Land & Animal & Nonanimal
The *intercalations: paginated exhibition* series is an experimental foray exploring the structure of the book as a potential curatorial space. As the reader-as-exhibition-viewer moves through the book-as-exhibition, she discovers that the erratic intercalations of the Anthropocene invite new forms of literacy, visuality, inquiry, and speculation that are, in the words of Clarice Lispector, less promiscuous than they are kaleidoscopic.

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Land & Animal & Nonanimal is an ensemble which contends that the meaning of the Anthropocene is less a geological re-formation than it is transformation of both land and animal; once exposed to some of the parameters defining this transition, the reader-as-exhibition-viewer may begin to discern erratic rhythms generated by the creatures of nonconformity that inhabit, with their violence, struggles, and love the vast, machinic reality called Earth.
The Anthropocene and the Postnatural

The “Anthropocene” was first proposed as a new geological epoch defined by human-driven changes to the global atmospheric and geologic order. Since then it has been taken up within the natural sciences, social sciences, and humanities, used to describe large-scale changes to the environment and ecology through deforestation, extinction, atmospheric alterations, transformations of the landscape, and the propagation of invasive species. Presently, there is no consensus on precisely when the Anthropocene began, but some proposals include the dawn of agriculture, the first sedimentary evidence of human activity, the industrial revolution, the development of non-solar-based energy production, and the dawn of radioactive contamination. In this essay, we will walk through a brief history of the Anthropocene as illustrated by a tiny town in the western United States and introduce the concept of the “postnatural,” a more specific biological interaction between humans and our environment, which we offer as a lens through which to examine the broader construct of the Anthropocene.

At first glance, Wendover, Utah may not be an obvious destination for the study of the Anthropocene, but the tiny,
remote desert town on the border between Utah and Nevada bears the marks of thousands of years of human endeavor. All around Wendover, materials are extracted from and injected into the earth in poetically equivalent proportions. Various surface-mining operations recover rocks, minerals, and salts from the ancient floor of the Great Salt Lake. A bit further down the highway, toxic and radioactive waste disposal companies operate reverse-mines, inserting unwanted materials from all over the country into the earth, while the Tooele Chemical Agent Disposal Facility incinerates the nation’s chemical weapons stockpile, releasing particulate leftovers into the atmosphere.

The vast “emptiness” of the area attracts activities that benefit from remoteness. Wendover shares its southern border with the edge of the Utah Test and Training Range, part of an immense, closed military area that includes the Dugway Proving Ground, the United States’ largest open-air chemical and biological weapons testing site. A few miles southwest of the military area, the remains of a crashed experimental aircraft litter the desert with tiny pieces of titanium.

The area also serves as a receiving site for sample return missions from outer space. In 2004, the Genesis mission collected solar particles from the sun and attempted to return them to Earth. However, the probe’s parachutes failed to open, resulting in a rare geological event wherein a metal canister of solar dust was injected directly into the Earth’s crust.

During World War II, the Wendover Airbase operated as a part of the Manhattan Project—the top-secret operation that developed the atomic bomb. Here, the crew of the Enola Gay bomber was trained for their flight to drop the first atomic bomb on a populated area. The active bombing range, to the south of the Wendover Airbase, is pockmarked with craters and the wreckage of non-nuclear demonstration models of the first atomic bombs. Radiation from these and subsequent atomic bomb tests at the Nevada Test Site are among the proposed geological reference points for the start of the Anthropocene.

While Wendover exhibits many of the common contemporary symptoms attributed to the Anthropocene, it is also the site of the first evidence of human intervention in biological systems in the Americas. In the debate over the specification of the “Anthropocene” currently spearheaded by scientists of the Royal Geographic Society, human-driven changes to the biology and genetics of living organisms are a less commonly discussed example of how we have altered our environment. The earliest evidence of domestication in the Americas, between 9,000 and 10,000 years ago, was found in Danger Cave, just outside Wendover: the bones of domesticated dogs were found buried alongside human remains.1 The cave

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evidence of domestication, thousands of years before humans began practicing agriculture. Humans have selectively bred and domesticated a relatively tiny portion of the overall tree of life, starting with dogs and the subsequent development of agriculture, likely beginning with the selective breeding of maize. Such intentionally altered organisms have been widely propagated and now occupy essential roles in supporting and sustaining human culture all over the planet. They feed us, help do our work, comfort us, and are sacrificed for our benefit.

