures our sense that a given organism may develop appropriately in a multitude of environments, while maintaining its individual nature.

The sense that organisms are unified as objects of appropriate change is widely accepted despite controversies regarding other features of organismic essence. Each organism is characterized by an intrinsic potential to endure a range of possible alterations while other changes are prohibited. A given domestic cat, for example, may not endure an alteration of the natural kind to which it belongs, say, by becoming or being identical across possible worlds with a table or a butterfly.[250] Other alterations incompatible with identity involve lesser changes than of natural kind. A cat may have long hair whereas in warmer climates its hair may be shorter, and it may become a parent whereas if it is neutered or spayed it would not. But other alterations that do not involve alterations in natural kind also appear to be inconsistent with the identity of the organism, unless they are imposed by craft to override a natural property or disposition of the

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[249] Jonathan Lear, *Aristotle: the desire to understand* (Cambridge University Press, 1988). p. 25.

[250] Though it is logically possible to imagine a cat changing into a table, it is not possible (metaphysically) that the cat be identical with the table into which it transforms. Here one may define the natural kind as *organism* and/or *species*, keeping in mind the controversy regarding the objective existence of species (chapter two, section II).

organism.[251] A male cat, for instance, may not become or be identical with a female cat, even though both objects are members of the same natural kind (or species).[252] (If such alterations are produced artificially, for instance by a sex change operation, it appears less obvious that a change of the organism's *identity* has occurred. This topic is pursued in Chapter Five, Section I.) That is, such changes would be inconsistent with the identity of the given cat due to its inner principle of appropriate change. An organism's individual essence allows it to manifest a fixed range of possible alterations in a multitude of actual and theoretical possibilities. Characteristics excluded by its individually determined range of appropriate changes are thus giveaways of non-identity.

Genotype as the Inner Principle of Organismic Change

Aristotle was determined to demonstrate the empirical and material basis of all that is real (at least in the terrestrial realm), and his inner principle of change within organisms is a property that is only manifest in matter. Before considering the Aristotelian answer to the aspect of matter in which this identifying property consists, I would like to offer a modern proposal which meets Aristotle's notion of an enduring inner principle of change within the organism. I offer that an organism's genetic plan of origin is its identifying property through time and across possible worlds. In the organism's *genetic plan of origin* is a necessary condition of *identity of the*

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[251] The distinction between natural and unnatural is seldom hard and fast. I base this present distinction upon the "natural" range of properties that an organism may develop according to an inner biological cause.

[252] Whether a property is possible, given the organism's inner principle of change, may be a subject for dispute and investigation, like the proposal that a (an individual) chimpanzee is capable of conceptualizing a symbolic language in certain environments. In chapter five I raise the question of the influence of alterations imposed by craft (i.e., sex change) upon organismic identity.

organism. This is a criterion of organismic *configuration*, because it is the *arrangement* of the genetic material which determines the range of appropriate change in the organism, rather than the material from which the genome is constructed. However, because the genetic plan of origin consists in genotypic (configurative) and genomic (particular material) constitution, the essentiality of the organism's particular material of origin will receive our consideration in the next section, in a discussion of individuation the of twins.

Michael Losonsky offers a view that shares Aristotle's notion that an inner principle of change constitutes the individuality of each organism. Losonsky appears to echo Aristotle in his claim that "individuals have individual essences, and these are active principles that give an object the power to change as it does during its lifetime, as well as the power to remain identical through these changes."[253] Losonsky offers,

> The very same individual has many distinct properties, but all these properties have a dynamic unity. What unifies these properties is not just the fact that they are all exemplified by one object, but also that there seems to be some underlying property or causal principle that either determines that the object exemplifies all these properties, or at least makes it physically possible that it exemplifies these properties.... Something about the object gives it the power to change the way it does.[254]

Losonsky concludes that an organism's genetic constitution of origin serves this role, therefore constituting its essence:

> Consider the essence *being the human being that grows from Alpha in suitable environments*, where Alpha is the particular zygote out of which I grew. The casual power I have in virtue of this property is the ability to grow from Alpha, and to grow according to the genetic structure of that zygote.[255]

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[253] Michael Losonsky, (1987), p. 255.

[254] *Ibid.*, pp. 254-255.

[255] *Ibid.*, p. 256.

In the genotype of origin, Losonsky captures a feature of organisms that (when non-genetic cellular and extra-cellular conditions are satisfied) specifies what kind of organism it may become. It provides the basis of organization for each cell produced subsequent to origin (in multicellular organisms) which allows the organism to develop, as well as "the power to respond in particular ways in different environments."[256] Genetic origin contributes the organization which enables and limits all of the organism's life-processes. A given genotype can develop into an organism in a variety of appropriate cells (as evidenced by twinning), and allows the organism to respond in numerous ways in numerous environments. The genetic plan is present at origin, and while the organism can and must change through time, the *original* enabling plan does not. Graeme Forbes expresses this defining role of origin, claiming that an organism is "the product of the originating event fixing a certain nature that in turn determines a pattern of growth and metamorphosis or decay and death."[257] Genotype of origin serves as a principle of constancy in the organism, and although an organism's genotype mutates throughout its life, the genome of origin continues to serve as the template from which all mitosis in the organism is first derived.[258] As the inner principle of change within the organism, the genotype determines the individuality of the organism, and offers our first postulate for organismic essence.

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[256] *Ibid.*, p. 256.

[257] Graeme Forbes (1986), p. 12. Forbes adds, "(this is just a list of things characteristic of organisms–nothing is being assumed about the boundaries of persistence of a single organism)." Forbes rejects a material constitutive criterion for organismic identity, noting, "It is equally basic that place of origination *and composing matter* simply do not figure in the story about what being an organism amounts to" (p. 13). Forbes offers a more general defense of the essentiality of origin with respect to biological objects in "Origin and Identity," *Philosophical Studies* vol. 37 (1980). pp. 353-362.

[258] For instance, cancer involves mutations that can be life-threatening. See Chapter Five for a discussion of the influence of genetic mutation upon identity.

A Lesson for Aristotle

Although Aristotle did not have access to genetic science, I have suggested that genetic essentialism accords with Aristotle's inner principle of change. However, Aristotle had something else in mind to constitute this inner principle. In Aristotle's view, the source of an organism's individuality is its form: in Lear's words, "form expresses the essence."[259] Aristotelian form has nothing to do with the abstract immaterial forms that a popular meaning of the term has inherited from Plato. For Aristotle, form is only present in matter, and form plays a specific role in the matter in which it is present. Thus in organisms, the form of a plant is its nutritive soul; of a non-human animal, its sensitive soul; and in man, his rational soul. The rational soul is the inner principle of change and the essence of a human; it consists in the human's expression of its nature to develop into a rational adult according to its purpose: "the form is both the organism's development toward a goal and the goal itself."[260] Furthermore, the form of living things is dynamic, and finds its completion in the developed (i.e., adult) organism. For instance, Aristotle holds that a fetus in its early development only marginally expresses the form of a human organism, asserting that the fetus is more like a plant. He says of the earliest period of animal development,

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[259] Jonathan Lear (1988), p. 28.

[260] *Ibid.*, pp. 19-20; see also p. 39. Aristotle holds that in humans, the formal cause (what it is), the efficient cause (how it changes), and the final cause (its purpose) are united in form (*Physics*, Book II, Chapter 7, 198a 25-27): "these last three (fashions) often coincide. What a thing is, and what it is for, are one and the same, and that from which the change originates is the same in form as these. Thus a man gives birth to a man, and so it is in general with things which are themselves changed in changing other things."

> We ought to consider the original condition to be not sleep but only something resembling sleep, such a condition as we find also in plants, for indeed at this time animals do actually live the life of a plant.[261]

The form is embodied in different levels of actuality within the organism at different stages of its life. Thus form maintains the explanatory breadth to explain identity and change in organisms; in Aristotle's mind it is all of the organism's *potentiality*, howsoever it may be manifested toward the development of the organism in its greatest *actuality* of being (i.e. for humans, rational thinking). Indeed, *potentiality* is a fitting expression for our modern concept of an organism's ability to develop appropriately in many different ways.

Aristotle's teleology of life may satisfy our sense that life is purposive or ruffle our convictions that natural laws are purposeless. Mayr thus suggests abandoning the language of teleology in biology, and proposes the term, *teleonomy* to designate the causal organization of biological processes without connoting a sense that these processes are *intended*.[262] So perhaps Aristotle could learn from evolutionary theory, and withdraw his judgmental notions about the organism's proper development for the sake of achieving designated "higher actualities."[263] Might our view that genotypes necessarily exist in matter and are responsible for the appropriate developmental changes of an organism make a genetic essentialist of Aristotle?

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[261] Aristotle, *Generation of Animals*, Book V, Chapter 1, 778b 34-35 – 779a 1.

[262] See Thomas Fogle (1995), p. 540: "[Mayr] wished to avoid the connotation of conscious purpose associated with teleology and therefore be able to outline the nature of a biological program. Teleonomy is a purely biological statement about causation of the phenotype. Embryological development achieves endpoints, either physiological or anatomical, shaped through evolution by the process of natural selection. Mayr viewed these goal-directed endpoints, or teleonomic properties, as caused by a program."

[263] Indeed, the organism's development according to its telos is not ordinarily a conscious *intention*; the tadpole develops appropriately into a frog without its recognition that it is fulfilling its potentiality.

While form always exists in material manifestations, it is distinct from 'mere' matter (even when configured), which Aristotle views as lacking in order.[264] For Aristotle, the form of living matter is a principle of organization distinct from material organization, which may occur spontaneously.[265] Hence, form is not a material substance, even of organized matter.

> Both Aristotle and a modern biologist would agree to the following subjunctive conditional: 'If this young child were allowed to live in a supportive environment, it would grow into a mature, healthy adult.' However, for the modern biologist the truth of this conditional would be grounded in the already achieved material structure of the young child.... For Aristotle, by contrast, the actual material structure of the child is in itself insufficient to guarantee normal development.[266]

Lear argues,

> a young organism's form should not be identified with its current organization and structure. In addition to the structural articulation which the immature organism has so far achieved, it has within itself a force for future growth and development. This force is the form, though at this stage Aristotle thinks the form should be thought of as potentiality or power.[267]

Lear thus finds that Aristotelian forms are incompatible with the materialistic principles of modern biology:

> one can say that the spider builds its web in order to secure nourishment, but one can also explain its orderly activity via its neuro-physiological makeup and genetic inheritance. That is, actual physical structure grounds teleological behavior. It is important to realize that Aristotle does not believe in any such compatibility. For Aristotle, the reason one has to cite the form in its final,

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[264] See Jonathan Lear (1988), p. 20.

