but so too is the power of that meaning. Ultimately, then, I suggest that contemporary scientific work with GE laboratory mammals has much in common with past practices of domestication: it, too, deploys new technologies at the interface of lay and scientific cultures to collapse and reinscribe yet again Western cultural boundaries between humans and animals and between nature and nonnature. In so doing, this work offers us a future of newly naturalized and unstoppable marketplace inevitabilities. But I argue that, instead of seeing historical determinism in domestication, we might see in the elements of its relationality a possible point of intervention in contemporary debates over the future of genetic engineering and biopolitics more broadly.

Fanciers, Geneticists, and Other Humans: Early Domestication of the Mouse

Gregor Mendel—the Moravian monk most often credited with founding genetics—was himself a domestic breeder of peas and bees, so perhaps it is not surprising that when Mendel's work was rediscovered in 1900, U.S. breeders and agriculturalists were among the first to embrace it as a true science of inheritance (Paul and Kimmelman 1988; see also Kimmelman 2003). In turn, early geneticists recognized that specific variants of highly inbred animal populations—in current scientific parlance, "mutants"—could be used effectively as tools to sort many heritable features of organisms into biologically identifiable processes. In practice, however, such efforts were just as frequently taken on by so-called "amateurs": for example, German high school teacher Hans Duncker combined his rudimentary knowledge of genetic science with the bird-breeding expertise (ability to select for color and song) of fancier and shopkeeper Karl Reich in a quest to create what biologist Tim Birkhead claims was the first "genetically engineered" animal: a red canary (Birkhead 2003).

But the mutants used most productively in early academic genetic research did not come initially from highly prized cultivars; they were pests such as the fruit fly, *Drosophilia.* As historian Robert Kohler has shown, Columbia University zoologist T. H. Morgan and his "boys" (then–graduate students Calvin Bridges and Arthur Sturtevant) exploited this organism's proximity to humans and its biological capacity as a "breeder reactor"; Drosophila bred fast and generated copious mutants, which enabled Morgan's team to construct the first animal genetic map of its four salivary chromosomes in 1921 (Kohler 1995). For Kohler, as well as for his historical subjects, such laboratory domestication of the fly was continuous with its biological evolution and domestication more broadly and it created the kind of mutual dependency between the human and animal actors that Stephen Budiansky argues is the hallmark of domestication itself (Budiansky 1992). As Kohler writes, "when fruit flies crossed the threshold of the experimental laboratory, they crossed from one ecosystem to another quite different one, with different rules of selection and survival. . . . Once in the lab, *Drosophila* . . . revealed an unexpected and very remarkable capacity for experimental heredity and genetics which soon made it and its human symbionts famous" (Kohler 1995: 19). Soon after technological processes—such a X-rays and chemical mutagenesis—were developed to create even more fly mutants, which sealed Drosophila's fate in the development of classical genetics, and thereafter, in biological teaching laboratories (Muller 1928).

Mice have also been "hangers-on" to human culture for thousands of years, so their cultural, as well as biological, identity derives first and foremost from that relation. Taxonomically, mice are the smallest members of the order *Rodentia,* or "gnawers," and their evolutionary appearance dates to the Eocene epoch, 54 million years ago. But the present scientific name of the common house mouse, from which inbred laboratory mice are descended, has little to do with the creature's appearance. In *Mus musculus,* the Latin *mus* derives from an ancient Sanskrit word, *musha,* meaning "thief," which suggests that the mouse and its predatory feeding habits were familiar to cultures in Asia dating back before 4000 B.C.E. But regardless of when exactly they first started to associate with humans, mice quickly became successful commensals. House mice were common in the earliest farming villages of present-day northern Iran, as well as in areas surrounding the ancient Mediterranean. Some ancient civilizations recorded virtual plagues of mice—sometimes accompanied by disease—and modern biologists speculate that this prolific species increased its geographical dispersion by accompanying many early human migrations to present-day Europe and Africa (Moulton 1901). From there, "*Mus musculus* proper shared with the European his recent conquest of the globe" as ocean-vessel stowaways to all habited regions of the Asiatic seacoast and to the Americas (Keeler 1931: chs. 1–2, 1932; cf. Beckman 1974; de Gubermatis 1968/1872; Grohmann 1862; Malriey 1987).

