HYBRIDIZATION AND THE TYPOLOGICAL PARADIGM

A Thesis

by

CHARLES ROYAL CARLSON

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2011

Major Subject: Biology

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Approved by:

Chair of Committee,	Gil Rosenthal
Committee Members,	Adam Jones
	John J. McDermott
Head of Department,	U.J. McMahan

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ABSTRACT

Hybridization and the Typological Paradigm.

(December 2011)

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Chair of Advisory Committee: Dr. Gil Rosenthal

The presence of parasites in a population has an impact on mate choice and has substantial evolutionary significance. A relatively unexplored aspect of this dynamic is whether or not the presence of parasites increases the likelihood of hybridization events, which also have a significant role in ecological adaptation. One explanation of increased hybridization in some areas and not others is that stress from parasites results in selection for an increase of novel genotypes. Two swordtail species, *Xiphophorus birchmanni* and *Xiphophorus malinche*, maintain an active hybrid zone. The patterns of hybridization are unique in that they do not match up directly with expectations. We set out to test whether or not individuals can sense, using chemical cues, whether conspecifics in their immediate vicinity have high parasite loads and also whether this has an effect on mating and association behavior toward both conspecific and hybrid mates. Our hypothesis being that females will have greater association times with hybrid/heterospecific mates if conspecifics are heavily parasitized. We found that females exposed to parasitized males had a weaker preference for conspecific odor than those exposed to unparasitized males, both relative to a water control and relative to hybrids.

The empirical investigation described above is coupled with a historical and philosophical discussion of some of the issues surrounding the acceptance and understanding of the concept of hybridization. This discussion takes as its major themes: an analysis of the role that social views have on the formation of scientific hypothesis; the lag between epochal change in the scientific community and the assimilation of the consequences into social beliefs; the survival of hierarchical and teleological thinking in our concept of species and purity; and the failures of contemporary evolutionary theory to provide satisfactory explanations about the meaning and upshot of hybridization. Two specific misconceptions about hybridization are addressed: first, that hybridization clashes with the belief in kinds/types/species having separate and pure identities, and secondly, the teleological view that reads purpose into nature and places all instances of variation on a hierarchical scale, the top and bottom of which are determined by estimated closeness to the predetermined perfection of a type.

DEDICATION

To my beautiful wife, Danielle, with whom this project, and every project, including getting out of bed in the morning, would be without rhyme or reason.

ACKNOWLEDGEMENTS

Without a doubt I owe my greatest thanks to Dr. Gil Rosenthal for taking the chance on a philosophy Ph.D. student whose interest in the philosophy of biology led him to try and "get his hands dirty" doing some real work. Although the reaction to the announcement of this endeavor received uniformly 'raised-eyebrows' from almost all quarters, I have never received anything but full and confident support from him, his family and his lab. The Rosenthal lab is the archetype of what it means to be interdisciplinary and I greatly appreciate the patience and tolerance that they showed throughout my time with them. Thank you Brad Johnson, Zach Culumber, Holly Kindsvater, Machteld Verzijden, Michi Tobler, Ryan Easterling, Courtney Passow, Charles Criscione and Adam Jones among others.

Thank you as well to Kay Goldman for your work in navigating the minefield of doing something different and consequently bureaucratically difficult. There is no doubt about your care for your work, and the graduate students of the biology department are the beneficiaries of it.

A thank you is also in order to the designers of the philosophy Ph.D. program who made it a requirement that philosophy Ph.D. students receive a master's degree in a field supporting their philosophical work. Without this requirement I would not have had the opportunity to do this work. At the moment of this defense the requirement is under threat due to a general university wide devaluing of a master's degree. I can offer no more support than to say that I am a better academic and philosopher as a result of the experience of undertaking this work, and would almost definitely not have done so without this

requirement/opportunity. If the aim of this devaluing is to produce and attract higher caliber scholars, then exceptions should be made for interdisciplinary programs such as this.

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CHAPTER I

INTRODUCTION

Hybridization is increasingly considered alongside other mechanisms of genetic recombination as a driving force in evolutionary change by introducing genetic diversity and novelty.[1] (Arnold 1997, and Mallet 2005) Fitness increasing adaptations resulting from introgressive hybridization include the occurrence of traits not previously present in parent populations. These novel traits can bring about evolutionary change in various processes: the diversification of the parent genome through adaptative radiation (Mayr 1963, Bell and Travis 2005); the gradual replacement of parent populations through introgression (Anderson 1949); the replacement of parent populations if the hybrid genome is more fit and plastic in a turbulent environment compared to the static parent population, including antagonistic parasite/host relationships(Lande and Shannon 1996, Lewontin and Birch 1966, Gross et al 2004)*;* and the generation of novel functions and species(Barton and Hewitt 1989, Rosenthal and García de León 2011).

The "variation and selection" hypothesis first proposed by August Weismann in 1889 suggests that sexual reproduction increases the genetic material in the population that is available for natural selection to act upon. A similar mechanism operates with hybridization; the combination of the genomes of different populations produces variation upon which natural selection can act. The origin and maintenance of sexual reproduction is highly contentious, but the generally accepted theory suggests that genetic recombination

[1] This thesis follows the style of Biology and Philosophy.

provides a more adaptive framework thereby increasing the likelihood for populations to avoid extinction (Muller 1932, 1964). Similar explanations for the maintenance of hybrid zones between divergent populations for evolutionarily long periods of time are also highly contentious. In the research presented here we work on the hypothesis that the mechanisms that act to maintain and benefit sexually reproducing populations may also be at work in hybrid zones.

Meiotic recombination breaks up successful genotypes and consequently is advantageous only under conditions where genotypic stasis is more costly than novelty. When in an antagonistic relation to a co-evolving parasite there is selection for novel recombinant host phenotypes that are able to break the progress of the parasite population (Hamilton and Zuk 1982). Novel phenotypes are also formed through hybridization, and we report here about our investigation into the likelihood of hybridization as a mechanism to increase parasite resistance. Our hypothesis being that females will have greater association times with hybrid/heterospecific mates if conscpecifics are heavily parasitized. It should be noted that avoidance of conspecifics does not necessarily lead to an increase in hybridization events, however, association times are highly correlated with mating and in a structured population females that avoid conspecifics will likely have higher association times with hybrids and heterospecifics. The smoking gun cause for hybridization is difficult to identify as the direct and indirect costs involved in the breaking of the expected pattern is too varied. Many of the factors involved in mate choice, including predation (Willis et al 2010), may also be involved in hybridization events. With this in mind we aimed to observe a change of preference and mate selection behavior in female's exposed to highly parasitized conspecifics.

CHAPTER II

PARASITES AND MATE CHOICE IN SWORDTAILS

Introduction

Hybridization has been shown to affect the perceived attractiveness of males by females occasionally increasing attractiveness by producing novel phenotypes closer to the ideal female preference but one which is not actually present in the parent population. Recent studies have also shown that experience can modulate mate choice (Engeszer et al 2004, Irwin 1999). Specific to our investigation, learned behavior in mate preference has been demonstrated in the females of the closely related species of swordtails *Xiphophorus malinche and Xiphophorus birchmanni* (Verzijden et al 2011).(Figure 1) We tested the hypothesis that exposure to parasitized conspecifics should make them less attractive in naturally-hybridizing swordtails. (Figure 2)

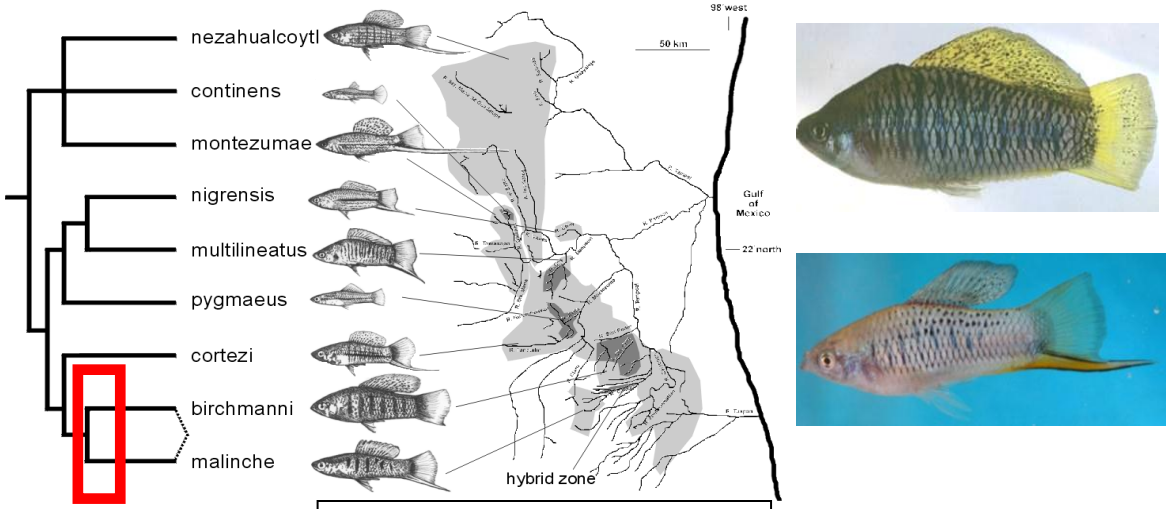

Figure 1: *Xiphophorus* phylogeny. Sister species *X. malinche* and *X. birchmanii* come into contact in numerous hybrid zones.

Experiments were conducted at the Centro de Investigaciones Científicas de las Huastecas "Aguazarca" (CICHAZ) , Calnali, Hidalgo, Mexico. All fish were wild-caught adults from the Río Pánuco basin in the state of Hidalgo. Male and Female *X. birchmanni* were collected from the Río Huazalingo at San Pedro Huazalingo, (20º 57' 3" N 98º 31' 26" W.) Male *X. birchmanni* were collected on the Río Coacuilco near the eponymous town (Hybrid males were collected from the Arroyo population and males from a highly admixed hybrid population (Culumber et al 2011) were collected from Tlatemaco (21 º 01' 22" N 90 º 47' 24" W). All males used in this study were sexually mature, as diagnosed from a fully developed gonopodium. In captivity, all animals were kept on a 12:12 h light:dark cycle, and fed twice a day on TetraMin flake food. The X. birchmanni stimulus used in choice tests was from a population other than the test females own population to remove any population familiarity effect.