[265] See *ibid.*, p. 37.

[266] *Ibid.*, p. 22.

[267] *Ibid.*, p. 19.

> realized state is that it is only by reference to that form that one can understand teleological behavior.[268]

According to Lear, as contemporary biology views material organization as life-conferring in itself, Aristotle and the modern world cannot meet.

However, Sheldon Cohen suggests that Aristotle's concept of form may be satisfied, in modern terms, by the *informational* nature of genetic organization.[269] Conceived as information embodied in matter, the genotype might serve Aristotle's theory of form. The genotype organizes the organismic matter in a causally teleonomic way, and even though it is always embodied in matter, genotypic properties express more than the mere existence of matter in a determinate configuration. We may say that the genotype *informs* the organized, life-long development of the organism, acting as more than a purely physical property, but also as an encapsulation of its future possibilities. Whether we view the informational nature of the genotype as "emergent" or as an expression that wholes cannot be characterized by compiling the separate properties of their individual parts, genetic information serves as a unifying cause of individual organismic development.[270]

The concept of genotype as information is well-established in biological thought, and may provide an opportunity for modern biology to merge with ancient Aristotelian empiricism. Aristotle lacked the molecular scientific methodologies to isolate genetic properties as essence-conferring, although he understood objects as composed of molecules. Just as we find delight in

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[268] *Ibid.*, p. 36.

[269] Personal conversation, April 29, 1998.

[270] As put by Richard Lewontin (1992, p. 122), "It is not that the whole is more than the sum of its parts. It is that the properties of the parts cannot be understood except in their context in the whole."

the ancient insight of Aristotle's scientific analyses, we may surmise that he would wish to accommodate the findings of genetic science in his view, and could integrate genotypic constitution with his view of form.[271]

The Original Configurative Criterion: Genotype vs. Extra-Genetic Constitution

The genotypic identity requirement is one of original configuration and, as opposed to the original material principle of identity, is not subject to notable controversy.[272] When an identity of *material* requirement is explicitly rejected, as appears to be the case with McGinn's theory of d-continuity, identity of *configuration* is not. We assume that McGinn means to include (at least some sufficient sense of) original identity of configuration as an aspect of the "certain sort of spatiotemporal *continuity*"[273] of his theory. The original configurative identity requirement may be largely *implicit* in many views because it is a manifestation of the physicalist principle that the properties of any object are a consequence of the configuration of its material particles.[274] Thus

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[271] Mayr considers whether Aristotle had inclinations towards an evolutionary concept of organisms; for instance, based upon his belief that "nature passes from inanimate objects through plants to animals in an unbroken sequence," but Mayr concludes that due to his concept of species fixity and an enduring natural order, "Aristotle was opposed to evolution of any kind." Though the revision of Aristotle's theory of forms to encompass evolution would require a reconceptualization of formal causes, this revision need not undermine Aristotle's theory of forms. See Ernst Mayr (1982), pp. 305-307.

[272] This view may attract controversy to the extent that the philosophical community responds to increasing potentials to manipulate the original genetic constitution of a zygote, and hence, the identity of an organism. See Chapter Five, sections I and II for discussions of identity and moral issues.

[273] Colin McGinn (1976), p. 132.

[274] Of course, physicalism does not commit us to a *reductive* view of material objects, but leaves the question open.

two objects that differ entirely in configuration of origin are thought not to be identical, in a view that is tied to the finding that "all our scientific experience goes against the possibility of there being two substances that differed solely in having radically different molecular structures."[275] In other words, identity cannot endure sufficiently considerable differences in material configuration at origin. *What counts as sufficient* identity of configuration to determine an organism's identity remains at issue, as it appears that an organism can endure some alterations of original configuration without altered identity. We recall that organismic identity can endure the ordinary changes of configuration that occur with development through time (i.e., growth), and some counterfactual alterations of original configuration may also pose no threat to identity.

Consensus regarding an original constitutive identity requirement thus calls for us to explain the role–essential or nonessential–of non-genetic constitution of origin. Can we determine that genotype of origin is essential without adding the rest of the original zygotic cell? As we emphasized in Chapter Two (Section I), genes do not work in vacuums, and original non-genetic cellular material is also directive of the organism's initial development. So not only is it necessary for organismic development that its genotype work in *some* cellular environment; the *particular constitution* of the extra-genetic cell also contributes to the individualized development of the organism; for instance, particular antigens in the cellular wall determine varied susceptibilities to harmful intruders. Cohen and Stewart note, "in most sexual animals the egg begins development without involving the embryo's own genes."[276]

Furthermore, no discussion to my knowledge clearly segregates the essence-conferring role of genetic constitution and the extra-genetic constitution of the organism. Elliot and Gallois'

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[275] John Dupre (1981), p. 72.

[276] Cohen and Stewart (1994), p. 81.

"alternative zygote construction" example preserves the constitution of the *entire* zygote, and even Losonsky, who attributes essence to unifying genetic "powers," does not distinguish genetic constitution from the extra-genetic cell: "one unique, essential feature I have is my biological origin in a particular *fertilized egg*."[277] These views, though consistent with the genotypic criterion of identity, call into question the role of non-genetic constitution.

Here I suggest a fundamental difference between original genetic and non-genetic configuration of the organism. First, let us consider the instrumental role of the extra-cellular zygote of origin, which (here we are referring to meiotically generated organisms only) is contributed by the mother with the fertilized *ovum* (the father's contribution being primarily chromosomal). Cohen and Stewart object to reductive views that DNA plays an independent role in determining the development of organisms, noting,

> The early development of an embryo is controlled not by its own DNA but by the architecture of the egg and by maternal genes. Many experiments have been performed in which the natural cell nucleus of the zygote is replaced by that of another species, and the development continues to follow the same path that it would have followed with the original nucleus.[278]

(To be sure, the cellular constitution into which the nucleus is transferred must be sufficiently similar to the original zygotic cell to allow for compatibility with the cellular apparatus to produce an organism.) Cohen and Stewart claim, further, that if mammoth DNA could be reconstructed within a living zygotic cell and implanted into an elephant to produce a viable organism, it would produce an elephant rather than a mammoth. This determination reflects their emphasis on the extra-genetic cellular, as well as maternal (gestational) contributions to how an organism develops.

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[277] Michael Losonsky (1987), p. 258.

[278] Cohen and Stewart (1994), p. 82.

Cohen and Stewart's anti-reductionism is supported by the integrative functioning of genes in cells, and in mammals, zygotes in "mommies." And as we saw in Chapter Two, anti-reductionism about genetic causation is sound. However, their argument does not show (and is not intended to show) that genetic constitution does not play a uniquely essential role when organismic *identity* is concerned. Indeed, the ability of genotypes to function in alternative cellular and maternal environments leads us to speculate that an organism's particular extra-genetic configuration of origin is non-essential. Consider how reproductive technologies have begun to infuse the cytoplasm of younger women's donor ova into the ova of "older" women in order to improve the parents' likelihoods of having "their own baby" (a sperm is also inserted to produce a zygote). Gina Kolata explains the utility of this "ovum cytoplasm transplant":

> In younger women, as many as half of all eggs end up with a chromosome too many or one too few, and those eggs rarely develop into a viable embryo. As many as 90 percent of the eggs of women 40 and older develop chromosomal abnormalities during meiosis, which is what makes it so difficult for older women to become pregnant.[279]

A second method for providing younger ovum cytoplasm for parents who wish to contribute their own genes to their offspring is the "ovum nucleus transplant" in which a nucleus from an older woman's ovum is implanted into the denucleated ovum of a younger woman. The success of this method, however, has not been proven by fertilizing the ova, due to regulatory prohibitions on embryo research.[280] (We should recall here that genetic material also resides outside of the nucleus in eukariotic (i.e., human) cells, and the ovum nucleus transplant therefore does not

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[279] Gina Kolata, "Scientists Face New Ethical Quandaries in Baby-Making," *New York Times*, Aug 19, 1997, p. B7, 11.

[280] Federally funded institutions may not create embryos for research purposes with no intention of implanting them.

replace the younger woman's mitochondrial DNA.) However, our interest in these techniques is their implications for the identities of the resulting organisms.

Parents are more interested in having their own genetic offspring than in having offspring from the mother's own cytoplasm, though this cytoplasm comprises the bulk of the zygotic material. While we leave aside moral issues of reasons to prefer genetically related offspring (and not assuming it to be a universal preference), we may suppose that parents perceive that the identity of an offspring, and the claim to biological parentage, are associated with the provision of the offspring's genotype. And this perception, I offer, is sound. Provided that the original non-genetic cellular constitution is compatible with viability of the DNA plan, counter-factual alterations of the particular constitution of the extra-genetic cell do not derail the unifying plan present in the original genotype. The number and size of individual ribosomes, the content level of the cytoplasm within the cell wall which results from differential chemical compositions at the cellular interface with its external environment, the looping pathways of the endoplasmic reticuli–the exact configurations of these are in a state of flux within each cell and are dispersed among descendent cells until they are completely replaced. DNA particles, on the other hand, maintain, with high exactitude, the identity of causative configurations within a cell until meiosis or mitosis occurs (notwithstanding motions of electrons and other properties such as spatial location within the nucleus, etc.). Furthermore, the extra-genetic constitution of the zygote of origin is not instrumental in producing any enduring properties such as particular disease states in the organism. So while the genetic plan of origin is directly instrumental in prescribing the variety of appropriate responses of the organism in many possible environments, extra-celluar configurations at origin are useful, but may be substituted for alternative exact configurations without loss of identity.

Cohen and Stewart might agree. They argue, "dinosaur DNA does not *describe* a dinosaur. It *prescribes* a dinosaur, within the context of another dinosaur."[281] Our notion of essentiality of genetic configuration of origin holds that DNA determines (prescribes) a range of developmental options in an organism. Whether or not we choose, like Cohen and Stewart, to call the product of mammoth DNA gestated in an elephant an *elephant*, I suggest that it is the identical *organism* to one that would have been produced from the same genetic material under more natural, mammothy circumstances.[282] The identity of an organism, as natural kind, is all or none; and where identical genetic material of origin is present, I offer that it is *all*.

Section II: Individuating Criteria: Biological Place vs. Material Constitution

Because the same genotype of origin can be multiply instantiated in twins, clones, and nonrelated coincidental genetic counterparts, the configuration criterion of identity fails to individuate. Theories of organismic essence must add to genetic configuration further identity-conditions that perform the job of individuation. Here we shall test the same-parents and biological place identity criteria against a genomic (genetic material) criterion in an effort to solve the problem that we began by examining Kripke's view.