Although the internationalization of the house mouse is a relatively recent phenomenon as measured by evolutionary time, ancient cultural traditions express many mouse mythologies and narratives. Some such legends are pejorative. For example, Aelieanus (ca. C.E. 100) of Lower

Egypt speculated disgustedly that mice developed from raindrops because they were so plentiful in that area. More recently, anthropologists have suggested that the Egyptians' hatred of mice accounts in large part for their well-known deification of the cat. Yet other stories and cultural images have cast the mouse in a positive light. More than 1,000 years before Christ, Homeric legend reported a cult of the mouse–god *Apollo Smintheus,* whose popularity reached its height around the time of Alexander the Great. White mice, because of their relative rarity and their associations with purity, were thought to forecast prosperity in a home. Beliefs in the healing powers of these mice originated with the Apollo worshippers and persisted among medieval scholars such as Hildegard of Bingen. Other colors of mice were also venerated; temples in Troas, for example, held marble sanctuaries overflowing with gray mice raised at public expense (Keeler 1932).

Many aspects of the mouse's ancient cultural legacy persisted in the United States through the early decades of the 20th century, but by the 1930s, these representations existed simultaneously with positive cultural depictions.[2] The modern heirs to the ancients' negative portrayals of mice included various accounts—both scientific and folkloric—of mice as harbingers of disease and "spookers" of women. At the same time, Walt Disney's personified Mickey Mouse made his public debut in 1928 and proved phenomenally popular.[3] Also in 1929, the popular magazine *Nature* ran an article entitled "White Mice," which fancifully described the daily activities of the author's real pet mice. The author gave a particularly pointed and modern spin to Egyptian "pure white mouse" myth: "If cleanliness is next to godliness, as the soap advertisements say, then Plato was wrong and our animals do have souls" (Johnson 1929).

For genetics, however, the most significant early 20th-century human activity explicitly centered around mice was a hobby called "mouse fancying." The exact origins of mouse fancying are obscure, although textual sources (believed to be early breeding manuals) indicate that the collecting and developing unique strains of mice in captivity dates as far back as 17th-century Japan (Grüneberg 1943). But the formation of many local and national mouse fancier organizations in the early 1920s indicates that mouse fancying clearly enjoyed increased popularity in the United States and Britain beginning in the early 20th century. Fanciers who belonged to the American Mouse Fanciers club, and its many British counterparts, selected for certain "standard" physical features and preserved the specimens that exhibited them ("Mice Beautiful" 1937). As described by a 1930s popular magazine article, fanciers thought "the perfect mouse should be seven to eight inches long from nose-tip to tail-tip, the tail being about the same length as the body and tapering to an end like a whiplash" ("The English Craze for Mice" 1937: 19). Fanciers most often kept these mice as pets and would travel with them to local or national "mouse shows," which awarded small cash awards to the owners of visually unusual and interesting specimens. Other mouse-breeding enterprises had more lucrative commercial interests in mind. In 1930s England, for example, mouse breeders could cash in on the demand for full-length women's coats made of mouse skins, which took 400 skins and sold for $350 retail ("Mouse Show" 1937).

One fancier, in particular, was of significance for the development of laboratory mice: Abbie Lathrop, who ran the Granby Mouse Farm in Granby, Massachusetts. Lathrop founded this institution around 1903 as an alternative to her failing poultry business. Mice and rats, for sale as pets, provided an inherently quicker turnover, and Lathrop probably believed the growing community of fanciers in the New England area would be her main market. But instead of receiving requests for a few mice of exotic coat color from mouse fanciers, she soon began to get large orders for mice from scientific research institutions and medical schools. Lathrop's farm quickly became the East's largest supplier of mice for research in the first two decades of the 20th century. She took orders from laboratories all along the East coast and from as far West as St. Louis.[4]

By 1913, the Granby Mouse Farm had become such a local curiosity that a Massachusetts newspaper devoted a feature article to it. The details of care taking provided in the reporter's account reveal clearly that Lathrop's mouse breeding for research was a large and resource-intensive undertaking, requiring extensive practical knowledge of proper mouse husbandry. Her stocks had gradually increased to 10,000 since her humble beginnings with "a single pair of waltzing mice which she got from this city." Lathrop housed her mice in wooden boxes, with straw as a bedding material, and because cleaning the cages had become too much work for her alone, she periodically hired town children at seven cents an hour for this purpose. The mice were fed a diet of crackers and oats, and Lathrop reported going through 12 and 1/2 barrels of crackers and a ton and a half of oats each month. Furthermore, the cages were given fresh water daily "in little jars which are first boiled as protection against disease germs." Lathrop even appears to have experimented with a primitive water bottle device, from which "a thirsty mouse has only to stand on his hind legs to quaff a cooling drink" (*Springfield Sunday Republican* 1913).