Figure 2: Examples of hybrids. The hybridization between the *X. birchmanni* and *X. malinchi* results in a large variety of phenotypic combinations. Photographs from Fisher et al. (2006).

Materials and Methods

The San Pedro population is well suited for this particular study for two reasons. First, it is a structured population and consequently the females have experience with hybrid males with introgressed traits. Discrimination between the olfactory cues of conspecific/heterospecific/and hybrid is thus likely more nuanced in this population. Secondly, San Pedro is known to have heavy loads of parasites during the summer months when the fish were collected for this study. In particular we looked at three well known parasites in this region: the monogenean *Urocleidoides vaginoclaustrum,* Metacercaria (digene larval) *Centrocestus formosanus,* Metacercaria (larval digene) *Uvulifer (*Salgado-Maldonado 2004). (Figure 3)

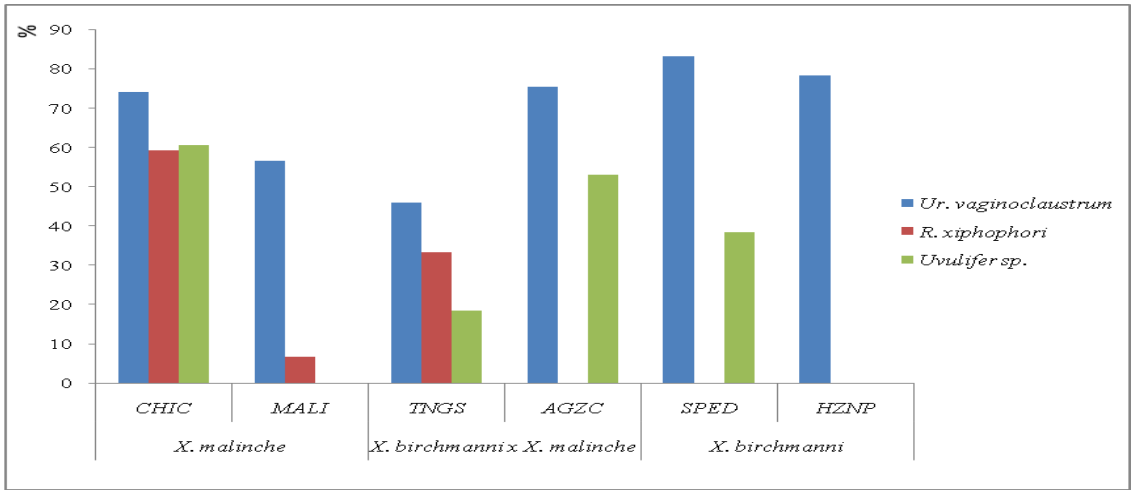

Figure 3: Parasites in region. Locations and frequency of three parasites known to be in populations around locations investigated. Bautista Hernandez (2011)

The subjects, females from the San Pedro site, were all given an anti-parasite treatment using a 5% formalin dip. The subjects were exposed to conspecific, San Pedro

males, of which, a random sample of half were also treated for parasites and the other half was left untreated. The females were randomly divided into four groups and placed into the center of 20 gallon tanks divided into three sections. Untreated males were placed in the outer sections of two of the divided tanks and treated males were placed in the outer sections of the other two tanks. (Figure 4) Consequently, of the four exposure tanks, two contained members that had all received anti-parasite treatment and in the other two groups only the females had received the treatment. After exposure the females were run through choice tests, described below, with three potential stimuli: Hybrids from the Tlatemaco population; conspecific *X. birchmanni* males from the Coacuilco population; and plain tap water.

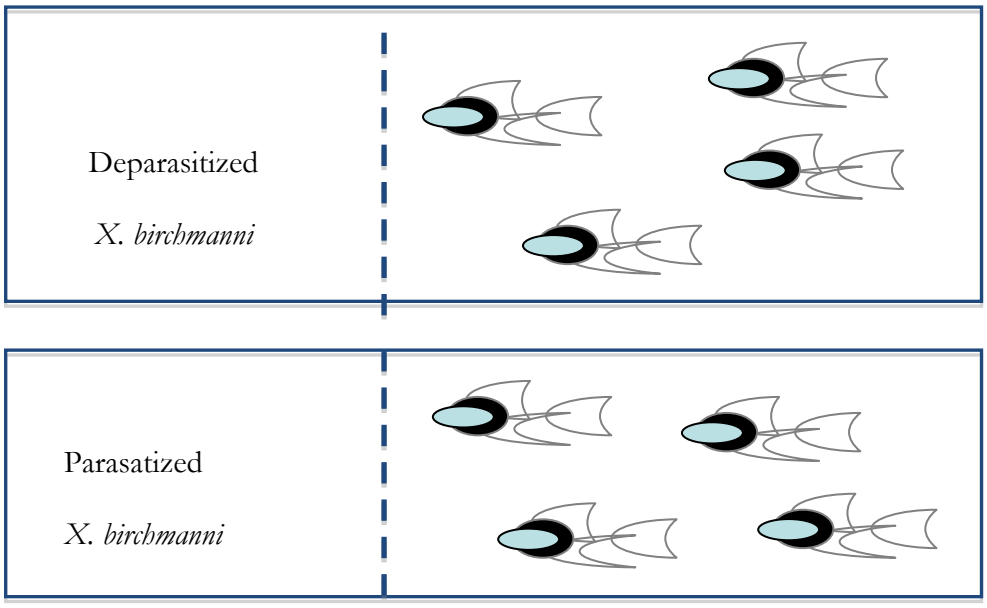

Figure 4: Exposure to conspecifics. Female *X. birchmanni* were either exposed to males from populations known to have high rates of parasites or males who had been given an anti-parasite treatment.

All individuals except males used in the parasitized exposure treatment were treated with a formalin dip. Upon death or at the conclusion of the experiment, all individuals were preserved in ethanol and subsequently examined for parasites. After 2 days of the 5 day exposure, all individuals were treated with fungicide due to an outbreak of fungus infection affecting the caudal peduncle. The fungicide appears to have had an effect on monogeans; while all males in the parasitized exposure treatment that died prior to fungicide treatment were infected with monogeans, only 4 out of the remaining 14 parasitized exposure males were infected. Nevertheless, females in this treatment were likely exposed to a full complement of parasitized males for the first 2 days.

Chemical preference tests closely followed previous studies (DA and MJ McLennan & Ryan 1997, 1999, 2008; Fisher & Rosenthal 2006a,b). To produce stimulus water, we separated Tlatemaco (hybrid) and Coacuilco (conspecific) males from females for four days and then placed ten males in tanks adjacent and visible to four conspecifics females. The males were put in an aquarium filled with 20 liters of water and were visually exposed to females of the same population in an adjacent, identical tank. Males and females were allowed to visually interact for at least 6 hours, the water in these tanks was used as the stimulus in the preference trials.

Laboratory trials of association time are a meaningful and widely used estimate of open-field association and are the standard measure for establishing preference in mate choice studies of fish, including swordtails (see Ryan and Keddyhector 1992, Wong and Rosenthal 2006, Walling et al. 2010, Rosenthal and Ryan 2011) Preference tests were conducted in an aquarium (length X width X height 75 X 30 X 30 cm) divided lengthwise into three equal sections by lines drawn on the sides of the tank, and filled with 40 liters of

clean, carbon-filtered municipal tap water. Testing tanks were refilled with clean water and tubes carrying stimulus water were flushed between each trial. Each test tank had two stimulus delivery systems located at either end of the tank carrying stimulus water.

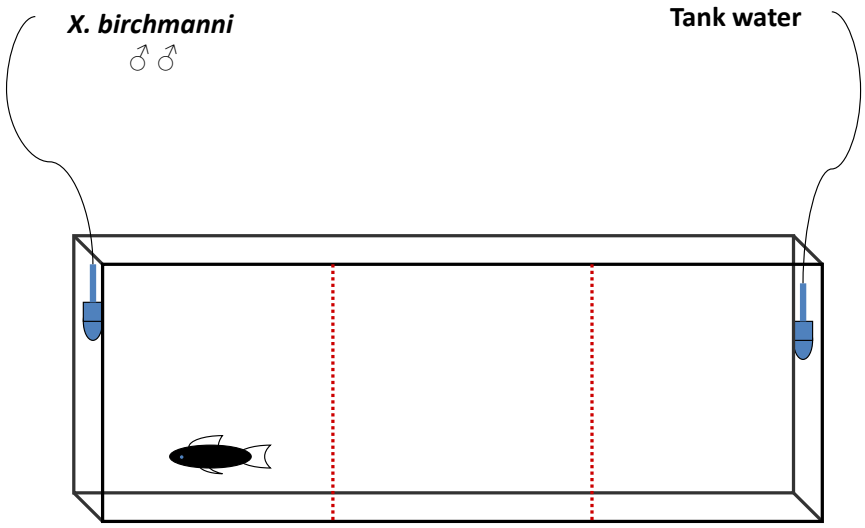

Figure 5: Preference tests. Females were presented with two preference tests. In one they were presented with options of conspecifics or hybrid water. In the other, which this figure depicts, the females were presented with a choice between conspecifics and tank water.

Each female was put through two trials with each trial consisting of a choice between two differing stimuli. In the first trial the stimuli compared were *X. birchmanni* and Hybrid and the second contained stimuli of *X. birchmanni* on one end and plain tap water on the other. (Figure 5) Each stimulus delivery system consisted of 2.5-mm silicone tubing fixed to the bottom of a collection aquarium with a valve controlling the flow to a rate of 5 ml/min. Each female was acclimatized for 25 min in the test tank containing testing water after which stimulus flow was initiated. A trial started when stimulus water started dripping,

and a latency period of 12 minutes was observed during which the female was expected to visit both sides of the tank in order to establish exposure to both stimuli. If the female did not visit both compartments within 12 minutes, the trial was ended. A preference test began once the female had passed into both side compartments, and then continued for 10 minutes. The variables measured were 1) how long of a latency period before both stimuli had been visited, and 2) how long was spent with each of the stimuli. The compartment was broken up into three sections and time spent in the middle section was not scored for either stimulus. We accounted for time of day effects by starting each of the testing days with individuals from the control in the morning and the individuals from treatment in the afternoon, the next day we would switch the pattern. We accounted for side bias by having any given stimulus on the right side for one observer and on left side for the second observer.