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[281] Cohen and Stewart (1994), p. 84.

[282] I would be inclined to call this offspring a *mammoth*, in keeping with the essential property of the range of possibilities prescribed by the original mammoth DNA (including, as in this proposed case, the possibility of development in an elephant cell and gestation within an elephant). So this example need not challenge the view that the species to which an organism belongs is essential to its identity. However, the prospect of assigning one individual to either of several species categories should not be troubling. Many classes of organisms are difficult for taxonomists to classify, and, as suggested in Chapter Two, many taxonomists and philosophers regard species classification as a stipulative concept that does not designate distinct essences.

Individuation and Biological Place

We now return to the concept of biological place to complete our evaluation of the same parents criterion of organismic identity. We introduced this concept to enhance McGinn's principle of d-continuity so that it could be seen more clearly to respond to the problem of identifying between distinct organisms produced by seemingly identical d-continuous paths (the properties problem illustrated by Sarkar's irradiated gametes example), and in consideration of the failure of d-continuity to individuate among distinct organisms that do not seem to differ in cotemporal properties (the twin-individuation problem).[283] Biological place enhances the principle of d-continuity by specifying the involvement of the organism's particular past and future evolutionary influences, as well as the biological principles that guide its life-processes and thus make biological relations possible. A given biological place thus requires the organism's particular parents, whose identities are as constitutive of the offspring's biological place as are the offspring's own properties. Further, as biological place preserves the organism's evolutionary individuality, it must explicitly include the genotype of origin identity-criterion which governs biological and evolutionary possibilities at the individual level. This allows biological place to meet Sarkar's objection that d-continuity cannot discern among an organism and its possible-world counterpart whose gametes of origin endure irradiation to produce an organism of a different sex. Thus the concept of biological place may explain what McGinn means by the "organized, law-governed, causally unified process of development"[284] that he claims is implicit

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[283] To review these problems see Chapter Three, Section II, "The Continuity Criterion: The Incompleteness of McGinn's Theory of D-Continuity."

[284] Colin McGinn (1976), p. 134.

in d-continuity, which otherwise may be viewed to fail, by itself, to identify and individuate among possible world organisms.

The view that identity of biological place constitutes organismic essence now requires further consideration. Evolutionary relations, which are inherently random and to a large extent historically removed from an individual organism, may appear to be an unlikely candidate for serving as a condition of its identity. In response to this issue, we are largely on our own, as there do not appear to exist well-developed explanations of how evolution and its contribution to an organism's biological organization might contribute necessarily to the identity of an organism. John Post contributes to this issue by his notion of teleofunction, where he posits that evolutionary history is essential to the classification of biological natural kinds.[285]

Post's main concern, distinct from our present one, is how to characterize the scope of properties that belong to biological objects.[286] His view has implications for the role of biological place in determining organismic essence because he suggests that whether an object belongs to a class of biological natural kinds necessarily depends upon whether it is produced by an appropriate history of evolutionary adaptation. Accordingly, Post argues that the *properties* belonging to an organism necessarily include properties of its adaptive history.

Post's view is based upon the concept of "teleofunction" implicit in biological adaptations. He holds that the adaptive properties of biological kinds are essential to their membership in the kind, and that objects within the kind cannot be essentially characterized

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[285] John Post (manuscript, 1998), and (1995). I understand Post's view to apply generally to biological natural kinds produced by adaptive processes.

[286] In (1995), Post considers whether physical (adaptive) properties other than an object's own may supervene upon (biological) objects. In (manuscript, 1998), Post considers whether properties that determine the proper values of ethical judgments may supervene upon biological objects.

independently of an evolutionary history that supplies the "what for" of their adaptive natures.[287] For example, a heart is necessarily produced by evolutionary processes that, though they extend way beyond the physical properties of the heart itself, determine its biological role and how it achieves this function. Post argues,

> a token heart, like any token, has a given teleofunction only in virtue of being a descendant in a reproductively established family of items in which a critical mass or proportion of ancestors – it can sometimes be a tiny proportion – performed that function and performed it… in virtue of having certain physical properties and relations to their physical environments. It follows that it is not the present token heart's intrinsic physical properties that determine it is a member of the biological kind "heart" (its physical structure and causal or other dispositions included), but rather a history in which it is a late arrival.[288]

Post holds that a heart which fails to perform its adaptive function is indeed still a heart in virtue of the adaptive teleofunction according to which it develops, though imperfectly. And though he cautions us to let scientific evidence direct our theorizing, he entertains the metaphysical possibility that a heart may be created apart from an adaptive history (suppose molecules spontaneously coalesce into a heart-likeness) or may be constructed by human craft. While people may choose to call such an object a heart, Post argues that it *fails to be* a heart due to the absence of a natural biological teleofunction. According to Post, the biological finding that hearts are produced by an appropriate adaptive history is explanatorily useful, and reveals a necessity in those objects derived from how evolution works.

A similar appeal to appeal to evolutionary processes seems to be involved in McGinn's defense of species essences:

> To be of a certain species is to be d-continuous with a stock of creatures from which the species actually evolved: to be of the kind *Homo Sapiens* is to be d-continuous by descent with a stock of pre-hominid primates…. If the thesis that

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[287] John Post (Manuscript, 1998), p. 6.

[288] John Post (1995), p. 81. Post attributes the concept of teleofunction to Ruth Millikan.

> species have their origins essentially is correct, it seems to follow that the earth wouldn't have been populated by the species it is populated by if the relations of evolutionary descent had been different from what they actually were. For the evolution of a species consists of a chain of d-continuity relations each link of which is metaphysically necessary.[289]

While McGinn's theory of species-essence involves ancestral history, as does Post's view of biological kinds, Post does not reveal his own view regarding whether species are biological kinds in the articles under consideration. In any case, as a view of necessity of adaptive history for biological kinds, it appears that Post is committed to a view of the necessity of adaptive history for individual organisms.

As is Post's urging, this view ultimately requires us to abandon a dominant metaphysical view of properties. Opposing an individualist view of properties for biological objects, where "individualism is the view that the nonphysical properties of an individual are always determined by its own physical properties (relational properties included),"[290] he argues that *global* properties (i.e., historical adaptive properties) supervene upon biological objects:

> A given instance *x* of an adaptation A... is determined by causal/mechanical affairs in a natural-selective history prior to the appearance of *x* (an instance of an adaptation), which affairs clearly do not include those of *X*'s own causal properties or relations that are entailed by how *x* itself actually behaves or is disposed to behave.[291]

He offers further,

> In biology... one encounters properties that on the evidence are not determined by their bearers' own base properties, relational properties included, but by those of other things at some distance in space and time.[292]

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[289] Colin McGinn (1976), p. 135.

[290] *Op. cit.*, p. 77.

[291] John Post (Manuscript, 1998), p. 7.

[292] *Ibid.*, p. 5.

For a relational property to be individualist, it must be determined by the individual's own base physical properties, and some philosophers allow that individualism may include relational properties that are determined by the individual's own base properties as well. Thus, according to Post, the essentiality of adaptive history requires us to abandon an individualist view of properties, because adaptive history is not causally or physically present in the object's own physical nature. As Post acknowledges, this metaphysical consequence of his view is not well-recognized by philosophers. He says, "nearly all the supervenience relations currently on offer (e.g., the many varieties of weak and of strong supervenience) are individualist."[293] Claims that parental identity necessarily contributes to an offspring's individual identity share this surprising implication regarding biological properties.

Indeed, non-individualism is rejected by many philosophers. Consider Aristotle's suggestion that the properties of a plant's progeny confer upon the parent plant a property of everlastingness: "reproduction serves "in order that they [even plants] may partake of the everlasting and divine in so far as they can."[294] Here Aristotle suggests that the property of everlasting existence is conferred to the parent plant by its descendants, even though the descendants do not necessarily impart physical properties upon the parent. To be sure, biological parents and their offspring are related at least by causation, and typically also spatially (unless, say, the biological parents are deceased and the gametes are fertilized artificially), to ancestors and descendents, but it appears bizarre to suppose that these other objects constitute properties of the organism itself. Losonsky characterizes a non-individualist view of properties as counter-

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[293] *Ibid.*, p. 5.

[294] Aristotle, 514a, 14-15. This statement is enigmatic in view of the materialism present in most of Aristotle's work.

intuitive: "if the property revolving around the sun has the sun as a constituent part, then the sun is wholly present in Earth as well as all the other planets revolving around the sun, which is absurd."[295] Dupre disfavors non-individualism in his objection to the appeal to distant relations of evolutionary history for comprising species-essence, arguing,

> the essential or privileged property in question is highly extrinsic to the individuals to which it may be supposed to apply. Not only does it offer no hope of examining individuals and determining to which taxa they belong, but indeed nothing short of the entire history of the organism will suffice for such a determination.[296]

While these examples are not meant to cursorily discredit non-individualism for the purposes to which Post applies it, we see that the implications of the biological place criterion for organismic identity present a challenging position to defend. Since evolutionary history is not physically present among the organism's own properties, an individualist interpretation of properties tells us that it cannot be a candidate criterion for essence of the individual. And as we shall see, evolutionary processes can also be interpreted to support the *non-necessity* of biological place.

Biological Place and the Randomness of Evolution

The genetic plan criterion of identity says that a necessary property of individual organisms is their particular genetic structure of origin. An added criterion of particular ancestry may be thought of as a counterpart to the genetic plan criterion to insure identity where distinct organisms have identical genotypes. Although ancestors are increasingly removed from the organism's own properties and time of existence as relations increase in distance, ancestors may

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[295] Michael Losonsky (1987), p. 255.

[296] John Dupre (1981), p. 87.

be regarded as each serving as a necessary causal and continuous link in the path that produces a subsequent individual.

The randomness of evolutionary events may be thought to support the biological place identity criterion. The hallmark of evolutionary randomness is mutation, which normally occurs at a relatively stable rate of approximately one mutation per one million nucleotides. Many mutations may be produced by deterministic, though anomalous causes, such as a multitude of known anomalies of nucleotide replication including ionization or deamination of a nucleotide base.[297] The present appeal to randomness, however, refers to evolutionary processes that are not deterministically caused by physical states, but involve a noncausal element of chance. Randomness in this sense may not be used to support a view that evolution proceeds deterministically and that thus the evolutionary path to a given organism is inevitable. On the other hand, a proponent of biological place may appeal to randomness to argue that evolutionary causation and non-causation are so sensitive that for a given organism to exist, its given evolutionary influences may not be replaced without producing an alternative organism. For example, efforts to repeat the outcomes of biological events by reproducing causal conditions that influence the transmission of genetic traits invariably produce nonidentical outcomes. This may be offered as evidence to support the view that ancestral links may not be substituted in a counterfactual world without altering the identity of organisms that follow the substitution.