Generations of selective breeding, and more recently genetic engineering, have dramatically altered the morphology and behavior of these life forms. These purposeful changes to the living world are a contribution to the evidence for the Anthropocene epoch, paralleling the geological changes to the earth resulting from human activity that are more commonly referred to as signs of the Anthropocene.

When we speak of the “postnatural,” we refer to anthropogenic interventions into evolution that are both intentional and heritable, regardless of their subsequent unintentional consequences. The postnatural therefore is not an epoch of Earth’s geohistory, but a conceptually inclined adjective used to describe the purposeful and permanent modification of living species by humans through domestication, genetic engineering, and synthetic biology. The stages of this process will be outlined in detail in the following sections. The term arises in response to the conception of nature that is commonly presented by natural history museums. In contrast to this traditional image of nature, we will use specimens and documents from our collection at the Center for PostNatural History to elucidate what postnatural life is in the Anthropocene.
Stage One: Habitat Control

Postnatural changes begin when humans take responsibility for the habitat of another species. By cohabitating or building a fence to protect it from predators, humans modify the “natural” selection pressures on the organism, hence the term “artificial selection.” This allows for physical traits and behaviors to emerge that would quickly be selected out in the wild. For example, animals bred in captivity are far more likely to express the stark white fur of albinism than their “natural” or wild counterparts.

In the early nineteenth century, rats were bred in captivity for a blood sport known as rat-baiting. The amusement was created during a time when large cities such as London and New York were becoming infested with rats to an unprecedented degree. In dark taverns, men would gather around a large wooden pen and bet on how long it would take for a dog to kill one hundred rats. Developed as an entrepreneurial rat abatement strategy, the sport proved so popular that it inadvertently created a cottage industry in rat breeding. Occasionally, an albino rat would be born and set aside as an oddity. In the wild, stark white fur against a dark ground makes an easy meal for a predator, but in the postnatural habitat of a rat breeder’s care, the sheer novelty of an albino specimen could help save it from the dogs.

It wasn’t long before the outwardly clean white rats had shed their cultural association with filth and the plague, and transformed into pets in the homes of Victorian women who rebranded them as “fancy rats.” The popular nineteenth-century activity of “rat fanciers” fetishized the aesthetics of novel coat colors and patterns that emerged from the “mixing” of black, brown, and albino rats. Later on, in 1900, the rediscovery of Mendelian genetics revolutionized the speed at which an organism could be changed through selective breeding.

Stage Two: Reproductive Control

Breeding dramatically accelerates postnatural change. By breeding plants and animals in captivity, humans play a curatorial role in the reproductive life of another species. Whether breeding cattle, decorative flowers, vegetables, or pets, humans can increase the potential for traits to stabilize in a population.
persist among some dog breeders, who will cull or sterilize any dogs that do not exhibit all of the textbook traits that have been assigned to the “pure breed.” In some cases, highly awarded inbred traits put the basic health of the animal at risk. For example, the skulls of English Bulldogs have grown to such an extent over the last hundred years that most females can only give birth through caesarian section.

Another example is the Cavalier King Charles spaniel, a popular pure breed in the UK, which is highly inbred and suffers a high instance of the disease syringomyelia—wherein the dog’s brain is too large for its skull. Researchers traced the majority of Cavalier King Charles spaniels with this affliction to a single bitch born in 1956, and the two offspring from her single litter.²

Among laboratory organisms, the process of breeding has become an extraordinarily quantified and systematized practice. The most common breed of laboratory mouse in the world is the “C57 black 6,” sold by Jackson Laboratories out of Bar Harbor, Maine. This mouse is used in genetics studies all over the world, including The European Conditional Mouse Mutagenesis Program, where for every gene in the mouse genome a variety of mouse is created that is missing that gene.³ C57BL6 mice, as they are known, are all very closely related because they have been carefully inbred to be as genetically similar to one another as possible.