Results and Discussion

Examination of male parasite loads following trials revealed that one of the groups treated with anti-parasite dip contained several males with parasites, while one of the untreated groups contained only sporadic incidence of infection. We therefore excluded females exposed to these groups from subsequent analysis. We performed one-tailed Mann-Whitney (MW) tests of the *a priori* hypothesis that females exposed to unparasitized male conspecifics would be more strongly attracted to conspecific scent than females exposed to parasitized male. We found that females exposed to parasitized males had a weaker preference for conspecific odor than those exposed to unparasitized males, both relative to a water control ($N = 23$, $U = 107$, $P = .006$) and relative to hybrids ($N = 23$, U

= 95, P = . 037). This confirms our hypothesis that being exposed to parasitized males would alter the mate preference of females. (Figure 6) However, it does not speak directly to an increased likelihood to hybridize if females are in a population where conspecifics are heavily parasitized. Although there were occurrences of large association times with the hybrid stimulus for females from parasitized exposures there were also occurrences of strong preference for the water control over the conspecific scent. This suggests something like avoidance of conspecifics if they have recently been exposed to conspecifics in a parasitized state, but does not demonstrate an overall preference for hybrids. The avoidance of conspecifics in a structured population containing both hybrid and conspecific individuals may lead to higher association times and thus matings with hybrid individuals. Future investigations could further substantiate this claim by measuring the expected percentage of hybrid embryos assuming random mating compared to the actual number of hybrid embryos in populations with high parasite loads.

An outdated and yet common assumption is that hybridization is inherently too costly for an individual organism to ever make it an evolutionarily successful strategy for a population. Much like the debate between the benefits of sexual reproduction over asexual reproduction, there are many theoretical possibilities as to why mating with heterospecifics/hybrids is disadvantageous and costly, and yet it is a phenomenon that is widespread across kingdoms, phylums, and life as a whole. Once assumed a byproduct of entropy, it is now considered a major avenue for the creation of new material upon which selection can act.[2] Our investigation began with the possibility that in certain situations hybridization acts as a mechanism to increase genetic variation and combat parasitization, a

[2] see Arnold (1997) for review

common environmental stressor. Hybridization allows for advantageous alleles to be passed from one population to the next through introgression (Barton 2001) and it is possible that there is great advantage of having an open connection with neighboring population co-evolving with parasites on a different trajectory. The benefit may be significant enough for parasite resistance that those individuals, who develop isolating mechanisms, such that they are no longer able to hybridize, are replaced by those that can.

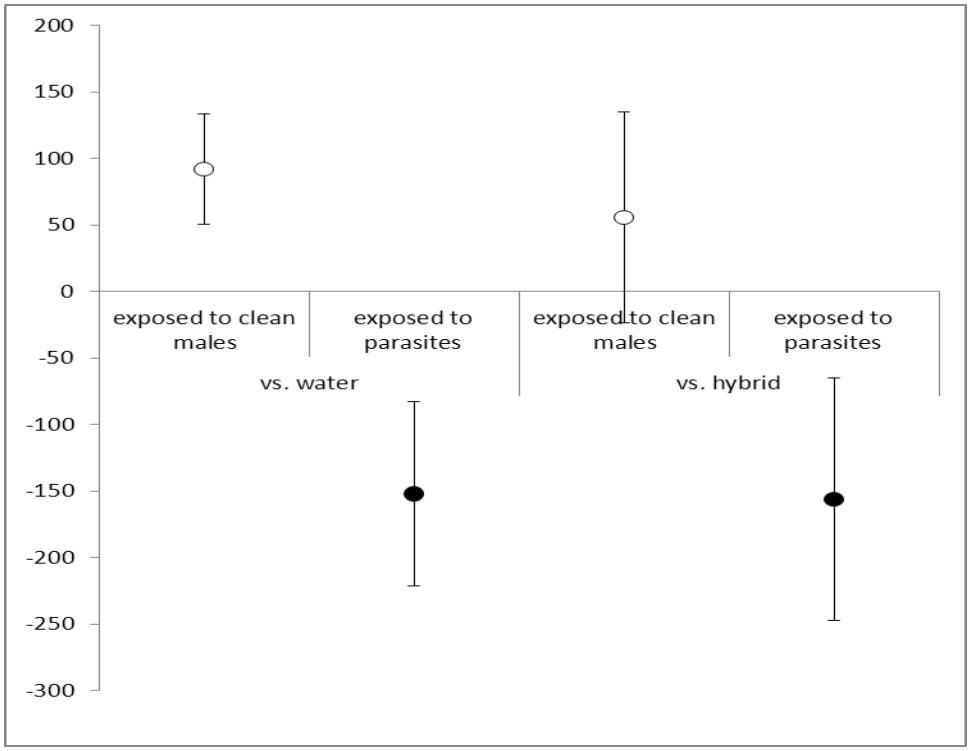

Figure 6: Net association time with *X. birchmanni* (s). Females had greater association time with both the control and with the hybrid water. It is unclear whether this indicates an actual preference change favoring hybrids. Combined with the result of the control tap water treatment, it may be that females have something like disdain for conspecifics when exposed to parasitized conspecific males.

CHAPTER III

HYBRIDIZATION AND THE TYPOLOGICAL PARADIGM

> Society offered the profile of a long, straggling caravan, stretching loosely toward the prairies, its few score of leaders far in advance and its millions of immigrants, negroes, and Indians far in the rear, somewhere in archaic time. -Henry Adams[3]

> An analysis of almost any scientific problem leads automatically to a study of its history…the many unresolved issues in evolutionary biology are no exception to this rule. To understand their history, one must deal not only with the state of factual knowledge at the given period but also with the *Zeitgeist* of the time. The interpretation any investigator gives to the results of his observations or experiments depends to a very large extent on this conceptual framework. For many years a major objective of my historical studies has been to discover the concepts-or sometimes, even more broadly the ideologies – on which the theorizing of certain historical figures was based. – Ernst Mayr[4]

> Find a scientific man who proposes to get along without any metaphysics…and you have found one whose doctrines are thoroughly vitiated by the crude and uncriticized metaphysics with which they are packed. - Charles Sanders Peirce[5]

Introduction

The continuation of the practice of ranking humanity on a scale that seeks to justify the maltreatment of a particular group suggests that there is a deep seated blind spot in our thinking about race. That blind spot does not only occur because it is in on group's interest to subjugate another, although this is often the case, but because of misconceptions regarding kind, type, form, and class. Needed is a reminder, philosophical and otherwise, that the species concept is a heuristic tool used to make scientific investigation more precise

[3] (Adams 1931)
[4] (Mayr 1988)
[5] (Peirce 1931-1958)

and not a description of an eternal Platonic truth. Also needed is the recognition that although a scientific study may not be directly addressing a counterpart in human culture, interpretations of any work in evolutionary theory will invariably be viewed in light of what it means for our humanity. The contemporary debate about hybridization is a fertile area to explore, carefully, the continued existence of typological thinking and the racial artifacts such thinking supports.

The historical inability of well-meaning scientists to differentiate between conclusions derived from empirical observation and those derived from cultural superstition serves as a recurring reminder that much of what we *see* is influenced by where we are from, and what we feel confident in claiming that we *know*. In other words, the now notorious histories of racism and sociobiology are filled with individuals, scientists and philosophers alike, that sincerely believed that they were defending justifiable truths that could be clearly demonstrated if one merely looked at the data through the right lens. However, the self-righteousness of hindsight does not guarantee that the current scientific ground is stable or free from similar unexamined prejudices that future generations will look upon with scorn. The potential for cultural bias to influence empirical data is fraught with ambiguities that racist stereotypes can fill. Even, as it most often is, if the work is well intentioned: whether the work being done is on the anthropological origins of humanity, or in the tracing of the spread of global epidemics such as HIV or Influenza, or in the attempt to understand biological factors that make a population more susceptible to a disease such as sickle cell – when it comes to telling the evolutionary story of humanity there are cultural idea-mills that stand readymade knowledge that can influence how data is seen and interpreted.

The "biologist's eye" as Agnes Arber described it[6] can be unknowingly blind to its influences but, on the other hand, can willfully engage in the act of limiting the scope of an observation. Intentionally ignoring the implications of an investigation is problematic due to something akin to a failure of responsibility - even if the limiting of scope to the system in which they work is done in good faith.[7]

The unwritten rules that have been gathered from these missteps are usually taken seriously when conscious of them, that is, the exact same mistakes are no longer made. However, in the situations where the lessons learned are less clear, areas are carved out of the available discussion topics and labeled as sacred and rarely broached in public discourse unless wave-making is the intent. Hybridization is just such an area, and the silence that is reserved for its application to humanity has allowed erroneous thinking to fester and remain intact.

The aim of this is twofold. The first task is to examine the historical roots of scientific thinking surrounding our understanding of hybridization and to explore its misappropriation to human evolutionary theory. The second aim is to make the case that on the issue of hybridization there has historically been a mutual reinforcement between the act of forming hypothesis and cultural pressure for the confirmation of common sense notions.