Evolutionary processes involve an element of whimsy, whereby given influences may produce variable outcomes. Events at both subatomic and broad ecosystemic levels of interaction can act upon organisms to produce indeterminate outcomes if a particular outcome is not entirely favored by the physical influences. To begin with, seemingly minute physical phenomena can

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[297] Anthony Griffiths et. al., (1993). Many mutations can be averted by repair enzymes in the cell.

have tremendous consequences. Post appeals to the sensitivity of atomic particle behavior to support the view that an organism's properties are influenced by ancestral relations, noting,

> chaos theory, among other things, tells us that minute differences, at the level of physics, in the initial conditions of individual processes or systems can make radical differences in their outcomes."[298]

Post reminds us of Schrodinger's cat, to whom it is a matter of life or death whether by chance a single exosomatic atom emits a barely detectable quantum of radiation in the next few seconds. Furthermore, chance can act at both the microscopic and macroscopic levels. Mayr refers to the complex interrelations that influence organismic development and genetic transmission as partially indeterminate processes involving "stochastic perturbation," in which

> two highly variable systems (unique individuals and unique environmental constellations) [interact] with each other. Chance determines to a large extent how they mesh together."[299]

Richard Monastersky offers an example of the indeterminacy of evolutionary outcome at the macroscopic level in discussing a class of prehistoric organisms called Vendobionts. These organisms "resembled thin, fluid-filled air mattresses divided into many compartments–a pattern unknown in the animal or plant kingdoms, says [Dolf] Seilacher. 'We have nothing like this today.'"[300] Although the Vendobiants did not survive, it is surmised that the evolutionary circumstances at that time might have produced an alternative outcome:

> Before the Cambrian, though, animals held no advantage. The curious fact about the Ediacaran [period of approximately 600-550 million years ago] is that large, bizarre organisms outnumbered small, mobile animals.... There was no hint that

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[298] John Post (1995), p. 86.

[299] Ernst Mayr (1984), p. 59. Parentheses are the authors.

[300] Richard Monastersky, "Life Grows Up," *National Geographic*, vol. 193, no. 4 (1998). p. 112.

> animals would survive and Vendobiants die out. "We're looking at evolution sitting on a knife-edge. It could have gone in many different ways," says [Jim] Gehling. "This was a time of experimentation."[301]

The lesson of evolutionary randomness might be used in defense of the biological place identity criterion to claim that since counterfactual substitutions of even identical evolutionary conditions are overwhelmingly likely to result in distinct genotypic outcomes, then evolutionary history is a necessary influence upon genotypic, and hence organismic, identity. To return to the Elliot-Gallios example, even if the Trumans' bodies produce gametes in identical meiotic conditions, chance will almost certainly produce genetically distinct gametes. In such a counterpart world, random outcomes at the level of the internal behavior of the gametic particles, including developmental noise whose effects upon gamete production are undetermined, will result in some distinctions in the zygotic outcome. In other words, since even identical counterfactual conditions are unlikely to produce an identical outcome, it might be posited that changed counterfactual evolutionary conditions will *necessarily* produce a distinct outcome.

However, the biological place criterion must preclude even our *stipulation* that evolutionary processes *may* occur in counterfactual parents to produce an identical organism. Scientific demonstrations cannot actually *identically* repeat evolutionary conditions to show that identical evolutionary effects are or are not possible. However, the existence of a given organism, although produced by randomness and vast actual improbability, provides evidence that the evolutionary processes that produced it may be theoretically repeatable in counterfactual circumstances. Given this possibility, we may also suppose that sufficient similarity of evolutionary conditions may occur in counterfactual parents, provided that the genetic make-up of the alternative parents is compatible with the production of the genotype of the given

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[301] *Ibid.*, p. 114.

organism.[302] In fact, mathematics proves that it is possible for a given genotype to be reproduced in alternative circumstances. Given the random possibility that either of four nucleotides are formed in a sequence three billion base pairs long (to comprise a genotype of the length in humans), there are 4 to the power of 3 billion possible combinations of nucleotides.[303] Few of these random possibilities will produce viable organisms, so the number of possible genotypes of this size is actually much smaller. So if the number of organisms produced by separate evolutionary histories were to exceed the number of possible genotypes of this size, some genotypes would necessarily be identically repeated by alternative evolutionary histories. Of course, these organisms will not be identical with each other. The point is that alternative evolutionary conditions may produce identical genotypes, which allows the possibility that the essential conditions required to produce a given organism may be produced by distinct evolutionary histories. This possibility is a necessary precondition of the claim that an identical organism could be created by distinct evolutionary histories. However, these same possibilities may instead be used to favor a biological place criterion as required to distinguish among genotypic identicals who are clearly historically and materially distinct. So the issue remains open.

Before moving on, we may now take stock of some of the merits of the biological place criterion. By requiring identity of ancestors, the biological place criterion preserves the evolutionary conditions that produce an organism, and reflects the astounding improbability of

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[302] Recall “the immaculate gametogenesis” problem of the Elliot-Gallois counterexample, Chapter Three, Section I.

[303] Indeed, this number is exceedingly large, amounting to approximately one followed by one billion and eight hundred million zero’s. This vastly surpasses the number of particles thought to exist in the universe, which is one followed by eighty zero’s.

conditions that lead to the creation of any given organism. First, this criterion preserves the organism's genotype of origin, which I have argued is an essential property and which is also immediately present in the organism. Furthermore, by placing the organism in the context of its actual evolutionary path, this criterion offers an answer to the problem of differentiating non-identicals among organisms that share identical genotypes (provided that they are not also produced by the identical evolutionary path, as are identical twins–a problem discussed in the next section). This criterion also preserves the organism's actual evolutionary teleofunction which is conferred by the millions of years of evolutionary influence that culminate to prescribe how the organism is designed to fulfill its life-functions. This adds a contextual foundation to organismic identity that is in keeping with many biologists' views that biological processes cannot be properly understood in isolation.

Problems with the Biological Place Criterion

In spite of the reasons for its appeal, a number of considerations pose problems for the biological place criterion and the essentiality of being born of particular parents.

Ultimately, the randomness consideration reveals that even if counterfactually identical parents produce an offspring in identical evolutionary causal conditions, the outcome would most likely be genotypically and phenotypically different from the actual organism. For example, genetic mutations will continue to occur at a rate of approximately one per one million nucleotides, and random influences are likely to locate these mutations differently on distinct occasions.[304] If the genotypic identity criterion is to be retained, the argument from evolutionary

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[304] Richard Lewontin (1992), p. 48. The phenotypic differences that are likely to occur are not entirely a result of genetic differences, as shown by Lewontin's example of fly wing variations: "the variation between sides of a fly is as great as the average variation from fly to fly. But the two sides of a fly have the same genes and have had the same environment during

randomness cannot be used against alternative parents without also using it against actual parents in counterfactual conditions as well. This line of argument would force the biological place and identical parents identity principles to retreat to the extremely narrow view of counterfactual organismic identity and maintain that an identical organism cannot be produced by any alternative influences upon genotypic identity, even given identical parents of origin.

Further, as a principle of evolutionary cause and continuity, biological place faces the problem of delineating its boundaries as an identity condition. As we discussed at length in Chapter Two (Section I), genetic processes are fundamentally dependent upon and influenced by both local and broad, organic and environmental, conditions. So although an individual organism has a discreet genetic consitution, the evolutionary causes and biological d-continuities that produce it are not discreet and linear. This consideration has been central to philosophers who reject the view that biological species are natural kinds. The adaptive survival of one's own parents, for instance, is contributed in part by conditions as broad as the adaptive failure of the Vendobiants who might otherwise dominate the ecosystems that allowed humans to develop, the adaptive success of food sources that provided their food, and by socio-political circumstances that enabled them to secure food, shelter, the support of a community, and so on. Thus, Post recognizes the breadth of a view of adaptive history in determining an individual's membership in a biological kind. However, McGinn's claim that an individual's identity is premised upon the identities of its ancestors does not offer boundaries for the delineation of these ancestors, and does not address the necessary or nonnecessary influence upon identity of the environmental contributions to the evolutionary processes that produce a given organism.

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development. The variation between sides is a consequence of random cellular movements and chance molecular events within cells during development, so-called 'developmental noise'" (p. 64).

According to Post, appropriate adaptive teleofunctions are necessary for membership in biological kinds, and this implies the suggestion that teleofunction is an essential property of individual organisms. Against this view, we may reply that organisms can be characterized as performing the same functions independently of a given evolutionary history. To say that an individual organism has a *function* does not necessitate reference to its adaptive history, but rather to its constitution in such a way that certain effects are achieved by particular individualized means. If the organism has a congenital heart defect which does not support a long life, thus, we may reason that the heart might have sustained life under specified other conditions, without referring back to the evolutionary history that caused the life-sustaining property of the "successfully functioning" hearts of its ancestors. Sarkar offers a parallel suggestion that *species* membership may be isolated from a given evolutionary history. He supposes that in another part of the universe, elements undergo a

> chemical accident similar to the one on Earth [which] produce the first amino acids which led to the evolution of more complex biological species *vis a vis* the first primitive cells.... What finally evolved from its biological history were *homo sapiens*; or so I wish to maintain. But these are emphatically not *homo sapiens* for... McGinn.[305]

Dupre also suggests that organisms, as members of species, are separable from essential characterization by evolutionary history:

> If, say, a chicken began to lay perfectly ordinary walnuts which were planted and grew into walnut trees, I would not wish to refer to this result as the production of a grove of chickens. If accepted, this intuition shows that the right ancestry is not a sufficient condition for taxon membership.[306]

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[305] Husain Sarkar (1982), p. 150.

[306] John Dupre (1981), p. 88. To be sure, Dupre does not wish to rely heavily upon a fanciful example that discords with what we know about biological relations. He adds, " having expressed suspicion of this style of argument, I do not want to rest any weight on this example of it."