and thus accelerate the rate of change. Purebred dogs are an especially visible example of this phenomenon, possessing traits that were once subtle signifiers of a cherished breed one hundred years ago but that rapidly became cartoonish exaggerations of themselves. Eugenic concepts of racial purity still

The reason Little chose to purchase a mouse from a pet store, rather than catching one in the wild, is that the mice in Lathrop’s shop were already quite distinct from their feral counterparts. The hobbyist breeders of “fancy mice” had already been selecting for traits that they found beautiful or interesting for generations; because of this, the mice exhibited obvious signs of human intervention such as unusual coat colors and patterns. Some of the breeds even exhibited strange behaviors, like shaking or “waltzing.” These are traits that would easily get a mouse killed in the wild, but to Little these tendencies were evidence of underlying genetics. He sought to isolate these traits by breeding the mice to be virtually identical, allowing researchers all over the world to compare results using specimens that were as genetically standardized as possible. Little recognized that in order for biology to be compatible with the reproducibility required by the scientific method, the subject of study needed to be standardized. The mice and all subsequent model organisms thus needed to have predictable, repeatable, and interchangeable parts.

Standardization presents its own challenges. Genetically identical populations of crops or animals are monocultures, making each specimen equally susceptible to disease, even across a large population. Such loss of genetic diversity was a contributing factor to the catastrophic Irish potato famine: the initial founding population of potatoes brought to Ireland from Peru lacked the genetic diversity necessary to fight off disease. In fact, Michael Pollan argues that the monocultures created by industrialized agriculture have set the stage for potentially similar outcomes in the future.5

The mice have been subsequently bred and engineered to possess and embody human afflictions including cancer, baldness, obesity, depression, anxiety, Parkinson’s disease, and more.

If we take any two members of the C57BL6 family from anywhere in the world and trace their ancestry back through their parents, grandparents, and great-grandparents, their two family trees will eventually converge. Specifically, they will converge on a black female mouse that was for sale in Miss Abbie Lathrop’s pet shop in Granby, MA, in 1921.4 This mouse was known as number 57; it was purchased by Jackson Laboratories’ founder, Dr. C.C. Little, who contributed the “C” to its name. These mice have been subsequently bred and engineered to possess and embody human afflictions including cancer, baldness, obesity, depression, anxiety, Parkinson’s disease, and more.


Stage 3: Genetic Engineering

With the advent of genetic engineering in the late twentieth century, the rate of postnatural change underwent a dramatic increase. No longer limited to emergent mutations or constrained by the rules of breeding, scientists were able to directly manipulate organisms’ DNA. One of the first techniques developed was the ability to turn an individual gene “on” or “off.” Still a common practice, “knocking out” a gene is useful in beginning to understand what the function of an individual gene is. While the vast majority of single-gene changes do not manifest in a visibly altered organism, genes that influence pattern formation in early body development can have a dramatic effect on the appearance of an organism. For example, in the lab of Dr. Moisés Mallo in Portugal, developmental pattern formation genes, known as HOX genes, were altered in embryonic mice, with wildly diverging results.

Genetic engineering also allows for the exchange of genes between disparate species, as well as the incorporation of entirely synthetic genes into an organism’s genome. In the lab of Dr. Randy Lewis, a genetics researcher at Utah State University, dairy goats have been repurposed as living “biofactories” in pursuit of the large-scale production of spider silk. These so-called “Biosteel goats” have been given the genes that allow orb spiders to produce their incredibly strong silk fibers.
Most genetically modified organisms are confined to restricted containment facilities. To date, those that have intentionally been let out of the lab include industrialized crops and trees, fluorescent ornamental pet fish, disease-resistant plants, and experimental insects modified to mitigate human disease and crop predation. The trend is for many more genetically modified organisms to be raised in less captive environments. One of the first plants in line for this distinction is the Transgenic American Chestnut Tree.

Prior to the early twentieth century, in the Appalachian region of North America one in four trees was an American Chestnut. These iconic trees grew to mythic dimensions and provided useful nuts and wood. However, a shipment of wood cut from Asian Chestnut Trees in Japan arrived in the US around the turn of the century, carrying with it a fungus that American trees were not adapted to. It wasn’t long before the fungal blight had killed off nearly every adult Chestnut Tree in America.