The comparison between evolutionary theory broadly construed and human evolution, social and otherwise, is the single most marred intellectual tradition that humanity has undertaken. This has not deterred everyone from the task, nor has it slowed down the

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[6] (Arber 1954)

[7] e.g., Pastalkova E, Serrano P, et al. (2006)

rate in which there has been direct translation from evolutionary theory in any organism, voles for instance[8], to human counterparts, whether they match up cleanly or not. The tragedies of our history have only made certain ways or types of doing this kind of work less accepted than others. This translation practice continues to return in various and different forms even after the dangers of social Darwinism and the various oppressions done in the name of human progress. As mentioned earlier, there is blindness on this issue that has led to monumental failures underwritten by scientific authority, and yet it continues. These failures might have scared us off of the topic long ago if not for the fact that the abiding existential question that fuels the pursuit is at the philosophical center of why science is undertaken in the first place, namely – what is/was/will-be a human?. The continued resurgence and fascination that surrounds its present and seemingly indefatigable incarnation, evolutionary psychology, has resulted in the familiar tension within human evolutionary theory's past - between cautious optimism and the greedy grasping for quick answers to big questions. To be clear, there is no suggestion here that this undertaking is not of the utmost importance. What is being suggested is that regarding the complex and thorny issue of hybridization it is imperative to take an honest look at social influences altering the development of scientific theory. Differing lessons from Spencer, Kuhn and of course the pockmarked past of human history make such an undertaking a worthy one.

The following essay takes as its major themes: an analysis of the role that social views have on the formation of scientific hypothesis; the lag between epochal change in the

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[8] (Ross HE, et al 2009)

scientific community and the assimilation of the consequences into social beliefs; the survival of hierarchical and teleological thinking in our concept of species and purity; lingering Lamarckianism resulting from failures of Darwinism and Neo-Darwinism to provide satisfactory explanations about the evolutionary meaning and upshot of hybridization. Also, a specific misconception about hybridization will be addressed. The two central sources for this misconception are as follows. First, hybridization of any two types clashes with the belief in kinds/types/species having separate and pure identities. Secondly, a teleological view that reads purpose into nature results in the classification of different variations of a kind as being more or less developed towards the perfection of that kind.

Hybridization will serve as the test case for these claims as it has remained a highly contested idea with a rich history that exemplifies the misconceptions between our thinking about evolution and the desire to apply it to broader philosophical questions regarding what it means to be human. Racism has also had a longstanding claim on how we address this issue, but its current construction has a surprisingly recent developmental history. The history and theory of hybridization is fertile ground for exploring the recurrent themes in focus here. For instance, concepts of hybridization and racial mixing are exemplars of the confusion resulting from the inability to clearly separate out culturally perpetuated pseudoscience from unbiased empirical observation. Also, of note, is the long history of the failure to transfer theoretical work on plant and animal hybrids into commonsense notions of race. Take for instance the early 20th century work on hybrid vigor and heterosis

in plants (e.g. hybrid corn[9]), the still faltering application of these principles to animals, and the almost uniformly negative perception of hybridization as applied to humans.

Common to both of these difficult translations from science to popular science is the theme of the misapplication of scientific authority to areas of vagueness. That is, vagueness within human culture, and vagueness about what it means to be human. Deferring to dubious authority to cover gaps in explanation is often considered to be the province of religious authority – however – misused scientific authority has a similarly corrupted past. In these unexamined connections, the ones that faith in science or God has sealed off, lie assumptions and preconceptions that are culturally conditioned and worth examining for inconsistencies. To establish the menacing and stubborn influence of such views regarding hybridization take as an introductory example Henry Hughes 1854 claim that "Hybridism is heinous," he argues: "Impurity of races is against the law of nature. Mulattoes are monsters. The law of nature is the law of God. The same law which forbids consanguineous amalgamation forbids ethnical amalgamation. Both are incestuous. Amalgamation is incest."[10] Although this particular example is so overtly racist that a contemporary might easily disregard it as a sentiment old, forgotten, and solved, the exact same conception of nature, (involving concepts of species purity, and the moral necessity between humanity and nature) is very much alive within the present-day disposition towards of the meaning of a hybrid.

A limitation of this particular investigation will be the focus on primarily American history regarding hybridization. A negative bias towards hybridization is not an American-

[9] (Shull 1946)
[10](Hughes 1854) p 31

only trend but by focusing specifically on one strain of development the hope is for a digestible and clear picture of an issue that is anything but. Of course, the American version is impossible to cleanly separate from conceptions of race that developed much earlier. This is simply a difficulty of doing any historical investigation. That being said, the civil war and the scientific investigations into hybridization that resulted from the desire to use non-white soldiers creates such an undeniable wave in future scientific assumptions about hybridization that it makes for a fairly well demarcated test case.[11] It has been an American identity issue that from the beginning can be seen in some of the oldest surviving colony records that document the public announcement and punishment placed on white men deemed criminal for fornicating with non-white/African women.[12] Explaining the "one-drop" rule Booker T. Washington writes in 1900:

> It is a fact that, if a person is known to have one per cent of African blood in his veins, he ceases to be a white man. The ninety-nine per cent of Caucasian blood does not weigh by the side of one per cent of African blood. The white blood counts for nothing. The person is a Negro every time.[13]

This separation carries forward and when so-called hybrids/mulattos were in an unclear social state where all that mattered was that there was "one-drop" of African blood to be considered non-white, and consequently not American.[14] The phenomena of 'passing' has been noted by Winthrop Jordan as being a uniquely American judgment caused by a social, and in-turn, scientific community that did not recognize inter-racial interactions.[15] This bias can be directly tied to a denial of the *real* existence of hybrids because being *real*

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[11] For just such a history that focuses primarily on Hungary and Romania see Turda (2007)
[12] (Cope 1973)
[13] (Jordan 1900) p 158
[14] See (Pettigrew 1964) A Profile of the American Negro p 68. Although the estimates are contentious and change, Pettigrew contends that 72 to 83 percent of African Americans have white ancestry. Pettigrew's study is hindered by the general lack of a standard of comparison.
[15] (Jordan 1962) p 189

meant being natural. Attempting to untangle this habitual method of thought will be a primary focus moving forward. Consider further the wording of a judicial decision on such a matter in 1835 South Carolina: "The condition…is not to be determined solely by …visible mixture… but by reputation…should have the rank of a white man, while a vagabond of the same degree of blood should be confined to the inferior caste."[16] Rooted deep in the American worldview is a conception of hierarchy that was placed upon the newly stratified racial identities, and which was required to justify a separation of class between slaves and owners; owners who themselves often migrated from a low cultural location.[17]

The concept of the 'mixing of blood' is a phrase and notion that still pervades our language, often in seemingly innocuous forms. For example, the harmless question of asking a stranger with a dog what kind of dog it is. Notable here is the notion that a 'mutt', whatever that may be, is not thought to be its own separate kind that comes with any predefined behavioral attributes. This distinction between kinds is a consistent feature of the attempt to clarify our thought and the terms we use. In other words, we often have difficulty acknowledging the in-between; it would blur the lines of separation. The historian J.G. Mencke sees similar trends in our thinking about race. Without clear separation of kind

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[16] Judicial Cases Concerning American Slavery and the Negro (1926) Vol II, p 269. See also Berlin (1974) pp 163-165.

[17] "An additional factor underlying this story is the new form of slavery that arose to generate this wealth. For the first time, Europeans systematically enslaved people with whom they had no territorial dispute – Africans. The "Atlantic system" of commerce had people of one continent, Europe, taking people from a second continent, Africa, to a third continent, the Americas, to serve as a labor supply to generate wealth for the first continent. This rather curious arrangement was a racial system. In fairly short order in the New World blackness and slavery became associated. To be black was to be a slave and to be a slave was to be black." in Jackson (2004) p 7

the default labeling of identity is to simply delegate the vague identity to a lower hierarchical status. Regarding people of mixed race he contends:

> Certainly there is no inherent logic in this attitude. A person whose ancestry is half white and half black could just as easily be defined as white than Negro, yet this has never been the case in the United States. Deeply rooted beliefs in the permanence and distinctiveness of racial traits have led Americans to see all who possess "black blood" as Negroes, even if that black blood is greatly outweighed by white.[18]

In short, no scientific judgment is done untethered from social responsibility. It is difficult to separate out our scientific understanding of the biological world while not also indirectly making analogies to humanity. There is an unintentional cost to avoiding the practice of making the stretch from non-human investigations to potential interpretations within the human domain. Philosophical and anthropological explanations of nature that are unaware of the potential connections that will be drawn to humanity are done free and untethered from implication. The scientific judgment that is blind to its implications is too often put forth without thought of what it would mean if translated to a human counterpart. When this is done there is potential for misuse by others. The potential for misuse increases if the work receives recognition and community attention. If the misguided interpretation gains any traction, often if it has ontological import, it may get lifted up to the Zeitgeist and return as a fixed component of the conceptual framework conveyed to future biologists as an accepted fact that it is not necessary to question. The resulting misconceptions and confusions between scientific community and general opinion are rarely blamed on the holders of the general opinion. It is the experts, the scientific authorities, that are responsible for clearly and cleanly thinking through the implications. If

[18] (Mencke 1976) p 3

serving truth and not political position, then taking care that one's non-political work does not have political implications is as important as disinfecting the instruments. The ideas also need disinfecting.

Underlying preconceptions are often found when looking at the motivations behind the decision to look into one subject and not another. The sheer number of studies done on a topic/subject stands as an unintended artifact of the scientific method itself. This artifact is an interesting tool to identify what sorts of things are of interest, and consequently identifies the questions that are deemed the most important, valuable, or likely to produce success. When does the interest in a particular subject for an individual researcher begin? Rarely do we ask someone what *philosophical* underpinnings inform their research interests. Is it merely the case that interest springs into existence on its own? Not likely. In other words, why study parasites or sexual selection instead of genetic drift? Surely in this choice there exists an implied valuing that suggests that some problems are more interesting to ask. Going further, if there is a prejudgment of value before a specific interest is even formed, can a scientist ever hope to form a hypothesis with phenomenologically open eyes? Keeping these questions in mind we could evaluate whether or not hybridization and racism are pre-conceptually biased by doing a simple count of the number of studies done over the course of the past couple of hundred years that take as their initiating hypothesis some sort of negative impact resulting from outbreeding. If we then compared this number to the amount of studies that look for the potential benefits of mixed species interactions we would likely get a one sided picture depicting more interest in demonstrating that hybridization was costly. This is certainly no deductive argument for implicit racism, regardless, the impact of racism on the meaning of

hybridization does not need to be proven in this manner. We can, however, speculate as to why it keeps coming up, that is, what underlying theoretical worry makes it necessary? The combination of the historical misuse of evolutionary theory regarding hybrids and the continual reinvestigation suggests many things, and at the very least we can say that the subject is interesting, or that scientists have an interest in finding something.