These examples suggest that alterations of evolutionary history do not destroy the essences of species. If species membership is regarded as an essential property of organisms, then these examples would further suggest that evolutionary history, as a nonessential property of species, may be nonessential for individual identities as well. However, at least in Dupre's case, this suggestion may be dismissed by the fact that he rejects the concept of species essence altogether. Yet the examples are illustrative without referring to species essences. While Dupre's example appears to be physically impossible, our ability to conceive of it depends upon a separation of the organism's essential properties from necessary ancestral causes. And if this example is unintelligible, it at least makes sense to conceive of the first organism(s) to be created (i.e., from the so-called primordial soup) without individual ancestors preceding it. Since some organism(s) must originate without an ancestral history, it does not appear illogical to suppose that any given organism might have done the same. To do so is to view the organism's essence as constituted by intrinsic properties, and is apparently consistent with physical laws. Thus, an organism's own physical properties of intrinsic *function* can be characterized without losing essential physical, behavioral, or dispositional properties that are offered by the wider concept of adaptive teleofunction. To say that biological place is essential to the identification of organisms appears to be unduly attached to the way that evolution *actually* acts and does not appear to refer to essential properties of the organism that cannot be characterized intrinsically. However, the proponent of a biological place criterion may still wish to respond that evolutionary history is essential, as these examples do not demonstrate identity through altered evolutionary histories of the counterfactual organisms.

While the biological place criterion has what appears to be the merit of focusing upon the biological particularities that contribute to the existence of each organism, (which must include those particularities that result from randomness), this criterion is not able to defend itself by appeal to an essential nature of evolution. Evolution itself does not proceed along a necessary path, but unfolds according to the many contingencies of environment, organismic behavior, and randomness. Lewontin argues to this end,

> Every living organism is in a constant process of changing the world in which it lives by taking up materials and putting out others. Every act of consumption is also an act of production. And every act of production is an act of consumption. When we consume food, we produce not only gases but solid waste products that are in turn the materials for consumption of some other organism.
>
> A consequence of the universality of environmental change induced by the life activity of organisms is that every organism is both producing and destroying the conditions of its existence.... So, we must put away the notion that out there there is a constant and fixed world that human beings alone are disturbing and destroying.[307]

Accordingly there is neither a constant and fixed evolution, as Lewontin also urges. Thus, it appears misguided to regard as metaphysically privileged the actual evolutionary path which leads to an organism's creation. By contrast, the view suggested in the first section asserts that a genetic plan is an organism's individual unifying principle. While we still need a principle to distinguish among genotypic identicals, the evolutionary processes that produce a given organism are themselves contingent, and are conceptually removable from an organism's intrinsic properties. The non-determinism of evolutionary processes casts doubt upon their role in determining the identities of organisms that they produce. To imagine an organism apart from its evolutionary history is admittedly to withdraw it from an important context that contributes to the organism's individual properties, but to find that evolutionary history is nonessential does not discredit its importance for other, more appropriate, explanatory purposes.

A final concern about the biological place identity-criterion is its failure to satisfactorily individuate among monozygotic twins. Forbes states the problem of distinguishing between twins, who appear indeed to have two separate origins. He says, "after the first mitotic division

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[307] Richard Lewontin (1992), pp. 114-115.

of the zygote, the resulting daughter cells separate and develop independently into distinct embryos.... Each daughter cell receives a copy of the chromosomes of the parent cell, and each copy is, so to speak semi-original."[308] Twins that separate at the one-cell stage share identical biological histories and d-continuities except for the spatial divergence that occurs in the mitotic separation and the subsequent divergences in biological development.[309] And both of these conditions are dismissed from consideration as constituting an organism's essence, including, it appears, by McGinn.[310] The only way that biological place could individuate between twins is if they contribute differentially to subsequent evolutionary history by bearing their own offspring. And likewise, no one believes that an organism's own identity is based upon the contingencies of whether it produces offspring. In sum, breaks in continuity are comprised of distinctions among physical properties, and when we ask what properties are produced by the formation of distinct continuities when fission of organisms occurs, we find that these differences do not amount to essential properties. So although biological place succeeds in precluding Sarkar's gamete

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[308] Graeme Forbes (1980), p. 354.

[309] Divergence at the one-two cell stage produces two organisms of (almost) identical developmental constitution. (Recall that a certain number of mutations will occur during mitotic division: my argument disregards this developmental distinction between twins, supposing that in at least some cases exact genotypic (and thus evolutionary and developmental) identity may be present.) In some cases, the genetic distinctions between identical twins are more considerable; for instance, "there have even been instances–at least three are known–of genetically identical twins who were of different gender. In each case, one of the pair was born with only one X chromosome and no Y" (Lawrence Wright, "Double Mystery," *New Yorker,* August 7, 1995. p.56).

[310] Regarding subsequent biological development, Colin McGinn (1976, p. 128) supports our inclinations to believe "that origin is essential but subsequent history is accidental;" and regarding spatial location, he notes (p. 130) that we be "suspiciou[s] of any view that lets the necessity of origin attach to the *circumstances* of origin." To be fair, McGinn might object to my construal of spatial relations of origin as a circumstance of origin, holding this to be essential, but to defend individuation by this sole state of affairs is not defensible.

irradiation counterexample against the d-continuity criterion, it does not solve the problem of individuation among genetic identicals. It is by the example of identical twins that I consider an alternative criterion for individuation.

The Problem of Twins: Individuation and the Material (Genomic) Constitution Criterion

In Chapter Two (Section II) we distinguished an organism's genotypic (configurative) constitution from its genomic (material) constitution. In proposing the genotypic identity criterion, the matter from which the genotype is constituted was intentionally left from consideration, since the genotypic criterion plays its own role in constituting identity and because this criterion appears to be less controversial than a material identity criterion. However, genotype of origin, like biological place, fails to individuate among genetic identicals (of origin). In the example of monozygotic twins, the material genome presents itself as an obvious candidate for individuation.

The occurrence of monozygotic twins is among the most challenging problems of organismic identity. In fact, twinning occurs much more commonly than most people realize. Because twinning adds a danger to pregnancy, one or both twins often do not survive, masking the occurrence of twinning. This suggests that each of us without twins may possibly be the identical twin of a sibling that did not survive.[311] Twinning in humans can also occur as late as two weeks into gestation, suggesting that a zygote is only contingently a 'singleton' until this expanse of time elapses. Twins have two origins of sorts; one at the time of conception and the

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[311] Lawrence Wright (1995, p. 52) notes, "Twinning is a far more common occurrence than anyone had previously imagined. Although only about one out of eighty or ninety live births produces twins, at least one-eighth of all natural pregnancies begin as twins." These figures include both identical and fraternal twins.

other at the time of separation. This circumstance challenges Locke's principle: "(that which) had one beginning is the same thing; and that which had a different beginning in time and place from that is not the same, but diverse."[312] Twins, it seems, are both the same *and* distinct. A genomic identity criterion, distinguished from the genotypic, allows us to explain the simultaneous identity and distinctness of twins.

In fact, the number of plants and lower animals that routinely reproduce by mitotic genotypic replication is vast. In Section I of this chapter, I proposed an essential role for genotype of origin in constituting the identity of organisms, so that if an organism's genotype of origin was counterfactually altered or replaced, the counterfactual organism would be non-identical with the actual one. (Recall, on the other hand, that non-genetic cellular configuration of origin could be altered without influencing the identity of the organism, as in the ovum cytoplasm transplant example.) But although an organism's genotype is essential to its identity, counterfactual "switches" between monozygotic twin genotypes of origin would not alter the organisms' identities. Suppose, for instance, that monozygotic twins *Imajean* and *Gina* experience a switch in genotype at the point of twinning: Imajean's genotype is counterfactually traded for Gina's, and *vice versa*. This switch, being among identicals (setting aside, for the sake of argument, the probability that the twins would in fact have minute mutational differences in genotype), does not involve any alteration in either organism. It might be argued that a switch of identical genotypes is unintelligible because it is impossible to discern each twin's genotype from

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[312] John Locke, An Essay Concerning Human Understanding, Chapter XXVII (J.W. Yolton, ed. (J.M. Dent and Sons: 1965), p. 151). The occurrence of incomplete twinning, illustrated for example by humans with two heads, contrasts against the problem of double origins in twins. Single-bodied humans with two heads are known to exist peaceably, but although they are given two names (corresponding to two "persons" in the philosophical sense) they are nevertheless thought to share only one complete (zygotic) origin and are correspondingly regarded as a single organism.

the other's under any circumstances; and as Hirsch describes, "the duration rule... [provides] that a thing cannot go out of existence just to be replaced by a coessential thing."[313] However, a counterfactual genotype switch between fraternal twins, being a switch of *different* essential properties, is an intelligible switch. By comparison, the indiscernibility of the theoretical monozygotic genotype switch instructs us that monozygotic twins share an essential property. Although each monozygotic twin's genotype of origin will direct different developmental and behavioral outcomes resulting from the influences of distinct environments, chances, and wills, there is a sense of identity shared between monozygotic twins and any organisms that share genotypes.

We are thus pressed to discern what individuates between genotypic (of origin) identicals. The answer, I propose, is in the genome that materially constitutes the genotype of the individual organism. This indeed appears to be the only property other than spatial location and future development (criteria that we have rejected) that is not shared between twins at the time of separation. Consider, this time, that the *genomes* of Imajean and Gina are switched so that the genetic material of each is substituted in the other twin. This example still produces *genotypic identity*, but now the organisms are *genomically reversed.* In this case, the difference in material constitutes a theoretically discernible difference in the resulting organisms, and the identity of each organism is, I propose, likewise switched. To be sure, this material distinction does not alter the organismic possibilities for appropriate development in whatever among multiple environments the original genetic constitution begins, but here the particular matter is seen as an integral part of this principle of change as embodied in organisms. The strength of the added genomic identity criterion is supported by its necessary coupling with any actual genotype, since

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[313] Eli Hirsch (1971), p. 38.

genotype is already shown to be partially constitutive of essence. Losonsky, who as we saw defends the genotype of origin identity-criterion, also views a material (genome) of origin criterion as its counterpart:

> the zygote's genetic structure together with how this structure is duplicated in the matter generated by this structure determines or at least makes physically possible the changes a human goes through.... The human's genetic structure and how it is passed along, *together with the material of this structure*, gives the human the physical capability to remain identical as it is undergoing its changes.[314]

We may be surprised now that a continuity criterion resurfaces in the genome. It is only by tracing the histories of given particles across possible worlds to common origins that their own identities can be theoretically evidenced across possible worlds. Thus to assure the identities of material particles, recalling Kripke,[315] would be an unfathomable feat of comprehension. We therefore rely heavily indeed upon our ability to *stipulate* material identities across possible worlds.