The American Chestnut Research and Restoration Project uses the techniques of genetic engineering in an attempt to produce saplings that are resistant to the fungal blight. In their lab at the SUNY Environmental Science and Forestry program in Syracuse, NY, Dr. Charles Maynard and Dr. William Powell are raising Chestnut Trees from cell cultures and attempting to pass them the genes they hope will allow them to resist the fungus. The slow life cycle of trees complicates genetic engineering methods that often rely on multiple attempts over many generations. Fearing that their research could be derailed by a negative public reaction attributed to the so-called “yuck

Fig. 08. An American Chestnut Tree growing in the middle of the street in Cambridge, MA. From the collection of the Center for PostNatural History; photo origin unknown.
Beyond the organisms themselves, the habitats that humans create for them also carry postnatural significance. What does a postnatural habitat look like? Traditionally, the habitat of an organism is defined by natural phenomena such as climate and ecology. In the case of postnatural organisms, habitats are defined by cultural circumstances. Whether defined by a fence line, cage, leash, home, isolated test site, concentrated animal feeding operation, or a negative air pressure laboratory, postnatural habitats are human cultural constructions. In particular, genetically modified organisms are tightly controlled by policy, regulations, and various international agreements. They are allowed to exist in certain countries and states and not in others.
classic American “corn belt” regions like Iowa and Missouri explode with activity, there are also some surprises. Puerto Rico and Hawai’i are, respectively, major sources of applications for genetically modified soybeans and corn. These islands are home to habitats for the production of upstream experimental “parent seed” varieties for a host of biotech companies attracted by the year-round growing season and relative isolation from cross-fertilizable crops and human intervention.

Many of the specific details—such as the origin of the transgenes with which crops have been enhanced—are closely guarded secrets obscured with the label “Confidential Business Information” in the APHIS database. Similarly, the test fields where they are permitted to be released are highly contained. Genetically engineered crops’ habitats are defined by protective fencing and a lifeless buffer region surrounding the perimeter. The plants themselves are not permitted to leave the sites; similarly, unsanctioned humans are not permitted to enter.

They are permitted to exist in certain kinds of containment facilities and not in others. In the United States, they require Federal permits in order to be transported across state lines.

When viewed from a postnatural perspective, a document like the US Animal and Plant Health Inspections Services (APHIS) database of Transgenic Release Permits becomes a unique catalog of migrations and habitats of genetically modified organisms that would otherwise be difficult to discern.\(^6\) We call these documented areas “Permitted Habitats.” A visualization of release permit data mapped geographically and over time shows the areas of the US most active in providing habitats for genetically modified fruits, vegetables, and grains. While

\(^6\) The database is available at www.isb.vt.edu/data.aspx.
The tests, conducted mainly at night, involved large towers and aircraft spraying clouds of tularemia, Q-fever, and anthrax over gridded test patterns carved into the desert floor. These bacteria were the product of decades of laboratory study and selective breeding for particular traits, such as their ability to be airborne or survive under particular conditions. Depending on the nature of the test, the grids were populated by mice, rats, guinea pigs, sheep, rhesus monkeys, and on several occasions, human beings.

Some postnatural habitats are best understood when viewed from above. The Institute for Radiation Breeding Gamma Field in Ibaraki, Japan appears as a circular farm arranged in concentric rings around a central tower. The tower contains a retractable lead cylinder in order to expose an element of radioactive cobalt-60 to the surrounding vegetation, which increases the natural mutation rate in the plants, causing random changes in their DNA. Researchers periodically inspect the crops in search of new, desirable traits, such as adaptability to harsh soil conditions and novel colors or shapes.

Gamma fields have been built in many countries since the 1950s, when they were considered an important step toward developing popularly acceptable and peaceful uses of radioactivity. They have since been well received in developing nations, with facilities constructed in Bangladesh, Brazil, China, Costa Rica, Egypt, Ghana, India, Indonesia, Japan, Kenya, Nigeria, Pakistan, Peru, Sri Lanka, Sudan, Thailand, and Vietnam. Gamma farms have been the origination point for a number of now common foods, such as the popular Rio Red grapefruit, Calrose 76 rice, and disease-resistant cocoa, among others.