Hopefully, these questions will serve as an introduction to the primary themes of the following historical analysis. They will be kept in mind throughout the essay, particularly the idea that separating what we look at is potentially inseparable from why we look.

The Age of Expansion

This section aims to provide a brief discussion of the formation of the view of humanity that results in the demarcation of different types of humans and consequently labels them as being a member of a race. The historical context in which this demarcation initiated is often referred to as the age of expansion.[19] This expansion carried with it a theoretical framework for the concept of hybridization that considered the act of hybridizing to be causing violence to the teleological trajectory of nature, in other words, hybridization is viewed as an evolutionary evil, a natural bad. To say it differently, the political climate at any moment in time helps form scientific worldviews that are compatible with it. Put in the context of hybridization, the 'age of expansion' helped create a fertile

[19] See for example Louis Agassiz's letter to his mother in which he describes his reaction to seeing black people found in its entirety in Stephen Jay Gould's Mismeasure of Man pp 44-45. See also Harrisons (1996) for a history of the relationship between British imperialism and racial theories. pp 68-93

space for a definition of the concept of *species* that was useful to the hierarchal framework at the heart of the justification for the imperializing activities of the expansion act itself. [20]

In historicist-Hegelian terms, the rapid closing of gaps between cultures and geographical spaces that was a necessary byproduct of the cultural expansion of the age of expansion creates an unsustainable conflict. This conflict is the Antigone moment of the expansion age. A new cultural opinion emerges during the cultural clashes of the expansion, one that uses a conception of the natural good to justify the very act of expanding in the first place. The expansion/colonization process provides moral justification for the dominating attitude towards those labeled as non-humans, or if human, then in a lower type/class of human. Misconceptions about evolution and hybridization were cited as scientific justification for the position that there are higher and lower humans. There is one primary misconception that is the focus of the upcoming discussion. The misconception is this: There is a hierarchy of old and new within humanity where some races are evolutionarily newer than the outdated, inferior and soon to be replaced older types. This misconception worked in conjunction with an expansion whose expanders marveled at the different types of people that they came across, and invariably placed in a crisis of identity, both for those being assimilated and for the expanders themselves. Scientific theory played a major role in giving authority to the justification of the chosen resolution. The scientific discipline that arose took many forms, but essentially aimed to provide answers for the questions about what exactly a human is. For the most part, this discipline's many incarnations have been abandoned as dangerously partial to defining outside groups as "others" and promoting a plethora of rational to deem them inferior. The interpretation

[20] e.g., (Rex 1986)

that it is being presented in this paper argues that the underlying rational for the labeling of inferiority was the placing of all differences among culture and people as being indicative of a specific location on a hierarchal evolutionary timescale. One in which it was unquestionably assumed that the expanding groups were the most recent and superior outcome. The hypothesis being that the different types of humanity encountered on this expansion are further back on the evolutionary scale, and scientific authority provided justification for the question of how far back and removed they were from the expanders. Questions arose about the kinds of differences and the exact history of the separation of these types.

Specifically relevant for our discussion is the notable trend of this scientific wave is the vilifying of the intermixing of types, as it was thought to only be able to result in sliding back down the evolutionary timescale. Within this paradigm, hybridization represented the undoing of the natural separation of human types. The prevailing philosophical assumption, both then and now, being the confusion of natural with what is good. Naturalism of this sort vilifies any impediment to the unfolding of nature's plan. This teleological understanding of nature is another major component of the philosophical assumption that has led to the various misunderstandings of hybridization under investigation here.

Another consequence of this worldview is that an argument was made designating subhuman 'others' as being in need of help from those higher up the chain. This belief gives moral rationalization as to why exploiting people as natural resources of labor is the right thing to do - it was transporting those people into the superior present, saving them from the burdens of being in the evolutionary past. Throughout the age of expansion this

argument was repeated as mantra.[21] A major assumption of the worldview being that it is better to be slaves for evolutionarily advanced people then it is to continue living in historical evolutionary times. A past where nature's good had not yet been as developed as it is now. It is difficult to trace concrete consequences of the historical and theoretical understanding of human hierarchy to the scientific work that followed. However, the themes that have been introduced of a teleological naturalism have had fairly clear reverberations in numerous instances of the misapplication of racially charged interpretations of differences among humans to non-human animals. (insert figure) The next section will look at the development of the science of separating humans into kind and type giving emphasis to the rational and philosophical arguments used to justify the distinctions.

Creating the Meaning of Race

Carl Von Linnaeus is commonly credited with the first separation of humanity based on skin color, but he was working in a tradition and on a discussion that was already established by Francois Bernier, a close friend of John Locke. However, it wasn't until Linnaeus that the ideas were disseminated widely and taught in Universities. For instance, his major work *Systema Naturae* saw ten editions between 1735 and 1758. Johann Friedrich Blumenbach (1752-1840) continued the classification work by adding distinctions of human type based on psychological phenotypes. In the second edition of his *On the Natural Variety of Mankind* (1781) Blumenbach accepted most of Linnaeus's work but hoped to refine them by not looking only at skin color but by also adding hair, skull shape and size, facial

[21] e.g., (Gluckman 1975)

structure and features. He aimed not to overturn the previous classification system, or even to weed out inconsistencies, but merely to refine it as a tool by elaborating on more criteria for division. This process was continued by others, highlighted by the general trend of looking for differences and suggesting just-so stories as to why the differences demonstrated hierarchical placement in the evolutionary past. Within this scientific discipline almost any difference is enough to conclude different kind, and even the smallest difference made it more likely that there was a species difference. The scientific process takes as a major task the separating of things into kinds, and the application of this to concepts of human race assumed that within humans there were species differences, all that is up for debate is what counts as a difference.[22]

It is notable that within this tradition many of the characteristics of non-whites were easily identifiable by the unaided eye and became the subject of vast research projects aimed at explaining their existence. On the other hand, whiteness, notoriously dubbed Caucasian by Blumenbach, required very little measurement to determine what being a member of this category implied, and also came with the rarely questioned presumption that being a member of the Caucasian type made the individual socially and evolutionarily superior.[23] In Blumenbach's own words: "Besides, it is white in color, which we may fairly assume to have been the primitive color of mankind, since, as we have shown above, it is very easy for that to become white, when the secretion and precipitation of this carbonaceous pigment

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[22] Presently a similar rational is being employed, except that the subject is genes, e.g. the recent work on the elevation tolerance genes of the Tibetans. Beall CM, GL Cavalleri, et al (2010)

[23] "He took the name 'Caucasian' from Mount Caucasus because its southern slope had cradled what he felt to be the most beautiful race of men, the Georgian. The Caucasus, near Mount Ararat, upon which the biblical Ark came to rest after the Flood, seemed the appropriate source for the original race of man." (Haller 1974) pp 4-5 citing (Bendyshe1865) p 269

has once deeply struck root."[24] It easy to question just how 'fair' is Blumenbach's claim that we can "fairly assume" that whiteness denotes the more ancient and thus more pure of the colors. "Cress Theory" proposes an interesting contrast by postulating that the basis of white supremacy is the result of an awareness of a lack of melanin in contrast to much of the world's population. This theory turns on its head the idea whiteness is the original race by suggesting that racism is the byproduct of fear of genetic annihilation and the possibility that whiteness is under extinction threat. In the vein of Nietzsche's *Geneology of Morals* she suggests that whites have taken on an active campaign to define whiteness as superior and at the center of the historical world as compensation for the realization that the opposite is the case. For Frances Cress Welsing,

> whites defensively developed an uncontrollable feeling of hostility and aggression. This attitude has continued to manifest itself throughout the history of mass confrontations between whites and people of color. That initial hostility and aggression came only from whites is recorded in innumerable diaries, journals and books written by whites.[25]

The divisions among humanity initiated by Linnaeus and Blumenbach were mostly accepted as confirmed fact by generations of scientists working on classification, including William Lawrence (1783-1867), James Cowles Prichard (1786-1848), and Theodore Waitz (1824-1864).[26] Most importantly, even after Darwin's theory had been established and spread, the notions of racial difference and inferiority on species/typology ground continued to persevere. The historian Haller notes: "This they did by defining the races as "forms" that diverged from the proto-stock at some early stage in life and which remained separate and distinct for long periods of time, to the point of becoming fixed in their

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[24] (Bendyshe 1865) p 269
[25] (Welsing 1991) p i
[26] (Haller 1971) p 6

characteristics.[27] This perception of multiple ancient origins is a discussion point that will be addressed in subsequent sections. For the moment what is important to note is that throughout various scientific epochs these divisions remain distinct, supported by popular perception, and under-addressed by the scientific community. It isn't that the scientific community fails to see the error in some of these assumptions; instead it is the failure to convince the general populace of their authoritative claim that their previous authoritative claim should be revised.[28] Haller again discusses the issue eloquently:

> Rather than dispute the division, they moved on to develop measuring devices which gave additional accent to the previously established divisions. Furthermore, their instruments established stock differences within each of the major divisions and went on to prove a gradation from the anthropoid through the varieties of man.[29]

Put in this historical context it is not surprising that anthropometry gained the traction that it did. The next section will discuss anthropometry focusing on the theoretical underpinnings of typology, teleology and other misconceptions that shaped its research agenda and fueled its credibility.

Anthropometry and Typological Thought

A specific example of the scientific work done on types of humanity can be found in the discipline of anthropometry. The example that this section will discuss serves as an introduction to the concept of *typological thinking* that is a primary subject of this essay.

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[27] Ibid p 6

[28] The contributions of Franz Boas are relevant to this issue. Boas introduced the idea of cultural relativism into the discussion thereby making a clear distinction between what would later be 'nature' and 'nurture'. His distinction between culture and race is largely influential but was itself fused with racial undertones such that it did not make a clear condemnation of the practice. see Mencke (1976) pp 75-76 for further discussion.