The genotypic and genomic criteria are together characterized as *genetic constitution.* Here we may conceive of a particular genotype as a multiply instantiable class determining the essential nature of objects which express it. The genome is accordingly regarded as the token of the essential type in actual individuals. Thus, a given organism is a token of the general essence that is shared by any others who share its type. On this view, the phrase "identical twin" is literally fitting when understood in a nonmaterial sense, as monozygotic twins are manifestations of essences of identical type and could trade genotypes or origin without loss of formal essence. The nonidentity of twins consists in their distinct material origins. The double origins of twins

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[314] Michael Losonsky (1987), p. 256. Italics are mine.

[315] Recall Saul Kripke (1972, p. 115), cited in Chapter Three: "It is ordinarily impossible to imagine the table made from any substance other than the one of which it is actually made without going back through the entire history of the universe, a mind-boggling feat."

thus confer upon them both identity and distinctness, in the type and token senses of essence respectively.

Individual essence is, on this view, highly specific – both temporally (pertaining to origin) and constitutively (genetic constitution alone). So this view allows the organism to exist in counterfactual worlds in which its many remaining properties may be altered (provided that the alterations are consistent with life of the organism). In order to identify an organism in possible worlds, one must look only for its genetic constitution of origin. Although an organism is a materially distinct individual, it shares its formal essence with many possible (and perhaps actual) organisms. Accordingly, those of us fascinated by the idea of having an identical twin are responding appropriately to the possibility that one might share their type of essence with others. And our fascination with counterfactual lives that we might experience is an appropriate response to the possibility that we could be the same organism in spite of originating (and developing) in vastly different environments. These different environments may indeed include having different parents, reinforcing the validity of the deeply felt human angst that we have all experienced about our origins and our lots in life, such as "if I had had different parents, I wouldn't have had to do so much damn homework."[316]

Finally, the view expressed here offers a potential link between identity-conditions among organisms and non-living objects, which all share the feature of being unified hunks of matter. Elliot and Gallois regard it as a merit that their constitutive view of identity may be shared by non-living objects and organisms, noting,

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[316] Greg Mikkelson, "Worlds, Individuals, Species, and Traits: Analogy Between Possible-Worlds Semantics and Biological Classification," from Internet site.

> In the case of non-organisms it is true that, necessarily, an object must have been originally constituted out of the very same elementary particles out of which it was actually, originally constituted.[317]

However, in comparison with non-living objects, organisms are also members of a natural kind whose wonder and beauty are limitless. The view offered here acknowledges the genetic irreducibility of organisms, as life-processes are only possible in beings with genetic origins that are produced in the context of cellular, ecosystemic, and (in some organisms) familial environments.

Conclusion

I have argued that views that parental, ancestral, and evolutionary origins play an essential role in determining organismic identity are mistaken. However, the biological place criterion is not to be readily dismissed in any case. Biological place, like the criterion proposed here, can never fail to properly identify an organism in the *actual* world, because all organisms are in fact produced by the ancestral histories (*and* the material constituents) from which they actually develop. It is only in counterfactual situations that the biological place and genetic constitution criteria conflict. The biological place criterion allows organisms to exist in counterfactual worlds where their parents' gametes are composed of alternative particles, but not in worlds where the gametes are developed from alternative parents. The opposite is true of the genetic constitution criterion.

It may be possible to reconcile these criteria by requiring them both, as appears to be Kripke's view, resulting in a highly restrictive view of counterfactual possibilities. Alternatively,

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[317] Elliot and Gallois (1984), p. 293. The extent to which material identity must be preserved remains an open question, to which we shall turn in Chapter Five, Section I.

we might adopt metaphysical pluralism for this matter and offer that the satisfaction of either one criterion should suffice in cases where they conflict, to produce an expansive view of counterfactual identity that an organism may exist in counterfactual worlds where their gametes are composed of alternative particles and in counterfactual worlds where they are born of different parents' gametes, provided that the rival criterion is met. (I would surmise that most people intuitively hold such an expansive view.) Some subjects appear to warrant this kind of non-absolutism, as illustrated by Tauber and Sarkar:

> In quantum mechanics [Bohr's dualistic approach] led to his controversial principle of complementarity whereby, in the quantum description of nature, conflicting modes of interpretation, such as those in terms of particles or waves, would be necessary because no single mode could ever be complete.[318]

My own rejection of these options is based primarily on what I regard as the inexplicability of a biological place criterion that characterizes parental and other historical identities among the organism's own properties, as well as upon the possibility that alternative evolutionary process may produce organisms with identical intrinsic properties. Since genotypic identicals can be individuated by an added material criterion that is intrinsic to the organism, the biological place criterion is not useful in the task of identifying and individuating organisms if we are willing to accept the few surprising implications of rejecting it.[319] Thus it appears that an identical organism may be produced counterfactually by alternative evolutionary (and perhaps nonevolutionary) means.

Furthermore, a *material* genomic identity criterion is easy to overlook for two reasons. First, the identities of material particles are contingent during the persistence of the organism; for instance, an organism could endure a counterfactual change of dietary particles that are

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[318] Tauber and Sarkar (1992), p. 230.

[319] These are presented in the next chapter, Section I.

incorporated into its body, or the counterfactual loss of a toe. This consideration lends us to suppose that matter *of origin* is likewise contingent. The second reason is that the particular matter that instantiates an organism's genotype of origin may be exchanged (in principle) without discernibly affecting the nature of the organism. Of particular relevance, although a distinct organism is produced by substituting its genomic matter of origin, the *experienced personal identity* of the distinct organism (supposing it to be a human) would be unaltered in the organism's own perception or others'. People would be disinclined to worry about their material identity at origin because the organism produced by different particles is, for all experiential purposes, indistinguishable. The persistence of the genotype which directs the range of appropriate development and behavior (including experiences) of the organism thus camouflages the essential importance of the material of original constitution.

On the view presented in this work, genetic configuration (genotype) and genetic material (genome) each plays an essential role in constituting an organism's identity. The genotype determines the range of changes appropriate to the individual organism, allowing it to develop in a variety of ways and in a variety of environments. Although genotypes may be shared among individuals, they independently determine the complete range of what the organism may be like (its nature) and which environments are consistent with its survival. The genomic material that necessarily comprises an organism's genotype does not contribute essentially to what the organism is like, except to distinguish it from other organisms that may share its genetic configuration. Further, the particular non-genetic zygotic constitution at an organism's origin does not contribute to its essence, although only certain such constitutions may be consistent with the organism's life. While an organism is an embodied consequence of the interdependence

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between its genetic constitution and its non-genetic qualities, it is *essentially* the consequent of its *genetic constitution of origin*, such that any changes to this alone would change its identity.

In sum, I offer that the biconditional, *same organism if and only if same genetic constitution of origin*, is true. This allows us to solve the problem of the Queen's identity that set us on our search for identity conditions. Where the Queen's genotype of origin is present, complete with identity of the original particles from which it is constituted, there too is the Queen. The Elliot-Gallois gamete reconstruction example preserves the identity of the organism that becomes the Queen in the actual world. On the other hand, an alternative organism produced from different genomic particles by identical processes of gametogenesis in the Queen's actual parents, (due, say, to different food intake), may be indistinguishable (except for materially) from the actual Queen, but this origin does not produce the Queen. And so, the Elliot-Gallois offspring is the same organism as the Queen, even though less similar to the actual Queen than the latter organism! The possibility to exist in counterfactual worlds under considerably different non-genetic conditions allows us to imagine that "in effect, we could have lived another person's life and still be who we are."[320]

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[320] Robert Wright (1995), p. 62.

CHAPTER FIVE

Implications

Is it really moral to go to the depths of genetics to find out why someone is better than somebody else? I think it is.[321]

Section I: Conceptual Implications

I have argued that the essentiality of an organism's original genetic constitution is based upon the provision of a unifying genetic plan, while identical organisms can endure multitudes of alternative non-genetic properties in counterfactual worlds. Genetic constitution of origin plays a special role in determining an organism's identity and persistence, compatible with the causal irreducibility of non-genetic and environmental influences upon organisms. An organism's identity is reducible to the identity of its genetic constitution of origin only provided that a set of additional conditions necessary for its existence are also satisfied. The genetic constitution of origin interacts with all of these other conditions to create the organism as an integrated whole.

I shall now consider some conceptual implications of the view offered in this work, which will allow us to see more clearly its strengths, its scope, and further unresolved questions.

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[321] James Watson, at a University of Wisconsin conference regarding ethical implications of modern genetics. In Stacey Anderson, "Creating a Stir with Genetics; Noble Prize Winner Favors Using it to make 'Better' People," *The Capital Times*, Saturday April 22, 1995. p. 3A.

Setting Boundaries: Genetic Material, and the Inner Principle of Appropriate Change

Earlier, we considered the possibility that the gametes from which a zygote originates might have been composed of alternative particles, such as if the parents had eaten an alternative meal from which particles were used in gametogenesis, producing gametes of identical configurative properties. And I think that most of us are inclined, at least initially, to suppose that the difference between egg salad and linguini does not affect the identity of the offspring that parents produce. The view proposed in this work suggests that this inclination is wrong. Where any identity of genomic material of origin is lost, organismic identity is lost also. Of course, this surprising consequence is necessary to support the competing inclination that some of us share that origination from counterfactual parents need not alter an organism's identity.

We also noted earlier that a problem with an ancestral identity criterion is the vagueness of who counts as a necessary ancestor, and suggested that a theory involving this criterion would have to be able to offer an explanation of the boundaries of this group. The view offered here must also confront issues of determining boundaries.

First, genetic constitution is ordinarily regarded to consist of an organism's complete complement of chromosomal and extra-nucleic DNA. This regard offers an easy grouping of the material that is a part of genetic constitution and that which is not; i.e., in humans we will normally find 23 pairs of chromosomes in the zygotic nucleus and further genetic material in each mitochondrion. However, genetic constitution can also be regarded more exclusively.
A DNA molecule consists of a purine (adenine and guanine) or a pyrimidine (cytosine and thymine) bonded with a sugar-phosphate. Each sugar-phosphate is identical in structure, and together these comprise the "ladders" that hold together the purine and pyrimidine "rungs" in each chromosome. The sequence of purines and pyrimidines determines the amino-acid sequences in protein construction, while the sugar-phosphates serve only a structural function.

This leads us to question whether these different aspects of genetic constitution serve distinct roles for organismic identity.