If Wendover, Utah provided a starting point for a genealogy of the postnatural, it might also hint at what the endpoint will look like. South of Wendover lies the Dugway Proving Ground, the nation’s largest chemical and biological weapons testing facility. During the 1950s and 1960s, Dugway was home to elaborate military exercises involving the exposure of live pathogens to human and nonhuman test subjects.

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During Project Whitecoat, human volunteers from the Church of Seventh Day Adventists in Frederick, Maryland were flown directly to Dugway, where they were driven at night by bus to the desert test site. Each subject was told to sit in a chair, arranged at regular intervals, separated by great distances. The subjects were instructed to “breathe normally” when they heard the sound of the sprayers in the distance. Following the test, the subjects were picked up, once again by bus, though this time the driver wore a containment suit to protect him from the now potentially pathogenic volunteers. The subjects were then flown back to Frederick, where they were quarantined at Fort Detrick and monitored for sickness. If successful, the subjects would become ill for a period of days and then recover. The disease they were exposed to, Q-fever, was intended to be a biological weapon that could sicken and disable a population for a period of time, without causing mass casualties. Under normal conditions, the illness has a death rate of one in thirty.9

Since the chemical and biological weapons ban in the early 1970s, Dugway has redirected its mission away from weapons development toward protective gear testing. Today the site houses some of the nation’s largest facilities for growing and spraying pathogenic bacteria and viruses, and maintains an on-site repository of many deadly germs. Throughout its history, Dugway has served as a playpen of contained catastrophes, where worst-case scenarios are continuously enacted and reenacted. It is in a state of constant preparation for, and against, anthropogenic apocalypse. It is the ultimate postnatural habitat, in which fear becomes the primary driver of selection. Whether or not the beginning of the end of postnatural history is likely to be found here, the site is an exemplary homage to the imaginative capacity for closure.

Changes in Humans

It is worth recalling that postnatural change is not unidirectional. We do not simply sculpt the world to our liking and stop there. Our environment, in turn, is constantly sculpting us; the changes we make to organisms have consequences for how humans conduct themselves. In nearly every case, the changes humans have made to an organism push back against us and inspire further changes to the constitution of the human. If we revisit the early moments of postnatural history, the human domestication of dogs very likely occurred in parallel with the discovery of pack hunting, a practice that wolves had mastered long before modern humans came on the scene. It is thus not outlandish to ask: to what extent have humans been domesticated by dogs?

Similarly, the development of agriculture allowed humans to live at higher densities than ever before. Then we began to stockpile food. Seed was shared and traded, and in doing so, the plants we thought we had placed under our control had quietly tricked us into carrying them around the world. As our newly stationary communities grew, so did our need to defend these resources. Cats found employment by catching the rodents who ransacked our seedstocks, an opportunistic partnership that continues to this day. And, later on, the rodents seduced us into propagating them in expensive laboratories, where we in turn visit upon them every imaginable form of genetic suffering.

Every living thing that we have heritably altered has also altered us. Because of our obsession with unusual dog breeds, we have created a habitat so specialized that some of these breeds can now only exist with our help. The various regimes of selective breeding, mail-order semen, and artificial insemination used in specialized breeds of dogs, pigs, and cattle have assigned humans a job so essential that if we were to quit, the result would be their inevitable extinction. And the list of animal breeds that can no longer reproduce without human intervention is only growing: corn, English Bulldogs, and Belgian Blue Cattle are just a few of the organisms that require human help, either as cross-species sexual facilitators or midwives.

The Postnatural Footprint

While we began by making the case that there is a biological and genetic component to the Anthropocene, we would like to close with a discussion of the postnatural influence upon the properly geological strata of the Anthropocene. The imprint on the landscape resulting from domestication and the industrial alteration of food crops can easily be seen from a satellite orbiting Earth. Across the continental plains and into the barren deserts one can see a repeated pattern of green circles laid upon a grid. The hallmark of automated irrigation systems, they are also the product of crops that have been selectively bred and engineered to exist at high densities and thrive in poor soil conditions. They are monocultures, symptomatic of the economic pipelines that produce them, determined by the mechanization that defines their habitat.

They must be the same size and must all reach maturity at the same moment; indeed, uniformity is an essential quality of industrialized agriculture.