[29] (Haller 1971) p 6.

Typological thinking has the defining feature of relying on assumptions about Platonic inspired immortal Forms within and underneath nature.[30] For the issues of race and hybridization, nowhere can this be seen more clearly than in anthropometry's arbitrary choice of facial angle as a racially distinguishing mark. The passage below from Haller contends that the ties to Platonic Form and conceptions of deity were not merely subtle undertones, but cited as the stand alone justification for using facial angle as an instrument.

> The facial angle, used as early as Aristotle as an indication of intelligence, showed a distinct gradation and an implicit manifestation of inferiority. The Greek sculptors, in representing the superhuman attributes of their gods, gave the deities a facial angle of 100 degrees, exceeding that of the highest human. The artistic ideal that gave substance to the statuary scale of beauty in Greek art was incorporated in the speculations of later ethnologists and guided the theory of Camper's facial angle as well as the cranial beauty of Blumenbach's Caucasian skull.[31]

There was little rational given for the justification of using the facial angle as criteria other than the Greeks had thought it a good standard of measure.[32] Anthropomorphic reinterpretations of the facial angle had little difficulty incorporating evolutionary theory into the ancient Greek concept. All that was required was the addition of a teleological trajectory towards Godliness that was occurring within humanity.[33] On this scale angles farther away from the Godly ideal are judged to be evolutionarily behind. Using these criteria it was simple to differentiate races on a hierarchal scale based on an ideal facial angle, even if the ideal used as the measuring standard had its origin in Greek religion and not reason.

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[30] For more on the development of Anthropometry within anthropology see Shapiro (1959) pp 371-379

[31] (Haller 1971) p 9

[32] One thinks here of the contemporary practice of choosing differences to measure where it is unknown if this difference has any real significance. For instance, vertical bars and the like.

[33] (Gobineau 1915) pp 108-109. See also (Jordan 1968) Ch. 13.

The facial angle paradigm routinely ran into contradictions including data suggesting that Africans and Scandinavians were so similar in measurable head traits as to be indistinguishable.[34] Despite this, the trend continued and the philosophical assumptions were carried unchanged into the discipline of phrenology.[35] This is certainly not the only example of an assumption that was carried forward by research programs looking to justify and reinforce common sense notions of race. Phrenology in particular was guilty of this quest to reinforce conceptions that had dubious beginnings, as Haller notes:

> The measuring devices, developed as a result of the science, outlasted the premises called them into existence. While phrenology bowed to the harsh criticism of the late nineteenth century, craniometry and its measuring devices survived.[36]

The tools of measurement change, but the desire for a specific result alleviating the need to respect the 'other' remains. One question to ask is if a similar sentiment continues in contemporary attempts at classification based on genetic or phenotypic difference. We have continued to have increasingly precise and sophisticated tools within the social and biological sciences but this does not remove the historical constraint/trajectory of prejudice. Its continual recurrence and cycling back into the creation of new scientific disciplines suggests that it is more than just a stubborn artifact that can be removed quickly from the public psyche.[37]

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[34] (Garth 1931), (Fiske 1902) Vol. III , pp 195-197, (Simmons 1961) p 1

[35] "From the evidence of skull differences, the statistical generalities made from the measurements of particular stocks, nationalities, or races, phrenology offered an easy transition from biology to the suggestive classification of man. It also became a vehicle for the generalities of sociology. Phrenology was for the generation of Comte what Herbert Spencer's psychology became for the era of evolutionism."(Haller 1971) p 14 citing (Fiske 1902) Vol. IV 107-109; (Davies 1955) pp 145-148

[36] (Haller 1971) p 16

[37] The correcting of a public perception is not a public relations game that natural scientists often engage in eagerly; this is one possible explanation for the fact that the average American has such a poorly informed and/or mistrustful view on global warming and evolutionary theory.

By the time Phrenology was fully discredited around 1860, the increasing popularity of Herbert Spencer's evolutionary psychology served as a ready replacement as the scientific discipline supporting beliefs of racial hierarchy and superiority. The concepts of race were carried over into evolutionary psychology with little to no critical assessment. The racial classifications thought to be "proven by the phrenologists, relegating Mongolian, Malayan, Indian, and Ethiopian to inferior roles beneath the Caucasian, was seldom criticized."[38] Hierarchical concepts of race were carried over into evolutionary psychology with little to no critical assessment. There is little doubt about the continued presence of this way of thinking in the contemporary worldview.

Hybridization and Variation in Type

A motivating question within evolutionary studies asks why, if extinction has claimed almost every organism that has existed, are there so many different kinds of things? This is a question that Charles Darwin struggled with and that biology-focused thinkers in general have struggled with, including those predating Darwin. Hybridization plays a central role in many of the explanations offered, albeit often considered an error or misfiring of nature. For instance, Linnaeus explained the origin of species by Special Creation, but also thought that hybrid speciation was possible and could bring about new species. There can be little doubt which of these two forms of creation is superior on this interpretation as hybridization is designated only 'possible' whereas everything else is given divine sanction.

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[38] (Carlson 1958) pp 535-538

Darwin on the other hand, took his position on hybrids from the botanist Joseph Kolreuter who held that hybrids often were sterile, leading Darwin and subsequent Darwinists to discount hybridization in explanations of evolutionary change and in the creation of new species.[39] The belief that hybridization was supposedly a rare and usually unsuccessful event had vast waves of impact on future thinkers, including Ernst Mayr, "Successful hybridization is indeed a rare phenomenon among animals…available evidence contradicts the assumption that hybridization plays a major evolutionary role…"[40] The contemporary evolutionary biologist Michael Arnold discusses hybridization in terms of genetic exchange. He argues that there are two philosophical underpinnings to the contention that genetic exchange is deleterious:

> The first of these is the fact that genetic exchange may prevent systematic/taxonomic treatments from being sharply defined. It is much more satisfactory to have multiple, resolved, and concordant phylogenies…the second factor affecting negative viewpoints towards the role of genetic exchange can be couched of germs of violations of species integrity.[41]

Essentially, it is easier to have phylogenetic trees and we have a habit of not wanting to mess with our established concepts of species identity. Note as well that both of the philosophical hangups Arnold discusses have as their guiding impetus the desire of the scientist to see the world a specific way. He cites Paterson: "In English, notice how approbative are words such as 'unpure', 'purebred', 'thoroughbred' and how pejorative are those like…'hybrid'. Such cultural biases…might well predispose the unwary to favour ideas like that of 'isolating mechanisms' with the role of 'protecting the integrity of

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[39] (Darwin 1859) pp 276-277
[40] (Mayr 1963) p 133
[41] (Arnold 2006) p 4. See also (Arnold 1997) p 13

species"'.[42] The assumption of negative hybrid fitness is largely still in place and appears to have an ancient origin. There has been a lack of work on environment-dependent hybrid fitness and genetic exchange in general, with much of the work focusing on plants.[43] Arnold is not alone in the suggestion that the analogy of a tree to describe ancestry is fundamentally flawed, especially when applied to humans. The image of a web is more accurate as it has no teleological top or bottom and can account for reticulate evolution, hybridization, lateral gene transfer, retroviruses and all directions and kinds of impact.

A Philosophical Divide over the Human Origin Story

One issue of conflict during the rise of these disciplines was between the mechanism of inheritance, as seen, for example, in the debates between Darwinist camps and Lamarkian ones. Another issue among the various scientific theories and disciplines that took up the project of separating humanity into different kinds of race fell on either of two poles. One the one side was the monogenists and on the other was the polygenists; the philosophical distinction that divided them has long become a meaningless problem. Supporters of both often rooted their argument simultaneously in both Biblical scripture and some version of evolutionary thinking. As discussed earlier, a central question for both Lamarck and Darwin is "why are there so many species?" Neither the environmentalists who favored the Lamarckian explanation nor the defenders of Darwin provided a satisfactory explanation that was able to shape public opinion. Darwin himself was famously an on and off again Lamarckian on this issue and the frustration of extending

[42] (Paterson 1985)
[43] e.g. (Anderson 1949) and (Arnold 1997).

Darwin's own view to answer this question results in various contradictory positions held regarding the answer to this question.[44]

The implications for accepting one view over the other are profound and went a long way in either justifying or making immoral the practice of treating another person as either an equal or as some 'other' not within the same species, and consequently not within the same moral sphere. The social demands of respect that come from moral claims through the lens of polygenism are of an altogether different kind. The argument between these two positions is deep in origin and goes past the obvious division between whether or not humanity comes from one single ancestor or numerous. The recent discoveries surrounding Mitochondrial Eve and the controversy that followed has seemingly put an end to many of these questions. However, implicit in this debate there remain basic unaddressed assumptions about what counts as a 'kind' and what exactly is the meaning and use of separating out one population from another, human or otherwise.

Monogenism

In short, monogenism contends that humanity came from a single origin/creation event, whereas polygenism argues that humanity has numerous origins. George W. Stocking discusses the origin of why this question became central to 19th century thought:

> [P]olygenism and monogenism can be regarded as specific expressions of enduring alternative attitudes towards the variety of mankind. Confronted by antipodal man, one could marvel at his fundamental likeness to oneself, or one could grasp at his immediately striking differences.[45]

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[44] See (Mencke 1976) p 78 for discussion of how this split actively participated in American thought both before and after the civil war.