The concept of genetic plan allows us to give a clear answer in setting boundaries between the purine and pyrimadine groups and the group of sugar-phosphates. The former groups constitute the organism's unique genetic plan for appropriate change by determining a viable and distinctive protein-coding pattern, while the sugar-phosphates play only a derivative role. So to be more precise, genetic constitution of origin on this view refers to the amino-acid encoding groups, and sugar-phosphate chromosomal material may be replaced with alternative matter. This breaks the physical continuity present when genetic constitutions are conceived as the entire chromosomal ladders, but the identities of the sequential purine and pyrimidine matter are all that are needed to fulfill the organizing principle of identity.

Yet we are now led to consider a further distinction. Genetic material includes vast expanses of sequences that are not involved in the role of amino-acid coding. The non-coding portions of genetic sequences may be loosely categorized as "junk DNA," in contrast with the genes that act as templates for amino-acid coding. To be sure, an interesting range of functions have recently been identified for junk DNA, and its chromosomal locations and functions remain active subjects of research. But much of this material is vestigial from evolutionary history and serves no active purpose in an organism's own development.

Here I think that a clear answer consistent with the proposed view is less forthcoming. Junk DNA may have specific purposes at some locations, but in large measure its function appears to be indeterminate. For instance, one of its roles is to serve as raw material for the development of useful coding sequences in the progress of evolution. I do not have a clear suggestion about whether to consider this role as instrumental in determining the organism's plan of appropriate change. Thus I suggest that it remain an open question whether only coding genetic sequences, or non-coding sequences as well, be included in the genetic constitution criterion.

A further problem regarding the boundaries of our proposed identity criterion is posed by developmental changes within organisms that challenge the concept of an original plan of appropriate change, upon which our principle is based. Some of these changes are only theoretical, but others are actual.

As organisms develop, the original genetic plan may appear to become removed from the genetic constitutions of subsequent cells, and from the phenotypes that the organisms manifest. At the DNA level, cells undergo mutational alterations from the original sequence, and these alterations are perpetuated in their own cellular progeny. Most mutations do not impair functioning, but some do, such as many forms of cancer. Organ and blood transplants also insert different genotypes into the organism. In addition, somatic cell therapies (presently limited in application and success) aim to fix anomalous genetic constitutions in order to improve the functioning of the organism. At the phenotypic level, an organism may also manifest deviations from the outcomes that would be expected in virtue its original genotype. For example, an organism may have its hair dyed, or have a surgical sex-change. Are *these* developments a part of the original plan of appropriate change?

Marjorie Price suggests a more extreme developmental alteration that drastically alters the organism from what would be expected from its genetic constitution of origin. Price suggests a counterfactual occurrence in which a dog named Rover transforms, over a six-month period, into an amorphous mass of cells, "Clover," whose cellular genetic constitutions are also transformed."[322] According to Price, the process of alteration is gradual and is distinct from

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[322] From Marjorie Price, "Identity through Time," *Journal of Philosophy* 74, 1977. Cited in Baruch Brody (1980), p. 76.

normal processes of metamorphosis. And while Price concludes that this transformation does not involve a substantial change in the organism, it appears bizarre to assert that Rover's genetic constitution of origin offers a principle for persistent identity of this transforming organism.

The range of examples here shows that original genetic plans allow for great deviations of outcome without destroying persistent life (though Price's example may push the limits of possibility). But are the altered organisms always *identical* with the original organisms, merely in virtue of spatio-temporal continuity with the original life-form whose genetic constitution of origin it shares? With respect to genetic mutations as the organism develops and its cells reproduce through mitosis, and perhaps Price's transformation example (if possible), these need not be regarded as conflicting with the originally encoded plan. This plan unifies the developing organism without requiring that the cellular genotypes remain static or completely homogeneous, and finally allows death when the integration of genotype and environment fails. Unusual phenotypic alterations, such as sex changes, can be considered similarly. As Lewontin argues, human artifice is a product of nature that, in turn, comprises the environmental conditions in which organisms maintain life and evolve, and the genetic plan cannot be considered in isolation from the human manipulations with which it interacts.[323] The plasticity of the original genetic plan's contribution to organismic development can be conceptualized as including the ability to respond to alterations in cellular genotypes as well as organismic phenotypes. As suggested by Ernest Nagel, the genetic plan

> [has] the twin characteristics of being plastic (meaning you can get from here to there following a variety of routes) and persistent (meaning that disturbances in

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[323] Richard Lewontin (1992).

> the system can be compensated for, and do not prevent realization of the goal).[324]

Organisms are meant to change, and the acceptable outcomes of organismic development are not predetermined by the original genetic plan. It is thus appropriate to hold that any form of persistent life of a spatiotemporally continuous organism is a manifestation of the organism's original plan of appropriate change.

A Final Problem of Individuation: McKay's Puzzle

It appears that an organism's individual essence should allow us to discern its identity in all possible worlds in which these essential properties are known (i.e., when constitutive properties are stipulated). However, a puzzling challenge for individuation occurs on the present view when we consider that non-identical organisms that are not distinguishable by differences in constitutive properties may exist in possible worlds.

Thomas McKay demonstrates an indeterminacy of transworld identity when identity is defined by constitutive criteria alone. He supposes that two distinct organisms may theoretically originate from identical constitutions in the same world, and then adds that each of these distinct organisms originates, each in a different possible world, at identical times. In this case, according to McKay, there is no way to discern individuating properties that distinguish the organisms from each other. He offers,

> Suppose that some organism o1 originates from certain genetic material arranged in a certain way. The atoms constituting o1's genetic material might become independent of o1 (after o1's death, if not sooner) and by chance be reconstituted in the same configuration, originating o2 at t2. (This is bizarre and unlikely, but not logically impossible.) Yet it also seems that o1 could originate later (at t2),

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[324] Ernest Nagel, "Teleology Revisited," *Journal of Philosophy*, vol. 74, 1977. Cited in Fogle (1995), p. 541.

> making these two possible situations of origin just alike. (If o1's parents outlive o1, then o1 and o2 might even have the same parents.)[325]

How are we to know which among distinct organisms that share constitutive identities of origin is present in a possible world? We can see how McKay's replication could occur. As a zygote develops into a multi-cellular organism, the original zygotic material may slowly disperse from the body and re-coalesce at some later time, perhaps even in the same original parents, to form a zygote upon a new act of conception, perhaps even while the original organism is still living. The numerical distinctness of this organism formed from the exact material in the exact configuration as the former appears indisputable; as the slogan says, "two is not one." Yet it appears that the first organism, o1, might also have originated at t2 if it had not already originated at t1. So McKay asks us to discern how to differentiate whether an organism is o1 or o2 in a further possible world, as it seems that both o1 and o2 have claim to identity with this singular object.

While the distinct time of o2's origin is necessary for the purposes of demonstrating McKay's point, it is not the distinct time of o2's origin that is responsible for its distinctness from o1, as McKay proposes that the organisms may also originate in distinct counterfactual worlds at the same time. (They may not *both* originate at the same time in the same world because the same material must constitute each organism.) The indeterminacy problem is caused, rather, by the possibility for identical constitutive duplication of a given organism, so that no essential constitutive properties can distinguish them in alternative worlds. McKay's example thus threatens to debunk all claims to certainty that organism *x* in w1 is identical with organism *y* in

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[325] Thomas McKay, "Against Constitutional Sufficiency Principles," in Peter French *et. al.*, (1986), p. 297. McKay appeals only to identity of genetic constitution of origin, but the point of trans-world indiscernibility could be made by appeal to more complete identities of constitution (the entire zygotic constitution) if necessary.

w2, impelling us to rule out in any counterfactual world whether an organism is one of McKay's uninvited replicas.

Indeed, the possible worlds methodology allows us to circumvent this problem by stipulating identity in each counterfactual world; barring any incompatibilities with transworld identity we say, for instance: "this possible organism is identical with a given organism, *x*." Kripke holds,

> there is no reason why we cannot *stipulate* that in talking about what would have happened to Nixon in a certain counterfactual situation, we are talking about what would have happened to *him*.[326]

Such a discriminating role for our stipulative acts allows us to prevent a proliferation of all imaginable indeterminacies. Possibilities are narrowed by stipulation according to the intended purpose of the possible world in question. In the sense that possible worlds are stipulated places, their inhabitants may be safe from McKay's proliferation of replicas making claim to be identical with them.

However, this methodological response to McKay does not solve the indeterminacy of identity for organisms of identical genotype of origin on the present view, as we have sought necessary and sufficient identity criteria that function independently of stipulated identities. Perhaps we can be reassured that McKay's own example does not exclude the *possibility* for transworld identity of particular organisms, excluding rather the possibility for us to know when this occurs. Accordingly, it may be appropriate to accept this indeterminacy and conclude that McKay shows that in some transworld possibilities, individuation is not possible. Alternatively, we might look for ways to amend the theory proposed here in order to provide criteria that discern non-identity among these theoretical duplicates of original genetic constitution. McKay's

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[326] Saul Kripke (1972), p. 44.

problem of individuation between distinct but apparently identical organisms will continue to call for consideration.

The refinements and further concerns proposed here for the original genetic identity-criterion are offered to illustrate that this criterion can be applied intelligibly, as well as to show more clearly the commitments and challenges of this view. Yet a good deal more discussion would be necessary to reconcile problem cases in defense of the present view. Here Becker's advice is reassuring; he says, "the inability of a definition to settle bizarre cases need not be considered an overwhelming defect. Bizarre cases can often be settled only by equally bizarre definitions."[327] The flip-side of bizarre cases is that solutions may appear plausible once the details are fully thought out.

Section II: Ethical Implications

The ethical implications of a theory of the genetic essence of organisms come only through added beliefs about ethical value and how moral goods are best achieved. So the implications of the theory offered in this work and how it can offer normative guidance will be

interpreted differently according to different theories of value. Now having a proposed criterion of organismic identity, questions remain open as to the *ethical value of organismic identity*; values that may vary among organisms with different kinds of genetic plans of origin. Merely having an essence throughout the persistence of an organism's life neither alone tells us its moral value, nor obviates the relevance of issues regarding its possession of moral values

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[327] Lawrence Becker (1975), p. 358.

based upon non-original properties, such as the possession of dignity or sentience. My aim in this section is primarily limited to suggesting some areas where a theory of genetic essence may be ethically relevant. Questions of genetic essence are especially central to issues involving the creation, alteration, and destruction of original genetic constitutions.