Lathrop's fancy mice, then, can rightly be called the "raw materials" for the creation of laboratory mice, and the boundaries between the "field" and "amateur" knowledge making of fanciers, and the "laboratory" "professional" science of genetics remained porous for several decades. Fanciers learned from and exploited their relationship with scientists, and vice versa. For example, Harvard zoology professor W. E. Castle himself attended mouse fancy shows, and encouraged his students to do the same—some even acted as judges. Also, Lathrop herself was interested in science and worked with University of Pennsylvania pathology professor Leo Loeb to breed and analyze patterns of tumor inheritance in several strains (most importantly, one that fanciers had named "silver fawn" for its coat color, but geneticists renamed *dba* as an abbreviation for its coat color genes: dilute, brown, and nonagouti; Rader 2004: ch. 1). One Castle student in particular—C. C. Little—sought out Lathrop's particular variants and the use of these materials shaped his own genetic research, which aimed to make Mendelian sense of mouse coat and eye color inheritance as well as mammalian cancers. Little ultimately translated his vision for the role of inbred animals in research into the Jackson Laboratory, a Bar Harbor, Maine research institute and mouse supplier founded in 1929 and still going—stronger than ever—today (cf. Rader 1999). Another—Freddy Carnochan—cofounded a commercial animal breeding farm called Carworth Farms, and continued to work closely with card-carrying mouse geneticists—especially, L. C. Dunn of Columbia—to identify and develop new mutant stocks.

Some early mouse geneticists, like Castle student Clyde Keeler, self-consciously used the metaphor of domestication—especially the idea that laboratory domestication represented a process continuous with mus musculus' evolution as a human symbiont—to argue that there was no important boundary between past and present practices. For a scientific audience, Keeler wrote *The Laboratory Mouse: Origin, Heredity, and Culture* (1931), a handbook cum homage to his favored laboratory creature. It aims to comprehensively collect "literature upon the house mouse, its origins, history, distribution, development, the nature of its variations, the hereditary transmission of its varietal characters, as well as methods of rearing it suitable for the needs of laboratories" to "present it in a useable form." But what counts as "useable form" amounts to a kind of claiming of past domestication efforts in the name of genetics. The book, for example, provides a list of the most important Mendelian unit characters in mice—the first being dominant spotting in 1100 B.C.E. and the last being George Snell's dwarf mutant in 1929—to show that out of 18 then extant, eight had been recorded since 1900. Likewise, in another article for the popular *Scientific Monthly,* Keeler led his readers on a journey "In Quest of Apollo's Sacred White Mice," only to conclude that although much of the mouse's ancient history lies buried "in the religious auguries of Babylon and Troy," "we may say definitively that Apollo's mice were albinos of the species *mus musculus* and that our laboratory mice are probably descended from the temples of Apollo. [This is] the longest heredity of a simple variation of which we have a written record" (Keeler 1931: 51, 53, respectively).

At the same time, other genetic scientists mobilized existing cultural boundaries between humans and animals, as well as nature and culture, to advance their own domestication practices in the laboratory. In 1935, for example, Little penned a *Scientific American* article he titled "A New Deal for Mice." First, he juxtaposed gains the mouse had made in science during the last decade with a prevailing cultural stigma of the animal: "Do you like mice? Of course you don't. 'Useless vermin,' 'disgusting little beasts,' or something worse is what you are likely to think as you physically or mentally climb a chair." Then against this background, Little cast himself as "attorney for the defense," and argued that through their involvement with science, mice had been positively transformed. Inbred laboratory mice—as opposed to their "not very convenient" wild mice relatives—"provided a particular service" to both science and to humanity. Little invited his lay readers to visit the *domus* through which this became possible: the Jackson Lab's "mouse house" or, in another more Progressive description, one of the "mouse laboratory 'cities' with its cleanliness, orderly arrangement, and activity." Such arrangements testified that "thoroughbred" mice (a concept Little acknowledged some people would find "amusing") had become "an integral part of man's helpers." "Under these circumstances," Little concluded, "perhaps mankind will accept and develop his relationships with mice in a different light" (Little 1937).

In all these cases, however—some rhetorically self-conscious, and others practically strategic—domestication functioned as an active, relational, if sometimes contradictory, meaning-making metaphor that united and ultimately naturalized the coexistence of diverse domains of knowledge making and history in mouse–human relations. Mouse fanciers routinized the activity of mouse breeding in captivity well before scientists became interested in this animal—and in so doing, established traditional husbandry assumptions while lowering the practical thresholds to mouse use in the laboratory. Fanciers provided genetic scientists with both a unique mammalian material resource and a broader practical context in which the controlled breeding of animals for human ends (beyond food) was an accepted cultural activity. But scientists' active collaboration with this group of animal producers and pet owners also highlights the kind of ambiguous and fluid boundaries that separated domestic fancy animals (even nonagricultural ones) from humans.