If we were to point our satellite toward the mouth of the Mississippi River, a river which drains half of the continent of North America, we could see a visible signature of industrial agriculture: the huge algal blooms that periodically occur due to the intensity of fertilizer runoff from American farmland. In order to grow the yields that we now require, human-cultivated plants need their soil to be regularly treated with synthetically produced ammonia, which “fixes” single nitrogen atoms in order to produce nitrogen compounds that can be utilized as fertilizer. Prior to the discovery of the Haber-Bosch process for synthesizing ammonia over one hundred years ago, there were natural limits to how much food could be produced by an acre of land and, as a consequence, how many people could be fed by it. Since the introduction of synthetic fertilizer, the world’s population has grown fourfold; we now live atop an agricultural system entirely dependent on fossil fuels, which make their own geological impacts and contributions to the Anthropocene.

The crops produced using fossil fuels and industrial farming techniques are, in turn, fed to cattle in concentrated animal feeding operations (CAFOs). These operations allow the animals to be raised at higher densities and grow to greater sizes than could have been imagined even several decades ago, similar to their agricultural feedstocks. Uniformity also still rules the day, as the animals must fit the dimensions of the processing equipment used to make their

way from slaughterhouse to human feeding establishments. From our satellite-enhanced anthropogenic vantage point, these CAFOs are engines producing a fountain of inexpensive meat, methane, sewage, and occasionally, disease. They are a part of a feedback loop that both responds to and creates new desires.

Postnatural changes are a product of a complicated renegotiation between human desire, the autonomous vitality of living organisms, and simple contingency. It is impossible to predict with any degree of specificity what the consequence of any single action will be. It is also impossible to separate the changes we make to the biology of an organism from the resulting changes to its larger ecology. They continually create one another, with human desire as the fuel in the engine, or the nitrogen in the soil.

To conclude, we revisit the basic difference between what we refer to as postnatural and what is generally described as the Anthropocene. Although both concepts are connected to human-driven influence over the Earth’s ecosystems, it would be tempting to divide them according to geological and biological registers. However, the postnatural is a specific construct that remains irreducible to the biological dimension of the Anthropocene.

As we explained above, our definition of the postnatural hinges on biological changes that are both heritable and intentional. Heritability means that the changes are, evolutionarily speaking, “in play.” In this sense, they may also be out of our control. They may push back and consequently alter us, perhaps on an evolutionary level. Mutation and natural selection will continue regardless of human input. For a feral genetically engineered organism, yesterday’s genetic containment strategy becomes tomorrow’s adaptive advantage.

By focusing our attention on changes that are also intended, we have selected a specific area of research distinct from the broader debate related to the Anthropocene. By using this more precise lens, we get an inkling of what it is that humans want from the life that surrounds them. Desire is made flesh, even if the signature of human intentionality at this scale evades identification within the geological strata to come. Human intentionality is fuzzy, accompanied as it is by all the conflicts and internal contradictions that emerge from the interpretation of cultural work. This situates the postnatural outside the realm of pure science and, more remarkably, in the zone of human culture.

If we were to propose a place in the library to locate the postnatural, it would not be alongside ecology, biology, or even the Anthropocene; instead it would exist in a wormhole that paradoxically disappears and reappears alongside books on textiles, architecture, engineering, military history, agriculture, design, religion, sports, music, art, and erotica. It is one of the oldest forms of cultural production, present in our stone-age cave dwellings, our rented apartments, our organic vegetable gardens, and our industrial plantations. We cannot avoid it any more than we can avoid ourselves.

Just as the mark of the Anthropocene is etched into the landscape in the form of deforestation, mineral deposits from mining operations, and trace amounts of radiation from atomic testing, so is it etched into the morphology of living organisms that have been shaped through the interventions of human breeders. Nowhere is this more clear than in domesticated dogs. Dogs are the first species known to have been domesticated. The difference between the largest and smallest breeds of dog is the largest of any species in the animal kingdom. The sometimes bizarre changes to the shape of the skulls is best seen with the aid of the third dimension. Behold, this is the biological architecture of the Anthropocene.

All photos courtesy of the CPNH.
Aged Borzoi Skull
Great Dane and Pug Skulls