The full possession by fetuses of organismic essence from the time of conception forward may be offered as a basis for equal moral value of organisms throughout all stages of their development. For instance, John Noonan bases the moral value of human organisms upon the presence of the genetic plan at conception. He claims,

> The positive argument for conception as the decisive moment of humanization is that at conception the new being receives the genetic code. It is this genetic information which determines his characteristics, which is the biological carrier of the possibility of human wisdom, which makes him a self-evolving being.[328]

Noonan uses this principle to defend a *prima facie* moral inviolability of the human fetus. Because the genetic plan that leads to developed humans who have a right to life is shared by fetuses, Noonan holds that fetuses share in this moral value and ought not to be aborted. Noonan does not develop a defense of why genetic origin alone constitutes a moral good even before the fetus possesses the developmental properties that clearly show a human right to life. (This is the problem of potentiality.) Indeed, a theory of genetic essence cannot be expected to resolve this problem alone.

The theory of original genetic essence may also play a role in the moral evaluation of creating and altering an organism's genetic properties. Dan Brock illustrates the need for a solution to issues regarding genetics and identity, asking for a distinction between

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[328] John Noonan, Jr., "An Almost Absolute Value in History," in John Noonan, ed., *The Morality of Abortion: Legal and Historical Perspectives* (Cambridge, Mass: Harvard University Press, 1970). p. 58.

> Some properties of a person as internal and essential to the particular individual and, therefore, inviolate to manipulation, from other properties that are merely arbitrary and inessential external contingencies affecting the self.[329]

Brock proceeds to suggest a

> genetic basis ... of internal properties essential to our psychological conceptions of identity. However, to view these properties as merely an accident of the genetic lottery and therefore subject to manipulation by genetic therapy if they serve as barriers to equality of opportunity by disadvantaging us in our life expectations, is to see them as external and inessential to our identity.... Deep and difficult tensions in our conceptions of individual identity will arise.[330]

The view that genetic origins constitute the identities of organisms offers a principle that can help us distinguish whether different forms of genetic manipulations influence identity. Dr. Seed, the physicist who has notoriously embraced the potential to engineer human life by cloning, has claimed that this act will allow him to *be* God.[331] And on this view, Seed is right in so far as genetic engineering of life *creates* organismic essence.

More general ethical questions here involve issues of moral partiality to kin and closest genetic relations. Evolutionists have argued that moral preference for family members and close relations have developed as a strategy that enhances the transmission of genes found in high proportions among those groups.

Genetic relations between parents and children may be a part of parental desires to have their own biological children, even at great expenses in some cases where fertility technologies are used. Parents seldom choose instead of having biological children to adopt babies and older children who are in great need of secure and loving families (who comprise a gigantic population

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[329] Dan Brock, "The Human Genome Project and Human Identity," Houston Law Review vol. 29, no. 1, 1992. p. 12.

[330] *Ibid.*, p. 13.

[331] *Nightline* (television broadcast), January 7, 1998.

when the needs of international children are considered). Aside from practical issues and parental desires to ensure the "quality" of a baby's gestational and early environments, the view presented here suggests a further context for parental desires to have biologically related children. On this view, a parent's act of biologically creating a new child is an act of transferring part of his or her own essence onto the offspring. The act also maximizes the similarity of the offspring' essence with its parents'. These factors may be a part of the personal significance of having biologically related children. Whether this significance should take precedence over present children's needs for families in decisions to raise a child is an issue of urgency that is easily overlooked. Here it may also be appropriate to consider the close essential relations that a parent shares with non-biological children, which brings us to the next issue.

Genetic relatedness is also offered in explanation of xenophobia and species (human) favoritism. The close genetic relatedness among humans and even between closely related species is surprising. Humans share 99% of their DNA structure with chimpanzees, and the relation between non-kin humans is about 99.9% shared genetic structure. This amounts to a difference between me and you of about 3 million base pairs. Of course, much of this genetic variation between individuals occurs at coding regions of the genome that manifest themselves in differences in traits, helping to explain why so much genetic similarity produces such distinct organisms. The fact that degrees of closeness between organisms' genotypes of origin amount to similarities in their essences offers a context for evaluating whether genetic relatedness constitutes a justifiable basis for preferential treatment. The sociobiological claim that preference for genetic relatedness is "the evolutionary way" tells us neither whether these practices are rational nor that they are ethical. The claim that genetic constitution comprises an organism's essence also invites questions about how to measure the moral worth of an individual and whether degrees of shared essence ought to constitute a basis for moral favoritism.

Studies in metaphysics and metaethics are both complex on their own, and the intersection of a theory of genetic essence and ethical problems will assuredly lead to doubly complex ground. In short, these are topics for further work.

Section III: Beyond Genetic Reductionism

The social adoption of genetic reductionism which is presently underway is a dramatic illustration of how scientific and philosophical theories interact with and shape society and the way that we conceive of our relations in the world. While methodological and essentialist applications account for the valid appeal of genetic reductionism, these are well-defined in scope. That is, methodological genetic reductionism serves us as we search for the chemical processes of genetic influence upon the organism, and genetic essentialism serves to determine the identities of organisms in actual and possible worlds.

When reductionism is stretched beyond these methodological and identifying uses, it invites the broad potential harms of geneticization. The expansive allure of genetic reductionism appears to be seductive indeed. James Watson, famed for discovering the chemical composition of DNA, shows no restraint in characterizing the power of the gene: "Is it really moral to go to the depths of genetics to find out why someone is better than somebody else? I think it is."[332] Dismissing as "nonsense" the concept of sanctity of life, Watson asserts that "there's good life and there's bad life and there's no sense in perpetuating bad life." Watson's determination of

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[332] Stacey Anderson (1995), p. 3A.

(human) value is surprisingly simplistic, and warns us that concerns about actual and possible misuses of genetics are absolutely warranted. With respect to ethical issues such as determinations of what makes individuals "better" than others, our holistic experiences of ourselves and our social interrelations must assume fundamental importance. This is one among many senses in which reductionism must acknowledge the irreducibility of non-genetic levels of explanation of organisms. In turn, non-reductive investigations must account for the truth of physicalism.[333]

The identities of the participants in science plays a formative role in determining its agendas, methods, and findings. Science always starts with the interests and values of its participants, and is likely to find what is sought and fail to find what is not sought. Longino, who holds that an objective world exists as the scientist's subject matter, also cautions against an absolutist sense of its findings:

> as we have no other access (than experience) to the purported entities, processes, and relations, there is no possibility of our knowing in any absolute sense whether they are true.[334]

Implicit in the subjectivity of scientific observation is the influence of the scientist's sense of the importance (or the desired importance) of her or his work. Jon Pryor, a physician specializing in in vitro fertilization, reflects upon the unrestrained momentum that scientific practices can generate: "I can tell you that you get so wrapped up by the science, so wrapped up by the frenzy of it, that you don't ask yourself what are the potential consequences."[335] Sinsheimer counsels that a vision of ethical and social considerations should exert a restraining caution upon this zeal:

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[333] As Philip Kitcher (1987, p. 202) claims, "no antireductionist should deny it."

[334] Helen Longino (1990), p. 220.

[335] In Gina Kolata (August 19, 1997), p. 7.

> Do we want to assume that basic responsibility for life on this planet – to develop new living forms for our own purposes?.... Shall we take into our hands our own future evolution?.... Perverse as it may, initially, seem to the scientist, we must face the fact that there can be unwanted knowledge.[336]

As science is a contextual product of subjective influences which, in turn, influences social and ethical understandings, it can neither defend a claim to moral immunity nor professional impenetrability. The participation of a diverse scientific community, including persons who are not active scientists, is thus appropriate to enhance the democratic outcomes of scientific agendas, methods, and findings.[337] Recent efforts by the National Academy of Sciences to avoid governance by committee openness regulations (the Federal Advisory Committees Act) are thus a discouraging example of a continuing scientific denial of the subjectivity implicit in the profession, a detachment of scientific practices from social accountability, and a denial of the rewards of diversity in seeking to characterize the outside world. Brian Goodwin puts the stakes of genetic science into stark perspective:

> According to current biology, genes determine organisms, and organisms are simply accidental collections of genes that are functionally useful to us human beings. Therefore, it is perfectly legitimate to change the genetic composition of an organism to suit our needs. We can create chickens or turkeys with enormous amounts of breast meat, even though these animals cannot reproduce and cannot live a normal life. It's O.K. to change them this way.
>
> But such things are deeply wounding to our relationship with the natural world and with each other because it means turning everything in life into a commodity. It encourages me to think of you as just a bunch of cells or genes. These all have potential commercial value and to me, that's suicide. Organisms

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[336] Robert Sinsheimer (1969), cited in Alexander Capron (1990), p. 48.

[337] See Carolyn Szetela, "Toward Increased Public Participation on Bioethics Committees: Lessons from the Human Radiation Experiments," *Accountability in Research* (forthcoming), for a discussion of the need for public participation in bioethical decision-making.

> are not merely survival machines. They assume intrinsic value, having worth in and of themselves.[338]

As we recognize the evaluative dimensions of the scientist's work, we become freer to openly and reflectively seek a more socially responsible science.

Philosophy may be helpful in guiding public policy by clarifying the logic of issues bearing upon ethics and society, and by clarifying those areas of ethical and social uncertainty which are beyond the grasp of a purely empirical analysis. Genetic essentialism, confined within its justifiable limits, should not be implicated in the undesirable social consequences that are often associated with reductionistic thinking. However, much of the difficulty implicit in organizational and personal decisions about how to deal with the new genetic knowledge cannot be alleviated by our essentialist analysis. In particular, a theory of genetic essence alone fails to tell us how to deal with genetic screening, diagnostics, and treatment modalities. Such answers are not within the explanatory power of genetics. Accordingly, any responsible reduction will acknowledge the evaluative dimension of organic life which empirical investigation alone cannot supply.

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[338] Sandra Blakeslee, "Some Biologists Ask 'Are Genes Everything?'" *New York Times*, September 1, 1997. pp. B7, B13.

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VITA

Carolyn Teresa Szetela was born in Holyoke, Massachusetts on August 2, 1964. She is the daughter of Therese Cecile Martel Szetela, a registered nurse, and Walter Frank Szetela, a professor of Mathematics Education. She is the sister of Martin, Stephen, and Kathryn Szetela and April Darsch. At the age of six, she moved with her family to Vancouver, British Columbia.

She earned her baccheloreate in Philosophy at the University of Victoria and the University of British Columbia (B.A., 1986). In 1987, she moved to Knoxville to begin graduate studies in Philosophy with a specialization in Medical Ethics at the University of Tennessee. She has taught courses in Philosophy and Medical Ethics at the University of Tennessee and at Auburn University. She completed her Ph. D. at the University of Tennessee in 1998. She has a publication forthcoming in *Accountability in Research* and is pursuing interests in philosophical and ethical issues in medicine and biology.

She is married to news photographer, Christopher James Berkey.