The cultural turn to "mice-as-pets" that the mouse fancy represented could potentially have resulted in increased emotional attachment to the species (Midgley 1983: chs. 9–10)—and resistance to their use in laboratories. In fact, this was not the trend: mouse fanciers were more interested in what the new science of genetics could do for them than in viewing it critically. Fanciers sought to use genetic knowledge to understand their own breeding process and get a leg up on the competition (other commercial breeders and/or competitors at mouse fancy shows). In turn, thanks to the existence of fancy mice, mice did not need to be trapped messily from one's home or field to be obtained for research. Instead, mice could be ordered from a breeder, making contact with them in their "natural" state unnecessary—as shown by the highly stylized pictures of fancy mouse variants from a Jackson Laboratory catalog, circa 1950.

Many of these early domesticating projects of mammalian geneticists were linked to making their discipline more relevant to larger U.S. Progressive goals. For example, both George Snell and L. C. Dunn have said that their ultimate decisions to do such genetics with mice rather than with flies hinged on a belief that such work would be (in Dunn's words) a more "novel" and socially useful contribution to the field. Little became preoccupied with mice while listening to Castle's undergraduate genetics lectures and appears to have chosen to do murine genetics—instead of the dog coat color genetics he first intended to pursue—because such mouse research would ultimately have relevance to larger biomedical problems of public health (Little 1916; cf. Provine 1989: 60). Case studies by Barbara Kimmelman (corn; 2003) and Judith Johns Schloegel (paramecium; 2006) show that the mouse geneticists were not alone in embracing this goal. Philip J. Pauly has even gone so far as to argue that the impulse "to culture"—understood in its 19th-century meaning as cultivation—marks a significant feature of early 20th-century biology, which was defined (except in universities) by "an ongoing effort on the part of scientists in the United states to 'culture' the Western hemisphere and its organisms—to influence the distribution, reproduction, and growth of plants, animals, and humans, and to improve them" (2000). It is difficult, if not impossible, to evaluate this grand narrative at this moment in the historiography of biology, because, to generate anything resembling the panoramic view to which Pauly aspires, we need more detailed studies of how the practices of U.S. biology constituted and were themselves constituted by the practices of U.S. politics and culture. But the important point here is this: the metaphor of domestication was one about whose relevance early mammalian geneticists and fanciers agreed. In turn, this metaphor was itself a potent resource through which early mouse breeders achieved knowledge-making power, within the laboratory as well as outside of it.

Human–Animal Relations in the Domestication of Genetic Science

Decades later, a vast enterprise of scientific breeding of animals for research in the laboratory now exists on top of an even vaster enterprise of scientifically breeding animals for the purpose of companionship or recreation—and the metaphors and practices of domestication remain powerful tools that actors in these technoscientific worlds use to make sense of their work. By best estimates (which are always old and methodologically virtually guaranteed to be low), the numbers of research mice bred and sold alone are staggering: In 1965, a total of nearly 37 million mice were consumed in U.S. laboratories, and by 1984, that figure had risen to an estimated 45 million—or 63 percent of the total number of (counted) animals used by U.S. scientists (Rowan 1984: ch. 5; cf. National Institutes of Health [NIH] 1990).[5] The primary producers of laboratory animals are now commercial or industrial labs (such as Charles River Laboratories), but various academic scientific institutions (such as the Jackson Laboratory and the NIH) retain a significant market share (Rader 2004).

Alongside the expansion of laboratory animal domestication, animal fancying has persisted; biologist Tim Birkhead estimates: “in each case, starting with a single species, humans have created more than three hundred breeds of domestic pigeons, over one hundred dogs, dozens of breeds of cats, mice, sheep, pigs, and cattle—and some seventy canary breeds” (2003: 87). Animal fancying might even to be said to be becoming part of the 21st-century cultural mainstream again. Some examples: the last Rodent Fancy show held in New York was reported in the front page of the *New York Times* (1996), and the Westminster Kennel Club Annual Dog Show is now televised (on CBS, a major network), and was itself the subject of parody in the successful 2002 Christopher Guest film, *Best in Show.* Indeed, animal breeding for the laboratory and for