[45] (Stocking 1968*)* p 45

Whether it is "antipodal" man as Stocking suggests, the Great Apes that would later become the standard of comparison, or simply the exposure of European cultures to different cultures as a result of their increased colonialism, there arose an explanatory need regarding the differences among humans. Monogenism and the concept of a single origin/creation event provided an answer that relied heavily on the impact that environment has on selecting organisms that are better adapted. This produced the view that there are not necessarily better or worse types of human, just different adaptations depending on the variable ecological settings. This explanation seemed reasonable to many of the Monogenist supporters, but it also was deemed reasonable to include intellect, personality, and character in with features such as skin color and body type among the hereditable environment selected traits. Thus, monogenism was used by some to suggest that there had been degradation in the genus Homo, and monogenism was held up as scientific proof justifying the predetermined prejudice that non-whites can be classified as inferior.[46]

Polygenism

Polygenism also sought confirmation through a mix of creation-story-inspired interpretation and ideas from the burgeoning field of evolutionary theory. In the 1800s there was a practice among both professionals and amateurs alike of applying the new versions of evolutionary theory to reinterpret all understanding of the natural world. No place was this more evident than in the increased practice of categorizing, separating by name, and assigning estimates of hierarchical location within evolutionary history.[47] This

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[46] (Haller 1971) pp 70-74

[47] See (Mencke 1976) for explicit discussion p 80, for instance, "Some even tried to reconcile their ideas with the Bible, arguing that other peoples had existed along with the Adamite family, or in extreme cases, that

practice came to include Anthropometry and the fascination with applying cranial shapes and other variables to differing groups of people. The 'cultural trend' led many of the most well-known scientific figures of the time, (including Louis Agassiz and George Morton among others) to favor a polygenist philosophy of human origin.

The numerous human origins of the polygenist view required separate and yet conflicting explanations of evolutionary change. In their favor was the opinion that polygenism had a more ready explanation than the monogenist position as to why there were differences among populations. However, they also had the challenge of explaining why the products of separate creation events have so much similarity. Implicit throughout the efforts to explain this was the perceived need to keep the species distinct and separate. This is helpful in understanding why interspecies interactions were considered immoral, it was an unnatural mixing of kinds that if let run rampant would negate the evolutionary 'progress' that has occurred since this separation.[48] The resulting Great Chain of Being provided a clear hierarchy among not only animals and humans but among human populations.[49] It is this notion of racial inferiority that survived the scientific communities move to Darwinian explanations, especially in the application of theory to humans and anthropology in general.[50]

Josiah Clark Nott is an example of a public intellectual who went from an initial pre-Darwinian mindset to a full acceptance of Darwinian principles, while keeping his polygenist position intact throughout the change in worldview. In 1854 Nott contends that

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non-whites were actually sub-human and had been created before Adam."

[48] (Menke 1976) pp 80-81 and (Haller 1971) pp 75-76

[49] For further discussion see (Lovejoy 1936)

[50] See (Stanton 1960) and (Haller 1970) pp 1319-1329

"it is evident…that the superior races ought to be kept free from all adulterations, otherwise the world will retrograde, instead of advancing, in civilization."[51] Giving further support to the previous discussion of the concept of Platonic Form being tied up inconsistently with our concept of species the historian Stocking notes that there is "some hereditary essence expressing itself in a number of visible peculiarities that mark every member of a "pure" race and distinguish it from other races, the clarity of the distinction depending on the purity of the essence—since the only process which could significantly modify a race was racial mixture."[52] It is in this well-rehearsed language that the idea of species as a fixed and final form came to survive the transition to evolutionary thinking. It remained a cornerstone in Spencer's survival of the fittest and continues to carry the label of common sense in many explanations of hybridization.

Lingering Lamarckianism in Evolutionary Theory of Culture

Within the debate between monogenism and polygenism lie many of the themes that are under discussion in this essay. That is, many of the areas of confusion are similar. One area where the development of evolutionary theory was unable to separate these two positions was whether Lamarckian heredity was accepted as a viable mechanism. Tracing the fall of the Lamarckian theories reputation in public spheres coincides largely with the eventually fading of most of the polygenist defenders. Specifically, the Lamarckian position that the specific events that physically alter a trait in a parent population will result in changes to the same trait in offspring. One key to differentiating the Lamarckian

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[51] (Nott and Glidden 1854) p 405. For another public intellectual expressing ideas more directly related to the application of hybrid theory to human interracial conceptions see (Broca 1864) especially pp 16ff, 27-29, 38-40
[52] (Stocking 1968) pp 55-56

understand of hereditarianism from the Darwinian conception is that in many Lamarckian style accounts psychological concepts of mental instinct were built into the histories of the different races. Hereditary concepts of mental instinct were taken up as support for something like different Platonic essences for the races, even if physically there was not significant difference. For instance, due to the local cultural setting of one's ancestors one could instinctually possess certain traits like trustworthiness, violence, greed, lust, etc. As was discussed previously, the concept of Platonic essence is part of the same rational used to distinguish differing species. Much of the confusion between race and species is tied up in this misconception. The concept of an inherited mental aspect of offspring resulting from the actions of the previous generation looms large behind hierarchical views of human populations and is often cited as cause for avoiding racial admixture and, consequently, hybridization.

The prejudice was applied inconsistently. It was often a selective process in which it was only acceptable to appeal to Lamarckian ideas if it continued to justify the extant social stratification based on race.[53] For instance, Nathanial Shaler is notable for holding the contradictory position that Lamarckian forces have been the key factor in the historical separation of human species/races but no longer continue to have much of an impact. He notes: "The creature of to-day, though it endures for but a moment of a time, is the heir of all the ages and embodies in its life the experiences of the past."[54] He contends that the races were unequivocally separated at some point in the past due in large part to the "vigor

[53] (Zack 1993) p 121
[54] (Schaler 1890a) p 661

with which they do their appointed work"[55], a clearly Lamarckian position. Despite this notion of Lamarckian change he did not apply it to any recent change because the races of humanity are "still to a great extent what their primitive nature made them."[56] Shaler held the position that traits such as *will* and *desire* in a previous generation had led to what is essentially a polygenist split, but he also contends that humanity does not have much input on the process anymore. Despite the contradictory nature of such a position it was often defended by sympathizers of Shaler's position on the grounds that miscegenation of any kind was a mixing of two kinds so different that the necessarily weak offspring would certainly not be evolutionarily successful, and would likely be sterile.[57] It will be interesting to see if the rise of Lamarckian explanations that has recently been hailed along with the developments of epigenetics brings with it the same implications for the study of human history that early Lamarckians had.

The narrow focus on the debate between the polygenist position and that of the monogenist may seem overly truncated. However, I think that it captures a historical moment where an assumption about race snuck through and was buried deep in the collective psyche. Social scientists by the end of the 1950'a had generally come to the consensus that racial mixing simply resulted in intermediate types.[58] However, as Haller notes:

> …the most sententious critics of the nineteenth century's concept of the survival of the fittest in a struggle for existence considered the structure of race as outside the framework of their discussions. Dissent about the character of evolution had little

[55] (Schaler, 1890b) p 364
[56] Ibid p 364
[57] (Menke 1976) pp 92 and 108
[58] (Williamson 1980) pp 134-135

> bearing on the concept of race inferiority and much less upon the derivation of its racist ideas.[59]

The Misconception That Hybridization Is Unnatural

The previous sections have sought to lay out some of the historical character behind the present conception of race and hybridization. The following sections aim to discuss and further outline some of the misconceptions and assumptions within this history while also placing it within contemporary discussions. The first misconception that needs to be addressed is the claim that there is something unnatural and, in the eyes of some, 'unholy' about two closely related species producing offspring. In other words, what went wrong in the 'natural' system that caused this mistake? Essential to this misconception is the social taboo that surrounds the idea of humans interacting across boundaries, whether they are arbitrary state lines or boundaries based on cultural mores such as caste or wealth. The inability of science to have an immediate and direct impact on social descriptions of nature where the prevailing belief is an obvious error is a significant contemporary problem. The conflation of morality and belief in the debate over whether or not one should *believe* in concepts such as evolution and global warming is a telling example. Certainly, the histories of anthropometry and social science should serve as a warning that our preconceptions influence how we see the world, but it is troubling that the authority of empirical scientific data has been eroded to such a degree.

The recent controversy over hybridization between the accepted ancestors of modern humans and Neanderthals is another illustrative example. To be honest and self-

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[59] (Haller 1971) p 210

aware of any preconceptions held before undertaking a research program is difficult. However, in the case of the Neanderthal and human admixture it is as easy as asking why it would matter if there was interbreeding. One major consequence would be that we would have to retell the history of humanity to go further into the past, and at an ugly/unaesthetic angle, as well as including something that looks and acts in a way that is less recognizable to contemporary human activity. The overarching quest of anthropology is to understand our origins, and we would prefer if they were understandable. Denying that intermingling occurred is just simpler, even if, as anthropologist Melvill J. Herskovits (1928) notes: "two human groups never meet but they mingle their blood."[60] The current justification for making a clear distinction between Neanderthals and modern humans is that there is no surviving genetic material of the Neanderthal, so even if they did interbreed the 'unpure' element that was none human has been 'successfully' purged.[61] It is not important to the discussion at hand whether or not this explanation actually resembles the truth of what has historically occurred. More interesting is identifying the prejudice that fuels such a 'just-so' story. In other words, why do we need to separate 'us' from 'them'? Take for example similar straw grasping stories on why interracial reproduction cannot be 'successful':

> Neurologists claimed there were electrical currents in the human body that flowed in one direction in black people and in the opposite direction in white people. In people of mixed race, these currents were jumbled and confused, leading to all manner of physical ailments, not to mention mental confusion and overall flightiness.[62]

Once the goal of distinguishing between different types and kinds of humans became a task worth undertaking, because like anthropology on the whole it answers these fundamental

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[60] p 3. See also (Reuter 1937) p 3

[61] (Hodgson and Disotell 2008)

[62] (Williamson 1980) pp 94-95

questions about our humanity, certain claims were put under the umbrella of scientific authority and approved by society. The historical period under focus is interesting not for its conclusions, but for the way that the questions were formulated and how it mirrored other scientific movements that parallel it chronologically. Moving from simply visually identifying people as different from oneself to actually devising a measurement to justify the assumptions behind these snap visual judgments is the common theme. The rise of anthropometry and the acceptance of select portions of its often contradictory conclusions is an excellent test case.[63]

Misconceptions Supported by Scientific Authority

This paper aims to make the case that there has historically been a mutual reinforcement between the act of forming hypothesis and cultural pressure for the confirmation of common sense. In other words, the mutual reinforcement of problematic but accepted theories between science and public opinion where each justifies the other and thereby further increases each other's worth, a Ponzi scheme of prejudice. On the issue of hybridization there has been well-documented collusion. In the early American scientific community there was widespread publication in support of hybrid misconceptions. Mencke (1976) discusses this issue:

> Theories generated by the scientific community often reflected popularly held assumptions about mixed-bloods, while scientific notions were passed on to the public through a variety of popular writers. However, the fact that a growing number of scientists and social scientists gradually began to deviate from traditional racial positions, particularly after the turn of the century, seemed to have little significant effect on the material which reached the popular audience. Notions long discarded by much of the scientific community continued to reach the lay reader

[63] See for instance: (Hall 1954) p 283, (Davis 1861), (Curtin 1964)

> and presumably thereby to shape or confirm his beliefs about the mulatto and the Negro in general until well into the twentieth century. Certainly it is questionable whether even today all of the late-nineteenth-century suppositions and superstitions about race, racial differences, and the effects of race mixture have disappeared form the mind of white America.[64]

In the case of hybrids and human race there have been long standing clashes between scientific theory and public opinion where the general trend is the quick grasping of a scientific theory that seems to support popular opinion and then a blind eye if that theory undergoes revision.[65] There is nothing inherently misguided with attempting to make correlates between science and human behavior; the working of the scientific into the popular opinion is understandable. More suspect is when the hypothesis of an experiment is set up in such a way that it might provide a readymade answer to a charged question. Science has been continually referenced as authority when a common position on hybridization has been threatened, specifically assumptions about concepts of race and species being interchangeable.[66] The primary area where this careless translation from scientifically established conclusions to related human counterparts is the mixing of the concepts of biological and social evolution. This confusion is no more pronounced or consequential as when misapplied to concepts of race.[67]

The Assumptions and Uncertainties of the Species Issue

The continued existence of the lack of belief in evolution is in part due to unclear explanations by the scientific community regarding so-called black box gaps in explanation

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[64] p 95
[65] For further discussion and references see (Mencke 1976) p 95
[66] See (Newby 1969)
[67] See (Haller 1971) pp 121-122 and (Mencke 1976) p 89

that theory has not satisfactorily handled in the eyes of some. The need for cleaning up the language of species is crucial, as it reflects deeply ingrained, and socially shared, understandings of how we cut up the natural world. The selection of one definition over others only because it is functionally expedient will only serve to perpetuate its misuse. Nowhere is this misuse more apparent than in the parallels between the historical development of the concept of race and the discussion over what constitutes a human species. Carl Von Linnaeus (1707-1778) is tremendously influential for both the taxonomic system he developed using Aristotelian derived criteria, and for initiating the study of anthropology by using skin color as the primary mechanism of separating and delineating human history. The result of the latter was four families of humans that, for Linnaeus, although only separated visually by skin color, came complete with intellectual and social profiles of determined behavior.[68] The classifications themselves[69] were frequently brought into question and modified by different scientists, philosophers and anthropologists. However, the assigning of behavioral traits would linger: "These 'insights' into what Linnaeus divined as racial character, personality traits, behavior, intelligence, language, and a host of other related categories were transmitted into subsequent attempts at a science of classification and became more fixed than the races themselves.'[70] The success of his taxonomic system for non-humans came with the unfortunate cost of giving his other positions authoritative power. The consequences of this species-like division among human

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[68] (Linnaeus 1806) Vol. 1 p 9.
[69] *Homo Europaeus, Homo Americanus, Homo Asiaticus, Homo Afer*
[70] (Haller 1971) p 4. For further discussion see also: (Snyder 1939*)* p 12, (Greene 1954) pp 31-41, (Scheidt 1950) p 354-391

populations are far reaching and its impact is well documented in our confused history of conflating concepts of race and species.

One way to enter into the discussion of what defines a species is to look at much older and more fundamental question regarding whether there are universal kinds or whether each individual is self-determined. Both within the literature on what makes a gene and what makes a species there is this same tension, and the accepted definition is chosen on criteria that is more pragmatic and functional then it is helpful in explaining why we want to make distinctions between kinds in the first place.[71] The belief in a fixed unchanging species that is somehow hurt, hindered, ruined, spoiled or lessened because its 'purity' is not being held intact is a destructive position to hold.[72] If Darwin teaches us anything it is that concepts of species purity only exist in hypothetical vacuums without selection and time. Ernst Mayr's classic definition of speciation is still the taproot for many of the more recent species definitions. Mayr divides species by determining those populations that can produce viable offspring with each other, and those that cannot. Notable here for our discussion is that under this definition hybridization is the razor's edge that separates types/kinds/species. Put differently, hybridization between two species is logically impossible because if they are able to do so then they are necessarily of the same species. Nothing is in between.

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[71] Wonderful exceptions to the criticism that follows can be found in Hey et al (2003) and Pigliucci (2003) in which their concept of species is in flux because it is difficult to impose fixed species definitions on continually developing processes.

[72] Mencke (1976) provides a summary of early conceptions of this problem: "In these terms, the mulatto was clearly superior to blacks. At the same time, it was widely believed that the mulatto was constitutionally weak, prone to debilitating diseases, and, like all hybrids, basically infertile—facts which indicated certain basic inferiorities to both of the parent races." pp 71-72

The species issue is still alive and well, even if there are less reductionistic ways to view the natural world that make the species distinction meaningless. If we take seriously the idea that all knowledge is conditioned human knowledge, then it should remain a potential truth that the culturally accepted divisions of the natural world are merely pragmatic ideas that currently work. Given the historical failures to accept hybridization as a meaningful and real activity, rather than a backwards failure or an Augustinian evil, I contend that this statement needs to be made stronger. Hybridization is a clear biological implosion of our artificial distinctions placed on the natural world. Holding up their very existence as evidence, it is necessary to understand kind and type within the biological world as merely mock-ups and placeholders that have a function for our understanding, but do not exist as metaphysically real entities. This paper contends that ignoring or not taking serious this idea has resulted in frequent, various, and damaging misconceptions of human identity.

In the debate over what counts as a species and whether it is more useful to be in the lumper (those that argue for a fewer number of species) or on the splitter side (those that count all differences between populations as enough to deem them separate species) there is another factor that should be considered, that being, whether the disposition to be splitter also entails an ordering of populations along a hierarchical gradient.[73] Implicit in a hierarchical ranking of nature is that nature is endowed with a teleological tendency, but this

[73] An example of such thinking can be found in Zack (1991) discussing Madison Grant: "In 1916, Madison Grant, a graduate of Columbia and Yale universities, who was a lawyer in New York with an avocation in Zoology, wrote *The Passing of the Great Race*. Drawing on Darwinism, Grant argues that whites had physically evolved to such a specialized level of mental, moral, and social organization that they were vulnerable to mixture with "lower" races. According to Grant, the result of white and non-white racial mixing would always be a race reverting to the "Lower race" in evolutionary specialization. Therefore, Grant reasoned, the mix of a white man and an Indian was an Indian; a white man and a Negro, a Negro; a white man and a Hindu, a Hindu; and any European race and a Jew, a Jew." p 100

position often requires the positing of a motivating will. Think here not only of Aquinas's designing God from the *Summa Theologica*, but also of Bergson's *Elan Vital*, Schopenhauer's Will to Life and Aristotle's Prime Mover. It would be quite unorthodox to set out a research program with these positions as intentional guides, but their philosophical assumptions and common sense mis-intuitions are often brought along as silent unknown partners in the interpretation of a natural world that provides mostly evidence suggesting that nature has no purpose and has no ranking system. An inclination to assume that hybridization between species is ruining some *thing,* or not going in the right direction, is quite clearly operating under such assumptions.

CHAPTER IV

CONCLUSIONS

Faulty Assumptions in Psychological Thinking about Intelligence

A more recent and perhaps familiar controversy that exhibits many of the characteristics of human typology and overenthusiastic splitting of kinds can be seen in some of the faulty assumptions surrounding IQ testing and how the results hierarchically rank individuals. A trend of thought in the evolutionary theory of behavior is the association of physical traits with mental, intellectual, and psychological counterparts. Hybridization and its perceived interference with the natural order is an excellent test case here. Consider the following statement from the highly influential Civil War era analysis by Sanford B. Hunt in 1869 that compared the intelligence of individuals with African ancestry and those of mixed race:

> Other studies measuring the size of the brain of mixed blood was slightly larger than expected confirming the theory that the superior intelligence was passed to mixed race offspring but that they were still of a lower intelligence than whites.[74]

Note here the correlation of physical brain size and intelligence, also present is the discovery of the desired result; a result that confirms the practice of treating as inferior some types of humans.

[74] (Hunt 1860) pp 40-54

More recently, Stephen J. Gould has been an active proponent of weeding out the faulty assumptions of heredity. In *The Mismeasure of Man* Gould takes a direct look at IQ. He offers historical demonstrations that our measurements of human intelligence contained subjective, racist, and inaccurate assumptions that have shaped our conclusions. Much like the history of thought regarding hybridization, these biases were not intentionally malicious or propaganda, rather, they were the result of unexamined common-sense and accepting unquestioned assumptions. In the introduction to the text Gould states his aim:

> This book, then, is about the abstraction of intelligence as a single entity, its location within the brain, its quantification as one number for each individual, and the use of these numbers to rank people in a single series of worthiness, invariable to find that oppressed and disadvantaged groups – races, classes, or sexes – are innately inferior and deserve their status. In short, this book is about the Mismeasure of Man.[75]

The continual recurrence of the phenomena of ranking humanity on a scale that seeks to justify the maltreatment of a particular group suggest to all that there is a deep seated blind spot in our thinking. That blind spot does not only occur because it is often to a group's benefit to subjugate another, although this is also often the case, but it reoccurs because of misconceptions regarding kind, type, form, and class. Needed is a reminder, philosophical and otherwise, that the species concept is a heuristic tool used to make scientific investigation more precise and not a description of an eternal truth. So too is the recognition that although a study may not be directly addressing a counterpart in human culture, studies in evolutionary theory will always be viewed in light of what it means for our humanity, and scientific authority necessarily carries of burden of social responsibility. The contemporary debate about hybridization is a fertile area to explore, carefully, the continued existence of built-in racism and typological thinking.

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[75] (Gould 1996) p 21

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